Auctions for CO_2 allowances – a straw man proposal

May 2007

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[1] This paper builds on ideas and arguments presented during a workshop on auctions for CO_2 allowances held at Cambridge University, January 15th 2007 with academic, industry and policy participants from European countries and the US. This is however not intended as a consensus document that represents the view of all participants or captures all the arguments and perspectives presented during the workshop. The workshop presentations are available at http://www.electricitypolicy.org.uk/TSEC/2/euetsworkshop/. I am grateful for comments on this draft from Andreas Pick, Jonathan Mirrlees-Black, Angus Johnston,, Rupert Edwards, Kate Hampton, Cameron Hepburn, Hubert Kieken, Misato Sato, Stefan Teiss, Maximilien Tse and David Newbery. All conclusions and errors remain my own. This work was only possible thanks to financial support from the research network Climate Strategies www.climatestrategies.org (financed by some European governments), and the UK research council funding under grant TSEC. Address; Faculty of Economics, University of Cambridge, Sidgwick Avenue, Cambridge, CB3 9DE, karsten.neuhoff@econ.cam.ac.uk

Abstract

As the European Emission Trading Scheme is evolving, an increasing share of allowances is expected to be auctioned. This paper summarises the insights from a workshop with European stakeholders and experts reporting from related auction experiences.

The auction design can pursue, and might satisfy, multiple objectives, including non-discrimination against small participants, minimising transaction costs, supporting liquid secondary markets, reducing risk exposure for market participants and maximising revenue for governments and increasing confidence in allowance prices.

To make the discussion more tangible, a straw man for an auction is presented and used to discuss, and where possible quantify the choices of frequency, auction format, credit risk, reserve price, harmonisation, concerns about the exercise of market power, institutional arrangements and interaction with secondary markets and transparency.

1. Introduction

The success of an emission trading scheme hinges on a credible, transparent, stringent and non-distorting market design. This paper assumes that auctions are one component of the overall design – and does not discuss whether to auction or not. Instead it focuses on the technical details of the implementation of an auction.

When deciding on the detailed implementation of such an auction, governments are likely to pursue several objectives. One of the primary objectives would be to maximise revenue for governments auctioning public assets while minimising transaction costs for government and market participants. Stability and predictability of revenue could be a further objective as it facilitates government budgeting not only if revenues are hypothecated. For political acceptability and also to encourage participation, an auction should be careful not to impose unnecessary participation restrictions, and should not create management, information or set up costs that indirectly result in their exclusions. The design, frequency and timing of auctions should serve to minimise cash flow problems for market participants. As in other auctions, the design of EU ETS auctions should avoid opportunities for market participants to exercise market power – and should also address concerns about the exercise of market power in secondary markets following such as short-squeezing of the auction. Finally, one could consider whether an auction might contribute to market stabilisation e.g. by setting a reserve price in the auctions that serves as a price floor for the overall allowance market.

These objectives can inform the choice of the various parameters of an auction. The optimal choice of any one of these parameters can be contingent on the other parameters. For example, a weekly auction does not seem to be compatible with a complex auction format and inclusion of small installations would require simple procedures for credit risk mitigation and bid submission.

To facilitate the discussion I suggest a straw man for an auction in this paper. This allows evaluation of the choice of any design parameter given the choice of other auction parameters. This straw man was inspired by but not explicitly discussed during the workshop.

The auction is held by an existing financial or energy trading platform on behalf of participating Member State governments. Governments pass allowances to be auctioned to this platform. The platform registers bidders, checks the collateral, receives bids and performs the physical and financial clearing of the auction. Remuneration for these activities is on a fee basis. From the platform, auction revenues are passed on to governments. If some allowances are not auctioned or sold, then these are returned to governments proportional to their share of allowances submitted for the auction.

The auction timing and format is similar to existing auctions of power exchanges. This allows for participants to build on existing experience. Bidders have to register for the auction and submit a collateral (or deposit) of say 10% of the value of the bid they want to submit. Bidders submit individual bids specifying the volume and maximum price they are prepared to pay or a set of such bids. Any participant can only submit bids up to

20% of the total volume of auctioned allowances. The auctioneer determines the market clearing price, which all winning bids will pay (uniform price auction).

Auction results are announced about an hour after closure of the auction, and financial clearance follows within a day or two. The auction is executed weekly or monthly.

During a transition period when conventional technologies dominate our infrastructure and industry, most product prices and internal performance benchmarks are set by conventional technologies. Low carbon or energy efficiency projects are evaluated against conventional technologies and are frequently only viable if CO_2 allowance prices exceed a certain threshold. Relative to conventional technologies they therefore face the additional risk of CO_2 price uncertainty. The short history of price formation and policy and regulatory interactions complicate the evaluation and quantification of the CO_2 price risk and therefore induce investors to make conservative estimations. For example, in a value at risk evaluation projects would have to be viable even in cases of unfavourable CO_2 prices. Investment in low carbon projects could be facilitated and thus real emission reduction achieved, if market participants have confidence that the allowance price will not fall below their threshold level. Allowance auctions offer an opportunity to achieve this objective. If about 10% or more of all allowances are auctioned and supplementarity criteria are implemented sufficiently stringent, then a reserve price of e.g. 20 €/t CO_2 could be implemented in the auction. As some allowances from the auction are likely to be required in the market, their sales price could set a price floor to the market price.

The choice of the auction frequency is driven by three main criteria. First, high frequency allows most emitters to find an auction close to the time of their demand. While financial intermediaries could bridge the timing gap, they would bear financial exposure to price risk on the open position, thus resulting in lower auction revenue or higher costs for emitters. Second, higher frequency auctions imply that the volume of any individual auction is limited. Thus even if a market participant could acquire all allowances of an auction, he could not short-squeeze the secondary market. Third, transaction costs of the auction are mainly determined by initial set up and registration costs and costs per bid. With higher frequencies of the auction the costs of executing individual auctions gains weight, and starts to increase overall transaction costs.

The choice of the auction format - a sealed bid uniform price auction – is mainly driven by the desire to minimise complexity and avoid discrimination against small players with limited information. Two reasons that might in other circumstances motivate a more complex design are less relevant. First, with large number of auction participants there is little concern of unilateral or coordinated exercise of market power in the auction. Second, as there is a liquid secondary market, there the auction is not required to reveal additional information.

To ensure that auction participants will pay for their bids, requirements for credit or collateral posting are common. The discussion inspired by the Hungarian and Irish experience in Phase I suggested that the fixed deposits turned out either too low to create financial incentives for large players and/or too high to allow for participation of small players. If the deposit has to cover the entire submitted bid this might create excessive costs and pose accounting difficulties for installations that are not typically active in trading. A deposit proportional to the potential cost burden for the auctioneer (if an

accepted bid is not cleared and allowances have to be resold at a lower price) is common in other markets and would address most concerns.

Finally we had been discussing in the workshop extensively the question as to whether auctions need to be harmonised across Europe. The Directive does not require any harmonisation, and the subsidiarity principle suggests that Member States should retain as much independence as possible in implementing the EC Directive. In practice, these principles seem to have little relevance for the auction design.

First, preferences for specific auction designs or implementations do not seem to vary across Europe, such that early harmonisation could avoid difficulties involved in harmonising later on once Member States have adopted heterogeneous and randomly chosen designs. Second, in some policy areas it is argued that we can learn about the best policy instrument if Member States explore different approaches. The discussions suggest that with auction design for CO_2 allowances, the risk of "getting it wrong" is small, and learning is likely to be limited (decades of different auctions designs for government T-Bonds still have not allowed for strong statements about the preferred approach).

Third, some stake holders argue for national auctions, anticipating that by restricting participation to specific sectors or domestic installations, competition can be restricted and hence lower market clearing price would result (thus allow for hidden subsidy of domestic industry). Any such attempts are prima facie clear violations of the EC law rules on State aid (and possibly also on the free movement of capital).

Fourth, while it is sometimes argued that competition among Member States benefits industry, it is more likely that uncoordinated timing and volumes of auctions between Member States can result in dynamics that confuse market participants. The close coordination of central banks across countries, or even the formation of a European central bank provides some indication that a common currency benefits from common governance.

Fifth, indicative calculations presented in this paper suggest significant cost savings if all Member States have their allowances auctioned by one institution (commercial or public) rather than implementing similar procedures in parallel. Market participants active in several countries would also benefit as they do not have to develop expertise and systems to interact with multiple auctions.

Finally, if governments aim to implement a price floor for CO_2 allowances to increase investment certainty and thus facilitate investment in low-carbon technologies they might do so via a reserve price in the allowance auction. If binding, the reserve price will imply that not all allowances available in the auction will be issued. Governments might play with the auction timing or put pressure on national industry so as to increase the share of allowances sold of the allowances envisaged to be sold in the auction. This can be avoided if in a joint auction, all governments submit their allowances and the auctioneer sells the same proportion of allowances from each country.

