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The Ten-Year Rule: Allocation of Emission Allowances in the EU Emission Trading System

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B1633

June, 2005

IVL

Organisation/Organization

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RAPPORTSAMMANFATTNING
Report Summary

Projekttitel/Project title

The Ten-Year Rule: Allocation of Emission Allowances in the EU Emission Trading System

Anslagsgivare för projektet/ Project sponsor

Mistra's Climate Policy Research Programme (Clipore). Additional funding from the Swedish Energy Agency

Rapportförfattare/author

Markus Åhman, Dallas Burtraw, Joseph Kruger and Lars Zetterberg

Rapportens titel och undertitel/Title and subtitle of the report

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Sammanfattning/Summary

In its guidance on National Allocation Plans (NAPs), the European Commission has discouraged Member States from adopting allocation methodologies that would provide incentives to firms affecting their compliance behavior. The purpose is to promote economic efficiency and to prevent strategic behavior that deviates from individual and collective cost-minimization. For example, some methodologies would reward one type of compliance investment over another. To discourage such actions, the EU Emission Trading System guidelines prohibit ex post redistribution of emission allowances within an allocation period based on behavior in that period. Similarly, the Commission has indicated that decisions about the initial distribution of allowances in the second phase (2008-2012) must depend on measures prior to 2005 so as not to give companies an incentive to adjust their behavior to receive a larger allowance allocation. However, two other aspects of the NAPs—the treatment of closures and new entrants—may also affect firm behavior. An undercurrent in these guidelines is the question of whether Member States should allow incumbent emitters to hold infinitely lived, once-and-for-all property rights to a share of the emission allowances in the future.

This paper develops an approach for balancing efficiency considerations with perceived issues of fairness. We propose a ten-year rule to guide policy regarding closure of existing sources and the status of new sources and to guide the initial distribution of emission allowances in general. A ten-year rule would address issues of fairness and capture an important part of the potential gains that could be achieved through an efficient initial distribution of allowances.

Nyckelord samt ev. anknytning till geografiskt område eller näringsgren /Keywords

Emission trading, allowance allocations, closures, new entrants, tradable permits, air pollution, cost-effectiveness, greenhouse gases, climate change, global warming, carbon dioxide. **JEL Classification Numbers:** Q2; Q25; Q4; L94

Bibliografiska uppgifter/Bibliographic data

IVL Rapport/report B1633. Also available as RFF Discussion Paper 05-30.

Rapporten beställs via /The report can be ordered via

Hemsida: www.ivl.se, e-mail: publicationservice@ivl.se, fax: 08-598 563 90 eller IVL, Box 210 60, 100 31 Stockholm

Abstract

In its guidance on National Allocation Plans (NAPs), the European Commission has discouraged Member States from adopting allocation methodologies that would provide incentives to firms affecting their compliance behavior. The purpose is to promote economic efficiency and to prevent strategic behavior that deviates from individual and collective cost-minimization. For example, some methodologies would reward one type of compliance investment over another. To discourage such actions, the EU Emission Trading System guidelines prohibit ex post redistribution of emission allowances within an allocation period based on behavior in that period. Similarly, the Commission has indicated that decisions about the initial distribution of allowances in the second phase (2008-2012) must depend on measures prior to 2005 so as not to give companies an incentive to adjust their behavior to receive a larger allowance allocation. However, two other aspects of the NAPs—the treatment of closures and new entrants—may also affect firm behavior. An undercurrent in these guidelines is the question of whether Member States should allow incumbent emitters to hold infinitely lived, once-and-for-all property rights to a share of the emission allowances in the future.

This paper develops an approach for balancing efficiency considerations with perceived issues of fairness. We propose a ten-year rule to guide policy regarding closure of existing sources and the status of new sources and to guide the initial distribution of emission allowances in general. A ten-year rule would address issues of fairness and capture an important part of the potential gains that could be achieved through an efficient initial distribution of allowances.

The research was performed under the Emissions Trading in Climate Policy project (ETIC) as part of Mistra's Climate Policy Research Programme. Additional funding was provided by the Swedish Energy Agency.

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1 Introduction

In January 2005 the world's largest emission trading scheme took flight as the European Union emission trading system (EU ETS). It directly involves 25 countries, covers approximately 45% of the emissions of carbon dioxide in the EU and includes five of the most energy intensive sectors: iron and steel, mineral, pulp and paper, refineries, and energy. The EU ETS is divided in five-year trading periods, with an initial three-year trial period from 2005-2007.

One of the most important and contentious issues in the design of an emission-trading program is how to initially distribute the emission allowances. At play is the creation and transfer of wealth in the form of a tradable property right to emit carbon dioxide (CO_2). These already have an annual value of approximately € 38 billion (1.88 billion tons of CO_2 annually at a current price just over € 20), which can be expected to grow substantially in coming years. Moreover, the way in which the emission allowances are distributed initially provides incentives that affect economic behavior, which has important consequences for the costs of reaching emission targets and for perceived fairness and stability of the trading program.

