Auctioning in the European Union Emissions Trading Scheme

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Executive Summary

Considering the empirical evidence with regard to free allocation in the European Union Emissions Trading Scheme (distorted price signals, eight years of free allocation as sufficient compensation for an eventual devaluation of assets, major windfall profits, etc.) and the opportunity of raising double dividends from a targeted recycling of revenues, the phase-in of auctioning should be seen as the preferable way for the further development of the EU ETS.

As a bottom line, full auctioning should be phased in for the power sector as of 2013. This would represent about 60% of the allowances in the EU ETS. For other sectors free allocation should only be retained as an option when there is a concern that the EU ETS can result in leakage of emissions and production. But also for these sectors priority should be given to other instruments to address leakage and competitiveness distortions and no commitment should be made to continued free allocation at this stage.

Against this background, the volume of allowance auctions in the EU-27 could range from 1 to 1.5 billion allowances a year in the third phase of the EU ETS.

Some decisions on key design issues must be made for the phase-in of auctioning and some design issues should be considered to address concerns of abuse of auctions for manipulations. We recommend the following features:

- All entities with registry accounts should be eligible to take part in the auction.
- The auction should be organised as a single round, sealed bid auction.
- The price formation should rely on a uniform market clearing price.
- A relatively high frequency of auctions should be aimed at (at least monthly).
- Governments should credibly announce distribution of allowances over time.
- A reserve price based on prices in secondary markets on the previous day should be announced.
- Credit posting for fraction of maximum bid value (e.g. 10%) ensures integrity of auction.
- Set-up, running costs and implementation delays are likely to be lower if an institution with similar operations is commissioned to carry out the auction on behalf of one or multiple governments.
- A restriction of bids to certain maximum limits should not be introduced for the phase-in of auctioning.
- A market monitoring mechanism should be set up as is the case for most commodity and financial markets.

Regarding the European harmonisation the assessment of different options suggests that harmonisation could create a range of benefits. However, many of the benefits for market participant could be achieved even without formally-defined harmonisation of the

design, if Member States commission one institution to auction allowances on their behalf.

The power sector is the sector for which 100% auctioning should be phased in from the third period of the EU ETS onwards. For this time frame, the following assessments regarding the impact on power prices can be made:

- In competitive wholesale markets, the transformation from free allocation should not have an impact on power prices because even the opportunity costs of free allowances were passed-through to the power prices.
- In the long term different mechanisms must be considered. Removing free allocation for new installations is tantamount to removing an investments subsidy. This could delay some investments on the one hand, which could lead to higher power prices. On the other hand, distortions of the CO_2 price signal (free allocation to new entrants, closure provisions, updating, etc.) could decrease the efficiency of the scheme which would increase future allowance prices and as such increase power prices.
- Some stakeholders argue for free allowance allocation as a form of capacity payment to subsidise new investment in power generation. Given the uncertainty of future allocation provisions and allowance values, market participants discount the value of this payment. Thus, significantly more public assets have to be used to achieve the same objective that efficient capacity payments could achieve.

The net effects of the latter effects are highly uncertain and depend on many factors which vary in different regional power markets in Europe. The reflection of the undistorted CO_2 price signal will decrease the future vulnerability of the power prices regarding the CO_2 allowance prices.

In summary, auctioning of CO_2 allowances will enable undistorted CO_2 price signals. It is also possible to implement it within the framework of a robust and slim design and offers a plenty of options for European harmonisation by cooperative implementation.

However, the upcoming auctions in the second phase of the EU ETS as well as the use of auctions in other emerging emissions trading schemes in the United States and Australia should be subjected to careful analysis and scientific observation in order to speed up the learning process on this important feature of market-based environmental policy.

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1 Introduction

Although auctioning of emission allowances is extensively discussed in the scientific literature the practical experiences with auctions in emissions trading schemes is comparatively poor. Nevertheless, auctions play an essential role in many dimensions of economic life, from the finance sector to many commodity markets or other trading activities.

The European Union Emissions Trading Scheme (EU ETS) is the world's largest and most important project of implementing market based instruments into environmental policy. The issue of auctioning was one of the most controversial issues in the debate on the EU ETS from the beginning what lead to a restriction of auctioning in the first eight years of the EU ETS. Only a few countries made use of auctions or plan to do so during the next years. The total budget for auctioning which was allowed under the recent EU ETS Directive was not used fully during the first phase and will not used fully in the second phase.

Nevertheless, the issue of auctioning is increasingly raising attention in the debate on the further development of the EU ETS

- the deficiencies of free allocation become more and more obviously;
- eight years of free allocation should be sufficient to compensate for a potential devaluation of incumbent allocation;
- the wealth transfers related with free allocation raised debates;
- in other emerging emissions trading schemes (RGGI and probably California in the USA, etc.) auctioning will play a significant more prominent role.

Against the background of the recent debates on the revision of the EU ETS Directive and the emerging debate on the ETS in the different international arenas, auctioning will, without a doubt, play a much more important role. However, some concerns are brought forward against auctioning in many debates:

- Will the phase-in of auctioning in the ETS allocation process create the need for new complex regulations and result in huge transactional costs?
- Will the broad use of auctioning prepare the ground for market manipulations by the big emitters or other entities with strong market power?
- How can a level playing field be ensured for the many small and medium emitters under the EU ETS?
- Will the phase-in of auctioning cause major competition distortions and result in major increases of power prices?

To discuss and address these concerns in a comprehensive manner, we review the debate on auctioning in terms of three aspects. In chapter 2 we discuss some key aspects of free allocation versus auctioning which reflect the experiences from the real world design of the EU ETS. In chapter 3 we analyse what essential design options exist for the phase-in of auction schemes and point out the preferences we derived from the debate. Furthermore, we address some important concerns which are frequently put forward in the discussion on auctions related to the EU ETS. Last but not least, we discuss some aspects of European harmonisation regarding the phase-in of auctions. Hence the power sector plays a special role in the EU ETS and in the auctioning debate, we discuss some aspects of power price formation in the European power markets in the framework of free allocation and auctioning of allowances.

We do not address one important dimension of auctioning in this paper. The issue of recycling of the auction revenues is important from an economic as well as a political perspective. Hence the discussion of this essential element is too complex and must reflect an abundance of special circumstances in different Member States which would have exceeded the scope of this paper. We only outline the options on an aggregate level.

Last but not least, it should be mentioned that in the second phase of the EU ETS, the phase-in of auctioning makes major progress. In some important countries of the EU auctioning will be implemented to an extent close to the limits given by the recent EU ETS Directive (10% of the total allowances). However, in our analysis we try to combine the challenges resulting from auctioning in the framework of an allocation scheme which is still dominated by free allocation with the needs which will arise if full auctioning, or auctioning of the majority of allowances, will make up the new framework of the EU ETS.

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2 Introduction to the EU ETS and background for the auctioning debate

2.1 Main features of the EU ETS

The European Union Emissions Trading Scheme (EU ETS) is the most comprehensive environmental regulation in climate policy at least and the largest experiment with market based policy instruments the world has ever seen:

- It covers medium and large point sources of carbon dioxide (CO_2) in an internal market of 27 Member States of the European Union (EU) with a total population of 493 million inhabitants and an aggregate gross domestic product (GDP) of about 11,580 billion Euro.
- It covers a variety of point sources from the energy sectors (power production, refineries, etc.), from other heavy energy consuming industries (iron and steel, cement and lime, glass, etc.), from combustion installations of other industries as well as the commercial sector which represent an aggregate emission of about 2.15 billion metric tons of CO_2 (Mt CO_2) or about 42% of the total greenhouse gas emissions and 50% of the CO_2 emissions covered by the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol.[1] However, the structure of these sources differs widely between the Member States.
- Although the roots of the general design of the EU ETS clearly originate from the early US emissions trading schemes in general, the design of the EU ETS as a multi-period scheme with an initial three-year trading period followed by one of five years (as of June 2007) constitutes a significant new feature which lead to significant consequences for the allocation provisions.

In comparison to other emissions trading schemes some special circumstances originate from the strong element of subsidiarity in the EU Emissions Trading Scheme Directive[2]:

- The cap as well as the allocation of allowances to the installations in the National Allocation Plans (NAP) is subject to the Member States. The legal framework for these decisions offers an abundance of flexibility to the Member States. Although the European Commission has narrowed the degrees of freedom for the Member States especially in the approval process for the national caps a wide range of approaches is still available for the Member States regarding the allocation to installations.

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1 These data include emissions of 110 Mt CO_2 from installations covered by the EU ETS in Romania and Bulgaria, based on an approximate estimation for these two countries since official and consistent data are not yet available..

2 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, 25.10.2003)

- The only significant feature of the allocation to installations which is strictly fixed by the Directive is the minimum of free allocation of 95% of the total amount of allowances for a certain Member State for the phase 2005-2007 and of 90% for the phase 2008-2012. The only other provision where the Commission established a very strict approach is the ban on ex post adjustments, which is still under legal dispute between Germany and the Commission.

However, all provisions of the existing Directive could be subject to revision or amendment for the time beyond 2012. The shift of the allocation scheme under the EU ETS constitutes a major change of the scheme which will have been running for a period of eight years at the time when a significantly higher share of auctioning could be phased in. In contrast to other schemes, with regard to which this design element is discussed as playing a major role right from the start of the scheme the existence of a pre-auctioning phase should be considered in the design of auctioning provisions and the related debate:

- Since the EU ETS mainly relied for the first eight years mainly on free allocation to installations, it is no longer a valid argument that free allocation should be seen as an appropriate approach to compensating operators for a potential devaluation of existing assets which were invested at a time when the EU ETS was not yet foreseeable (stranded assets). A fundamental adjustment of the scheme in its ninth year should be possible without considering the problem of stranded assets anymore.
- Although the majority of allowances were allocated to the installations for free, a significant secondary market for EU allowances has emerged. Within the framework of this secondary market, an abundance of information was made available to the market and its participants.
- The institutional setting for the EU ETS has improved significantly. Already at the end of the first period different government and industry institutions, service providers and market intermediates have settled. A plenty of services is available for all players on the markets.
- The identification and resolution of legal uncertainties relating to the EU ETS has made significant progress in the last years. Although some of the legal disputes between operators and the government authorities as well as between the Member States and the European Commission result from the free allocation to installations some other legal clarification (taxation and balancing issues, etc.) improve the starting point for auctioning as the potential major approach of allocation significantly.
- With the targeted interventions of the Commission in the approval process of the National Allocation Plans for the period 2008-2012 a strong signal was sent to the market that a major streamlining of the scheme must be considered which should decrease the problem of a lock-in attitude significantly.

Against this background, the introduction of auctioning as a major allocation approach in the EU ETS should face less technical challenges than it is the case in other schemes.

2.2 Overview on allocation approaches

Allocation of allowances in emission trading schemes consists of two steps that can be clearly separated.

First the cap is set, and governments determine how many allowances will be issued. Setting the cap determines the scarcity level and thus the allowance price. Second, allowances defined by the cap are issued and allocated either for free or in auctions.

We will first present the approaches available to allocate allowances to existing installations, and then discuss how national allocation plans treat closure of installations and new installations.

To *grandfather* allowances, governments measure or estimate emissions for a historic base period. For example, for most national allocation plans in Phase I of EU ETS, the period 1998-2002 was used as a base period. Governments distribute allowances proportional to some average of the emissions of installations in this base period.

While theoretical models and the precedences of emission trading in the US assumed that the base period does not change, we observe *grandfathering (or benchmarking) with a moving baseline* in the second phase of the EU ETS. In the negotiations about national allocation plans for phase II of EU ETS, governments used recent emission data, usually including the year 2004 and some cases even the year 2005 to decide on the volume of allocation to individual installations. Governments do this in order to support growing firms and to avoid handing out excessive volumes of allowances to firms that closed or scaled down their production. It is sometimes argued that the move of the baseline was a one-off event under the second national allocation plan, and mainly inspired by the motivation to make use of emission data of a higher quality. However, it seems that most industry participants assume that the baseline will continue to move.

Allocation according to *benchmarks* is not related to the emissions of individual installation. Instead the same characteristic that describes the size of the production process is used to determine the scale of the operation and then multiplied with a bench mark emission rate to determine the volume of free allowance allocation.

The *benchmark rate* can be set at average emission factors for the industry, at the emissions of the best available technology for the production process or at a lower level. In the power sector benchmarks differ depending on the technology used. In many countries a higher benchmark is used if power is produced by burning coal than by burning gas. In all countries a benchmark of zero is applied to non-fossil generation.

Five different *characteristics* can be used as a basis for a benchmark allocation:

- historic production using a fixed baseline
- historic production using a moving baseline
- current production (violates ex-post adjustment criteria of Directive)
- projected production, using some model-based approach
- installed capacity.

In countries in which benchmarks are applied, usually in the power sector, the installed capacity has become the preferred input parameter. Installed capacity is then multiplied with the number of full load hours that an installation is expected to produce to determine an annual production. The number of full load hours is sometimes set differently for different fuel types, thus introducing a fuel-differentiated benchmark through the back door.

Rather than allocating allowances for free, governments can also sell the allowances. Usually an *auction* is used for such government sales. This can ensure a transparent process and the mechanistic determination of a market clearing price in the auction avoids the difficulties associated with government officials having to negotiate a price with buyers.

The national allocation plans envisage that installations that *close* do not continue to receive free allowances. National allocation plans have explicit provisions according to which installations seize to receive free allowances when they close or within a year of their closure. Even in the absence of such explicit provisions, the repeated free allocation suggests that installations that close would not receive free allowances in subsequent commitment periods.

All national allocation plans provide for allowances for *new installations*. They receive allowances based on projected emissions, or according to benchmarks in the power sector.

A few Member States implemented at least for the first phase of the EU ETS *transfer provisions*. Transfer provisions combine the allocation approach of non-updated grandfathering with provisions for plant closure and free new entrants allocation. Under a transfer provision operators can transfer the allocation of old plants to new plants in the case of closure and substitution by new plants. However, transfer provisions faced strong resistance from many operators and even the Commission because they constitute a bureaucratic version of a grandfathering approach in combination with a generous plant closure provision, their interactions with other provisions for free allocation to new entrants which led to significant differences in the allocation to identical plant and the related problems of distribution and competition distortional. As a result transfer provisions played almost no role in the allocation for the phase of 2008-2012 and will not be discussed in more detail in the following chapters.

2.3 Experience with free allocation

2.3.1 Distortions (existing installations and new entrants)

2.3.1.1 Preliminary remarks

When the European Emission Trading scheme was put into place, few people anticipated that free allowance allocation will create distortions for the economic efficiency of the scheme. Economic textbooks usually emphasise that allocation does not affect the economic efficiency of cap and trade scheme as trading allows market participants to find the least cost emission reduction opportunities. The implicit assumption in all these models is that allocation is based on one, fixed, historic baseline. US emission trading programs for SO_2 and NO_x largely followed this model. Allowances are typically allocated for more than a decade using an historic baseline for fuel consumption multiplied with a benchmark emission rate. The allocation is not altered irrespective of subsequent operation, investment or even closure decisions of the installation.

The European Emission Trading scheme however is characterised by initially three and subsequently five year allocation periods. The experience from the first two periods suggests that allocation decisions are based on recent information regarding individual installations. Allocation of allowances is not, like in the text book, a one off lump sum transfer. Instead, future allocations are contingent on today's operation, investment and closure decisions. Hence, managers of installations form expectations as to how their current behaviour will influence future allocation decisions of governments. The expectation about the form of future free allowance allocation can thus distort today's operation, investment and closure decisions. Repeated free allowance allocation can create economic incentives that reduce the efficiency of the emission trading scheme.

The existing and potential distortions in the EU ETS are increasingly focussed in the debate as well as the literature[3]. In the following chapters key aspects of distortions resulting from free allocation of allowances are described and discussed. In the framework of this analysis we characterise those provisions as distorting provisions which eliminate or diminish the carbon price signal which enables the economic entities to allocate their resources in the most efficient way.