The question of a price floor for allowances raises the related question of a safety valve that prevents excessive allowance prices. Governments could issue additional allowances once a ceiling price is reached, perhaps with the commitment to spend revenue on CDM projects. Phase I exhibited another *de facto* safety valve by allowing for 'borrowing' from Phase II with a penalty fee. Alternatively the use of additional project credits by market participants could be allowed beyond the constraints of the supplementarity criteria if a penalty fee is paid. The question of price ceilings has wide

economic and political implementation, and goes beyond the scope of this paper. It is less of an issue for auction design and therefore not discussed here.

Closely linked to the question of allowance auctions is the question of revenue recycling. We are working on a parallel document to reflect the workshop debate of economic, legal and political aspects associated with revenue recycling.

Table 1 Summary table: how auction designs address auction objectives

	Maximise revenue	**Minimise transaction costs**	**Increase predictability**	**Include small installations**	**Minimise risk of market manipulation**	**Contribute to market stabilization**
Frequency	Higher frequency matches demand profile	Lower frequency reduces transaction costs	Higher frequency makes it 'normal' event	Predictability and auction close to demand time	Higher frequency reduces auction size and impact on secondary market	Price floor stronger implemented at high frequency auction
Auction format	Large number of participants reduces impact of choice	Uniform price auction allows uninformed bidding		Uniform price auction simple		Reserve price in auction
Credit risk mitigation	Less stringent requirements facilitates participation, but risks losses	Less stringent requirements easier	Stringent requirements further reduce risk of high bidders (that don't pay)	Easier with less stringent requirements	Stringent requirements prevent bids as options	
Harmonisation across Europe	Harmonised auction reduces need for arbitrageurs	Lower overall number of auctions and bids	Avoids distortions from national idiosyncratics	Less complexity facilitates participation – international transfers have to be managed	Clear structure reduces manipulation chances, or gaming between countries	Price- floor in auctions requires at least close coordination

2. Objectives of the auction

A diversity of possible objectives of EUA auctions is already apparent from limited experience in Phase I and emerged from our discussions. This section sets out potential aims that governments may set out when designing EUA auctions.

2.a Achieve efficient allocation of allowances

Market participants are best informed about their emissions and abatement costs. Allowance auctions and markets should allow the economy to identify the least cost approach to comply with the reduction targets. However, as secondary markets for allowance trading are liquid, these secondary markets should allow for an efficient allocation (trading) irrespective of the initial allocation.

2.b Maximise government revenue

Allowance auctions represent a sale of public resources, and thus a prudent government will be expected to maximise revenue during such a sale.

2.c Minimise costs for government and bidders

The costs for government include design costs and costs for hosting and executing the auction. The private sector participants bare costs in preparing for and participating in the auction, and posting credit guarantees.

If auction results are uncertain, or uninformed players pay at their bid prices that might be above market clearing prices in discriminatory bid auctions, then these players would either have to invest in improving their information basis or abstain from participating. Thus a simple design that allow for risk free participation can reduce the costs of third party expert advice and minimise the management attention that is required for the participation in the auction.

2.d Increase predictability of revenues

According to economic theory governments are able to balance volatility in auction revenue streams against payments of their typically large debts, hence should aim to maximise overall auction revenue. The institutional set up could however qualify this argument:

(i) Phase I allowance revenue is sometimes used for the operation of emission trading offices (e.g. Ireland), and covering costs is likely to be a high priority (see presentation by Macken).

(ii) Some proposals envisage the hypothecation of auction revenue, e.g. to finance innovation. Stable budgets allow commitment to longer term investment projects, and are thus likely to be more effective.

(iii) Treasuries are weary of volatile income flows, if they need to calculate future budgets. They thus prefer auctions which produce more predictable their revenue streams.

The auction revenue is determined by the market clearing price and auction volume. While only few percentage points of allowances are auctioned, both variables can be volatile. With overall auction revenues small, this might be less of a concerning.

With an increasing total number of allowances auctioned, the uncertainty in emission predictions, and therefore auction quantity, will be small relative to the total auction volume. In this case the main factor determining revenue stability will be the auction price. In this case reserve prices can secure a minimum level of revenue.

2I.e Avoid discrimination against small installations (maximise participation)

Acquiring market information, developing strategies and participating in allowance markets and auctions requires management time and creates other costs. Relative to the value of allowances these costs burdens are likely to be much higher for firms with low emission levels. Market and auction designs that address this will contribute to a level playing field across installations.

Even if small installations can acquire their allowances in secondary markets, it might be difficult for policy makers to justify auction designs that explicitly or implicitly exclude small installations.

2.f Avoid cash flow problems or price risk for emitters

We require further discussions to understand at what timing emitters would like to buy allowances. The following factors are potentially relevant:

- Increasingly, the CO_2 allowance price is passed through to product prices. Thus installations might time their participation in auction with their product sales.
- If installations sell their products in forward markets, e.g. electricity, then the forward contracts can either be conditional on the allowance price at the time of delivery (increasingly in electricity) or fixed. In the fixed case, installations might want to fix their exposure to allowance costs, either using forward contracts or buying allowances in advance.
- Some installations might face uncertainty about their verified emission quantity for some time, and thus might prefer to acquire a fraction of their allowances at the time of their auditing.

The diverse preferences suggest that auctions should be scheduled periodically (see presentation Edwards).If the timing and volume of auctions does not match these requirements exactly, then financial intermediaries can take open positions to match their positions at the relevant time(s). This will fix some of their capital and expose them to the risk implied by the volatile CO_2 markets. Therefore intermediaries will charge a risk premium which either results in a reduction of auction revenues or higher allowance costs for (small) emitters that can not bear the risk on their balance sheet or are cash flow constraint.

2.g Minimise risk of market manipulation

The CO_2 allowance price is (a) the core signal for investment decisions and (b) policy decisions about the ongoing scheme require a trustworthy price signal. An undistorted price signal is thus important to support efficient investment decision and inform policy design.

2.h Avoid distortions of bilateral market and derivatives

A liquid CO_2 allowance market gives participants the flexibility to adjust their operation and investment decisions in response to the market price. It also allows participants to sign forward and derivative contracts on the spot market price, and thus hedge exposures if CO_2 price changes influence their input, their product prices or the profitability of their investment decisions.

2.i Create market confidence in robust allowance prices

In the short term, CO_2 emissions are not very responsive to CO_2 allowance prices. Thus allowance prices react strongly to balance the allowance budget with changes in fossil fuel prices, weather conditions and GDP growth rates. Also governments are struggling with information asymmetries that exist with emitters when determining the appropriate level for the cap, while past experience illustrates that companies tend to overestimate/overstate the costs of pollution reduction measures. Both government and industry participants are risk averse and want to avoid the risk associated with excessively stringent constraints. As a result, we observe generous budgets and potentially rather low CO_2 prices. The potential of rather low CO_2 prices creates a significant obstacle for investments in low-carbon or energy efficiency projects and thereby delays overall emission reductions. *During a transition period when conventional technologies dominate our infrastructure and industry, most product prices and internal performance benchmarks are set by conventional technologies. Low carbon or energy efficiency projects are evaluated against conventional technologies and are frequently only viable if CO_2 allowance prices exceed a certain threshold. Relative to conventional technologies they therefore face the additional risk of CO_2 price uncertainty. The short history of price formation and policy and regulatory interactions complicate the evaluation and quantification of the CO_2 price risk and therefore induce investors to make conservative estimations. For example, in a value at risk evaluation projects would have to be viable even in cases of unfavourable CO_2 prices. Investment in low carbon projects could be facilitated and thus real emission reduction achieved, if market participants have confidence that the allowance price will not fall below their threshold level.* If governments could credibly commit to a price floor for CO_2 allowances, this would reduce such investment risks (see presentation by Mirrless-Black). Allowance auctions might offer an opportunity to deliver such a price floor in the short-term. In the mid and long-term an alternative approach could be option contracts on CO_2 allowance prices issued by governments (Ismer, Neuhoff 2006).

Price floors would also increase the credibility of the EU ETS. It is argued that governments have some target corridor for CO_2 prices in mind. If prices are extremely high or low, then governments are pressured to intervene in the market. Under the NOx program in California the high prices resulted in live changes to the program, while the UK government negotiated voluntary withdrawal of allowances in an attempt to secure a viable allowance market and price in the UK emission trading scheme (see presentation by Smith). As the SO_2 cap under the US clean air interstate rule was ‘set in stone’ the allowances issued after 2010 are devalued. Anticipating any such intervention and formulating explicit solutions would increase the stability of scheme and thus facilitates investment.