Annex III of the EU Directive, which lays out the rules of the trading scheme (European Union 2004), presents criteria for the allocation of allowances. For example, a central feature of the EU guidelines is that ex post adjustments of allocations are disallowed. That is, regulators must decide prior to each trading period how many allowances will be allocated and to what installations, and the regulator cannot redistribute these allowances within the trading period. Hence, an approach that updates the allocation based on some measure or behavior within the same trading period is precluded. In addition, the EU rules specify that in the first period (2005-2007) only a small percentage of allowances may be auctioned, and at least 95 % of allowances should be allocated for free. In the second period (2008-2012) the amount to be given away for free has to be at least 90%.

Still, considerable freedom is left to the individual Member States to decide the magnitude of allowances to be allocated and how allowances should be distributed among participants in the trading scheme. Ultimately, each Member State develops its own National Allocation Plan (NAP)[1], which must be approved by the EU Commission ahead of each trading period.

[1] All National Allocation Plans, as well as EU Commission decisions on them can be found at the official European Union website, http://europa.eu.int/comm/environment/climat/emission_plans.htm

There is currently a process of reviewing the allocation process following the first set of NAPs. The EU Commission will publish the results of this review in a report by June 2006. However, Member States to the EU Commission must submit the second set of NAPs that same month. Revised guidelines from the EU Commission for the design of the second set of NAPs are expected to be available by the end of 2005 (Moser, 2005).

A full discussion of the lessons from the first round of NAPs is beyond the scope of this paper. However, clearly two of the most important issues are how to address installations[2] that close (closures) and how to treat new installations that enter the trading system (new entrants[3]). Both of these issues are connected to the short-run question of ex post adjustments to allocation within a period. They also relate directly to the overarching issue of how emission allocations are to change between periods. For instance, if an installation closes but continues to receive an allocation within a period, shall that allocation continue into the next period? And if a new installation begins operation, does it have access to a pool of free allowances? Further, how the transition from the status as "new entrant" into "existing installation" should take place is not clarified in the EU Directive. These questions ultimately lead one to ask whether free allocations based on a historic measure from the beginning of the century are to survive indefinitely as climate policy evolves, or should that measure be updated over time? [4]

This paper analyzes how treatment of closures and new entrants should be handled in a cap and trade system, with a particular focus on the efficiency of the trading scheme and the inevitable connection to changing of allocation rules between trading periods. We first explore how the allocation of allowances based on historic data raises issues about whether the compensation inherent in an allowance allocation is appropriate for existing installations and, if so, at what level. We also consider whether this compensation should continue indefinitely. Next, we look at the related issues of treatment of closures and new entrants and examine the efficiency implications of different policies. We also report how EU Member States have addressed closure and new entrants in their NAPs, and we examine the efficiency and fairness implications of different policies across Europe.

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2 "Installation" is the term most commonly used in official EU documents. The technical definition is given in the EU directive on Emission Trading, article 3 (e) (European Union 2004), but in the context of this paper, the term can be regarded equivalent to "facility" or "plant."

3 Put simply, "new entrant" is an installation that starts its operations after the NAP has been submitted to the EU Commission. The technical definition is give in the EU directive on Emission Trading, article 3 (h) (European Union 2004).

4 Here we make a distinction between issues associated with an updating base year and issues associated with the need to change allocations to reflect an increasingly stringent cap over time.

In the penultimate section we consider in which cases these decisions can be left up to Member States without placing efficiency goals at risk and in which cases the decision is better made in a uniform manner by the EU. In the final section we characterize a "ten-year rule," which offers a way out of the dilemma of historic allocation and creates a framework to reconcile efficiency and fairness as the EU goes forward with its emissions trading system.

In sum, we find that adjusting allocation upon closure of an installation will have a negative effect on efficiency. Yet the dominating policy in the EU Member States is to withdraw allocation or at least require transfer to another installation, in the event of closure. This, combined with the fact that firms are capital constrained, may justify free allocation to new entrants. However, there is a need to harmonize the rules on new entrants and closures. We propose that this should be done centrally in the EU.

The ten-year rule describes an approach to updating the metric upon which allocation decisions are based when using a purely historic approach. The rule would replace an indefinite linkage to a frozen base year or period with a linkage that is gradually modernized. With a sufficient time lag—ten years—from current decisions to the updated allocation, incentives for current behavior would be affected slightly or not at all.

The ten-year rule captures the lion's share of efficiency gains from a stable system of property rights. Yet it addresses the perception of fairness by providing a finite horizon for the potentially infinitely lived property rights that could be created under historic allocation and that have been created in previous systems. Finally, we also suggest that it may be even more desirable to have a second "ten-year rule," which would provide for a gradual transition to an auction over ten years.

2 The "Historic" Dilemma

The limitation placed on use of an auction and the preclusion on adjusting allocations during the trading period has effectively forced Member States to allocate allowances for free to incumbent installations based on a historic measure of performance (often called "grandfathering"). In preparation for the second compliance period, the question will be reopened somewhat.[5] It is unclear whether the allocation rules will continue to rely on the original historic performance criteria, or if the measures used for distribution could be updated based on performance during the first compliance period. However, the Commission has reportedly signaled its desire to continue to use base years for allocation that predate the first period of the EU ETS (Vis, 2005).