2.3.1.2 Distortions from grandfathering with moving baseline

The distortions from free allowance allocation to existing facilities are strongest, when allowances are grandfathered based on a moving baseline.

Let us assume for example that a chemical installation received free allowances for the period 2005-2007 to match the average annual emissions in the period 1998-2002 and subsequently received allowances for the 2008-2012 period based on average annual

[3] See Neuhoff et al. (2006a), Matthes et al. (2005), Ellerman (2006), Ellerman et al. (2007) for more details and discussion.

emissions in the 2000-2004 period and a comparatively generous compliance factor[4] of 0.9875 as it will be applied for industrial installations in Germany for the 2008-2012 phase. The managers of the installation will use the historic precedence as the best indicator for future allocation, and will assume that allowance allocation for the period post 2012 will be based on emissions in the 2005-2009 period. Any reduction of emissions in the 2005-2009 period will thus result in fewer free allowances post 2012. A simple calculation shows that if the carbon price in 2008 is 25 €, the producer might only implement emission reductions up to a cost of 11.34 €/t CO_2.[5]

Grandfathering according to a moving baseline seriously undermines the incentives for emission reductions. This is frequently referred to as the strong early action problem – reducing emissions too early reduces future allocation. If the EU ETS would continue with grandfathering according to a moving baseline, then most emission reductions could thus be postponed indefinitely.

2.3.2 Distortions from benchmark allocation

Benchmarks are frequently proposed as a solution to reduce the distortions from the free allocation process. As future allocation is not directly related to past emissions, benchmarks do not undermine the incentive to improve efficiency and thus reduce CO_2 emissions within the installation.

But benchmarks can still create distortions. Distortions are strongest when they are directly related to output. Let me explain this using the example of the currently proposed (as of mid April) allocation to fossil fuel power plants in Germany. Fossil fuel power stations receive allowances in the 2008-2012 period in a manner proportional to some average of the power output in the base 2000-2004 period. As the base period is historic, the allocation does not create distortions by itself.

However, the allocation plan states that a similar approach will be used for the next allocation period.[6] Table 1 illustrates what happens if managers believe that the same approach will be used in the next allocation period. It is assumed that their combined cycle gas turbine emits 0.4 t CO_2/MWh and that allowance prices in 2008 are at 25 €/EUA. Then the (opportunity) costs of emitting CO_2 from this plant are 10.1 €/MWh.

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4 The compliance factor is defined as the ratio between free allocation and the level of historic emissions.

5 If the current approach of matching historic emissions will be continued, then reducing emissions by 1 t CO_2 in 2008 will reduce the free allowance allocation by 0.2 allowances in each of the five years 2013-2017. If we assume that the allowance price increases at 2% real per year, then the value of the lost allocation will be 5.5 € in 2013, rising to 5.9 € in 2017. Discounting this reduced income back to 2008, assuming the company requires a real rate of return of 10%, gives a lost future revenue of 13.66 €/t CO_2 saved today. While the emission reduction saves 25 €/t CO_2 (opportunity) costs in 2008, it reduces future income from free allowance allocation by 13.66 €/t CO_2.

6 This is subject to some conditions. The European Commission has also previously stated that it will not assess any provisions that relate to post 2012 in its decisions on the allocation plans, thus retaining the opportunity to reject them as they are implemented in the allocation plan for post 2012.

However, if the current plan stays in place, then efficient gas plants will receive the benchmark allocation rate of 0.292 allowances for the average electricity production in the base period in the period 2013-2017.[7] The future price of allowance is difficult to predict – let us assume as before that it increases at 2% per year (in real terms). Let us assume that the firm discounts the value of the future allocation at 10%. Then the average value of allowances in the 2013-2017 period is 13.84 € on average and the value of the future allocation is 4.00 €. Subtracting this value of the future allocation from current costs the manager will only consider opportunity costs of 6.00 € per MWh of electricity produced. The CO_2 price signal provided by the EU ETS will be eroded by about 40%.

Table 1 *Illustration of output-based allocation with moving baseline*

	Emission rate	Allowance costs (= costs of CO_2)		Future allocation (2013-2017)			Opportunity costs
				Benchmark[a]	Discounted future value[b]		
	t CO_2/MWh	€/EUA	€/MWh	EUA/MWh	€/EUA[c]	€/MWh[c]	€/MWh
Natural Gas	0.403	25.0	10.1	0.292	13.8	4.0	6.0
Hard coal	0.846	25.0	21.2	0.600	13.8	8.3	12.8
Non fossil power	0.000	25.0	0.0	0	13.8	0.0	0.0

Notes: [a] assuming a benchmark of 365/750 EUA/GWh for natural gas/hard coal and an adjustment factor of 0.8. - [b] assuming an EUA price increase of 2% real and a discount rate of 10%. [c] in 2008 prices

Sources: German NAP-2 and authors' own calculations.

The example illustrates that output-based benchmarking with a moving baseline reduces the opportunity costs for power stations. If power markets are reasonably competitive and the respective power stations are setting the marginal electricity price, then this allocation could – in the simplified picture – result in lower electricity prices. However, as is frequently the case in economics, a partial analysis of the proposed solution can be misleading.

The proposed benchmarking approach distorts relative prices because the marginal generation costs do not reflect the full CO_2 price. This can have significant consequences.

Let us assume that in the 2008-2012 period some shift from coal to gas is required to achieve the emission target.[8] The higher environmental costs of coal in comparison to gas (in our example about 11.10 €/MWh) will then have to compensate for the potentially higher fuel costs of gas-fired generation. However, the output-based benchmark with a moving baseline reduces the cost difference related to CO_2 between coal and gas from 11.10 €/MWh to 6.80 €/MWh. For a set of gas and coal prices that are likely to materialise in the 2008-2012 period, firms will continue to operate coal rather than shifting to gas. As a result, the CO_2 emissions will be higher.

[7] Assuming the provisions laid down in the final version of the German NAP-2: a benchmark of 365 EUA/GWh, an adjustment of 0.83 for auctioning and a further adjustment based on the efficiency based adjustment to the overall cap which would lead in total to an allocation of 80% of the benchmark of 365 EUA/GWh.

[8] Given the current projected gas prices this might be possible.

However, the cap for the EU ETS for the 2008-2012 period has already been set. Higher emissions can be partially compensated by additional imports of CDM and JI project credits, but will also push up the CO_2 prices. If some shift from coal to gas in the German power system will still be required, then we might still require the CO_2 price signal to create a cost difference of 11.1 €/MWh. If we stick to our example, the allowance price has to rise to 34.70 €/EUA to allow for the shift from hard coal to gas.

The same mechanism would apply if non-fossil power generation, for example from renewable power generation, should be required to be competitive in the electricity market under the EU ETS.

The example illustrates that output-based benchmarks with a moving baseline do distort the level at which environmental costs are reflected in operating costs. This can distort the fuel choices, from gas to coal, from non-fossil generation to fossil generation, or from electricity savings to electricity generation.

As benchmarks differ across sectors and countries, they also create distortions across countries. If, for example, only Germany were to apply output-based benchmarks with moving baselines, then production choices will be shifted from neighbouring countries to increase the utilisation of the German production sites.

2.3.2.1 Distortions from closure provisions

Explicit and implicit *closure provisions* can delay closure of installations. Most national allocation plans do not allow installations to retain allowances beyond the period for which the installation is operating or at least operational. This constitutes a financial benefit for continued existence and can thus delay closure decisions.

Delaying the closure of inefficient plants creates an economic cost as it results in a deviation from the least cost equilibrium. Thus, the cost for a transfer to a low carbon economy is increased and the overall competitiveness of the European economy is reduced.[9]

Where production is highly carbon-intensive and exposed to strong international competition unilateral implementation of carbon costs could result in relocation of production into areas with weaker or no carbon price signals. If such relocation would result in closure of plants, then the relocation might be delayed if closure provisions create incentives to continue operation of installations. While the argument in principle seems a viable approach, a careful quantification is necessary to balance the costs of non-discriminatory free allowance allocation to prevent relocation against (i) the benefits for

[9] To address this concern in the power sector, some national allocation plans contain transfer provisions. The free allowances that an existing plant A would have received can be transferred to a new plant, plant B. Thus the disincentive to close plant A has been reduced from the high level of free allowance allocation of plant A to the lower level forgone free allowance allocation of the more efficient new entrant B. With the use benchmarks for the allocation to plants, such transfer provisions lost their relevance.

individual installations in some sub-sectors in delaying relocation (ii) alternative measures to avoid international competitiveness distortions.

While explicit closure provisions could – at least in theory – be avoided in national allocation plans, it is almost impossible to avoid implicit closure provisions. With repeated free allowance allocation, the negotiation about allocation to individual plants is also repeated. It is difficult to envisage a government allocating allowances to the previous owners of a no longer existing plant in such a negotiation. First, handing out valuable public resources without any direct tangible benefit would be difficult to explain to the public. Secondly, the previous owners have little weight in the bargaining process, where other installations can threaten closure and loss of jobs, promise innovation or promise future growth.

2.3.2.2 Distortions from new entrant allocation

All national allocation plans retain some allowances in what is called a 'new entrant reserve.' It is difficult to imagine why incumbents, despite their strong influence on the design of the national allocation plans, would provide support for new entrants. As it turns out, these reserves are available for all new installations, and are likely to be used mainly by incumbent players rather than by new entrants.

Similar provisions do not exist in the preceding US SO_2 and NO_X emission trading schemes and constitute a new feature of emissions trading schemes (Ellerman 2006). The initial justification for the free allocation to new installations in the European scheme was threefold:

- First, to ensure a fair treatment of all installations, new installations also need to receive free allowance allocation. For instance, in the absence of a free allocation to new installations it would have been difficult to justify the high levels of free allowance allocation to exiting facilities.
- Secondly, to avoid the risk that new installations would not be able to buy sufficient amounts of allowances in the market, e.g. allocate to new entrants to postpone the need for auctions. If not in auctions, then new entrants have to buy allowances from other installations – and these might either exercise market power or not engage in trade, thus constraining entry.
- Thirdly, to compensate for the distortions resulting from closure provisions (see previous section).

Over time the argument for free allocation to new installations has evolved. At present, it is argued that free allowances be allocated to new installations, particularly in the power sector, in order to increase the level of security of supply or reduce the impact of the emission trading scheme on the power price.

There are three sets of concerns arising from the new entrant allocation.

- First, outside of the power sector the first two national allocation plans have illustrated the difficulty of defining benchmarks for CO_2 emissions. Hence, allocation to new installations is likely to be negotiated on a project-by-project basis with the government. As all governments want to support new investment within their jurisdiction, new installations are likely to receive allowances to cover all their projected emissions during the allocation period. This undermines incentives to reduce CO2 emissions when making investment choices.

- Secondly, even where benchmarks are applied in the power sector, only installations that use fossil fuels receive free allowances. Frequently even the benchmarks (providing for the same result, the number of projected full load hours operation per year) differ between gas and coal. If coal-powered stations receive more free allowances than gas-powered stations than non-fossil power stations, it distorts investment decisions towards higher carbon-intensive fuel choices.
- Thirdly, investors in new installations expect that their installation will receive - not only initially - free allocations in the current period. In subsequent periods the installation will be an existing installation, and will receive allocations according to the provisions for existing installations. Typically this creates additional distortions towards the use of less efficient installations or higher carbon fuels.

It is sometimes argued that free new entrant allocation reduces the power price impact of emission trading. The argument goes as follows: The free new entrant allocation is a subsidy to new investment, and therefore results in accelerated investment, more installed capacity, therefore less scarcity and lower power prices.

Proponents of the argument usually fail to mention the US experience. Investors in power projects are weary of government interference in the power market. If government today subsidises new investment, then it is likely to do so in the future. But future subsidies to new investment undermine the future investment equilibrium, thus reduce future prices and increase uncertainty as future prices can no longer be predicted as long-term average generation costs. This effect can potentially increase the investment threshold and might result in net increases of today’s power prices.

In addition, if new installation allocation distorts the investment towards higher carbon technologies, or lower efficiencies, it will ceteris paribus increase future CO_2 emissions. Therefore, future CO_2 allowance prices have to rise to reduce emissions during operation. These higher allowance prices might well increase future power prices. As future power prices, more than today’s power prices, determine investment and closure decisions of the manufacturing industry, this is unlikely to be in the interest of industrial policy.

One effect of new entrant allocation was already apparent last year. The German government had initially envisaged in the national allocation for Phase II, that power stations which commence operation in Phase II will receive free allowances for more than a decade. Industry did attribute a high likelihood to this promise, resulting in a surge in demand for coal power stations to be commissioned by 2012 and correspondingly high prices in the (option) contracts for the construction of the power stations. This was the first tangible sign that new entrant allocation can increase costs of power generation.

2.4 How to remove distortions

We can summarise the distortions described in the previous section in the following pyramid of distortions. It illustrates that by moving up the pyramid some of the distortions can be eliminated.

Figure 1 Pyramid of distortions of EU ETS

Allowance allocation method	*Impacts*	More expenditure on extending plant life relative to new build		Increase plant operation		Less energy efficiency investment
	Distortions	Discourage plant closure	Distortion biased towards higher emitting plants	Shields output (and consumption) from average carbon cost	Distortion biased towards higher emitting plants	Reduce incentives for energy efficiency investments
Auction						
Bench-marking	**capacity only**	X				
	capacity by fuel/ plant type*	X	X			
Updating from previous periods'	**output only**	Y		X		
	output by fuel/ plant type*	X	X	X	X	
	emissions	X	X	X	X	X

Note: X indicates a direct distortion arising from the allocation rule. Y indicates indirect distortions if allocation is not purely proportional to output/emissions.
* Differentiating by plant type adds additional distortions compared to purely fuel-based.

Source: Neuhoff et al. (2006b).

With regard to European policy in 2007, it is important to note the origin of most distortions from free allowance allocation, namely expectations about free allocation post 2012. National allocation plans for the 2008-2012 period create few distortions on their own. The expectation that they are a precedence for the next set of national allocation plan creates most of the inefficiencies.

There are two notable exceptions: Closure provisions create incentives to retain installations in operation to continue operation until 2012 and new entrant allocations create incentives for investment decisions. But as most capital intensive investment will not be commissioned until the second half of the first commitment period, these distortions are likely to be small, relative to the impact of expectations about allocation and price level post 2012.

Hence, we can make the EU ETS efficient by ensuring that the expectations about allocation post 2012 do not distort investment and operation decisions. As illustrated above, even if we were to move to capacity-related benchmarks to determine the free allowance allocation post 2012, significant distortions for investment and closure decisions remain.

However, if governments were to credibly commit not to allocate free allowances post 2012 to specific sectors, then the distortions for these sectors can be eliminated.

Furthermore, the Commission made the limits on benchmarking approaches in some of the decisions on NAP-2 very clear in the framework of state aid policy. In its decision n the Austrian NAP-2, the Commission stated that it "*cannot exclude that State aid in allocations which go beyond expected needs will be found incompatible with the common market should it be assessed in accordance with Articles 87 and 88 of the Treaty*" (COM 2007). In addition to the view of those analysts who judge free allocation to installations as state aid in general (Johnston 2006), the Commission decision mentioned above indicated that strong restrictions exist on the use of benchmarks. At least a benchmark scheme even with the lowest degree of distortions as described above must be designed in such a way that the environmental benefits allow for an exemption in the framework of state aid and would avoid allocations which could exceed the expected needs of a certain installation. Considering the experiences with benchmarking in the real world, the unavoidable distortions even with a benchmarking approach and the framework of state aid policy, benchmarking can no longer be seen as a long-term alternative to auctioning of allowances.

2.5 Distributional effects and the use of revenues

Although removal of distortions of the carbon price signal should be seen as the prior foundation for the phase-in of auctioning, the public debate is much more focussed on the issue of windfall profits.

Without any doubt, the introduction of carbon pricing will result in wealth transfers. In the case of a free allocation of allowances and if the market enables the pass-through of opportunity costs, the operators of the installations which receive the free allocation will benefit mostly from these wealth transfers.