3. Design choices

3.a Frequency

We did not reach any firm conclusions on the optimal frequency for CO_2 allowance auctions. The following arguments can be brought forward in favour of a more frequent auction.

- More frequent auctions allows market participants to satisfy their allowance demand closer to product sales or emissions, and can thus minimise cash flow implications.
- More frequent auction could reduce price risk. Where product prices are closely linked to CO_2 prices, e.g. electricity, a producer would likely lock in to a CO_2 price at the time when selling the product, to avoid the uncertainties created by an open position. The producer or a financial intermediary could buy allowances at an earlier auction, but would carry the risk of an open position of CO_2 allowances with potentially changing price. The producer could also buy the allowances at a later auction and hedge the price risk with financial intermediaries. These in turn would carry an open position and charge a risk premium for that. In both cases the risk premium for carrying an open position would increase the effective allowance costs – and would likely feed back to a lower auction price.[2] We are working on a better quantification of the implied costs. Comments are welcome on the following argumentation: Bessembinder (1992), DeRoon, F.A. et al. (2000) and Garleanu, N. et al. (2005) observe risk premia as a result of hedging pressure (open positions held by speculators to allow other parties to hedge price risk) between 2% and more than 10% across various commodity markets, less consistent in financial markets. Assume a 5% premium applied to 10% of approx. 2.1 billion allowances each valued at 20 Euro. In an annual auction that would imply hedging costs of 5% * 10% * ½ * 44 billion Euro = 110 million Euro. These would drop to 27.5 million Euro in a quarterly auction and 9.2 million Euro in monthly auction, thus suggesting significant savings from a higher frequency auction.
- For government a more frequent auction reduces revenue uncertainty as auction prices capture the average annual allowance price. This reduces the possibly bad

[2] Assume X allowances are to be sold. To model the qualitative effects, we simply represent the 5 year commitment period as two periods. Demand in both periods is d1(p1)=D-p1 d2(p2)=D-p2. Assume financial intermediaries are prepared to enter the market if they make a profit margin (risk premium) of m.
Case 1: All allowances are auctioned in period 1. Combining the no arbitrage condition p2=p1+m with the market clearing in auction in period 1 X=D-p1+D-p2=2D-2p2-m
gives equilibrium prices: p1=D-X/2-m/2, p2=D-X/2+m/2.
Case 2: X/2 allowancs are auctioned in each period. The market clearing condition of each auction is X/2=D-p1 and X/2=D-p2. As all demand as satisfied from the auction, there is in this simplified model no role for financial intermediaries that take an open position. Therefore equilibrium prices are p1=p2=D-X/2.
Comparing both cases we note that (i) the one auction reduces total government revenue by mX/2 (the fee/risk premium for financial intermediaries), and (ii) deflated prices in period one and inflated prices in period two result in inefficient allocation of consumption, reducing consumer welfare by m^2/4. [I'M NOT SURE HOW HELPFUL THIS EXAMPLE IS. THERE IS NO RISK – SO WHAT IS m? MORE IMPORTANTLY IF THERE IS A SECONDARY MARKET THE INSTALLATIONS CAN BUY AT THE TIME OF SALE IF THEY WANT TO. THE COSTS OF HOLDING A PERMIT FOR AN EXTRA WEEK SEEM SMALL COMPARED TO THE COSTS OF RUNNING AN EXTRA AUCTION.]

press that could result if the auction timing happens to coincide with a low price period.[3]

- More frequent auctions imply that individual auction volumes are smaller. This reduces the maximum amount collateral posted at any one time and might thus facilitate participation organisations not used to trading activities.
- More frequent auctions reduce the risk of short-squeezing (pre-emption) of the auction. For a market participant to short-squeeze the market, he has to obtain a sufficiently large quantity of allowances. Only then is it profitable to withhold some allowances and sell (or use) the remaining allowances at a higher price. With frequent auctions the volume of allowances sold in any auction is likely to be too small. However, with sufficient transparency requirements, other bidders will observe if a market participant obtains all or most of the allowances in one auction, increase their bid prices in subsequent auctions, and thus make the activity unprofitable. Overall short squeezing is unlikely to be a substantial problem in ETS, due to the liquid secondary market for the homogeneous product.
- With more frequent auctions the relative importance of any auction is reduced, thus minimising market and political risks from mistakes during the initial learning phase. This might come at the cost of less time between auctions to address concerns. However, as we argued before the auction design for EU ETS is unlikely to provide a challenge thus this point is likely to be of limited concern.

Similarly, in favour of a less frequent auction are the following arguments.

- Every auction creates costs for governments and market participants, and thus it is argued that a more frequent auction increases the total transaction costs.
- If market participants focus on the auction, then this may distract and reduce liquidity in secondary markets and for derived products. The experience from T-Bond auctions does not seem to confirm this concern, but further analysis might be required (Andreas Pick presentation). To the extent that market participants want to hedge against uncertainties associated with auctions they might also increase the liquidity of secondary markets.
- If emitters can acquire their allowances in auctions, then this reduces the market opportunities for intermediaries. While direct acquisition of allowances in the auction might imply lower transaction costs for final emitters it is sometimes argued that intermediaries are beneficial in providing continuous liquidity for the market (see presentation by Edwards). Given the significant trading volume and presence of intermediaries in the market at a time of free allowance allocation (e.g. when they can not benefit from initial allocation), however, this seems to be less of a concern. Furthermore, one might argue that intermediaries should focus on how they can develop additional products to support the market and facilitate investment decisions.

[3] One solution would be for governments to hedge in the market, e.g. such as to ensure their auction revenue reflects the annual average of the allowance price. This would also eliminate the risk premium described in the preceding bullet point. De-facto it would replicate the high frequency auction but without the benefits of such an auction (e.g. easier access for market participants, clear and transparent interface between government and market, *ex-ante* clarity about nature, timing and volume of government actions).

- More frequent auctions reduce the cost and therefore risk for a market participant to buy all the allowances in the market. If large fractions of allowances are auctioned, and if most market participants do not participate directly in the auction but via 'when-issued markets", and if the secondary market is not sufficiently liquid, then this could increase the risk for short-squeezing. Maximum participation constraints should then be carefully monitored and enforced.

Figure 1 summarises the main trade-offs discussed in this section. A move towards more frequent auctions reduces concerns about pre-emption, but possibly at the cost of higher transaction costs. If the auction is explicitly or implicitly restricted to intermediaries, then emitters might have to pay a risk premium if intermediaries have to hold open positions for significant time stretches.

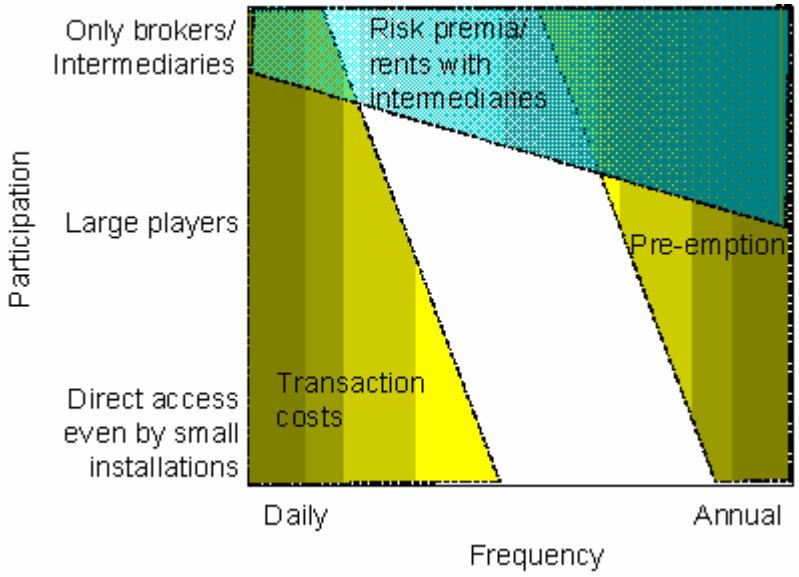

Figure 1 What concerns does the auction format need to address?

To better understand the interactions between auction frequency and auction costs we provide a first estimation of auction costs, assuming 10% of allowances are auctioned, taking industry values for electronic auctions costs and making rough estimation of the number of auction participants. For this and the later estimation of auction costs we do not consider the costs incurred by auction participants. This is not only because they are difficult to estimate, but also because participants would incur similar costs when interacting in bilateral markets to acquire allowances. If participants consider transaction costs too high to frequently participate in a high frequency auction, then they can choose to participate only at a subset of the auctions, at the time most suitable for their purposes (we later assume an average participation of emitters at four auctions per year).