[5] In the second period the limitation on the portion of allowances that can be auctioned is raised to 10%.

As discussed later in the paper, a historic approach to the initial distribution of emission allowances has several disadvantages when compared with an auction approach (Cramton and Kerr, 2002). However, a historic approach also has two big advantages. First, free allocation may reduce resistance from industry to stringent targets. Experience with the U.S. SO_2 program shows that the allocation of allowances at no cost to affected installations, has been critical in gaining political acceptance for the emissions trading concept (Stavins, 1998; Ellerman, 2005). Second, an economic justification for free distribution based on historic measures is to provide compensation to incumbent installations that are affected by the regulation (inter alia Tietenberg, 2001; Harrison and Radov, 2002). However, numerous economic studies have found that free allocation of CO_2 allowances typically overcompensates firms (Bovenberg and Goulder, 2001; Boemare and Quiron, 2001; Burtraw et al. 2002; House of Commons, 2005).[6] With this in mind, the crucial question is: “How does the compensation that an installation actually receives from increases in revenue from the allocation of emission allowances coupled with changes in product prices compare to new costs?”

Under a CO_2 cap and trade program producers have two sources of potential new revenue. One source is the sale of emission allowances to other installations. This mechanism rewards low-emitting installations on average at the expense of higher-emitting installations, leaving all installations neutral in the aggregate. The second and more important source of new revenue is the increase in product prices that enables the pass-through of costs to consumers.

On the other hand, producers experience an increase in marginal cost in two ways. One is the increased resource cost that is incurred for compliance with the emissions cap.[7] In the aggregate we expect resource cost to be minimized with a cap and trade program. The second new cost is the regulatory cost embodied in using emission allowances.[8] Even if awarded initially for free, the allowances have value because they could be sold to other installations. Hence they have an “opportunity cost” like other production costs (labor, fuel, materials).

Whether allowances are given away for free or sold in an auction is not expected to affect marginal cost in a competitive market, since the value of an emission allowance in the market is not affected by how it is distributed initially. Hence, free distribution

[6] The same does not apply necessarily to other pollutants. The finding depends on pollutant, sector, and market structure (Burtraw and Palmer, 2003).

[7] Resource costs refer to the increase in usual costs of operation including fuel, labor, and capital resulting from compliance strategies such as fuel switching and efficiency improvements.

[8] Regulatory costs refer to the opportunity cost of emission allowances used in electricity generation, that is, the market value of those allowances.

does not affect the firm's revenues; but it does reduce total costs compared to purchase in an auction and thereby provides compensation to shareholders of the firm.

Compared to previous emission trading programs, the market for CO_2 is special because of the magnitude of the program and the size of the allowance market. For instance, under the U.S. sulfur dioxide (SO_2) program the annual asset value of the federally created "intangible property right" embodied in SO_2 emission allowances was comparable in magnitude to the annual cost of compliance. However, under a cap and trade program for CO_2 in the EU striving to achieve initially, say, 5% reduction in emissions from baseline, the annual asset value of CO_2 allowances is roughly 40 times the size of the resource cost of compliance.

The relationship between the value of the allowance pool and the resource cost of compliance is illustrated in Figure 1, which provides a stylized example of an aggregate linear marginal cost schedule for reducing CO_2 emissions. Across the horizontal axis is the percent of emission reduction to be achieved. The vertical axis is cost. This picture illustrates that the first unit of emission reduction is virtually free, the next unit costs a little more, and so on. At a 5% reduction in emissions the height of the marginal cost curve determines the value (*P*) of an emission allowance, because this represents the cost of achieving one more unit of reduction (or the savings from avoiding the last unit). The resource cost of reducing emissions up to a certain level is the sum of incremental costs, or as illustrated it is the triangle underneath the marginal cost schedule.