Much analysis was carried out on the issue of cost pass-through in the electricity sector which showed the effect of CO_2 in the electricity prices in competitive power markets very clearly (Sijm et al. 2006a+b, Matthes 2007). On the other hand, in some power markets which are still subject to different types of regulation or other equivalent means (e.g. price regulation in Spain or Poland, special contracts for large customers in France, etc.) the effect of CO_2 cost pass-through is rather limited.

There is some indication that other industries are also able to pass-through the costs of carbon to their product prices (McKinsey/Ecofys 2006, Walker 2006).

However, a careful distinction should be made in the debate on such wealth transfers and the potential to redirect these transfers by the means of allocation:

- The free allocation represents a value which is provided almost for free in the recent stage of the EU ETS. If we assume a scope of about 2.15 billion t CO_2

(with Bulgaria and Romania) for the scheme, a total emission from power plants of 1.3 billion, an allowance price of 25 €/EUA and an average free allocation of 95% for the average of all installations and of 70% for power plants, the operators of all installations receive 47.5 billion € for free. The respective value for the power plant operators would amount to 22 billion €. If they are able to pass-through (which will definitely be the case in the EU power sector in the medium turn) a significant share of the opportunity costs, this will lead to windfall profits in a significant order of magnitude. If we assume an average pass-through of 500 g CO_2 at 25 €/EUA for the marginal power plants setting the price, for a net electricity production from conventional power plants of 1,778 billion kWh as of 2005, this would equal a potential for windfall profits for these plants of about 13 billion € annually. A phase-in of auctioning would minimise these windfall profits (Keats/Neuhoff 2005).

- If the costs of CO_2 will impact the commodity prices, even the producers of commodities for which no CO_2 is emitted (e.g. non-fossil power production) will gain from the pass-through of CO_2 costs to the market prices, whether these costs are real costs for purchasing allowances or are opportunity costs of allowances allocated for free. The total net production from hydro power plants in the EU-27 was 336 billion kWh in 2005, and the net electricity production from nuclear power plants was 946 billion kWh this would lead to a potential windfall profit of 16 billion € annually for these plants. A transformation of the allocation provisions away from free allocation would not change this kind of windfall profits.

It should be pointed out very clearly that especially the power markets in the EU-27 have not yet reached a stage in which the pass-through of CO_2 costs can be assumed for all Member States and all markets. Furthermore, many generators sell significant shares of their production in the forward market and gain from the windfall profits after a certain delay in time.

However, given the strong efforts to improve the Internal Market for Electricity in the EU-27 and the strong economic rationality of pass-though of opportunity costs, at least wind fall profits in the order of magnitude indicated above will occur in the medium-term if no major change is pursued.

If auctioning will be phased in under the EU ETS at a significant order of magnitude, the recycling of revenues from the auctions constitutes a crucial aspect even in the debate of wealth transfers. Even if different needs, different traditions and different opportunities regarding the recycling of auction revenues exist among the Member States of the EU, the transfer of wealth should be organised in a way that double dividends can be achieved (Cramton/Kerr 2002):

- by recycling the revenues to support innovation and technological development or to overcome barriers for cost-efficient mitigation options;
- by recycling the revenues to remove other distorting taxes or duties, e.g. on labour costs, social insurance, pensions.

The analysis of options for recycling the revenues does not lie within the scope of this paper, but we strongly recommend the use of the auction revenues with such approach.

2.6 Preliminary conclusions

The phase-in of auctions to distribute the allowances to the installations under the EU ETS could be based on different foundations:

- The creation of an undistorted carbon price signal should be seen as the primary motivation. The recent experiences show that no regulator was able to create a scheme of free allocation which does not create major distortions of the CO_2 price signal, which is crucial for the economic efficiency of the ETS.
- Even with the general trend towards more ambitious provisions for free allocation (benchmarking), the allocation is still far away from being simple and transparent because of the manifold distributional effects. Auctioning is the only way to overcome the complexity and remaining distortions of free allocation schemes.
- Having operated the EU ETS for 8 years with an almost free allocation in place, the phase-in of auctioning could provide the necessary and appropriate level playing field for incumbent and new installations and/or players on the market.
- The phase-in of auctioning could remove at least a part of the windfall profits arising from free allocation and the pass-through of opportunity costs in competitive markets.
- The appropriate use of auction revenues could enable double dividends in terms of innovation, emission reduction and prosperity.

Against this background, the following analysis focuses the question on how to phase-in auctioning and no longer on the debate as to whether auctioning is an appropriate approach of allocation of allowances.

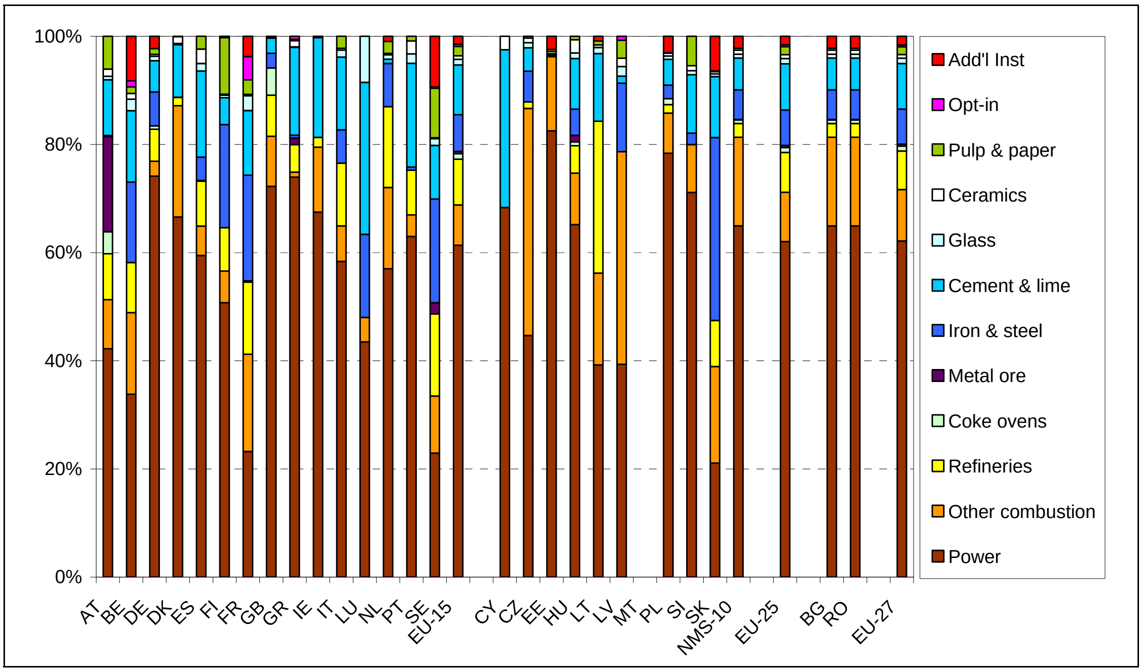
3 Phase-in of auctioning

3.1 Data analysis

The EU ETS has a total coverage of about 2,15 billion t CO_2 for the 27 Member States.[10] Figure 2 indicates the sectoral breakdown of CO_2 emissions covered by the EU ETS including the installations which will fall under the scheme from the beginning of the 2008-2012 period.[11] The relatively wide scope of the EU ETS leads to significant structural differences between the Member States.

In the EU-27 power production from both public and industrial power generators represent a share of about 62% of the total coverage of the scheme. Other important sectors with shares of between 7 and 9% are the refinery sector, the iron and steel sector, the cement and lime producing industries and the total of all other combustion installations with a thermal input capacity of more than 20 MW.

Figure 2 Sectoral structure of the CO_2 emissions covered by the EU ETS, 2005



Source: CITL, Member States, authors' own calculations.

However, the structure of emissions covered by the EU ETS varies widely between the Member States. In some Member States the power sector represents a share of 70% or more (Germany, Denmark, the UK, Greece, Estonia, Poland, Slovenia) whereas in some

[10] Assuming a coverage of the EU ETS of about 110 Mt CO_2 in Bulgaria and Romania.

[11] The sectoral breakdown is based on the definition of activities given by the Directive and the Registry regulation. In addition to this, the power plants were identified by an installation-by-installation analysis of data from the Community Independent Transaction LOG (CITL). The data for Bulgaria and Romania are based on the respective national greenhouse gas inventories.

other Member States (France, Slovakia) these installations cover only 20% of the total CO_2 emissions under the scope of the EU ETS in these countries.

In the case that mandatory auctioning is phased in during the third period of the EU ETS *and* for some sectors exemptions would be accepted (e.g. because of potential competition distortions), the structural differences between the Member States should be considered in the specification of mandatory auctioning in the Directive.

The following thought experiment illustrates the challenge of defining mandatory shares of auctioning and maintaining free allocation for some sectors at the same time in the EU ETS with its structural differences between many Member States: If the iron and steel as well as the cement and lime industry should continue to receive free allocation and all other installations would no longer receive a free allocation and must rely on the purchase of allowances at an auction or on the secondary market, the share of free allocation varies from 0.3% in Estonia to 44% in Luxembourg and 34% in France.[12] A flat rate for mandatory auctioning for all Member States could create serious challenges and would raise concerns regarding unequal treatment of sectors among the Member States. In some countries, operators who are able to pass-through the costs for the allowances could still receive free allocation whereas in other countries sectors would need to purchase allowances; in the latter case, the pass-through of allowance costs could be much more complicated. The competition distortions related to this situation could lead to major political and legal problems which probably would lead to a race to the bottom regarding the mandatory auctioning shares.

All flat rate shares for mandatory auctioning besides the option of full auctioning will face this complicated situation. However, if a 100% auctioning would not be possible as a result of the political process (probably depending on a judgment of potential competition distortions and/or the problem of leakage effects), the definition of mandatory shares of auctioning at a sectoral level (e.g. according to the sectors defined in the Registry Regulation) could be suitable as a second-best approach.[13] Such approach would, if needed, fit best in a general design of the EU ETS in which the cap is set on the EU level, either as a European cap or as the starting point for the breakdown into separate caps of the Member States relying on the sectoral structure of the emissions covered by the EU ETS.

[12] For this illustrative example we assume that the emission reduction and a potential set-aside for, for example, the free new entrant allocation are proportional to the base emissions. The percentage figures relate to the total emissions covered by the EU ETS in the respective countries in 2006.

[13] An illustrative example: If on the EU level a mandatory 100% auction for combustion installations would be defined and all other installations would receive a full allocation for free, the effective share of free allocation would amount to 4% in Estonia and 11% in Denmark on the one hand and to 63% in France and 64% in Slovakia on the other hand. Again, these shares assume that the emissions reduction and a potential set-aside are distributed proportionally among all installations.

3.2 Vulnerability to distortions of international competitiveness

A part of the controversial debate on auctioning derives from concerns on international competitiveness. Auctioning of allowances will impact the cash flow of the firms which operate installations under the scope of the EU ETS. The cash flow effects depend on the emissions of the installations on the one hand and on how far the costs of CO_2 can be passed through the product prices. In principle, there is no doubt about the ability to pass through the costs of carbon differs between different sectors and products. Consequently, the impact on the cash flow of the firms could create competition distortions (and in certain cases also leakage effects) if all or a significant share of allowances must be purchased in an auction or from the secondary market and if the company is exposed to international competition where main competitors are not subject to carbon pricing.

The effect of the EU ETS on the international competitiveness of certain industries is subject to a wide range of modelling and other analysis (Demailly et al. 2006, Reinaud 2004, Smale et al. 2006). However, the empirical evidence that the introduction of the EU ETS created major competition distortions or leakage is rather poor at this early stage of the scheme.[14]

In order to identify the sectors for which such distortions in international competitiveness could potentially be significant if allowances are no longer be allocated for free, different aspects should be considered:

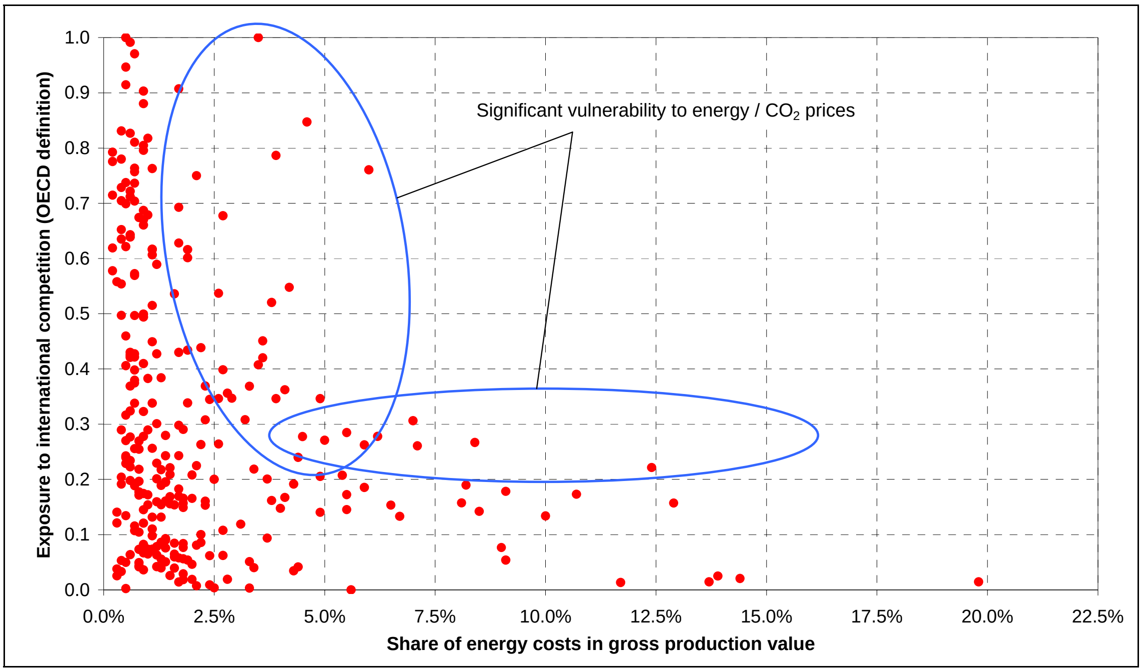
- One of the main advantages of the EU ETS is its large coverage. For the competition between the Member States no distortions will arise from a more stringent allocation approach if this approach is harmonised amongst the Member States. The issue of competition distortions is mainly an issue of competitions with firms outside the EU-27.
- The probability of competition distortions will not arise from the energy or CO_2 intensity of certain (partial) technological processes but from the share of energy or CO_2-related costs in the total value added. In this case, the risk of moving outside the EU (exchange rates, regulatory uncertainties, transport costs, etc.) will probably outweigh the additional costs from the EU ETS if the share of energy costs is relatively small.
- Some of the effects on competitiveness cannot be compensated by allocation provisions because they result from the increase of power prices which does not depend on the allocation (see chapter 4).

If we assume that the share of energy costs in gross value added is a robust proxy for the vulnerability to energy price changes, an analysis based on energy consumption data on the one hand and import/export data to the world outside the EU on the other hand

[14] One of the very few examples which is frequently quoted is the closure of the primary aluminium production in Hamburg (Germany). Only a few months after closure of the plant, which was made with reference to the increase of power prices in the framework of the EU ETS, the plant was re-opened by a new owner. However, medium term effects of the EU ETS on the location of investments should be subject to careful analysis.

(both on the four digit level of the German industry statistics) leads for *Germany* to the result shown in Figure 3 (Matthes/Graichen 2006).

Figure 3 *Exposure to international competition and share of energy costs in gross production value, Germany 2002*



Sources: *Statistisches Bundesamt, calculations by Öko-Institut.*

The comparison underlines that only a few German industrial sectors (at the four digit level) face a share of energy costs in gross value added higher than 2% and an exposure to international competition from outside the EU which amounts to 0.2 or higher.