For the auctioneer we assume the following cost components - where we provide first rough estimates. The development and installation of the initial IT system costs Euro 500.000 and lasts for the five years of the commitment period. For the execution of each auction fixed costs of 25.000 Euro are incurred. To register market participants annual

costs of 100 Euro/participants are incurred. Each submitted bid by a registered market participant then creates additional costs of 150 Euro.

Euro	Initial IT	Fixed cost/auction	Cost/registration	Cost/bid
Costs	500000	25000	100	150

Table 2 Components and example of transaction costs for an auctioneer.

To calculate the number of participants and bids we started from the national registries and counted how many entities are registered in individual countries (together 6714) and across Europe (6546). We assume that they will bid either in their national auction or if the national auction is not sufficiently frequent in neighbouring countries four times per year. In addition traders and financial intermediaries (up to 50) are participating in auctions. Annex 1 provides further detail.

Figure 2 illustrates how under these assumptions, the costs of a European auction increase with the auction frequency. When moving from an auction held once per year to an auction four times per year, the main impact is due to the increased volume of bids that is submitted throughout this year. As the frequency is further increased we assume that bidders do not increase the number of bids per year, but use the more frequent opportunities to submit their bids at their preferred time. Thus bid-costs do not increase further. With higher auction frequencies, the fixed costs per auction gain weight and increase the overall costs of the auction.

We did not contrast these costs to the administrative, negotiation and legal costs created by the process of free allowance allocation.

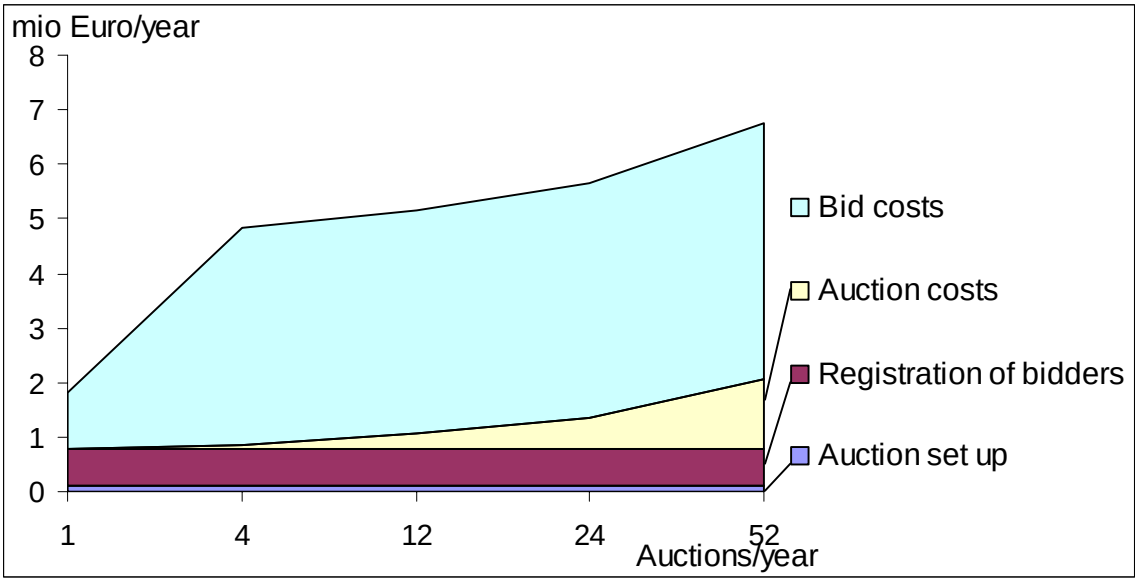

Figure 2 Costs for a European auction for CO_2 allowances dependent on auction frequency

We did not estimate the benefit of higher frequencies of auction both in lower costs for bidders and in lower risk of pre-emption of the auction.

Figure 3 illustrates the implications for the preferred auction design. Complex auction design of auctions is only viable if auctions are infrequent and the bidders are

sophisticated. With frequent auctions and many participants, a complex auction design that reduces strategic effects is not necessary. A simple auction design which does not benefit sophisticated players - e.g. a sealed bid uniform price auction - allows for wider participation and should also be efficient if there is extensive participation.

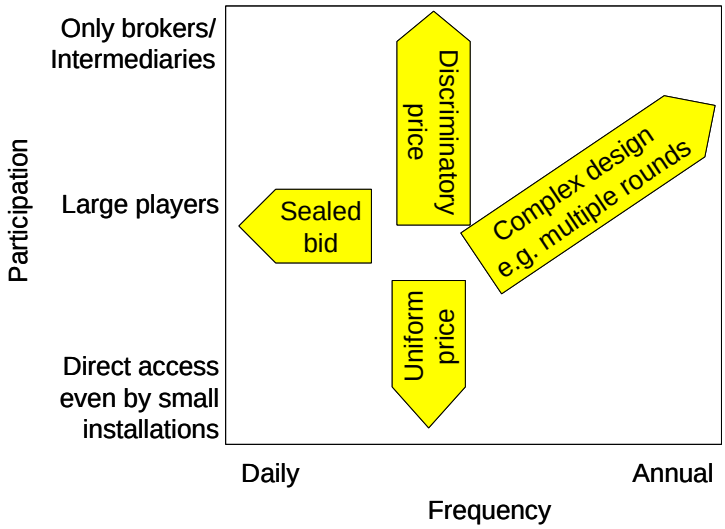

Figure 3 Preferred options for auction format

Combining the arguments of auction design and frequency, I would suggest a uniform price auction at weekly or monthly frequency. If European countries implement independent auctions that are easily accessible across Europe, then the frequency of individual auctions can be significantly lower. I return to this point in the discussion on the need for harmonisation below.

3.b Auction format

Auction design allows for a multitude of auction formats and criteria. We have discussed the different options in more detail in Hepburn et al. (2005). If a simple auction design and set-up minimises entry costs, then many emitters and intermediaries are likely to participate. The Bulow-Klemperer theorem (Milgrom, 2004) suggests that every additional bidder is more effective in increasing competition than any complex auction design could be.

A simple sealed bid auction should thus do the trick. All bidders have to submit their bids, usually in electronic format, by a certain time. Existing power exchanges offer the opportunity for bidders to access the "order book" for a certain time period prior to the auction in order to be able to maintain their bids. This also leaves plenty time for the "small" participants not to have to act under time pressure. Nevertheless, bidders should have the opportunity to change their bids up to a short moment – however that is defined – prior to the auction. This would leave them the change to react to events that might happen in the continuous EUA-trading in the secondary market and avoids a separation of primary and secondary market and therefore an increase in volatility due to the auction (see presentation by Teis).

This leaves the option to use a uniform price auction or a discriminatory price auction. In the uniform price auction all market participants pay the price of the lowest bid that still gained access to allowances. In a discriminatory price auction all winning bids pay their bid price. Assuming that small players are less able to anticipate the market clearing price, e.g. because it is not worth their while to expend resources on this topic, they on expectation pay a higher price in a discriminatory price auction than better-informed, large players. Thus a discriminatory price auction tends to discriminate against smaller players. One option to address this concern is applied in sovereign bond auctions where they are designed as discriminatory price auctions. A fraction of allowances is set aside for small players and they receive these allowances at the average price of the accepted bids. Given the continuous size distribution of emitters it might be challenging to define a cut-off value. If set too high and the number and volume of competitive bids drops sharply, competitiveness of the auction too will be reduced.

A uniform price auction might thus be preferable. All winning bids pay the price of the marginal bid. As a result small players will pay the same price as big players, at whatever bid price above the market clearing price they bid at. The drawback of uniform price auctions is, that big players might reduce their bid volume or bid price in order to reduce the price they pay in the auction. With sufficiently numerous market participants, this possibility is of limited concern.

Sealed bid uniform price auctions have become common practice in power markets. In most European countries tens of auctions are executed daily on electronic platforms.

Modelling a CO_2 auction on the format of existing power auctions would have the added benefit that it would facilitate widespread participation as many emitters are already familiar with the procedure. A bid consists of pairs of quantities and prices (a demand curve). It could for example specify that at a price up to 20 Euro/t CO_2 the bidder would buy 2000 allowances, at a price up to 25 Euros/t the bidder would buy 1000 allowances and for any higher prices the bidder would buy no allowances.

The incoming bids are checked. The market clearing price is the lowest price at which the volume of accepted bids equals or exceeds the available quantity of allowances. If demand exceeds the supply at the market clearing price, then all bids at the market clearing price are scaled back proportionally until demand matches supply.

Other options instead of proportional scaling are possible - e.g. first submitted bids - but they seem to be less practical.