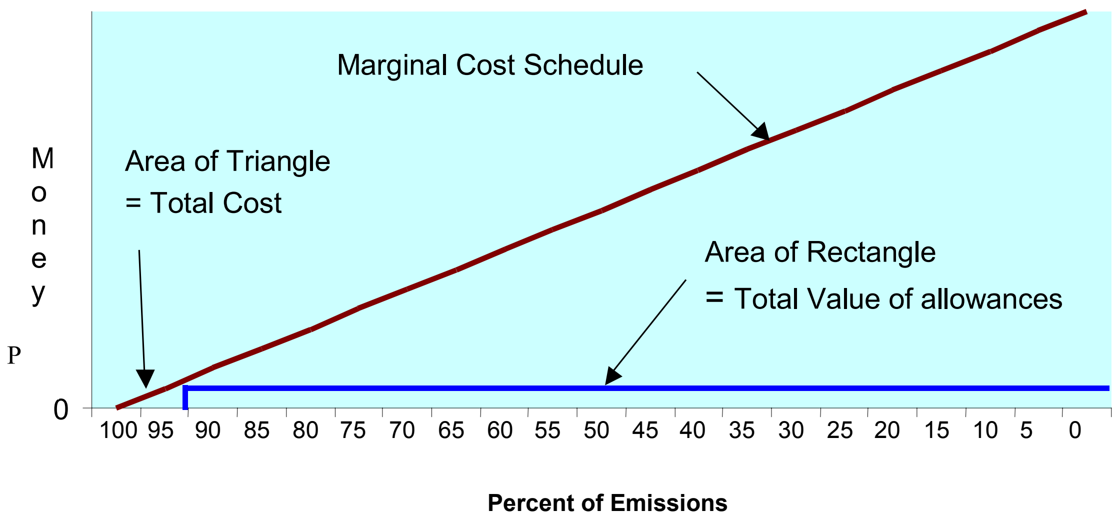

Figure 1. Illustration of relative value of allocated allowances vs. total compliance cost.

At a 5% reduction in emissions, the industry must still use emission allowances sufficient to cover 95% of its original emissions. The asset value of emission allowances therefore is the rectangle indicated by price (*P*) multiplied by the quantity of emission allowances. Simple geometry indicates that with linear marginal cost the area of the regulatory cost rectangle is 38 times the area of the resource cost triangle. Moreover, the magnitude of the allowance pool (regulatory cost) continues to increase relative to resource cost up to about 15% emission reduction.

Most installations would not realize an increase in revenues equal to the full value of their resource (compliance) and regulatory (allowance) costs because changes in marginal cost rather than changes in total cost determine product prices. However, when emission allowances are distributed for free, whatever increase in revenue they realize for the use of emission allowances is revenue that can be applied directly as compensation for resource costs. Under free distribution of CO_2 emission allowances, if the average installation is able to pass on to consumers only half of the value of allowances it uses then it would realize an increase in revenues that was dramatically greater than its increase in costs.

The relative magnitude of the compensation compared to costs is just one part of the issue. The full dilemma emerges in considering allocation over many years into the future. If distribution based on historic measures continues over a long time horizon, the present discounted value of the stream of emission allowances is likely to overwhelm the economic value of an emitting installation. The award of a long-lived stream of emission allowances constitutes a massive transfer of wealth associated with the designation of property rights on the order of magnitude of the 19th-century land giveaway to railroads in North America.

Once launched, the inertia created by historic allocation is difficult to reverse. For instance, in the new rule finalized in 2005 governing SO_2 emissions from power plants in the United States, known as the Clean Air Interstate Rule (CAIR), SO_2 emission allowances will continue to be awarded decades into the future according to a formula based on heat input at incumbent installations operating between 1985-1987.

In summary, the historic approach to the initial distribution of allowances is intended to compensate for sunk costs that lose economic value because of the regulation, but in the long run it is a historic dilemma. For investment decisions taken before current environmental regulation was announced, many would argue the authorities have a responsibility to attempt to provide compensation. However, even if one regards historic allocation as rightful compensation for sunk costs, the justification decreases as the undepreciated economic value of emitting installations decreases over time. The rate of depreciation varies by installation and typically ranges from 3% to 15% per year. A full analysis of the compensation criterion should consider the change in the asset value of affected installations, noting that the policy is likely to create winners and losers sometimes under the umbrella of a single firm.[9] One can argue that a phaseout of historic allocation commensurate with an increase in the age of the installation would be a reasonable approach to satisfying the compensation criterion. Such reasoning figures prominently in finding a resolution to the two other issues that attend a historic approach to distribution that we address below—closures and new entrants—and in the proposed ten-year rule.

3 Closures

The basic idea of a market-based policy instrument is to favor the most efficient firms and installations and to stimulate abatement options that are least expensive. An emission trading system forces installations to recognize the economic cost of emissions that is embodied in the value of emission allowances. Installations with relatively lower environmental performance will face relatively greater costs associated with the use of tradable emission allowances, and should give way to installations with higher environmental performance.

Providing the correct incentives for firm behavior is also the main argument to justify why the allocation is not changed if the installation reduces economic activity or even if it closes. If allocation is kept intact, the owner will consider the opportunity costs of continued operation—the marginal costs of operating, including the price of emission allowances—versus the relative opportunity cost of reducing emissions through efficiency investments when deciding whether to continue operation or not. If it is profitable for the operator to close an installation and sell the allowances to a more efficient plant, this will be the efficient solution and the intended effect of the trading scheme, everything else equal.

A different policy that conditions the allocation of emission allowances on the continued economic operation of an installation has different incentive properties that may lead to different results.[10] Instead of a one-time acquisition of tradable permits, the withdrawal of allocation based on an observed economic decision such as plant closure turns the allocation into a subsidy to production, because the firm earns the allocation *if and only if* it continues to operate the installation. In considering the marginal cost of operation, the firm will consider the allocation as a transfer that reduces the costs that it receives only if it continues to operate. Consequently the firm will not maximize its profits only with respect to the cost of production and market price of its products;

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[9] Burtraw, Palmer, and Kahn (2005); Burtraw, Palmer, Bharvirkar, and Paul (2002).