The analysis at the four-digit level in the United Kingdom identifies five electricity-intensive sub-sectors that are intrinsically exceptionally exposed (with proportionate value-at-stake at 15 €/t CO_2 that exceed 3.5% of value-added) irrespective of allocation: these are the production of precious metals, manufacture of industrial gases; other inorganic basic chemicals[15]; other technical ceramic products[16]; and household and sanitary goods. Manufacture of basic iron and steel follows at 2.55%.

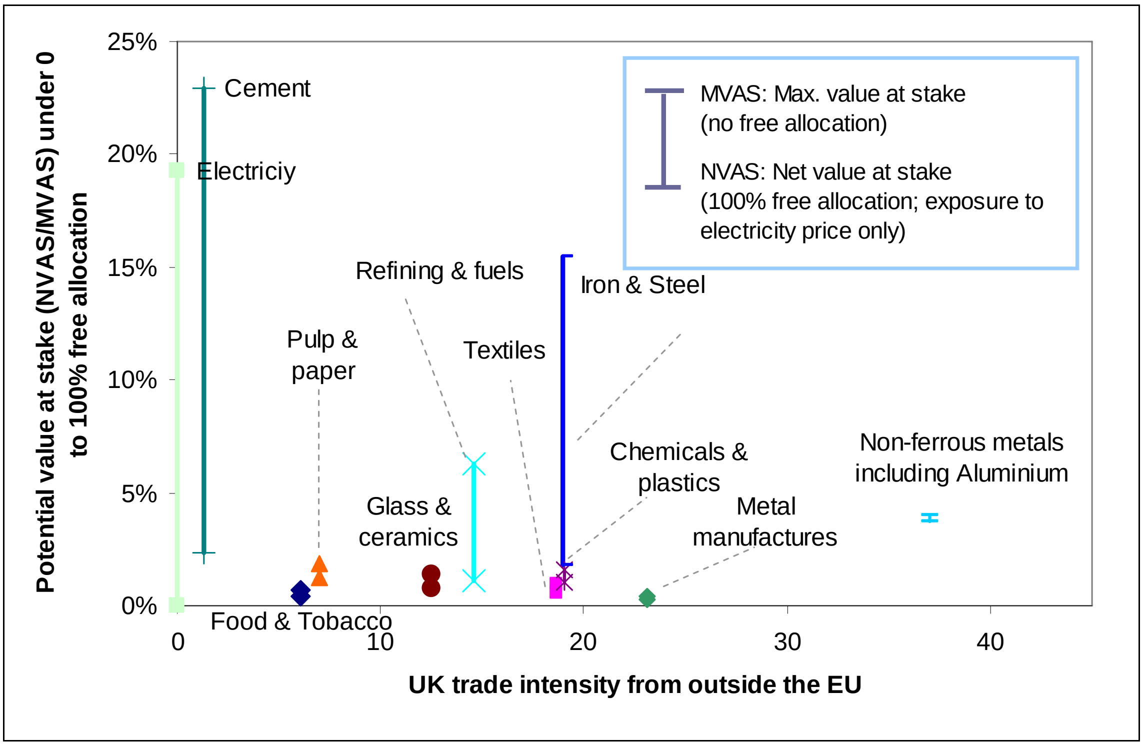
However, basic iron and steel and four other sub-sectors stand out in respect of potential exposure to carbon costs overall, for example when value-at-stake exceeding 10% of

[15] This class includes: manufacture of chemical elements except metals, industrial elemental gases and radioactive elements produced by the nuclear fuels industry; manufacture of inorganic acids except nitric acid; manufacture of alkalis, lyes and other inorganic bases except ammonia; manufacture of other inorganic compounds. Process emissions for this sector have been omitted, as they are poorly understood at the four-digit level.

[16] As noted before, process emissions are not taken into account in the case of the chemicals and plastics sector as they are poorly understood at four-digit level.

value added at 15 €/t CO_2 if there is zero free allocation: the other four include two of the ‘top five’ in terms of electricity exposure, plus the manufacture of cement, and of lime. If the threshold drops to 5%, 4 sub-sectors are added to the list: Manufacture of other inorganic chemicals (9.60%)[17], manufacture of household and sanitary goods and toilet requisites (6.70%), manufacture of refined petroleum products (6.58%) and manufacture of industrial gases (5.88%).

Figure 4 *Net value at stake relative to UK trade intensity from outside the EU*



Source: *Demailly et al. 2006*

Thus, the detailed data shows that significant impact of emission trading on competitiveness concentrates on a far smaller fraction of industrial activities than suggested by aggregate figures (Figure 4).[18]

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17 As noted before, process emissions are not taken into account in the case of the chemicals and plastics sector as they are poorly understood at the four-digit level.

18 The upper end of range indicates zero free allocation, and the lower end of range indicates 100% free allowances (effect of €10/MWh electricity price increase to sectors). An allowance price of 15 € and no CO_2 price pass through in the sector are assumed. Trade intensity is defined in this case as the value of imports from non-EU countries as a proportion of the total supply in the UK plus the value of exports to non-EU countries as a proportion of total demand in the UK. The vertical axis combines the full range of potential indices of net value at stake (NVAS), which we define as the net impact of the EU ETS on sector costs relative to sector value-added. The lower end shows the impact if the sector participates in the EU ETS and receives free allocations equal to its “business-as-usual” emissions, and takes no abatement action: the NVAS then represents the sector’s exposure to indirect costs through electricity price impacts only. The upper end shows the impact if there were no free allocations – equivalent to 100% purchase on markets or auctioning at the market price. The chart shows re-

The sectors which could reclaim a significant vulnerability to international competition distortions in the analytical framework presented here are the following:

- pulp, paper and paperboard
- basic chemicals, man-made fibres
- non-refractory ceramic goods other than for construction purposes; refractory ceramic products
- iron and steel
- cement
- basic precious metals and other non-ferrous metals.

Again, an analysis of the vulnerability to increased energy prices must reflect the fact that the most significant energy costs for the majority of the sectors mentioned above are electricity costs. Therefore, these sectors will face the effects of increased electricity prices independently of the allocation approach for the direct emissions of these sectors if we assume competitive power markets will allow pass-through of CO_2 costs.

Against this background, the compensation of potential competition distortions (and leakage) could only for some of the sectors mentioned above (pulp and paper, glass, ceramics, iron and steel, cement) take place in the framework of free allocation to the installations of these sectors. For the other sectors (chemicals, non-ferrous metals), other ways of compensating would have to be found in any case.

Given the limited number of sub-sectors and products which could face unacceptable competition distortions or leakage and the limited role of allocation to compensate for this, the issue of potential competition distortions should not be handled in connection with the phase-in of auctioning under the EU ETS but with regard to other means of compensation (border tax adjustments, international agreements, direct compensation, etc.).

sults for a carbon price of 15€/t CO_2 and an electricity pass-through resulting in a wholesale electricity cost increase of €10/MWh. Scaling the electricity price would move the lower point of the bars in direct proportion; scaling the carbon price would scale the height of each bar.

3.3 Conclusions on mandatory auctioning in the EU ETS

The broad scope of the EU ETS leads to significant differences between the EU Member States regarding the structure of industries covered by the scheme. Assuming that the ability to pass through the costs of carbon to the product prices differs significantly between some key sectors, the following conclusions can be drawn from the discussion in the previous chapters and the relevant literature:

1. Given the experience that no Member State of the EU was able to manage free allocation in such a way that major distortions of the CO_2 price signal could be avoided, a full auctioning should constitute the first priority for the further improvement of the EU ETS beginning with the third phase in 2013. All other shares of mandatory auctioning will create the need to differentiate between the Member States in order to avoid competitions distortions between the Member States. This could lead to a complicated political process.
2. There is some indication that essential competition distortions could arise only for a few products and industries.
3. For most of these products and industries the main problem will result from the increase in electricity prices as a result of the pass-through of the costs of carbon. This effect does not depend on whether the allocation for the power sector is free or not.
4. If a certain share of free allocation should prove to be inevitable, the respective breakdown among the Member States should start from an EU level and should be based on a transparent mechanism, preferably based on activity definitions laid down in the Registry Regulation. This approach fits best in a general approach to establish an EU-wide cap or to derive the national caps from a predefined cap for the EU.
5. The bottom line for the phase-in of auctioning in the EU ETS is the complete phase-out of free allocation for power production. This equals a maximum share of about 40% for free allocation for the EU-27 as a whole.

Last but not least, the set up of complementary measures to avoid or to compensate for potential competition distortions should be limited when there is a serious indication that leakage effects will also arise. Priority should be given to the following complementary measures[19]:

- border tax adjustments,
- sectoral commitments under the international climate regime,
- direct compensation, as far as possible under the EU's state aid regime.

The introduction of full auctioning will probably constitute a crucial precondition for such measures or to any other means of compensation.

[19] No further discussion of these options for such complementary measures will be made in this paper. See Hepburn et al. (2006) and Grubb/Neuhoff (2006) for more details.

3.4 Auction design

3.4.1 Introduction and overview

Auction design starts with the definition of the objectives to be achieved with the auction:[20]

- Simplicity and transparency to simplify communication, participation and acceptance of the auction and the overall emission trading scheme.
- Low transaction costs, information requirements, cash flow implications and price risk to facilitate wide participation, including by small players.
- A market clearing price that reflects the value of the allowances in the market.
- A design which minimises the problems arising from collusion and abuse of market dominance or market power.
- A design which helps to maintain a liquid secondary market for emission allowances.

While revenue maximisation is an additional objective for auctions, we think that this objective should not be pursued in this case on the back of small installations or players for which trading is not a core activity and which are therefore less informed players.

Efficiency of auctions is frequently analysed – and relates to the question as to whether the players who value the auctioned good the most will buy the good in the auction. As CO_2 allowances are freely traded in secondary markets, it is not of concern in our case.[21]

In the remaining part of this section, we will discuss how these objectives of the auction guide the choice of the auction design. The discussion focuses on aspects we perceive to be most important in the context of the specific market and objectives. A discussion of experiences from auctions across different sectors can be found, for example, in Klemperer (2002) or Jansen (2004).

For the set up of an auctioning scheme, seven key decisions on design options must be made:

1. What is the general format of the auction?
2. How will the clearing price be settled?
3. What frequency is foreseen for the auction?

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[20] These objectives can be subdivided into a more detailed set of options, including minimising the risk of manipulation, avoiding distortions of bilateral market, creating market confidence in robust allowance prices, avoiding cash flow problems or price risk for installations, increasing revenue predictability for government (see Neuhoff, 2007a).

[21] The secondary market is defined as the market in which the seller is not the original owner of the allowances. The original owner is, in the case of emissions markets, the institution which issues the allowances. In the case of free allocation, the secondary market covers all sales and purchases of allowances. In the case of auctioning as the primary allocation approach, all transactions besides the initial auction (or sale) are secondary market transactions.

4. What participants are eligible for the auctions?
5. Should a reserve price be set for the auction?
6. What are the needs regarding credit posting requirements?
7. What decisions must be made on the institutional setting?

Besides these general design options, some additional design options could be implemented to reflect concerns which are regularly raised with regard to the abuse of market power in auctions. These issues are analysed in chapter 3.5.

3.4.2 Single versus multiple rounds

The auction format can either require that all participants submit their bid by a certain time, or allow for multiple bidding rounds.

Multiple rounds offer the advantage that auction participants can learn about their competitors demand or valuation while the auction price rises (or falls) from round to round. Auction participants will use this information to update their valuation of the good that is auctioned. Multi-round auctions can therefore improve the efficiency of the allocation if goods are not re-traded after the auctions. The information revealed during the bidding process also reduces uncertainty for bidders and the resulting risk of bidding too high and their response of biasing their bids downward. As CO_2 allowances are already traded actively in secondary markets, all auction participants have reliable information about the value of these allowances in the market.

We could only think of two situations in which the auction clearing price would significantly differ from this price in secondary markets, and both of these can be easily avoided by the auction design.

- First, if strategic players want to short-squeeze the market and attempt to buy all allowance of one auction, then this could increase the market clearing price. We will discuss such gaming in more detail in section 3.5.2. If auction frequency is sufficiently high so as to ensure that individual auction volumes are small, it is then of little concern.
- Secondly, if the auction volume is very large then it requires demand-side and financial intermediaries to acquire large volumes of allowances for future use and reselling. Before the first auction it is not possible to deduce from the price of allowances in secondary markets to what extent players will be prepared to bear the risk associated with large positions. Hence, all market participants have to form expectations about the total willingness of the market to bear the risk of holding allowances. Whether these expectations are correct will only be revealed by the first auction. The auction clearing price could be higher than the price of secondary markets shortly before the auction, if market participants underestimated the willingness of financial institutions to take positions or the interest of emitters to hedge future emissions and vice versa. This effect can, however, only occur if the volume of allowances auctioned in the auction is large in relation to

the total volume of allowances and financial contracts in the market. It can be easily avoided if auction frequency is sufficiently great so as to reduce the relative size of any one auction.

In contrast, in a sealed bid auction, bids have to be submitted by a certain deadline. The auction closes, the market clearing price is calculated and then winning bidders are informed. This simple approach reduces transaction costs of interacting in the auctions, is easier to communicate and facilitates participation. As the main benefit of the multi-round auction – information revelation – seems to be of minor importance for a good that is actively traded in existing secondary markets, we suggest using a sealed bid auction format.

An alternative format could be an open submission of the bids that are visible to all participants. The additional information reduces the risk for market participants to pay more for their allowances than competitors are prepared to pay based on the information available to them and can thus make bidding more aggressive (Milgrom/Weber 1982). However, the open bids also facilitate collusion (Robinson 1985). As the secondary market already provides information, the risk of collusion is likely to dominate. Hence, we suggest the use of a sealed bid auction.[22]

3.4.3 Calculation of the clearing price

Three main approaches are used to determine how the auction clears. The uniform price auction, the discriminatory price auction, also referred to as pay as bid auction and the Vickery auction.

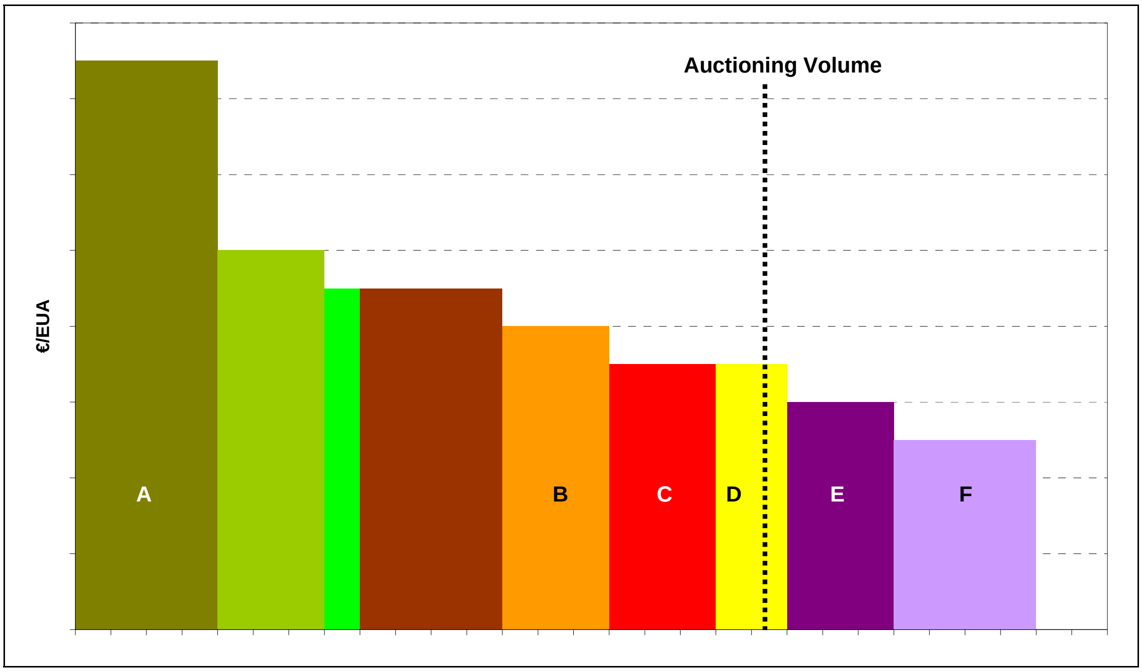
In a *uniform price auction* all bids are sorted in descending order of the bid price (Figure 4). The point at which the demand curve intercepts with the volume of allowances to be sold in the auction determines the market clearing price. All bids with a bid price above the market clearing price are accepted and have to pay the market clearing price. Let us discuss provisions for special outcomes:

First, the bids labelled C and D have bid prices equal to the market clearing price. If both bids were accepted, then demand would exceed available allowance volume. If neither bid is accepted, then not all available allowances are issued. Various solutions have been proposed to address such a situation. A 'first-come first-serve' approach gives preferential treatment to the bid submitted first, but could result in a rush to submit bids early. We suggest rescaling all bids with the bid price at the market clearing price. In our example, this would imply that both bids C and D receive 85% of their bid volume.