If a reserve price is implemented in the auction (Hepburn et al, 2006), then bids with a bid price below the reserve price will not be considered. If the volume of bids at or above the reserve price is below supply, then some of the allowances will not be issued. If a sufficient volume of allowances are auctioned with reserve price, then this could serve to implement a price floor for the overall market (see presentation by Edward).

In power exchanges, the results of the auctions are determined 30min to one hour after the closure of the auction to auction participants. The auction clearing price and traded quantity are then published on the web. Some power exchanges also publish the aggregate supply and demand curve (EEX, APX).

3.c Credit risk mitigation

In principle the auctioneer faces the risk that a winning market participant fails to honour his bid. For our purposes we need to differentiate between the occasional bankruptcy of any market participant and a strategic market participant that either wants to manipulate the auction price or uses a non-committal bid as an option rather than an obligation.

3.c (i) Credit risk implied by 'normal' bankruptcy

If a normal bidder cannot pay for the winning bid, then this will become apparent during the settlement of the transaction. At this point the allowances could for example be sold in the bilateral market. Thus the maximum potential loss for the auctioneer is the maximum price drop of allowances during the settlement period (e.g. one or two days) times the allowance volume of the winning bid. To protect themselves and their participants against such losses, power exchanges have implemented margin requirements. Market participants have to post credit guarantees or funds corresponding to this potential loss, and their bids have to be within limits that are covered by these margins (see presentation by Teis).

If we have to expect a repetition of a price drop as large as in Phase I (more than 10 Euros between 25th and 27th of April 2006), then the implied margin requirements would be very extensive, and participants would have to post credits corresponding to almost half the value of their bid. However, it seems that the event was unique due to the initial uncertainty about total emission volumes, and therefore day-to-day price volatility should be lower in the future. In the future the largest price impacts could be expected through changes in policy frameworks for post 2012 that feed back to current allowance prices via banking. For example, changes in the political landscape could suddenly reduce the confidence in post-2012 prices and interest in banking. As market participants intent to bank less, the allowance market would be long and the allowance price would drop. Thus it might be advisable to avoid auctions at times of key decisions on post-2012 design. This would be similar to other financial markets, where trading of some stock is halted while significant information on the relevant company is released.

Frequent auctions are likely to have less impact upon the market clearing price (if auctions have any such impact at all) and the volumes are smaller, thus margin requirements per auction are lower. Uniform price auctions reduce the exposure in the case of bidders defaulting . In contrast, in a discriminatory price auction a bidder could submit an excessively high bid, and therefore owe far more money to the exchange than the actual value of the allowances according to the market clearing price which is likely to be close to the price in the secondary market.

3.c (ii) Credit risk implied by the strategic behaviour

This in many ways is more problematic, as not only does it impose costs for the auctioneer, but it could also undermine the credibility of the auction and potentially the emissions market itself. Given the large financial and legal risks involved we consider it to be an unlikely scenario.

Market participants could consider their bid to the auction as an option, and only pay up to the bid if the allowance market price increases to a price above the price they have to pay. If the margin that is posted is sufficiently large, then the price paid for that 'option' will by far exceed the value of the option and thus prevent any such behaviour. To avoid

liability the market participant would probably have to set up a dummy company, and obtain accreditation with the auction place and registry.

Alternatively, market participants may strategically submit large, highly priced bids into the auction to push up the market clearing price in order to benefit in derivative markets that are indexed to the auction price. By subsequently defaulting on the bid, the bidder could easily profit, even if some margin has to be posted. However, it is likely that such behaviour would be illegal and could be easily traced. Explicit caps on bid quantities can in theory prevent such behaviour. Yet in practice, the Salomon Brothers case in the US T-Bond market of May 1991 illustrated that formal constraints can be circumvented if client accounts are used in the anticipation of week enforcement..

3.c (iii) Experience from the existing CO_2 allowance auctions

The Irish and Hungarian examples in Phase I reveal very different approaches:

- In Ireland, participants had to post as a credit guarantee, 3000 Euros in the first and 15,000 Euros in the second round of auctions (see presentation by Macken). The tricky aspect is that a higher fixed premium can be rather expensive for small players and thus restrict participation. At the same time, if a large participant would buy allowances to a value of 1 million Euros, then it would in theory be profitable to abandon the bid if the price fell by more than 0.15% during the subsequent two days. Thus the large player could perceive the 15,000 Euro as the price of an option.
- In Hungary market participants had to post the total value of their bid at the account of the auctioneer place two days before the bid, and the money was retained for eight days after market clearing (see presentation by Kaderjak). This created large entry costs and barrier and is likely to have contributed to the very low participation levels.

A margin-posting requirement as already applied in power markets seems to be a sensible solution. It would involve the posting of collateral corresponding to about 10% of the expected bid value prior to the auction. If the bid were unsuccessful, the collateral would be freed within one banking day. If the bid were successful, than within 2 days the collateral would be replaced by the payment of the bidder. If small players intend to buy allowances for their own use, then they are likely to bid so as to win in the auction and could thus pay 10% of their expected bid *ex ante*. Thus no extra burden is created. For financial arbitrageurs, the collateral posting should not create high transaction costs – this seems desirable to ensure their participation in arbitrage, in cases when the temporal distribution of allowance demand does not match the *ex ante* determined distribution of allowances across auctions.

3.d Reserve price in auction - and publication of the reserve floor

A reserve price in auctions can serve two purposes. First, a reserve price in an auction could serve as an insurance to avoid unreasonably low auction clearing prices that might result if only few buyers participate or if buyers coordinate their bid strategies. Sellers might not announce such a reserve price if they expect strategic bidding. Participants in an auction might use the announced reserve price as a price level at which to coordinate their bids. Sellers tend to announce the reserve price if strategic behaviour is less of a

concern or if it is required under transparency requirements. In the Hungarian allowance auction, the reserve price was announced to be 0.9 Euros/t CO_2 below the spot market price two days before the auction. In the Irish auction, the reserve price was not announced – it is only known that the market clearing price was above the price floor.

Second, an early announcement of a reserve price for all allowance auctions could create a price floor for the overall allowance market. This would require that a significant share of CO_2 allowances (e.g. 10%) is sold in the auction (see presentation by Rupert), and inflows from JI and CDM credits are limited (supplementarity criteria). In this case, some of the allowances from the auction will be required, and no market participant will sell allowances below the reserve price set in the auction. Options for how to treat any remaining allowances are discussed below.

3.e What is the optimal timing for announcements on timing, volume and reserve price?

In Phase I, governments have the flexibility to choose the time and volume of allowances dedicated for auctions, whether left over from new entrant reserves or returned from closing installations. Should this flexibility be retained?

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 Phase I of the EU ETS, some market participants have criticised the timing of the Hungarian and Irish government auctioning of CO_2 allowance – they took place in the autumn of 2006 during a period experiencing a general trend of falling prices. From the individual perspective of the countries involved, however, this seemed rather reasonable, cashing in allowances to retain revenue while allowance prices were still viable.

The choices of timing and volume of allowance auctions by governments may reflect a number of strategies:

- governments aim to maximise auction revenue;
- governments withhold some allowances and refrain from auctioning them at all, if this seems to be required to support a robust market price;
- governments develop a clear schedule and volume of allowances and thus reduce the regulatory uncertainty of the market (one simple schedule of this kind could specify *ex ante* the timing and volume of all auctions);
- governments create an independent agency to implement a timing and quantity of auctions to pursue some pre-defined strategy.

Pursuing any of these approaches, however, only allow governments to influence the 'lower bound' of allowance prices. If the allowance price were to peak despite all of the allowances being auctioned, then auctioning does not offer any further leeway.

We did not discuss in detail the extent to which market participants would perceive any of above approaches as credible. After all, market participants fear that

government has a strong incentive to announce strong allowance prices *ex ante* so as to induce low-carbon investment, and then renege on this promise *ex post* in order to minimise prices for consumers.

Thus, it seems – after this initial discussion –that announcing a clear and simple strategy such as a reserve price in auctions can be easily verified and implemented in a legally binding way with high credibility.

For market participants to develop confidence in the future market evolution, it is imperative that political uncertainty is minimised. After all, if market participants do not believe governments announcements that it will support a strong market price, e.g. by refraining from selling all allowances if the market is long, then they might not invest in low Carbon technologies.

3.f Harmonisation across Europe

It would be rather difficult to justify the exclusion of market participants from other European countries at an allowance auction both in political and legal terms, the latter relating to the internal market rules under EC law. Furthermore, allowances are freely tradable across Europe – therefore trades or bids can always be implemented on behalf of a third party. Hence we are dealing with a set of auctions of an identical product to one market. This raises a few questions:

3.f (i) Will there be a competition among Member States to maximise auction revenue?