[10] Stavins (2005) finds similar perverse incentive properties in vintage differentiated conventional regulations, such as the U.S. New Source Review Program.

instead, it will also take into account the value of the allowances that it will lose should it cease to produce output.

The changed calculus for the firm has implications for the efficiency of the market. It will lead to an oversupply of output and reduced efficiency of the system. It will also lead to increased demand for allowances and consequently a higher price on allowances than what otherwise would have been the case.

Indeed, there is an apparent paradox. If the allocation is unaffected by the decision of the firm, then the allocation is efficient in that it does not alter cost-minimizing behavior. By imposing a condition on the allocation—continued operation of the installation—the allocation transforms into a production subsidy that affects the opportunity cost of the firm's production decisions.

The effect of the subsidy is illustrated with characteristic industry data in Table 1.[11] Consider a firm facing a choice to select one of two existing electricity-generating installations for continued operation, and the other installation is to be shut down. The choice between an existing pulverized coal installation and an existing natural gas combined cycle installation is illustrated in the first two data columns of Table 1.

Each technology is expected to yield 2.85 million MWh of electricity generation per year. The going forward operating cost of the pulverized coal installation includes short run variable costs and fixed operation and maintenance charges that total €28 per MWh. The plant produces 3.27 million tons of CO_2, which at an allowance price of €18 per ton produce a regulatory cost (allowance burden) of €20 per MWh. The going forward total cost is €48 per MWh. In contrast, the existing natural gas combined cycle plant has a going forward total cost of €42. This measure is the resource cost of electricity generation including emission reductions and it is equal to social cost[12].

[11] Table 1 presents generation-weighted estimates of technical and cost parameters aggregated over the population of installations in the United States. Estimates are the results of simulations using the Haiku electricity market model maintained by Resources for the Future, which has been used in a number of peer-reviewed studies and reports. Burtraw and Paul (2002) provide an introduction. All values are in 1999 dollars, converted to Euros at the rate of $1.23 = €1.00.

[12] Social cost is the total of all the costs associated with an economic activity. It includes both costs borne by the economic agent and also all costs borne by society at large. It includes the costs reflected in the organization's production function (private costs) and the costs external to the firm's private costs, for instance damages caused by emissions of CO_2. Thus the example is equal to social cost under the assumption that the allowance price is a correct reflection of marginal damages caused by the emission.

Table 1. Comparison of Technologies and Costs. Generation-weighted estimates of technical and cost parameters aggregated over the population of installations in the United States. Estimates are the results of simulations using the Haiku electricity market model maintained by Resources for the Future. Burtraw and Paul (2002) provide an introduction. All values are in 1999 dollars, converted to Euros at the rate of $1.23 = €1.00.

	units	**Existing Coal**	Existing NGCC	**New NGCC**	**New Wind**
Capacity	MW	500	500	500	1000
Utilization	*hours/year*	5,694	5,694	5,694	2,847
Generation	*MWh/year*	2,847,000	2,847,000	2,847,000	2,847,000
Going Forward Operating Cost	*€/MWh*	28	32	39	41
Emission rate	*tons/MWh*	1.15	0.54	0.42	0
Emissions	*tons/year*	3,274,050	1,537,380	1,195,740	0
Allowance Price	*€/ton*	18	18	18	18
Allowance Burden	*€/MWh*	20.5	9.64	7.50	0
Going Forward TOTAL Cost (Social Cost)	*€/MWh*	48	42	46	41
Allocation	*tons/year*	3,274,050	1,537,380	1,195,740	0
Value of Allocation	*€/year*	58,427,239	27,435,399	21,338,644	0
Levelized Allocation	*€/MWh*	20.5	9.64	7.50	0
Adjusted Going Forward TOTAL Cost (Private Cost)	*€/MWh*	28	32	39	41

Imagine, however, that the emission allocation to an installation is withdrawn if an installation discontinues operation. For illustration we assume the allocation is exactly equal to anticipated emissions. In this case the decision to close the pulverized coal installation implies the loss of allowances worth €58 million per year, or €20 per MWh when levelized over the operation of the plant. Accounting for the opportunity cost of losing the allocation the adjusted going forward total cost is €28 per MWh. This is the private cost of operation as perceived by the facility, and it differs from the social cost. In other words, the value of this allocation is like a subsidy, which manifests itself when the installation passes on allowance costs to customers in the form of higher electricity prices and is deducted from the overall operating costs to get the new going forward cost. However, the value of allocation to the natural gas plant is only €10 per MWh. From the perspective of the firm, continued operation of the coal installation at €28 per MWh is the least cost option compared to the cost of the gas installation at €32, although the coal installation is not the least cost from a social perspective. The conclusion is that withdrawal of the emission allocation to existing installations alters their relative going forward costs and can affect retirement decisions.[13]

Table 1 also presents two new investment options. One is a new natural gas combined cycle plant with going forward total cost of €46 per MWh, and a wind installation with cost of €41 per MWh. Each of these technologies has a going forward total cost that is lower than the cost of continued operation of the existing pulverized coal plant. However, if allocation to existing installations is removed upon closure, then the adjusted going forward total cost of the pulverized coal plant falls below the cost of the new, more efficient technologies. Withdrawal of the emission allocation affects not just the relative comparison of existing installations, but it also affects the comparison with new installations. Hence many observers (inter alia Betz et al, 2004; Harrison and Radov, 2002; Tietenberg, 2001) have argued that in the interest of economic efficiency allocations should not be adjusted if an installation is closed.