[22] ERM (2005) expressed preferences for an ascending clock auction design if the number of allowances to be auctioned is high. The differing results are likely related to (i) differing perception of market liquidity (ii) differing assumptions about auction frequency and thus relative size/importance of any auction.

Secondly, let us assume in our illustration (Figure 5) the auction volume would intercept the demand schedule between bid D and E. In this case a price anywhere between the price of bids D and E clears the market. We suggest specifying that the market clearing price is in this case set at the price of bid E, so as to ensure that bidders never pay more than necessary to clear the market.

Figure 5 Graphical representation of submitted bids to illustrate clearing price



Source: Authors' own estimates.

In a *discriminatory price auction* ('pay as bid') as before, all bids are ranked in descending order and the market clearing price is set at the intercept of the resulting demand curve with the available allowance volume. Again all bids with bid prices above the market clearing price are accepted. However, bidders have to pay their bid price, rather than the market clearing price. A special provision is required with regard to bids C and D that are priced at the market clearing price. Re-scaling seems to again be a viable approach.

On first glance, a discriminatory price auction seems preferable for the seller: Bidders pay a higher price according to their submitted bid rather than just the market clearing price. However, in a uniform price auction a bidder submitted bid A with the expectation that if the market clearing price is lower he would pay a lower price. In a discriminatory auction, the bidder would most likely reduce the bid price to avoid excess payments at the expected lower market clearing price. In fact, most bidders will change their bids dependent on whether they bid in a uniform price auction or a discriminatory price auction. The revenue equivalence theorem has assessed this adjustment and concludes: Rational bidders adjust their bids according to the auction format in a way that the seller receives on average the same revenue irrespective of the auction format. Obviously this is subject to various conditions, of which we will discuss only a sub-set.

One frequent motivation for the use of *discriminatory price auctions* is to *avoid bid shedding*. If we assume that a big player in the market intends to submit bids B and D. In a uniform price auction, the bidder could reduce the volume of bid D, thus shifting the demand curve (including bid E) to the left. As a result, the market clearing price would be set at the price level of E. In a uniform price auction the player could benefit, because he would pay a lower market clearing price for his bid B (Ausubel/Cramton 2002). In a discriminatory price auction, the price paid on bid B does not change – and players have smaller incentives to distort their bids. Many players, including both emitters and financial institutions can participate in auctions for CO_2 allowances. If the auction design ensures that they really participate in the auction, then many bids will be submitted close to the expected market clearing price. A player shedding his marginal bid will be replaced by a similar bid from other market participants. The incentives for bid shedding are low. This reflects one of the insights from Bulow/Klemperer (1996) – when it is possible to attract additional bidders to an auction, their contribution towards increasing the competitiveness of the auction outcome is bigger than can be achieved by using a more sophisticated auction design.

One frequent criticism against the use of *discriminatory price auctions* is that less *informed players pay on average more* for the goods sold in the auction. While no player will predict the exact shape of the demand curve - a well-informed player will be better at estimating the curve. Thus the player might, on one occasion, submit the bid B and on the next occasion the bid E. The player only wins in the auction on one of the two occasions and pays a slightly higher price than the market clearing price for his winning bid B. The less well-informed player faces more uncertainty as to what the market clearing price will be, and might therefore steer away from the market clearing price in his bids. If we assume that he submits bid A on one occasion and bid F on the next occasion. Like the well-informed player, he wins on one of the occasions, but pays a significantly higher price. Discriminatory price auctions therefore have two effects. First, they increase the efforts and therefore costs incurred by market participants to predict the market clearing price. Secondly, they discriminate against market participants that have less information available to guide their bid.

In a *Vickery auction* all bids are ranked in descending order, and the highest priced bids up to the auctioned volume are accepted. To ensure that bidders bid their true value, the price they have to pay for their winning bid is not like their bid price in the discriminatory price auction. Instead the bids of all other bidders are arranged in descending order, and the residual market clearing price at which this residual bid curve intercepts with the auction volume is calculated. Thus, the bidder pays the price that would result in a uniform price auction if they did not participate. The own bid does not influence the price paid – creating the incentive to bid 'truthfully'. Thus the Vickery auction ensures that the bidders who value allowances the most will receive the allowances (Ausubel/Cramton 1998). This is of particular importance when secondary markets do not exist and therefore efficient allocation in the primary allocation is required, but seems to be less relevant in the case of EU ETS allowances.

Apart from the somewhat greater complexity of the scheme, which is difficult to communicate, the Vickery auction faces one major drawback. The larger the bid volume of a market participant is, the more the residual demand curve will fall if this bid volume is excluded to calculate the clearing price for this bidder. This implies that large bidders pay less per allowance than small bidders. Only if the number of auction participants is large will this effect be small, but with many bidders the complex format is not required. With few bidders an auction design that hands public assets at a preferential price to large bidders and thus discriminates against small bidders is unlikely to be accepted.

As the expected large number of bidders is likely to result in small incentives for bid shedding, we propose that a uniform price auction be used.

The simplicity of the auction and the limited need for bidders to acquire information by itself contributes to a higher participation rate. For example, a small player who wants to buy allowances in a uniform price auction only has to submit a bid that is priced 10% above the published price for allowances in the secondary market (corresponds to bid A in our picture). The bid will most likely be accepted and the uninformed bidder pays the same market clearing price as a sophisticated player.

3.4.4 Auction frequency

Some CO_2 allowances auctions are described as an annual or even less frequent event, perhaps similar to auctions for 3G mobile phone licenses. A sophisticated auction format, perhaps using several rounds, can thus be used to ensure that buyers reveal their true demand and pay the full price. The example of 3G illustrates the challenges of such a large auction. The auction outcome can have a large impact on the company's future performance. Senior management will devote much attention and will consult internal and external advisors to develop a bidding strategy.

An alternative example for CO_2 allowance auctions could be power exchanges. In most European countries, power exchanges hold daily auctions for electricity to be delivered on the following day.[23] Participants submit electronic bids to the exchange, usually using internet-based platforms. The exchange collects bids, and announces within half an hour of the submission deadline the market clearing price and informs the winning bidders. Participation in these auctions is simple and does not require continuous input from senior management.

[23] As CO_2 allowances – unlike electricity – can be easily stored, it would suffice to run an auction on (at least) a monthly basis.

Operating auctions more frequently has the following advantages:

- The value of any individual auction is relatively small. This reduces the potential risk for all buyers as they can return to buy allowances at later auctions or spread their bids across auctions. Likewise, government officials avoid the risk of setting a date for the auction when the allowance price happens to be low – revenues reflect the average allowance price over time.
- Emitters can buy allowances at times that match their requirements rather than determined by an exogenous schedule. Thus, they can avoid price risk if they buy allowances at the same time when they sign contracts that fix the price of their output. It could also avoid cash-flow constraints for participants.
- Bidders in auctions typically have to post collateral that is proportional to the value of their bid. With more frequent auctions, the bid value is smaller, thus avoiding difficulties which some participants might incur in posting large collaterals.
- As we will discuss in section 3.5, the risk of using the auction to exercise strategic behaviour seems to be smaller with frequent auctions.
- As will be further discussed in the section 3.5, some market participants are concerned that during auctions the liquidity in secondary markets could fall. By operating auctions more frequently, the volume of any auction is smaller, thus the impact on secondary markets (where it would be negative) is also limited.

In contrast, by operating an auction less frequently the following benefits could be achieved:

- A less frequent auction allows for the use of a more sophisticated auction format to avoid bid shedding (bidders understating their demand to push down price). However, bid shedding is of less concerned with smaller auctions, as many players – particularly financial intermediaries – can compensate for the shortfall of demand and thus minimise the incentive for bid-shedding.
- Reducing the frequency of an auction while keeping the design fixed can reduce the costs of running the auction. This benefit might not be matched by a similar benefit for buyers - even with frequent auctions they might only buy at a small number of auctions.

As a result, we recommend a rather high frequency of auctions. Especially if large shares of the total allowances will be auctioned and the Member States coordinate their auctions, at least monthly or even weekly auctions could constitute an appropriate approach. If we assume full auctioning in the case of monthly auctions, the average volume of an auction would amount to 130 million allowances even in the case of drastic reduction of the cap for the third phase of the EU ETS. For weekly auctions the respective amount of allowances for every auction would amount to about 30 million allowances.

3.4.5 Distribution of allowances across auctions

Governments can announce at the beginning of a trading period how they intend to distribute allowances across auctions or could retain the flexibility of changing that distribution over time. In treasury auctions the UK government used to tie auctions so as to sell T-bills in rising markets and maximise revenues. However, the approach was changed in order to increase market transparency, and possibly higher overall price levels with lower uncertainty levels. The same could be expected in allowances markets – if governments aim to time their sales so as to respond to market sentiments, it might seem to maximise revenues in any instant. But the market anticipates potential government interventions. Thus, it might be preferable to announce a transparent strategy so as to minimise uncertainty in the market.

When allowance prices fell during the first phase, some national governments were contemplating reducing the volume of allowances issued in order to support a robust allowance price. While improved market information and banking make such events less likely in the future, they can never be excluded. It would be more transparent if governments were to announce ex-ante a clear response to such situations, e.g. auctions with reservation price.

When determining the distribution of allowances across the year and period, governments could aim to roughly match the distribution of demand for allowances over time by market participants. This would reduce the need for financial intermediaries to bear open positions over long periods of time and thus the cost of the associated risk premia. The following basic groups could be used to assess such a distribution over time. First, emitters selling output on forward contracts hedge the price risk of CO_2 by buying allowances early on. Secondly, emitters selling products close to the time of production avoid open positions on CO_2 by buying allowances close to their production time. Thirdly, installations less concerned about CO_2 price uncertainty, for example because of limited emissions relative to turnover, might decide to buy allowances close to the compliance point. It is unclear what the relative weight of these different users is going to be post 2012 in any specific country. In the absence of additional information, a uniform distribution over time could be a good starting point.

3.4.6 Participants

In theory, one could envisage different groups of market participants being allowed to participate in different auctions.

First, participation could be restricted to emitters from a specific country. This might be formulated as a means to ensure that national industry has access to allowances. In practice, any auction offers access to allowances and so does the secondary market, hence the motivation for such a ‘restricted’ auction could only be to offer preferential access to allowances. This means that if the restriction reduces the number of participants, the market clearing price of the auction will be less competitive and participants could acquire allowances below the price in secondary markets. Such restrictions could be interpreted as either a means of subsidising national industry – probably violating state aid rules, or they could raise concerns as they restrict activities of enterprises in the common market. Apart from the legal concerns, the restrictions could potentially be circumvented by traders acquiring a small installation in order to qualify as participants.

Secondly, participation could be restricted to installations from specific sectors. Again the only motivation for such restrictions would likely be to subsidise a specific sector. As this subsidy would be harmonised across Europe, it might be easier to justify under state aid rules, less so under the common market. However, if such subsidies are intended, then it is difficult to see why they are not targeted directly. After all, the value of subsidies which companies can receive hinges on the level of market power they will be able to exercise in the auction – a quantity that is difficult and uncertain to predict. As the value of the subsidy would be very uncertain, firms cannot take the benefit from such auctions into consideration when making strategic decisions on investment or closure. But why then should governments provide the subsidy?

Thirdly, participation could be restricted to emitters, thus excluding parties who are only active in trading. Again, where desired, such a restriction could be easily circumvented by acquisition of a small installation. However, such restrictions are unlikely to be necessary or desirable.

Restricting financial arbitrageurs from the auctions is sometimes motivated by the fear that a player could short-squeeze or manipulate the market. As will be discussed in more detail below, with sufficiently frequent auctions and thus relatively small volumes, the allowances acquired in one auction, either by a financial player or emitter, are unlikely to be sufficient to short-squeeze the market. There is a concern that players can manipulate the allowance prices – in order to benefit on positions in other markets. This is a concern that might need to be addressed with clearly-defined market monitoring and data collection provisions, but is an issue that is not specific to the auction and is more likely to be implemented in secondary markets. Hence, specific restrictions for traders and financial arbitrageurs are unlikely to be necessary.

In contrast, it might be desirable to attract traders to participate in the allowance auctions. They provide the liquidity that is required for a functioning market. This reduces any remaining risk of bid shedding by large emitters, as the financial intermediaries will buy allowances if prices emitters do understate their demand. Also, it will be difficult for governments to exactly time the auctions and determine how to distribute allowances across the auctions so as to match the demand profile of emitters. Financial intermediaries can provide the liquidity and match distribution of allowance supply with allowance demand over time (albeit at a cost for carrying the price risk).

3.4.7 Reserve price

3.4.7.1 Introduction

The reserve price in auctions can fulfil two functions: first, to ensure that allowances are not sold below their value; and secondly, to ensure that the allowance price is strong and thus facilitates investment. If a reserve price is credibly announced and a sufficient share of allowances is auctioned, the reserve price in the auction can create a price floor for the overall allowance market.

3.4.7.2 Reserve price to secure auction revenue

Setting reserve prices to 'protect' auctions from unforeseen events that can result in unexpected low participation is common. It represents a transparent approach to dealing with such situations and reduces the need for ex-post interference in the auction outcome or the uncertainty associated with cancellations of auctions. The following two aspects need to be decided regarding the reserve price:

Should the reserve price be announced before the auction? Publication of the reserve price contributes to transparency, but creates the risk that market participants use this price to coordinate their bids. As transparency seems to be an important objective, and bid shedding is expected to be less likely, we would suggest announcing the reserve price.[24]

At what level should the reserve price be set? If the purpose of the reserve price is to avoid selling allowances below their real value, then the reserve price should be set relative to the market valuation of allowances, as traded in secondary markets. The reserve price could be set at 10% below the value at which allowances are traded on secondary markets on the day before the auction. While the forward market for allowances offers more liquidity, and thus a potentially more robust price signal, the spot market reflects more closely the characteristic of the auctioned product. To avoid exposure to any one of these prices, the reserve price could be set as a weighted average of some of the publicly available indexes.

[24] The literature in auction theory discusses an additional effect of the reserve prices – which ends up in a footnote because in the specific application it seems of less relevance. A reserve price can induce buyers to bid more aggressively in order to exceed the reserve price, particularly when it is not announced (Boergers/Damme, 2004). This benefit does, however, need to be balanced against disincentives which such 'tough' reserve prices create for potential participants in terms of bidding in the auction. Additional bidders in an auction increase the competitiveness and the clearing price. Bulow/Klemperer (1996) argue, thus, that the benefit of additional bidders dominates any specifics of individual auctions.