The example of UK Guilt auctions and the initial experience of CO_2 allowance auctions suggest that governments might aim to pre-empt each other in order to sell into rising markets. However, given the presence of financial arbitrageurs in the market, any clear evidence of rising markets will be reflected in the allowance price and thus eliminated.

For example, if all governments were to aim to sell allowances early in the process, then market participants would be prepared to buy them earlier. But as market participants would face the risk of holding the allowance, they would charge a risk premium thus reducing the government revenue. Hence, it is not clear how competition among Member States to maximise auction revenue would influence the timing of their auctions.

This result might not hold if governments' own information is not accessible to private market participants. If, for example, governments have private information that shows emission levels are lower than expected, then any individual government would face an incentive to accelerate auctioning before that information was disseminated in the market. Increased auction activity would in turn be observed by market participants and result in falling prices.

3.f (ii) Can independent action of individual Member States help to stabilise prices?

An individual state with a separate emission trading scheme might be prepared to withhold some allowances, and forgo some auction revenue, to avoid pumping up allowance prices. This corresponds to the experience of national central banks incurring costs to stabilise the national currency.

If countries share a common allowance markets, then they will be less inclined independently to withhold some allowances and thereby forego auction revenue in order

to stabilise the overall price level. This is, because with the larger market volume, they would have to withhold larger amounts of allowances to achieve a similar stabilisation effect.

This suggests, that close cooperation among Member States would be required, if the volume of allowances issued in auctions were to be used to avoid extremely low prices.

3.f (iii) Would auctions with a reserve price require coordination?

Yes, for at least three reasons:

- agreeing on the same reserve price is necessary, otherwise if country A sets the reserve price at 20 Euro/tCO_2, then country B has an incentive to undercut - e.g. set its reserve price at 19.90 Euro/tCO_2- in attempt to attract bidders and increase sales revenue, without significantly altering the investment incentives or abatement trajectory;
- even with a harmonized reserve price, countries might compete using sales bonuses or other incentives for the participation of international buyers. Thus the country could increase sales revenue if the reserve price is binding and across Europe only a fraction of total allowances are auctioned. However, such 'incentives' are an inefficient use of public resources and could create political tensions.
- if the timing is not coordinated, countries might compete for the most profitable timings - for example in a case where the market is expected to be long, a race to auction as early as possible could result.

Thus there are benefits if countries coordinate their auctions and ask one common agent to execute the auction on their behalf. If the reserve price implies that only a fraction of the allowances are auctioned, then the agent would sell equal fractions of allowances from each country and return the remaining allowances.

3.f (iv) If we just want to sell allowances, is harmonisation required?

The subsidiarity principle laid down in Article 5 of the EC Treaty suggests that any decisions that can be made on a national level should not be centrally taken unless, "by reason of their scale or effects" the results desired may be better achieved at the Community level. It might be argued that retaining flexibility at a national level with regard to the question of auction design could make auctions more attractive to Member States.

However, auction design is not really an issue that has much cultural history in any European country, so it seems difficult how retaining the flexibility about auction design is going to increase national identification with emission trading. Furthermore, the arguments discussed above concerning reserve price and timing suggest that the integrity of the EU Emission Trading Scheme may actually be undermined by continuing to permit extensive national flexibility on the issue of auction design and timing. Allied to the fact that the EU ETS itself already exists as a system mandated by a Directive at Community level (rather than individually by each Member State), this is a strong argument in favour of answering the subsidiarity question in favour of Community-level action.

A frequently made argument for the parallel evolution of national policies is that it creates space to explore the best options, and can provide for competition between policy approaches that might create incentives for industry participants and policy-

makers to improve all approaches. The preceding discussion on auction design indicates, however, that there is little magic about the auction design. The main dimension where national advisors might express differing preferences is whether the auction should be implemented as a uniform price auction or a discriminatory price auction. Years of experience with both auction formats used in Treasury auctions across the world has but resulted in a convergence, and there is little evidence to suggest why this would not be the case for EU ETS auctions.

Although the two are in principle equivalent, there is risk involved in the choice in that once national stakeholders have gained experience with any one auction design they are likely to be reluctant to change the design i.e. there might be some lock-in effect to the randomly chosen approaches.

One reason why Member State might prefer to implementation unique auction design is that they see this as an opportunity to implement explicit or implicit administrative constraints that put off participation of and hence competition from international bidders. If the number of bidders would be severely restricted, then the remaining bidders might be in a position to exercise market power in the auction and achieve a market clearing price below the competitive level.. Governments might sbe attracted by this approach, if they see it as an opportunity to subsidise their domestic industry. Any such attempts are *prima facie* clear violations of the EC law rules on State aid (and possibly also on the free movement of capital) and would require notification and justification: given the motivations simply to subsidise and protect national industry in the posited example, such justification would be highly unlikely to be forthcoming. If the Commission makes clear that it will investigate and inhibit any such attempts, then this motivation should vanish.

Thus there seems little benefit from a series of individualistic national approaches towards implementing a CO_2 allowance auction. In contrast, the feedback most market participants and policy-makers have given about the first experiences with the European Emission Trading Scheme is that more harmonisation would make everyone's life easier and avoid distortions.

Thus early harmonisation of the auctioning approach could be rather beneficial. It will reduce set-up costs for market participants that only have to learn about one scheme. It allows governments to commission one institution to run all their auctions, thus reducing their set-up costs. Finally it, it facilitates the later implementation of a reserve price.

3.f (v) Can harmonisation save transaction costs?

To better understand the value for individual Member States in joining up their auctions (for 10% of allowances each) we used the previous cost parameters to estimate the savings. If the member stats operate individual auctions we assumed that they would operate auctions once a year. Bigger Member States would increase the auction frequency, such that no more than 10 million allowances are auctioned per year. This implies, for example, five auctions per year in Germany. Figure 4 illustrates that the transaction costs for selling allowances can be above 0.1 Euro/allowance in small Member States.

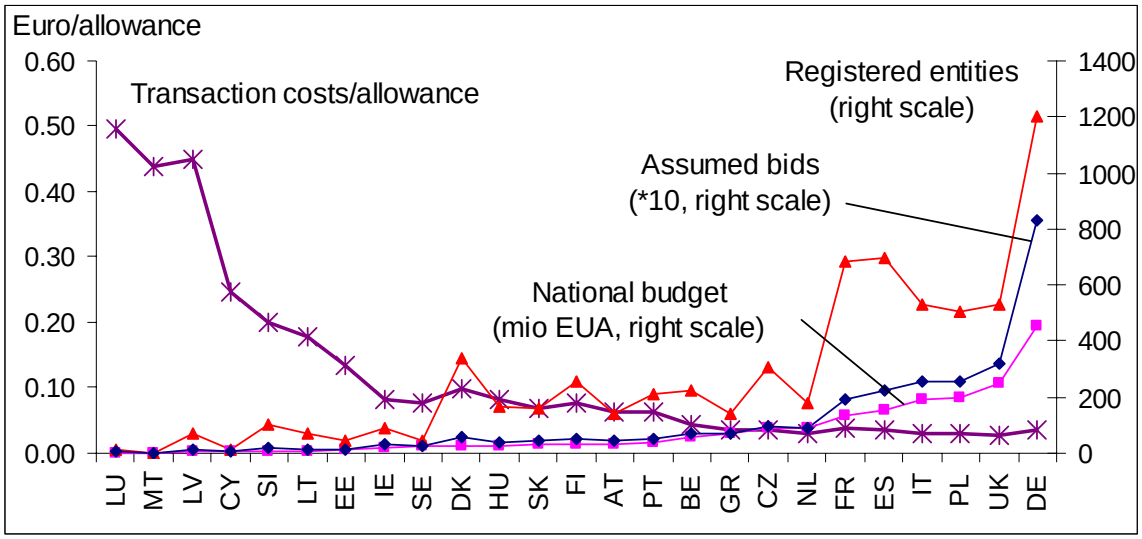

Figure 4 Transaction costs for auctions if set up in individual countries, right hand scale gives number of assumed bids per year (times 10) and registered entities

Alternatively, a joint auction would have to be held 20 times per year to meet the previous criteria of auctioning a minimum volume of 10 million allowances. Figure 5 illustrates the costs savings individual Member States could achieve with such a joint auction. This consists of three components. First, the repeated fixed set up costs for the auction can be avoided. Second, players can avoid having to register in multiple auctions, thus saving the costs for their registration. Third, with well time-coordinated auctions of sufficient volumes, there is less need to arbitrage auctions or to participate in multiple auctions, thus reducing the total bid volume.