In addition to the efficiency argument, a second argument for keeping allocation if an installation is closed concerns the concept and certainty of property rights. The underlying idea of a trading scheme is that the least cost abatement options will be achieved through trading of emission allowances owned by the agents of the market. However, if the certainty of ownership of the allowances is reduced, the credibility of the nascent trading scheme may come into question.

Nonetheless, there are arguments for withdrawing allocation to installations that no longer operate. Allocating a stream of allowances in perpetuity based on a historic measure may defy intuition about fairness and common sense. Permanent allocation is a difficult argument to make in the face of a question such as: "Why give allowances to somebody who doesn't need them?" This is an especially potent argument if it appears an installation would have shut down "anyway" in the absence of the program, and the allowances are thereby deemed "anyway credits." At the international level, similar criticisms have plagued the so-called "hot air credits" referring to emission budgets under the Kyoto Protocol for economies that have contracted since 1990.

Furthermore, if allocation is removed, authorities have the control of those allowances and can either withhold them or allocate them to other installations. Should allocation not be removed but remain unchanged indefinitely, it is possible that at some point all allowances are allocated to non-operating installations. This is not necessarily detrimental to the efficiency of the trading scheme, but it means the possibilities for

[13] An important assumption in this example is that the firm is able to pass through in electricity price 100% of its change in marginal cost. If the pass-through is less this then the value of the allocation subsidy to the firm is less than illustrated.

authorities to use allocation in order to drive changes in behavior, to compensate for losses, or to give rewards to desirable behavior are lost.

3.1 Treatment of Closures in the EU ETS[14]

Three options are applied in the EU ETS. By far the most common is that allocation is lost if an installation is closed. However, in a number of Member States the owner of a closed installation may transfer the allowances to a new installation instead of losing them altogether.
A third option is to leave the allocation unaffected, but this has only limited application.

In **Germany** an installation that is closed will receive no allowances the following year. Further issuance of allowances is labeled "a closure bonus" that must be avoided. Moreover, the German NAP also states that allocation to non-operating plants would "unnecessarily restrict the quantity of allowances available for use by other installations." Closure is defined as when an installation emits less than 10% of its average annual baseline emissions. Further, if an installation emits less than 60 % of its average annual emissions the quantity of allowances will be reduced by the same proportion as the reduction in utilization of capacity compared to the reference period. Thus an installation has an incentive to keep operating *and* to emit a certain volume of CO_2 compared to the reference period. If applied strictly, this punishes both adjustments in production and mitigation measures such as switching from coal to biomass.

In **Germany**, any allowances recalled or not issued will be placed in the new entrant reserve. If the operator of the decommissioned installation commissions a new installation in Germany within three months, producing comparable products, the allocated annual allowances of the old installation can be transferred to the new installation. The three-month deadline may be extended up to two years under special circumstances. Similar transfer rules exist in **Italy**, **Austria**, and **Poland**.

In contrast, in **Finland** and **Spain** the transfer of allowances is not allowed. If an installation is closed, it will lose is greenhouse gas emissions permit and consequently lose subsequent allocations.

Sweden and the **Netherlands** are the only Member States that apply the policy of letting operators keep the allocation in the case of closure. However, emission allowances are only allocated for one trading period at a time (Germany has introduced

[14] All National Allocation Plans, as well as EU Commission decisions on them can be found and downloaded from the official European Union website, http://europa.eu.int/comm/environment/climat/emission_plans.htm.

an exception to this, see below). That is, the operator of a closed installation may find himself without any allocation in the next trading period, should the regulators decide to update the allocation scheme in this way. Hence, in reality the difference between the policies of Sweden and the Netherlands and other Member States' may be small.

Finally, the above examples of how closures are treated in the EU ETS illustrate the point that "closure" is just an extreme form of output variation. Thus the distinction is vague between what is considered ex post adjustment or updating and thereby disallowed, and what is considered a legitimate withdrawal of allocation to closed installations under EU regulation.

3.2 Summary: Treatment of Closures

There is a strong case to be made against withdrawing allocations after closures of installations. Such a policy creates an inefficient subsidy for the continued operation of existing installations. It also may represent a burdensome intervention of government authorities into the market by unnecessarily changing the property rights associated with an allocation. At the same time, the understandable desire to treat participants in a trading scheme in a fair manner and to avoid awarding a perpetual property right to closed installations may argue for some limits to the indefinite allocation of allowances to closed installations. These fairness concerns seem to have dominated in most of the National Allocation Plans that we have analyzed, as most Member States have decided to withhold or require transfers of allowances from closed installations. In the next section, we will examine how the efficiency and fairness issues associated with closures interact with a related issue: the treatment of new entrants.