3.4.7.3 Reserve price to support robust carbon prices

The experience of the first phase of the European emission trading scheme illustrated that it is a challenge to set the caps so as to balance allowance demand and supply. In the short term, CO_2 emissions are not very price responsive - hence setting the cap too tightly could trigger really high prices. Fearing this risk, policy makers tend to set the cap too loose. If this creates even a low probability, perhaps in the order of 10-15% that prices drop to low levels, then the expectation about these low levels can have strong impacts on investment decisions. For example the financial structure of a project has to be set up to cope with the potentially low revenue associated with low carbon prices. This can increase financing costs and reduce the types or volumes of low carbon projects that are pursued. In most commodity markets, lower bounds for prices exist, since even in times of excess supply producers are unlikely to sell oil below variable costs of production. As the experience of Phase I illustrated, such a lower bound does not exist for CO_2 allowances, raising the question of whether governments should provide for a lower bound to allowance prices as part of the allowance market design.

The auction of CO_2 allowances could offer a transparent and credible means towards implementing a lower bound for allowance prices. Let us assume that the reserve price of auctions is announced in the long term and some allowances from the auction will be required to match emissions. Then some market participants will have to buy allowances at or above the reserve price, and hence no participant in the market will be prepared to sell allowances below this price.

We mention the use auctions to support a lower bound to the CO_2 allowance prices in order to avoid that auction design choices we make today prevent the use of auctions for this purpose in the future. First, the reserve price in auctions can only serve as a lower bound to the allowance price if auctions are spread across the commitment period. As the remaining discussion in this document suggests that a higher frequency auction is desirable, this seems to create little difficulty. Secondly, in the European context such a firm reserve price would likely require some coordination among Member States. They would have to decide at which price level to set the reserve price. In the section on European harmonisation, we will discuss other aspects that might be of relevance.

3.4.8 Credit posting requirements

Market participants could default on their bids when: (i) CO_2 price in secondary markets falls and bidders do not want to pay for allowances at the higher market clearing price of the auction any more; (ii) as part of some strategic behaviour of price manipulation; (iii) if the company participating in the auction goes bankrupt.

Such defaults could have multiple implications for the auction.

- First, some allowances would not be issued and would have to be auctioned in subsequent auctions or sold in secondary markets. This would require a transparent approach to avoid market distortions should the volume be significant.

- Secondly, the participants who subsequently defaulted might have contributed to a higher allowance price – and could have ‘tricked’ others to buy allowances or financial products linked to the allowance price at too high a price. Thus, the perception of a default risk reduces the credibility of the auction results and reduces the willingness to participate in the auction.

Auction design can address these concerns by at least two approaches. First, reducing the time between bid submission, announcement of the auction result and financial clearance. This reduces the probability that (i) companies go bankrupt during that period or (ii) the CO_2 allowance price in secondary markets is subject to large changes. The corresponding time window in energy auctions is usually one or two days.

Secondly, requiring market participants to post collateral could reduce their incentive to deliberately default. If the collateral covers, for example, 20% of the bid value, then a deliberate default would only be profitable if the CO_2 price dropped by more than 20% within the financial clearing period. This level of collateral would also ensure that companies that enter bankruptcy proceedings take the allowances they obtained in the auction in order to sell these in secondary markets in order to not loose the value of the collateral.

Thus, the question remains as to what fraction of the bid value should be covered by collateral. For this purpose bidders typically have to transfer money to an account under the control of the auction place by the morning of the auction. Assuming that the auction is set up effectively, a few hours later the money will be transferred back to participants who did not win in the auction. Assuming intra-bank transfer, the main costs imposed by the collateral to large bidders are the opportunity cost of the money for one day, e.g. 1/250 (working days) of 5%. Full coverage of collateral increases the opportunity costs and transaction costs involved in posting the collateral. This might be particularly relevant for traders who are submitting speculative bids in case the market clearing price is unexpectedly low. Their bids are desirable as they make the market more competitive and prevent bid-shedding that might otherwise be viable and result in auction clearing prices below the true value of the allowances to the marginal bidder. Hence, a professional set up of the auction that allows a quick turnaround of the collateral, probably involving an institution that is connected to the inter-bank transfer system, is important to reduce the costs imposed by collateral.

A second question relates to the type of collateral accepted. In order to facilitate the participation of small emitters it seems desirable to accommodate their preferences, e.g. to allow, for example, for the use of corporate credit cards.

3.4.9 Institutions and costs of auctions

The auction (i) could be executed directly by a government body, e.g. the emissions trading agency in Ireland, (ii) could build on the expertise that treasuries have with auctioning government bonds, or (iii) could be commissioned to a public or private institution that executes the auction on behalf of the government.

One motivation for hosting an auction within a government body could be that governments can thus retain more discretion when adjusting the auction over time to match policy requirements. However, even for government bonds, which are far more established products than CO_2 allowances, treasuries are increasingly moving towards a more transparent process communicating timing and volume of auctions clearly and in advance. Certainly the experience from the first phase of the EU emission trading scheme illustrated the importance of transparency. By hosting the auction outside of government, one can require government to clearly communicate the auction requirements, rules and implication to a third party. While there is no guarantee that all this communication will be public, the explicit separation of roles between setting the auction strategy and executing the auction is likely to increase transparency.

Furthermore, most government experience with auctions results from government bond auctions. While this could be valuable experience to decide on the auction strategy, it might be less relevant for the execution of auctions. Bond auctions are mainly attended by large financial institutions. Auctions for allowances may be attracting a significantly higher number of more diverse participants. This requires a more effective process of registration, verifying collateral, handling bids and clearing the market. Thus, the existing institutional arrangements at treasuries are unlikely to be directly transferable.

This suggests that commissioning the auction to an institution that has expertise in registration, collateral verification, bid handling and auction clearing might reduce set up costs and possible delays involved in building all the expertise internally. Existing trading platforms for CO_2 allowances (ECX, EEX, Nordpool) and power exchanges like (APX, UKPX, EEX, Nordpool, etc.) have developed the personnel, process and links with financial institutions to clear their decisions and IT systems that handle auctions in a simple manner that facilitates wide participation in the market and at frequencies and clearing time frames that are similar to what we would expect to be used for allowance auctions. Possibly market places for financial products, or other commodity trading platforms would be interested in expanding into the CO_2 market.

This suggests that there is a large set of potential institutions out there that could host such an auction at low transaction costs and possibly fast set-up times. Governments would thus only need to tender for the provision of auction services. The tender would have to specify the exact nature of the services and interfaces to be provided, perhaps for a period of 5 years. At this stage we think that such a tender should also address two concerns:

- Future tenders need to remain competitive, so that high quality and low cost auction services continue to be provided. Requiring in the initial documentation that the auctioneer passes on the relevant information to any successor facilitates future competition.
- If several countries implement allowance auctions, possibly in a harmonised manner, then they could choose to ask the same institution to execute the auction on their behalf. This puts the winner of the tender in the first country in a strong negotiation position towards countries that subsequently would like to ask for

the implementation of auctions. To avoid this asymmetry, the tender documentation could require that services will be provided to interested third countries at the same price.

Several publicly- and privately-owned market places have relevant infrastructure in place to execute the allowance auctions. A public tender could solicit which is the most suitable place to execute the auction. To tender might contain provisions that facilitate future competition and potential use of the same institution to auction allowances of various European countries.

Market monitoring both within the auction and probably more important secondary markets plays an important role to create market confidence and robust prices. Such monitoring is simplified if clear responsibilities are allocated ex-ante, determining who has to provide and collect data on the market performance and bids, and who investigates, possibly on an ongoing basis, the performance of the market.

From informal consultations with market participants we reached the following estimate for different cost components of setting up an auction (Table 2). These are only very indicative figures – to approximate the order of magnitude rather than the exact figure.

Let us illustrate how they might add up to the total costs for an auction using the example of a larger Member State. About 500 entities have an account in the national registry – the difficulty is to predict how often they would participate in the auction. Let us assume 10 entities are very active, participating in all auctions, 50 entities participate four times per year, and the remaining entities participate once per year at their convenience.

Table 2 Indicative cost estimates for setting up an auction

	Initial IT	**Execution of auction**	**Registration processing**	**Bid processing**	**Total**
Costs/item	500,000 €	25,000 €	100 €	150 €	
Number over 5-year period	1	12 x 5	500	(10 x 12 + 50 x 4 + 440) x 5	
Total Cost	500,000 €	1,500,000 €	50,000 €	570,000 €	2,620,000 €

Source Authors' own research

The total costs incurred over a five year period would thus be about 2.6 million Euro, or 520,000 Euro per year. If all allowances (about 200 million) are auctioned, it would translate to costs of 0.0026 € per EUA.

3.5 Concerns voiced about auctions

3.5.1 Influence of auctions on liquidity of secondary market

Participants can directly acquire allowances in auction – will this reduce liquidity of secondary markets?

Current allowance allocation aims to match allocation to emission volume in many cases – the total volume which installations were short of in 2005 was 170 million EUAs (Kettner et al. 2007); similar levels are likely in 2006. This would define the physical need to trade. The total trading volume in 2006 was, according to the World Bank (2007), 1,101 million allowances, of which more than half were traded over-the-counter (OTC). The trading volume at the European Climate Exchange alone was 463 million EUA in 2006 (ECX 2007). The financial trading volume thus already exceeds the physical need by at least the factor five.

This is a feature of many commodity markets. Table 3 illustrates using the example of gas and oil markets that the total volume of financial trades in energy exceeds the physical energy deliveries by more than the factor of ten.

Table 3 Daily trading volume (for all maturities) at NY Metal Exchange compared to US consumption

	Crude oil		Natural gas	
Daily consumption/usage	mmbl	18	Bcf	63
Average daily total trading volume-2005	mmbl	238	Bcf	763
Maximum daily total trading volume-2005	mmbl	406	Bcf	1,494
"Multiple" - average	mmbl	13	Bcf	12
"Multiple" - maximum	mmbl	23	Bcf	24

Source Ripple 2006.

Both the experience of recent emission trading and of other commodity markets suggests that trading volumes are a multiple of the physical transactions required. It is unlikely that the motivation for these trades vanish if initial allocation is based on auctions rather than free allocation.

In fact, there are two reasons which suggest that trading volume and market liquidity could increase with a move towards auctioning. First, anecdotal evidence suggests that some emitters still operate in compliance mode and do not actively consider their CO_2 position as long as they are satisfied that expected emissions will be covered by allowance. As these emitters have to pay for allowances, they are likely to take a larger interest in these costs and participate more actively in the market. Secondly, as emitters have to pay for CO_2 allowances, they are likely to take steps towards hedging risks associated with CO_2 costs. This hedging demand is likely to increase the volume of market transactions and market liquidity.

Thus we conclude that a move towards auctioning of CO_2 allowances is most likely going to increase the trading volume and liquidity in secondary markets.

A second concern that is sometimes voiced is that liquidity of secondary markets could be reduced at the times of auctions of CO_2 allowances.

In this context the early auctions for SO_2 certificates in the US Clean Air program are frequently quoted (Ellerman et al. 2000). One of the stated objectives of these auctions was to increase liquidity in the market which had not yet developed at the time of the first auctions. However, rather than contributing to liquidity, the trading activity in secondary markets dried out entirely during the long time-lag between submission of bids and auction clearance. This effect might be due to multiple reasons; it seems that none of them apply in the EU ETS context. First, the delay of several days between bid submission and auction clearance differs from the envisaged EU ETS auction format in which the market clearance price can be announced within an hour after the auction closer. Secondly, in US SO_2 auctions market, participants could submit allowances to the auctioneer who in turn sells these on their behalf. While this increased the auction volume, it eliminates potential sale offers in the secondary market. Thirdly, the trading activity in the EU ETS is already high with frequent trades of spot and forward contracts.

To anticipate the interaction between auctions with ongoing secondary markets the experience from US T-Bond auctions is likely to more representative. Additional bonds are auctioned into an existing liquid market for the same product. A more detailed analysis shows that liquidity of 2-, 5-, 10- and 30-year US T-Bond's increased in almost all cases of auctions of additional bonds into the market (Neuhoff 2007).

Thus, based on the currently available evidence, we conclude that auctions are unlikely to increase overall liquidity or liquidity at times close to the auction. In contrast, various indicators suggest that overall liquidity will increase with the introduction of auctions.

3.5.2 Potential for gaming

In this section we quickly review three possible gaming scenarios which could be relevant for the allowance market:

- Market participants understate their demand in order to reduce the price they pay for allowances in the auction (bid shedding, collusion)
- Market participants buy a large fraction of the allowances in the auction in order to subsequently resell these at a higher price (short squeezing)
- Market participants push up the price in the auction in order to benefit from the impact in associated markets.

We already discussed the potential for *bid shedding* and argue that with frequent auctions and a simple auction design the participation in the auction will be sufficiently large to minimise any incentives for bid shedding. To achieve this high participation we suggested using a simple auction format, although more complicated formats could potentially eliminate incentives for bid shedding.

While bid-shedding relates to a unilateral action of market participants to increase their profits, *collusion* requires their cooperation to increase their profitability. The auction format cannot eliminate the risk of collusion, but again an auction design that attracts many participants reduces this risk. The risk for collusion can increase, if a higher frequency of the auction allows market participants to implement punishment strategies in future auctions and thus reduces the motivation to deviate from the collusive outcome. However, the number of participants and the transparency of the auction suggest that collusion is unlikely, particularly as any detected collusion would trigger harsh punishments from governments.

If a market participant can buy large shares of the allowances so as to create scarcity in the allowance market, he could subsequently resell some of these allowances at a higher price. Such *short-squeezing* requires that the market player manages to acquire his large position unnoticed by other market participants, otherwise the market price will increase while he is buying and the strategy is not profitable. Salomon Brothers managed to short squeeze the US market for some government bonds in May 1991 by acquiring large fractions of the bonds that were issued in an auction. Institutional investors needed to buy these specific bonds to maintain their target portfolio mix, and therefore had to buy the bonds at a higher price from Salmon Brothers (Swierzbinski/Borgers 2004).

If auctions are more frequent, and therefore smaller, then a strategic player has to buy allowances in several rounds of auctions to obtain a significant share of the allowances. Other market participants will observe the auction results and also bid higher, the market price rises and the short-squeezing strategy is unlikely to be profitable. The risk can also be reduced by explicit constraints on the maximum share of allowances any one player can buy in the auction. While they did not prevent Salmon Brothers from using client accounts, they are likely to have facilitated subsequent legal action against Salmon Brothers.

A third area of strategic behaviour could be that market participants inflate the allowance price in the auction in order to benefit on open positions they hold in other markets that are affected by the allowance price.

If we assume that 10 million allowances are auctioned, and a market participant has issued a financial contract in which the sale of 100 million allowances is linked to the auction price. This participant would make a profit if he were to buy all allowances and push up the price by 2 € above the market price for allowances in the secondary market. Subsequently reselling the allowances in the secondary market creates losses of 20 million Euro. However, at the same time, the value of the financial contract indexed to the auction results is increased by 200 million Euro. This suggests that financial contracts should not be linked to the auction clearing price. However, such design features for financial instruments are issues for the financial sector and less a determinant for the design of auctions.

A second scenario could involve leveraging open positions in related markets, e.g. power markets. In systems in which coal power stations are at the margin, power prices could increase by about 2 € per MWh if allowance prices increase by 2.5 €. Let us assume that a power generator or a trader with an open position wants to sell a one-year base load power contract for 2 GW (about two big power stations). If 10% of European allowances are sold in weekly auctions, the volume of one auction would be about 4 million allowances. Our strategic player could buy all allowances and push the allowance price up by 2.5 €, even if this implies subsequent losses of 10 million Euro when reselling the allowances. After all, the increase of power prices by 2 €/MWh increased the sales revenue for the power contract by 35 million Euro.

Both of the above examples illustrate the risk of allowance markets. Their trading volume is small in relation to the markets they influence. This can make strategies to influence the price in the allowance market profitable. It is unlikely that the auctions will be the main instrument to achieve such manipulation – everyone would notice a jump of 2 €/EUA in the auction, and this might trigger investigations. It might be far easier to implement such manipulation using a more subtle approach in secondary markets. Furthermore, if the total volume of allowances available for auctions significantly increases the risks of (successful) gaming, strategies would drop considerably.