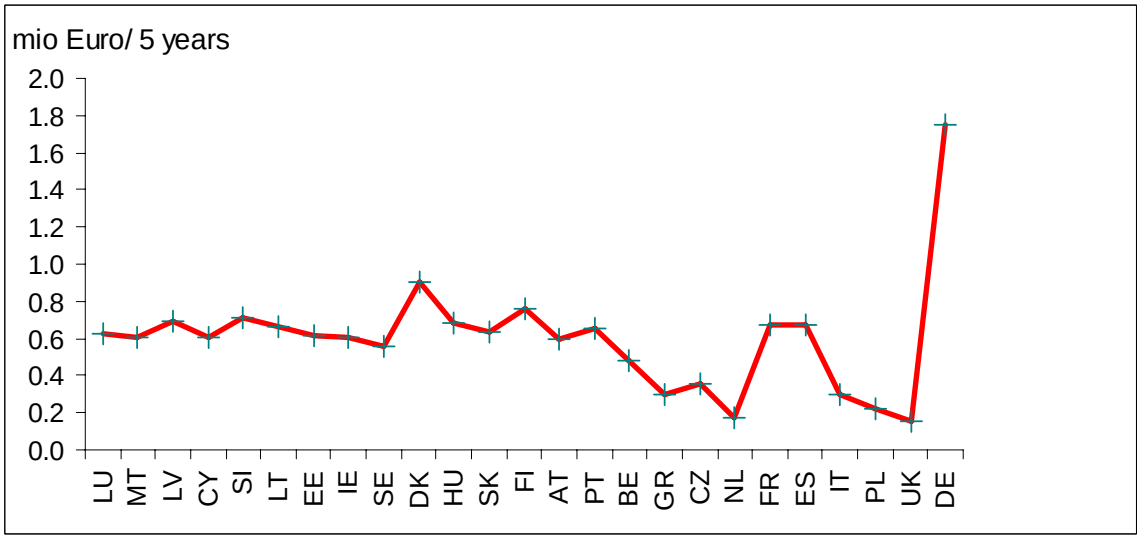

Figure 5 Savings from joining up auction for each Member State

Therefore in addition to these costs savings for governments or its agent, market participants also enjoy additional (and significant) benefits from the joint auction as they do not need to acquire information about multiple auctions or register to a subset of the

available auctions. The joint auction also facilitates timing of auctions well spaced across the year, thus increasing their comfort for market participants.

Preliminary analysis of cost reductions indicates there is significant value in joining up auctions.

3.g Distribution of allowances across auctions

If allowances are allocated in repeated auctions, then this raises the question how the allowance budget should be distributed across these auctions.

Allowances could be distributed equally across all auctions, as illustrated in Figure 6. Alternatively, if market participants express the desire to get an early exposure to the costs to be able to pass it through to their product prices, larger shares of the allowances could be issued in initial auctions. In contrast, if market participants preferred to wait to make their purchases, then more allowances could be retained for later auction rounds. If the match between the demand distribution and the allowance auctions over time is not exact, then financial intermediaries can cover the positions in the meantime – at the price of a risk premium.

Industry consultation might be beneficial to understand these various possible preferences and their incidences.

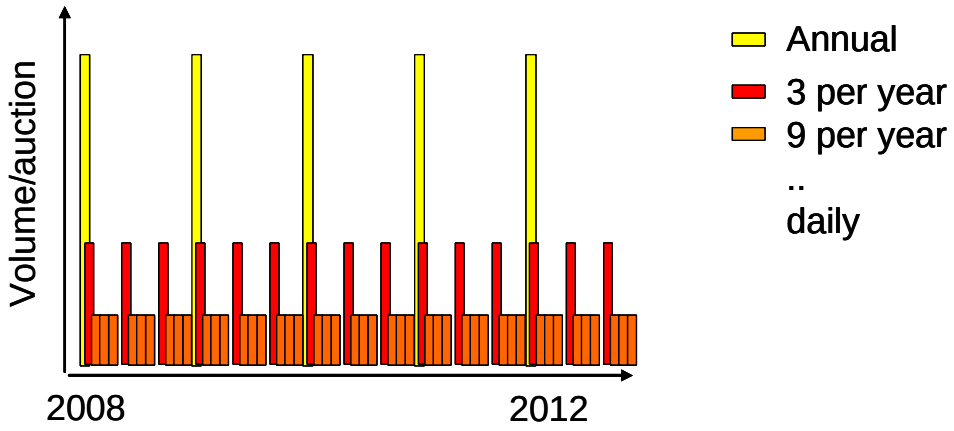

Figure 6 Homogeneous distribution of allowances across auctions

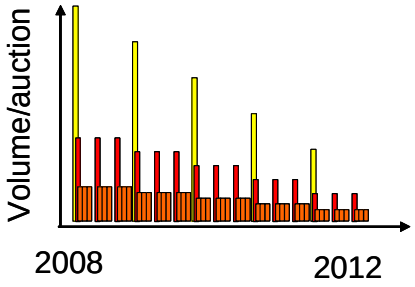

Figure 7 Front-loaded allocation of allowances across auctions

If allowances are auctioned with a reserve price, then not all allowances might be issued in the initial auctions. This raises the question whether (i) these allowances should

never be auctioned and (ii) these allowances should be auctioned in subsequent rounds e.g. by increasing the volume of all subsequent allowance auctions by an equal share.

I would suggest adopting of approach (ii) based on the following reasoning that however still requires thorough economic modelling. Imagine allowances that are offered and not bought in early auctions are not auctioned in later periods. Then the likelihood of scarcity and prices staying above the reserve price during later periods will be higher than in a case where retained allowances are auctioned later. In anticipation of this, emitters and financial intermediaries will buy more allowances during initial periods. Bigger sales in early periods increase the risk of later excess supply in the market, increasing the risk of prices below the reserve price.

If during the emission trading period new information comes up that suggests more allowances are required, then market participants cannot access allowances that were offered and not bought in early auction round, resulting in higher prices. Thus approach (i) can increases both the likelihood of high and of low prices. This higher volatility is unlikely to be desired.

3.h Participation constraints to address market power concerns?

It is sometimes feared that large utilities would have the power to manipulate auction results. The example of the activity of the Salomon Brothers in May 1991 suggests a possible way of doing this by buying all allowances in the auction, and then reselling them at a higher price. If the volume of allowances issued in one auction is small relative to the total volume of allowances in the market, then the allowances issued in one auction are less likely to suffice to short-squeeze the market. This would suggest that frequent, and thus small, auctions can avoid the challenges of short-squeezing the market. An option would be to limit the maximum bidding share of the allowances that one party can buy in an auction to, e.g. 25% as in UK government bond auctions.

If one is concerned that a market participant might acquire large fractions of consecutive auctions to then short-squeeze the market, then participation of sophisticated financial intermediaries could reduce the viability of such attempts. As they observe an attempt of large utilities, they also buy more allowances to participate in the profits thus halting the sole profit-taking by any one actor.

In our discussions, the question was raised, whether or not some market participants should be excluded from auctions. First, this could easily violate the EC's legal rules on the internal market. Second, reducing the number of market participants reduces the level of competition in the auction, risking a price further away from the efficient competitive level.

It has been argued that financial intermediaries should be excluded from initial auctions to facilitate learning by existing installations. However, submitting bids to simple uniform price auctions does not require strategic decisions. Furthermore, financial intermediaries are desirable market participants. To the extent that the distribution of auctioned allowances across time do not match the requirements of emitters, the intermediaries can take an open position and provide early financial security or hold allowances until they are required. Such arbitrage over time would also make it more difficult for market participants to oversupply the bilateral market in the days before the market to push down the allowance price to bias the auction price downwards.

Auctions per se will reduce the incentive for large emitters to pursue any such strategy, as they will not harvest the benefit from higher allowances prices on all the allowances they received in the free allowance allocation.

3.i Host of the auction

In principle several institutions can serve as the host for the auctions. The Irish Environment Protection Agency developed in-house experience to execute the auction, treasury departments already have experience with bond auctions, and various trading platforms have developed credibility in the market. Treasuries have extensive experience with issuing and usually auctioning bonds (see presentation Edwards), and could either directly host or provide advice on set-up and hosting of allowance auctions.

The main criteria that the host of an auction should satisfy are:

- independence from individual market participants, to create credibility that bids are monitored and judged fairly in case of difficulties.
- financial credibility
- The ability to handle large volume of bids from emitters across Europe in a short time frame. To minimise the uncertainty for market participants and reduce margin requirements the auction should be executed in a few hours, with rapid financial clearing of winning bids within e.g. two days
- leveraging existing infrastructure to minimise learning requirements and set up cost for auction place and market participants.

If a private party is to be commissioned to execute the auction and associated transactions, then a competitive bid or procurement mechanism can allow competition among potential hosts as to who could offer the best deal.