4 New Entrants

Many observers claim that the denial of free allowances to new sources discriminates against new sources. This is clearly true in the transfer of wealth, but is it relevant to economic behavior?

Under competitive conditions a one-time allocation to existing sources, even an allocation of an annual stream of allowances into the future, should not affect the variable costs or going forward cost of an installation. As long as the allocation is not affected by the decision to continue operation, there is symmetry in consideration of going forward costs between existing and new sources. This symmetry preserves the desirable efficiency properties of a market-based emission trading system. Hence, if the allocation to existing sources is not affected by the decision about whether or not to continue operation, one might conclude an allocation to new sources conditional on economic activity (entry) affects the going forward cost of that installation and undermines economic efficiency and fairness.

Table 1 provides an illustration of how the allocation to new entrants can affect investment decisions. If the existing coal plant receives its allocation whether or not it continues to operate (a point we revisit in a moment) then its going forward total cost is €48 per MWh. Similarly, the existing natural gas plant has a going forward total cost of €42 per MWh. We assume the cost of a new natural gas combined cycle plant is €46 per MWh, and the cost of a wind plant is the least cost option at €41 per MWh. We will assume the allocation to new entrants is based on expected future emissions expressed as fuel specific benchmarks. The natural gas plant would receive an allocation worth €7 per MWh. The wind plant receives no allocation since its expected emissions are zero. In this case, the new natural gas plant has an adjusted going forward total cost of €39 per MWh, which is less than the existing coal or existing natural gas installation. However, note that the cost of the gas plant is also less than the new wind plant. From the perspective of the firm, the natural gas plant is the least cost option, although the wind plant is the least cost option from a social perspective. The example illustrates how the allocation to new entrants benchmarked to fuel-specific performance characteristic alters the firm's investment decision.

There are three significant caveats to this example. One is simply to recognize that if new sources were not to receive an allocation then eventually the industry would be populated by two classes of installations, some of which receiving an indefinite valuable wealth transfer and some not. This may not be sustainable in the long run, and at some point adjustments would need to be made.

Second, as noted in section 3, most Member States in fact do adjust the allocation to existing installations that decide not to operate, so the symmetry between existing and new sources is already lost. As we have noted, the policies on closures and new entrants interact, enhancing the effects of the individual policies. Hence, the decision to withdraw emission allowances from an installation that closes alters the economic equation, placing incrementally more advantage to keeping the installation in operation. Section 3 illustrated that if new installations do not receive an allocation, then they are indeed at an economic disadvantage in the context of marginal retirement and investment decisions.

Given that most Member States do adjust the allocation to existing installations, we can ask: "Is an efficient set of incentives preserved if the allocation is removed from existing sources that close and allowances are simultaneously awarded to new installations?" If so, then there would be two efficient policy equilibria—one with no adjustments in the case of closures and new entrants, another with adjustments—and the

EU would be faced with the relatively simple problem of coordinating the choice of equilibrium.

We saw previously that an allocation to new sources that was benchmarked on a fuel-specific basis would change the investment choice among new technologies. If all new technologies receive the same allocation it would preserve the ranking among new technologies, but the level at which the benchmarked allocation is set would determine the relative competitiveness of existing and new technologies. Drawing on the example in Table 1, let us assume that wind receives an allocation per MWh that has equivalent value to that for a new natural gas plant. The new natural gas installation would have an adjusted going forward total cost of €39 per MWh, and wind would have a cost of €41–€7 = €34 per MWh. Wind would remain the least cost option among new technologies, preserving an efficient decision when considering the new investment options. However, the existing coal plant remains the least cost option facing the firm overall, at €28 per MWh.

This example shows that the relative ranking between new and existing installations is unaffected only if the value of withdrawals from installations that close and awards to new installations are equivalent. There needs to be a strong condition requiring that the adjustments for retirement and investment decisions have the same value per MWh of production in order not to undermine the efficiency of the ETS. Nonetheless it appears that an allocation to new sources remedies to a partial extent the imbalance between new and existing sources, although we see also that it can impose an imbalance among the new installations. One possible approach to solve the symmetry problem between new and existing installations would be to withdraw and award allocation based on common, fuel-neutral, benchmarks.

Another possible approach that preserves symmetry as well as the interest of a Member State is to take away emission allowances unless the allowances are reallocated to a new installation operating within the same country. This approach leaves the allocation unaffected, as long as the owner executes a transfer upon closure of the original installation. As discussed above this approach is applied, albeit in very different versions, under the “Transfer rule” in many Member States.

This option could also be adjusted to condition allocation to the sale of “leftover allowances” to another installation in the same country. If there is a limited number of potential buyers, this approach may lead to a source of emission allowances for a new installation within the country that is somewhat below market rates. Most importantly, however, this approach raises difficult monitoring and administrative issues. For instance, is the purchaser of the allowances required to use them at specified installations? Intervention in market decisions at this level of detail would threaten to undermine the operation and raise cost of the ETS.