We think the additional risk of the exercise of market power due to the use of allowance auctions is small. However, a careful review of the current market monitoring strategy to look both at secondary markets, auctions and related markets could be valuable. This raises the questions as to which institution collects the data relating to ongoing trades, where the ongoing market performance is monitored and which legal basis for investigation could be used.[25]

3.5.3 Limitations on bids

In many auctions no limits or other restrictions for the bids apply. However, for some auctions such restrictions were implemented. Some examples from very different auctions are:

- In the US Treasury auctions (bills, notes, bonds, securities) competitive bids are limited to 35% of the issue amount for each bidder.[26]
- In the Bank of Canada auctions for marketable bonds limits apply of 25% of the amount auctioned, if a primary dealer submits bids for several customers a limit of 40% applies.[27]
- In the E.ON Ruhrgas Gas Release Programme, the maximum purchase per bidder is one third of the total offer.[28]

[25] Some of these issues are raised in section 3.5.4.

[26] Cf. Code of Federal Regulations (CFR) at 31 CFR Part 356. 22. In addition the net long position of a bidder must be substracted from this 35% maximum bid.

[27] Bank of Canada Standard Terms for Auctions of Government of Canada Marketable Bonds.

[28] The E.ON Ruhrgas Gas Release Programme of import contracts is an obligation from the Ministerial Approval of E.ON's acquisition of Ruhrgas in 2002. The limit on bids as referred above is part of the rules laid down in the Ministerial Approval.

- For the DONG Energy Gas Release auctions a bid for 50% of the total quantity of lots can be submitted.[29]

This selective list shows that in some sensitive auctions limits for bids were implemented and that such limits apply in the range between 25% and 50%. However, we recommend on this issue:

- to not implement restrictions on bids to design auctions as simply as possible, to avoid regulations which are necessary to avoid an easy eluding of bid restrictions (affiliated companies, commissioning of market intermediaries, etc), to alleviate the coordination between the Member States and to maintain the European market for allowances;
- to foresee the option of limits for bids in the regulatory framework to enable such provisions if this proves necessary.

As a result, for other than for technical reasons the number of bids that an individual bidder may submit should not need to be restricted during the phase-in of auctioning of EU allowances.

3.5.4 Transparency and market monitoring

The confidence of market participants in the correct execution of an auction is important. Its execution should neither be distorted by commercial interests of the body implementing the auction, nor wider political interests of government. In other markets it seems to be a common procedure to require that the institution executing the auction does not have financial interests in the execution of the auction. This could equally be a requirement in this case. An independent observer or an existing regulatory body should in addition have access to all information about the auction and monitor that the auction is executed in line with the initial criteria.

We previously discussed the possibility of market manipulation and noted that we think the shift to an auction is unlikely to increase that risk. This does not imply that this risk can be ignored. We would like to refer to the situation of any commodity market in the USA. Exchanges report the daily positions and transactions of each clearing member to the Federal Commodities Futures Trading Commission (CFTC).[30] In addition, most large traders provide information on their bilateral trades and open positions on a voluntary basis.

This is in stark contrast to the current situation regarding CO_2 allowances in Europe. We understand that neither national nor European regulators receive this information other than at the time when an investigation by competition authorities is initiated.

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[29] The DONG Gas Release Programme is part of the package which constituted the basis for the clearance of the merger of the Danish companies DONG, Energi E2, Elsam, Nesa, Frederiksberg Forsyning and Copenhagen Energy by the European Commission.

[30] The information is published in aggregate format at http://www.cftc.gov.

Thus the continuous monitoring of the performance of the allowance market is not possible. In the US market – which is frequently argued to be more liberal – CFTC's market surveillance staff monitors the daily activities of large traders, key price relationships, and relevant supply and demand factors in a continuous review for potential market problems.

Furthermore, in the relatively small auctions for SO_2 allowances in the USA the full set of bids (including the amount requested and price offered) is published after the auction was carried out as well as the full list of successful bids.

However, the full transparency of bids and auction results raises concerns when it is applied to auctions of large shares of the allowances which are issued in total. The data analysis could improve the basis for gaming and some small and medium players might raise confidentiality concerns.

We think it is important that European governments either individually, preferably in a joint effort, or engaging the European Commission, pursue a similar market monitoring of the allowance market. After all, it is important that market participants continue to trust the market price to make their investment decisions and sign forward contracts and options to deal with uncertainty. Monitoring of the CO_2 allowance market is not an issue specific to auctioning of CO_2 allowances, but should be pursued and enabled independently of the role auctions will play.

After all, continuous monitoring of the market has been considered quite effective in the US in resolving most potential problems at an early stage.

As a further compromise between the full transparency of the auctions and the related concerns all auction data should be made available to the institution mentioned above on a mandatory basis to enable investigations on abuse of market power or other illegal activities. This institution should publish a report on the auctions and its results at an aggregate level on a regular basis to make sufficient information available to the market.

3.6 Conclusions and recommendations

If a general decision for a phase-in of auctions for significant shares of the total amount of allowances is made, some key decisions must be made on the design of auctions, considering functionality, simplicity and maturity of the market.

Regarding the different design elements, two groups of elements should be differentiated:

- The key design features cover all those which, it is decided, are able to carry out auctions.
- The additional design features are not essential for the auctions as such but could be important to meet the concerns which are regularly expressed with regard to the potential for the abuse of auctions.

Table 4 *Overview on design options and recommendations*

Aspect	**Options**	**Our preference**
Key design feature		
Participants	• Restricting participation to emitters from specific sector/country could reduce demand and offer lower price, but seems difficult to enforce and is likely to be incompatible with common market. • Restricting participation to emitters to exclude traders. Sometimes argued to avoid gaming/profiting. Such artificial restrictions increase profit margins and reduce benefit of intertemporal and spatial arbitrage and services provided by traders. • Allow participation to all entities with registry account.	Allowing all entities with registry accounts ensures competitive auction and contributes to liquid secondary market so as to achieve the overall objectives of the auction design and does not seem to create any real disadvantages.
Single/multiple rounds	• Multiple-round auctions reveal information about demand. • Sealed bid auction is simple.	Relevant information is already in secondary market, so simple sealed bid auction suffices.
Calculation of clearing price	• Uniform price auction is simple and allows participation by small/uninformed players. • Discriminatory price auction avoids bid shedding, but discriminates against uninformed players. • Vickery auction achieves truthful revelation, but discriminates against small players.	The number of emitters and financial players participating across Europe is large, so it is unlikely demand will not be revealed. The simple uniform price auction format suffices to address concerns.
Auction frequency	• Low frequency allows for complex format where required to address market power and reduces transaction costs. • Higher frequency auctions offer allowances at time required by participants, reduce need and costs for financial intermediaries to take short-/long positions to hold allowances, avoid gaming and reduce risks for participants.	At least monthly auctions of the simple format described above create limited transaction costs and can achieve the benefits associated with higher frequency auctions. If full auctioning will be implemented the shift to weekly auctions could be suitable.

Distribution of allowances across auctions	• Early announcement of government strategy reduces market uncertainty. • Governments could retain flexibility to respond to market prices (revenue maximisation, price stabilisation). • Selling allowances earlier on to provide for hedging demand when producers sell forward contracts, or produce and sell output. • Selling allowances later to meet compliance demand.	Governments should credibly announce distribution of allowances over time to avoid uncertainty and use transparent policies where there is a desire to avoid, for example, extremely low prices. Allowances should be distributed across auctions to meet market demands – this requires more information about, for instance, hedging demand.
Reserve price	• No reserve price increases number of participants. • Reserve price related to price in secondary market, e.g. 90% previous day(s) – protects auction from unforeseen events. • Announcing reserve price increases transparency but increases risk of market participants coordinating on this reserve price.	Announcing a reserve price related to prices in secondary markets on the previous day increases transparency and protects integrity from unexpected outcomes related to technical failures, etc.
Credit posting requirements	• Without any credit posting/collateral, bids in the auction are options, facilitating gaming and reducing confidence in clearing price. • Credit posting at full bid value creates transaction costs/entry barriers. • Credit posting proportional to fraction of maximum bid value, similar to margin requirements in financial market, ensures viable bids at lowest possible costs.	Credit posting for fraction of maximum bid value (e.g. 10%) ensures integrity of auction. Allowing multiple options reflects the diversity of bidders (letters of credit, ESCO account, posting of collateral, corporate credit card).

Institution hosting the auction	• New governmental body • Built on treasury bond auction experience, but usually not (yet) equipped to deal with large number of bidders. • Commission to institution with similar existing operations to implement separate auction. • CO_2 trading like ECX, EEX, Nordpool, Power exchanges like APX, UKPX, EEX, Nordpool, Financial market places.	Set up, running costs and implementation delays are likely to be smaller if an institution with similar operations is commissioned to execute the auction on behalf of one or multiple governments. A large set of potential candidates is available.
Additional features		
Restriction of bids	• No restriction on bids. • Limitation of bids to a certain share of the number of allowances to be auctioned (considering all firms of a group).	No limit on bids and enabling the implementation of limitations on bids in the regulatory framework if this should prove being necessary in future.
Market monitoring and transparency	• No regulation or market observation. • Regular observation of the market. • Full transparency of the auctions.	In the perspective, the allowance market should be subject to market monitoring as is the case for most commodity and financial markets. The responsible authority should get access to all information of the auctions and publish aggregate data from the auctions on a regular basis.

Source: Authors' own summary.

3.7 The European Dimension

3.7.1 Introduction

The design of auctions depends in some features on the general design of the EU ETS for the periods beyond 2012. On a very aggregate level, there are two options for the further development of the EU ETS regarding the European dimension:

- an EU cap and EU-wide harmonised allocation provisions,
- national caps (probably derived from an EU-wide cap) and a certain degree of flexibility for the Member States regarding allocation, etc.

In the case of the phase-in of auctioning, the EU-wide cap and EU-wide allocation provisions will generate revenue streams to European institutions which could create at least political and possibly legal challenges, and also the need for a revenue sharing agreement which would face distributional debates comparable to those that would be faced by a burden sharing or cap sharing agreement.

Against this background, several options must be elaborated as to how auctions of individual Member States could relate to each other:

1. All Member States auction their allowances independently.
2. All Member States auction their allowances independently, but harmonise design features of the auction.
3. Several or all Member States commission one commercial organisation to auction allowances on their behalf. The institution returns revenues to participating Member States in proportion to the volume of allowances they submitted.
4. All Member States commit or the Directive requires that one common institution (which could be private or public) auctions allowances on their behalf and returns revenues in proportion to the submitted allowances.
5. If allowances are not allocated to Member States, one institution could auction these on behalf of the European Union.

In this paper we do not discuss questions relating to the use and potential recycling of auction revenues and therefore treat options (4) and (5) as equivalent from the perspective of auction participants and auction design.

In the remaining section we will discuss the benefits and drawbacks of the different options. The main conclusions are summarised in Figure 6.

The assessment suggests that many of the benefits for market participant could be achieved even without formally defined harmonisation of the design, if Member States commission one institution to auction allowances on their behalf. This would also address concerns about independent auctions relating to the coordination of timing and potentially the higher transaction costs for buyers and sellers.

Figure 6 *Pros and cons of different approaches to relate auctions between Member States to each other*

Indicative results (+ positive / - negative)		Independent auctions	Harmonised design	Commissioning same institution	Joint Auction	Auctions under EU cap
Number of auction places in EU		**27**	**27**	**1 … few**	**1**	**1**
Subsidiarity principle		+		+		
Risk of failed implementation		-		-	-	-
Transaction costs seller		-	-			
Participants Perspective	Only one registration			+	+	+
	Frequent auctions available			+	+	+
	Simplicity ETS scheme		+	+	+	+
Coordination	Attention/demand fatigue if auctions conincide	-	-			
	Governments pre-empting to maximise revenues	-	-			
	Lock in 'random' national designs	-				
Predictability	Reserve price can support price floor			+	+	+

Source *Authors' own summary.*

3.7.2 Subsidiarity principle

The subsidiarity argues against centralisation wherever decisions can be made locally. This is an important aspect to create space for local democracy and institutions that reflect the local characteristics. While there is something called the "Dutch flower auction" and the "English" auction, we think national identity is not affected if all countries implement the same auction design or commission one institution to auction on their behalf. Certainly at this stage there is little evidence that different countries have distinct preferences for a specific auction design. However, once countries have established their national auction design, the stakeholders in the country will have gained experience with this specific auction design. Subsequently it might become more difficult to agree on a common approach, because stakeholders in individual countries might fear losing some of their competitive advantage from their private experience or involvement.

3.7.3 Risk of failed implementation

The reputation of the European Emission Trading scheme and thus low carbon investment decisions might suffer from any failed auction. The more countries implement auctions, the higher the likelihood that some stakeholders in these countries manage to detour the process of designing the auction to their private benefit and at the expense of the overall scheme. The creativity demonstrated in the design of national allocation plans is certainly fascinating, but we would all benefit if it would be channelled towards delivering emission reductions. Ex-post intervention by court or commission might be difficult or too late to prevent some of the damage.

In contrast, moving to only one auction on behalf of all or most Member States increases the impact if this auction does not work and thus the overall scheme does not work. However, given the simplicity of the approach and the competence of European governments, their treasuries or central banks, it should be possible to set up temporary alternatives within a few weeks.

One additional aspect needs to be considered in cases where governments commission one institution to execute the auctions on behalf of all Member States. This institution would then hold a monopoly position in the European context. This needs to be taken into consideration in the initial design of tenders and contracts when selecting the body. The tender offers the opportunity for multiple institutions to compete for providing the service. Contracts can ensure that the winning bidder delivers the required quality at the promised price. Repeated tenders, e.g. in five year cycles, could ensure ongoing incentives to offer a good performance. To facilitate competition in future tenders, the body executing the auction should be required to make relevant information available to successors.

3.7.4 Transaction costs for seller

If countries join up and commission one institution to implement the auction on their behalf rather than implementing separate auctions, this could save the following costs:

- Set up costs for multiple parallel auctions;
- Execution costs if there is a smaller number of joint auction events than there would have been individual auctions;
- Registration costs if the total number of auction events is smaller and if larger emitters and traders do not register at multiple auctions;
- Bid clearing costs, because of the join-up, and therefore likely to be somewhat bigger auctions, require larger emitters and traders to bid in fewer auctions.

A joint auction has to offer interfaces for multiple languages and more importantly deal with international money transfers. Given recent successful efforts of the European Commission to reduce transaction costs and delays of financial transfers across Europe, these additional costs are unlikely to weight up the savings described above.

3.7.5 Transaction costs for market participants

Market participants have to spend time deciding on whether to participate in an auction, and *register* the auction participation within their organisation as well as at the place of auction. For any auction event, collateral has to be posted and either winning bids have to be cleared or collateral has to be received again. Thus, reducing the number of auction places reduces the number of required registrations.

Smaller emitters might consider only registering in their national auction. Particularly in smaller countries with less frequent auctions, this might imply that an auction would not always be conveniently timed with regard to hedging demands, cash flow situation and time availability of staff. As auctions are combined, the combined auction is likely to be executed *more frequently* and might thus be timed conveniently.

For market participants, it is risky to participate in an auction if they are not aware of all the fine details. A harmonised approach reduces the transaction costs for market participants to learn about the auction designs, and is likely to allow them to participate in more national auctions. High participation rates in auctions will increase the robustness of the price signal and reduces any risk of bid-shedding and market manipulation.

3.7.6 Effects of coordination

A joint auction ensures a transparent timing of the auction. If Member States would individually execute their auctions, these could coincide or otherwise result in a rather unbalanced distribution of auction volumes over time. This could by itself result in more volatile auction results. Financial intermediaries would play a bigger role in matching the supply of allowances with the demand of allowances by emitters. As financial intermediaries bear a price risk for carrying open positions, they have to charge risk premia to offer this service. This can increase the overall costs of the scheme without delivering additional emission reductions.