Several Member States could commission the same institution to auction allowances on their behalf. This might raise questions as to which authority is responsible for monitoring the financial transactions and transactions in related markets. Further analysis would be required to resolve this question.

Initially smaller Member States could sell small volumes of allowances in the bilateral market and on existing exchanges. The lower transparency involved could raise questions regarding the choice of counter-party and might also raise concerns about integrity of individuals making the selection process or government supporting a preferred player. Auctions can provide a clear interface to avoid such concerns. With increasing volumes of allowances sold the discretion of government in such bilateral transactions paired with the minimal experience of the market with the intention and strategies of government might reduce market confidence.

3.j Liquidity

It is sometimes argued that CO_2 allowance auctions would undermine the liquidity of allowance trading and thus the effectiveness of ETS. This is based on evidence from early auctions of SO_2 emission allowances under the US Clean Air program. For several days preceding these auctions the already thin bilateral market dried out totally. The entire effect in these two cases is still not well understood. It might be attributed to (i)

strategic behaviour of market makers like ENRON and/or (ii) overall low liquidity in the market.

In preparation for the workshop we looked, for examples, at auctions of financial products into existing markets. In cooperation with Vanessa Smith and Andreas Pick (see Andreas Pick presentation) we analysed liquidity data for 2-, 5-, 10- and 30-year US T-Bond auctions during auctions of additional bonds. In almost all cases the liquidity of the bonds increased.

log(volume)				
	2yr	5yr	10yr	30yr
2yr auction	**0.38**	**0.52**	**1.09**	**0.46**
5yr auction	**0.96**	**0.75**	0.09	0.27
10yr auction	0.33	0.54	0.62	0.11
30yr auction	0.72	0.42	0.71	0.48

Figure 8 Increase of daily trading volume at times of auctions of T-bond bills[4]

For the review process the question was raised whether post-2012 countries should be required to implement a minimum level of allowance auctions. For example the RGGI scheme requires 25% (see presentation by Burtraw).

3.k Transparency

A transparent auction design has the advantage of increasing credibility with market participants. As the auction is likely to be rather competitive, the level of concern about tacit collusion is low. Thus there is less need to refrain from publishing much of the information accrued during the auction.

Markets that are likely to be less competitive, like national power markets refrain from publishing information that would reveal the identity of individual participants, as this might facilitate observations of individuals behaviour and thus punishment for deviation from collusions.

3.l Road map towards auctions?

Experience with the design and implementation of auction in other sectors, particularly for energy products suggests that there is a benefit of clearly outlining a time-frame and ensuring sufficient time to simulate and test the infrastructure both internally and also by offering training and a test period for market participants.

In the workshop, it was also discussed whether an international coordination of auction rules beyond Europe would be required. Given that the initial price expectations in the RGGI scheme of states in the US North East are currently significantly lower than

[4] Based on daily trading volumes for US treasury bonds, de-mean and de-volatise with moving average. Regress log(volume) on lags and dummies for auction dates. Bold numbers denote significance at the 5% level.

general market sentiment under the EU ETS, any immediate direct linking seems unlikely (see presentation by Burtraw).

4. Conclusion

The experience of auctions in other sectors suggests that with clearly defined objectives and careful implementation auctions can contribute to liquid and robust markets.

In the case of CO_2 allowances, the auction design is facilitated as the product is homogeneous and is already traded by many participants across Europe in liquid secondary markets. Tailoring the auction design to match the needs of the emitters can reduce transaction costs, risk exposure and limit cash flow constraints. This might even coincide with the objective of revenue maximisation for governments as emitters are prepared to pay higher prices for a more useful product.

With many market participants and liquid secondary markets, a simple auction design like a uniform price auction seems feasible and limits transaction costs. This allows for a frequent auction where emitters can participate at their preferred time. How allowances should be distributed across these auctions requires further research: should more allowances be issued in early auctions to satisfy hedging demands or in later auctions to facilitate compliance buying? Getting the distribution across time exactly right is less of an issue before 2012 where auctions represent a maximum of 10% of the total market, and even post 2012 traders are happy to match the imbalances – if they are paid for the risk of carrying open positions.

A question that remained open from the workshop is whether governments should announce price floors for the auction – this could, with credible commitment, and sufficient shares of auctioning across Europe – avoid any risk of a repeat of the low price periods observed in phase I and thus increase investment security, environmental effectiveness and ultimately political acceptability of the scheme.

Thus price floors bring us the one other remaining question – the level of harmonisation and coordination required across Europe. The discussion indicated various benefits of such coordination, and further work of governments and researchers are required to ensure that (a) we address coordination of auction approaches across Europe from the outset so as to avoid facing political and economic costs of changing uncoordinated auction formats and (b) complexity is minimised for market participants by avoiding uncoordinated timing, format, and possible price floors of auctions across Europe that would make lives of market participants more complicated than necessary.

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- Dallas Burtraw (Resources for the Future): The US RGGI program
- Stephen Smith (University College London) : The UK ETS auction
- Ken Macken (Environmental Protection Agency, Ireland) : Irish auctions for CO_2 allowances: learning from Phase 1
- Jonathan Mirrless-Black (Exane BNP Paribas) : ETS Auctions - Investor perspective
- Stefan Teis (EEX) : Organizational set-up of EU ETS- auctions
- Rupert Edwards (Climate Change Capital) : Trading aspects
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Annex 1 – calculation of transaction costs

	Auctioned volume	Entities in Nat register	Assumed additional traders	Auctions/year	National bids	Exported bids	Total bids	Total cost (mio Euro)	Cost/ allowance Euro	Savings Mio Euro/ 5 years
LU	0.3	15	5	1.0	20	45	40	0.13	0.49	0.6
MT	0.3	1	6	1.0	7	3	28	0.13	0.44	0.6
LV	0.3	70	7	1.0	77	210	100	0.15	0.45	0.7
CY	0.6	10	11	1.0	21	30	61	0.14	0.25	0.6
SI	0.8	104	16	1.0	120	312	180	0.16	0.20	0.7
LT	0.9	70	18	1.0	88	210	152	0.16	0.18	0.7
EE	1.2	47	23	1.0	70	141	154	0.16	0.13	0.6
IE	2.2	89	45	1.0	134	267	295	0.18	0.08	0.6
SE	2.2	47	45	1.0	92	141	255	0.17	0.08	0.6
DK	2.5	340	50	1.0	390	1020	571	0.25	0.10	0.9
HU	2.5	166	50	1.0	216	498	401	0.21	0.08	0.7
SK	3.1	157	50	1.0	207	471	431	0.21	0.07	0.6
FI	3.1	258	50	1.0	308	774	534	0.24	0.08	0.8
AT	3.3	138	50	1.0	188	414	426	0.21	0.06	0.6
PT	3.7	214	50	1.0	264	642	535	0.23	0.06	0.6
BE	5.9	222	50	1.0	272	666	697	0.26	0.04	0.5
GR	6.9	141	50	1.0	191	423	692	0.25	0.04	0.3
CZ	8.7	304	50	1.0	354	912	984	0.31	0.04	0.4
NL	9.0	179	50	1.0	229	537	882	0.28	0.03	0.2
FR	13.3	681	50	1.3	972	1818	1938	0.50	0.04	0.7
ES	15.3	698	50	1.5	1144	1724	2252	0.55	0.04	0.7
IT	19.4	532	50	1.9	1129	1096	2537	0.59	0.03	0.3
PL	20.0	502	50	2.0	1104	1004	2553	0.59	0.03	0.2
UK	24.6	530	50	2.5	1427	816	3213	0.70	0.03	0.2
DE	45.3	1199	50	4.5	5023	0	8309	1.58	0.03	1.8
Joint	195.4	6546	50	19.5	27161		27161	5.32	0.03	
Separate	195.4	6714					28221	8	0.04	

Assumptions for calculation:

- Auction volume is 10% of national budget as in proposed or accepted NAPs.
- Entities is number of entities with different names in national register or in set of all national registers for Joint.
- Assumed traders are twenty times auction volume in mio EUAs with a maximum of 50.
- Auctions per year is calculated such that no more than 10 mio. allowances are auctioned per event.
- National bids are volume of auctions times traders plus number of registered entities times number of auctions per year (maximum 4).
- Exported bids are four minus number of national bids times registered entities.

- Total bids are national bids plus a fraction of all exported bids. The fraction corresponds to the volume of allowances auctioned by the country relative to the total volume of allowances auctioned.
- Total costs are calculated using cost estimates as depicted in Table 2.
- Savings are the savings that a country could achieve if it would incur the average EU costs per allowance sold rather than the costs calculated based on national numbers.