This effect could be further reinforced, if Member States aim to time their allowance auctions so as to maximise the auction revenue, e.g. by selling into a rising market. The Gilt (UK sovereign bonds) auctions regularly conducted by the UK Treasury provide an interesting example. Until 1995, the Treasury was engaged in observing the market and announcing tenders of bonds when the market promised a favourable price. While in any individual event, this seemed to allow the Treasury get a better price for Gilts, it was argued that market participants already anticipated that the Treasury's intervention in rising markets and hence the *overall* price level was in fact reduced. The net impact on revenues is unclear. Eventually, the Treasury changed towards a system of pre-announced Gilt auctions with an annual auction calendar. In the EU ETS context, it would not only be one country that might aim to optimise timing, but multiple countries. Hence, the countries would not only look at the price evolution of the market, but also the behaviour of other Member States. It requires a behavioural understanding of market participants and careful economic modelling of the market interactions to understand what the best strategy for such timing would be. In the absence of such modelling, we want to caution that governments that might try to pre-empt each others' auction dates could contribute to uncertainty and increased volatility in the allowance market. A joint auction with clearly defined time-schedules avoids this risk.

The current directive does not specify requirements on either of these questions. The experience from the national allocation plans suggests however, that Member States were more creative in allocating allowances to installations than anyone expected. As a result, most stakeholders ask for harmonisation of the allocation provisions. Shall we repeat a similar process for the auction design – or is there a case for early harmonisation of auction design?

Market participants have a limited attention span and are therefore likely to focus on the evolution of auctions in the bigger countries. This might imply a de-facto harmonisation as smaller countries might be forced to follow the evolution in the bigger countries or earlier movers in order to be in line with the bigger market.

Finally, we had previously discussed the opportunity of announcing a reservation price for the auction to increase market confidence in a robust allowance price. If the reservation price is binding and only a fraction of the allowances envisaged for an auction are sold, then this raises the question as to whose allowances are sold? If all Member States commission the same institution to auction their allowances, then the institution can return the revenue and remaining allowances to the Member States in a way proportional to their initially submitted allowances. If Member States implement individual auctions, they could also harmonise on a reservation price. However, every Member State might have an incentive to attract buyers – or convince domestic buyers – to buy allowances in its auction in order to maximise the fraction of allowances that are bought. Such implicit, and potentially explicit, incentives to buy allowances in the national auction in order to maximise revenue at the cost of other Member States would distort the market. Hence, using a reservation price in auction to support a robust carbon price requires very careful harmonisation to avoid such complications, but could easily be implemented if all Member States commission one institution to auction allowances on their behalf.

4 Impact on the power sector

4.1 Introduction

One of the concerns regarding the phase-in of auctions in the EU ETS which often was expressed in the political debate on auctioning was the argument that auctions could lead to a (further) increase in power prices.

Bearing in mind that the power sector is the sector in which the full auctioning of allowances should start because of the extreme sensitivity of this sector regarding distortions of the CO_2 price signal (fuel-specific benchmarks, free new entrant allocation) and the significant amount of windfall profits, we will provide a short discussion of the effects of auctioning on the power prices.

We will limit this analysis on the wholesale market because much more regulatory aspects have to be considered in the case of electricity prices for industrial, commercial and residential customers and the regulatory regimes are still quite different between the various Member States.

However, even for the wholesale markets, different stages of the development towards competitive markets should be considered:

- Some markets are highly competitive and market dominance of a monopoly or an oligopoly does not exist (e.g. UK).
- Some markets are strongly moving towards competitive markets, but market dominance of an oligopoly must be considered.
- Some markets are strongly dominated by the old monopolies, some competitive structures (electricity exchange, etc.) exist, but some customer groups are still gaining from special arrangements (France).
- Some markets have competitive structures, but there is still price regulation on the wholesale market and some customer groups are still gaining from special arrangements (Spain).

However, for the next decade major progress should be assumed on the way towards fully competitive markets and the removal of regulatory barriers towards functioning wholesale markets. As a result, we assume for the following discussions that a price regulation will no longer exist on the wholesale markets and the abuse of market dominance will not be the dominating characteristics of the future Internal Market for electricity. At this point the fact should be highlighted that the introduction of market based instruments of climate policy like the EU ETS must be complemented with measures to enable functioning, liquid and competitive markets for electricity (and gas). So far the recent efforts of the Commission to drive forward the internal markets for electricity and gas are essential even for the European climate policy.

4.2 Short-term price impacts

The theoretical literature as well as the empirical evidence show that opportunity costs play a major role in the price formation in competitive electricity markets (FE 2007, Sijm et al. 2006a+b, Reinaud 2007).

In case an operator receives all allowances for free he has to decide to use the allowances for production or to sell the allowances into the market and stop production. As a result, the respective power plant will be operated, if the electricity price covers the operational expenditures (primarily the fuel costs) and the value of the allowances needed for production. The full costs of CO_2 will be included in the short-term marginal costs. If the price formation in the electricity market will rely on the short term marginal costs of the marginal plant (this is the plant which will produce the next unit of electricity), the wholesale market price for electricity should include the market value of the allowances needed to generate the marginal unit of electricity. Hence, the full costs of carbon will be reflected by the market price independently of whether the operator received the allowances for free or has to purchase the necessary allowances in the market.

The operators of all plants which have a lower demand for allowances (e.g. lower specific emissions) than the marginal plant will gain an additional benefit from the ETS and all plants which have higher emissions will get lower profit contributions from the operation of the plant.

As a result, in competitive markets the phase-in of auctioning will have no impact on the power prices in the short term, because the phase-in of auctioning will only transform opportunity costs of the free allowances to real costs for the purchase of allowances.

A different situation will emerge if the wholesale market is subject to regulation based on average costs (‘cost plus’ regulation). In this case the average costs of power production of a certain generator will increase if all allowances must be purchased. The regulator would have to agree to higher prices.

However, fully competitive markets should be assumed for the time when full auctioning for the power sector will be possible (seven years from now).

In such a framework of competitive markets, there should be no difference if auctioning is phased in. However, if alternatively allocation provisions will be implemented which distort the CO_2 price signal (e.g. updating approaches – see chapter 2.3) the impact of allowances prices on the power prices would be lower. Concurrently, the future impact of significant higher allowances prices (as a result of the lower efficiency of the scheme assuming the given targets) will increase.

4.3 Long-term price impacts

As long as significant amounts of power will be produced with fossil fuels, CO_2 prices and their increase will result in higher power prices. It is frequently debated whether this effect should and could be reduced using the allocation of allowances.

In principle, an efficient climate policy requires that power prices reflect the full externality costs of CO_2 so as to allow industrial and private consumers to make efficient choices between using electricity and investing in energy efficiency. As much of the electricity cost increase results from the cost of CO_2 allowances, industrial and private consumers will benefit if the allowances are auctioned and auction revenue is used to provide other services or reduce taxation. Thus, the efficient allocation of resources based on an undistorted CO_2 price signal in the full value chain will result in lower total costs of emission mitigation. Furthermore, the reflection of the undistorted CO_2 price signal will decrease the future vulnerability of the power prices regarding the CO_2 allowance prices.

However, a basic argument that is being brought forward with regard to the free allowance allocation is that free allocation to new installations constitutes a capacity subsidy for investments. This would result in an earlier investment relative to a situation without free allowance allocation. This earlier investment reduces the scarcity value of generation capacity and can reduce power prices.

Using economic instruments for additional objectives can have perverse effects. In this case, the use of emission trading as a capacity subsidy mechanism can have the following impacts (Burtraw et al. 2002, Neuhoff et al. 2006, Bartels/Müsgens 2006, Neuhoff et al. 2005):

First, the free allocation to new investments can distort the CO_2 price signal so that investment does not reflect the costs of CO_2 and efficiency of emission reduction is reduced.[31] Future allowance prices increase and could result in higher power prices in the future even if early investment took place as a result of the investment subsidy. This effect can be particularly strong when it delays the necessary structural change in the power sector that will result from an undistorted CO_2 price signal.

In a power market in which low carbon emitting plants (e.g. natural gas-fired plants) serve as the marginal production unit, investments in low emitting (natural gas) plants will result in lower power prices because the new installations will have lower short-term marginal costs of power production and will shift the merit order curve towards the units with lower production costs.

If the existing power sector is characterised by plants with high emissions and low fuel costs, the CO_2 price signal could lead to investments in low emitting plants with higher fuel costs. If these plants would shift to the margin over time the power prices could

[31] These effects result mainly from fuel-specific allocation for new entrants or other allocation approaches in which investment in more CO_2-intensive technologies leads to a higher free allocation as would apply in the case of an investment in less CO_2-intensive technologies.

increase, on the one hand, because of the higher fuel costs. On the other hand, the decrease in emissions would lead to lower allowance prices which would decrease the vulnerability to the change of allowance costs. If high emitting plants continue to be operated at the margin (which set the market price), the impact of higher allowance prices would be reinforced by the high emission rates of the marginal plant.

Secondly, the price - and therefore value - of allowances and their continued free allocation is rather uncertain. Thus, the value of the subsidy for investors is also uncertain. As a result, the subsidy is risky, and investors apply a risk discount to the value of the subsidy. Hence, the public will pay more to investors in power generation using free allocation than the investors value the subsidy. This is an inefficient way of offering the subsidy.

Thirdly, some studies propose particular methods of free allowances allocation and use numeric studies to demonstrate that lower power prices result. These studies are typically based on specific assumptions on the various fuel prices. When allocation is tailored to a specific set of fuel prices and fuel prices change, the result might also change.

The net effects of all mechanisms described above in a qualitative sense do strongly depend on a couple of parameters which leads to high uncertainties. Considering the many factors and parameters which influence the power price in liberalised markets, no robust conclusions can be drawn on the general level of power prices. However, if power plants with less CO_2-intensive fossil fuels run at the margin of the merit order curve, the sensitivity of power prices to volatile or increasing CO_2 prices will be less significant than in the case of more CO_2-intensive and cheaper fossil fuels operating as the marginal power plant.

This and the gains from emission reductions at the lowest cost based on an undistorted CO_2 price signal clearly outweighs the remaining uncertainties regarding the long-term effects of auctioning on the power prices.

In this section, we argue that the use of free allowance allocation to power generation constitutes an ineffective means of mitigating the impact of emission trading on power prices.

5 Summary and conclusions

The phase-in of auctions to distribute the allowances to the installations under the EU ETS could rely on different foundations:

- As the prior motivation the creation of an undistorted carbon price signal should be seen. The recent experiences show that no regulator was able to create a scheme of free allocation which does not create major distortions of the CO_2 price signal which is crucial for the economic efficiency of the ETS.
- Even with the general trend towards more ambitious provisions for free allocation (benchmarking), the allocation is still far away from being simple and transparent because of the manifold distributional effects. Auctioning is the only way to overcome the complexity and remaining distortions of free allocation schemes.
- Some simulation studies come to the result that free allowance allocation does not create significant distortions. They typically assume a tailored allocation mechanism and specific fuel prices. In reality, fuel prices are difficult to predict and technology evolution is uncertain - when these assumptions are changed, the supposedly harmless allocation provisions result in perverse results.
- Having operated the EU ETS for 8 years with almost free allocation, the phase-in of auctioning could provide the necessary and appropriate level playing field for incumbent and new installations and/or players on the market.
- The phase-in of auctioning could remove at least a part of the windfall profits arising from free allocation and the pass-through of opportunity costs in competitive markets.
- The appropriate use of auction revenues could enable double dividends in terms of innovation, emission reduction and prosperity.

Considering the empirical evidence with regard to free allocation in the EU ETS, the phase-in of auctioning should be seen as the preferable way for the further development of the EU ETS.

As a bottom-line, full auctioning should be phased in for the power sector from 2013. This would represent about 60% of the allowances in the EU ETS. There are many arguments for extending auctioning to all of the other sectors. Compensation for competition distortions should be given a higher priority than attempts to receive compensation in the framework of the EU ETS, which would exclude especially those industries from compensation which are subject to competition distortions because of the pass-through of CO_2 costs to the electricity prices.

Some decisions on key design issues must be made for the phase-in of auctioning and some design issues should considered to address concerns of abuse of auctions or manipulations. We recommend the following features:

- All entities with registry accounts should be eligible to take part in the auction. This wide participation ensures competitive auction and contributes to liquid secondary market so as to achieve the overall objectives of the auction design and does not seem to create any real disadvantages.
- The auction should be organised as a single round, sealed bid auction. Relevant information is already available in the secondary market, initial price discovery is not the main challenge.
- The price formation should rely on a uniform market clearing price. The number of emitters and financial players participating across Europe is large, so it is unlikely demand will not be revealed.
- A relatively high frequency of auctions should be aimed at. At least monthly auctions of the simple format described above create limited transaction costs and can achieve manifold benefits. If full auctioning is implemented, weekly auctions could be suitable. Concerted auctions of different Member States would increase the number of allowances available to auctions.
- Governments should credibly announce distribution of allowances over time to avoid uncertainty and use transparent policies when there is a desire to avoid, for example, extremely low prices.
- Announcing a reserve price related to prices in secondary markets on the previous day could increase transparency and protects integrity from unexpected outcomes related to technical failures, etc.
- Credit posting for a fraction of maximum bid value (e.g. 10%) ensures integrity of auction. Allowing multiple options reflects the diversity of bidders (letters of credit, ESCO account, posting of collateral, corporate credit card).
- Set up, running costs and implementation delays are likely to be smaller if an institution with similar operations is commissioned to execute auction on behalf of one or multiple governments.
- A restriction of bids to certain maximum limits should not be introduced for the phase-in of auctioning to ensure as much simplicity as possible. However, the regulatory framework should be designed in way which enables the future introduction of limits for bids if this proves to be necessary.
- A market monitoring mechanism should be set up as is the case for most commodity and financial markets. The responsible authority should get access to all information of the auctions and publish aggregate data from the auctions on a regular basis.

Regarding the European harmonisation, the assessment of different options suggests that harmonisation could create a range of benefits. However, many of the benefits for market participants could be achieved even without formally-defined harmonisation of the design if Member States commission one institution to auction allowances on their behalf. This would also address concerns about independent auctions relating to the coordination of timing and potentially the higher transaction costs for buyers and sellers.

The power sector is the sector for which 100% auctioning should phased in as of the third period of the EU ETS. For this time frame, the following assessments regarding the impact on power prices can be made.

- In competitive wholesale markets the transformation from free allocation should not have an impact on power prices because even the opportunity costs of free allowances were passed through to the power prices.
- In the long term, different mechanisms must be considered. Removing the free allocation for new installations equates removing an investments subsidy. This could delay some investments on the one hand, which could lead to higher power prices. On the other hand, distortions of the CO_2 price signal (free allocation to new entrants, closure provisions, updating, etc.) could decrease the efficiency of the scheme which would increase future allowance prices and as such increase power prices.
- Some stakeholders argue for free allowance allocation as a form of capacity payment to subsidise new investment in power generation. Given the uncertainty of future allocation provisions and allowance values market participants discount the value of this payment. Thus, significantly more public assets have to be used to achieve the same objective that efficient capacity payments could achieve.

The net effects of the latter effects are highly uncertain and depend on many factors which vary between different regional power markets in Europe. However, if the carbon intensity of the power sector is relatively low today the long-term effects are uncertain but will be comparatively low. If the power sector is carbon intensive at the moment, the long-term effects will also be uncertain, but could lead to slightly higher future power prices with a higher probability. However, this will be a result of the efficient allocation of resources and will result in lower total costs of emission mitigation. Furthermore, the reflection of the undistorted CO_2 price signal will decrease the future vulnerability of the power prices regarding the CO_2 allowance prices.

In summary, auctioning of CO_2 allowances will enable undistorted CO_2 price signals; it is possible to implement it in the framework of a robust and slim design and offers an abundance of options for European harmonisation by cooperative implementation.

However, the upcoming auctions in the second phase of the EU ETS as well as the use of auctions in other emerging emissions trading schemes in the United States and Australia should be subjected to careful analysis and scientific observation to speed up the learning process on this important feature of market-based environmental policy.

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