A third caveat to the advice that economic efficiency is preserved if there are no adjustments to allocations for retirement and new investment. The reasoning heretofore assumes a simple interpretation of "competitive conditions" that may be too aggressive because a variety of factor markets, especially the capital market, have characteristics that complicate the analysis.

Capital markets discriminate in the price they charge firms for acquiring new capital in response to observable accounting measures such as debt, liquidity, and cash flow and also due to uncertainties such as exposure to price volatility in factor inputs, including emission allowances. Hence, even a one-time allocation may have an indirect impact on the cost of an investment because the award of emission allowances may function as a subsidy of capital. Instead of having to go to the bank to borrow money to buy allowances, the investor has allowances available and a lower requirement to obtain capital. Since firms are capital constrained and their cost of capital varies with the accounting of revenues and costs on their balance sheet, the free allowances may lower the firm's cost of capital and convey economic advantage to owners of incumbent installations relative to owners of new investment. Hence, even if allocation does not affect short-run variable cost it may in fact have an effect on going forward costs and investment. Put simply, money in the bank is a competitive advantage.

4.3 Treatment of New Entrants in the EU ETS[15]

Treatment of new entrants is one of the areas where policies among the member states differ the most. Following is a discussion of some of the key differences for allocating to new entrants.

The EU Commission only asks Member States to describe how new entrants can gain access to emission allowances. There are no rules on whether or not new entrants should be allocated free allowances. Still, **all** member states guarantee a certain volume of allowances will be available to new entrants at no cost, by creating a set-aside of allowances reserved specifically for new entrants. Allowances from these reserves are usually provided on a first-come, first-served basis.[16]

The most common allocation methodology is to base allocation on general emission rates, specified for a sector or a product type, and forecasted activity. However,

[15] All National Allocation Plans, as well as EU Commission decisions on them can be found and at the official European Union website, http://europa.eu.int/comm/environment/climat/emission_plans.htm.

[16] A limited number of Member States (e.g., **Poland** and **Italy**) also plan to purchase allowances from the market for new entrants if their new entrant reserves are oversubscribed.

benchmarks differ significantly across Member States, even for identical products such as heat or power.

When sectorwide benchmarks cannot be defined, Member States often refer to Best Available Technology (BAT) as the benchmark to be used. The emission factors can be specific to an installation, or common for an entire sector. The latter is mainly used in the energy sectors, but for instance **Italy** also applies sectorwide benchmarks in the mineral and ceramic industries.

The definition of BAT also varies across Member States. Some Member States refer to existing official EU studies (for instance the BAT reference documents or Joint Research Center, 2005). Others refer to national legislation or to the IPPC directive (European Union, 1996), which allow BAT to be defined on a case-by-case basis. In **Sweden**, for example, BAT is to be defined "in accordance to environmental law," on a case-by-case basis. For energy installations, only combined heat and power plants (CHP) are eligible for allocation from the new entrant reserve. A benchmark based on a fuel mix containing significant shares of renewables is used together with forecasts of generation in order to calculate the allocation. In contrast, **Poland** does not specify how BAT will be established.

Once benchmarks are selected, they are multiplied by a level of activity (e.g., output) to arrive at an allocation for sources. The most common method for estimating activity levels for new entrants is to use a forecast of future production. There are significant differences among Member States in how the forecasts are estimated and production calculated. In some cases (e.g., **Sweden, Poland**) allocation is based on production forecasts specific to the new installation. In other Member States (e.g., **Denmark, Finland, Austria**, and **Italy**) allocation is based on the size of the new installation, expressed as installed capacity, and general assumptions on utilization rates for specific technologies. However, even among these general methods, there are differences. For example, **Finland** and **Denmark**, whose energy systems to a large extent are integrated, use different utilization rates when calculating the allocation to new entrants.

This construction creates a range of potential problems. Basing allocation on forecasts provides an incentive for firms to exaggerate forecasts of future production. Since ex post adjustments are not allowed in the EU ETS, the only possibility for regulators to police incorrect forecasts is to update the allocation between trading periods. However, as will be discussed later in the paper, this has the potential to distort operational decisions made by firms.

Finally, there is at least one example of a Member State that explicitly guarantees an allocation to new entrants for a significant number of years. Germany guarantees free allowances to a new entrant for up to 14 years if it is a completely new installation. If the new installation is replacing an old installation and allowances are transferred from the old installation, allocation may be guaranteed for up to 18 years. It is not clear if this guarantee of property rights is compatible with the revision of the EU directive on the ETS that will take place in 2006 and most probably again in 2012, where significant changes in allocation methodology at the EU level might be mandated.

4.4 Summary: Treatment of New Entrants

Under perfect conditions, investment decisions should not be affected by whether free allocation is given to new entrants or not. However, as discussed above, there may be additional inequities (e.g., in the cost of capital) that arise by allocating to existing sources and not new sources. Furthermore, since Member States adjust allocation to closures, incumbent emitters are currently subsidized over new entrants. Moreover, at this early stage in the EU ETS, it may be difficult to convince Member States that there is adequate liquidity in the system to prevent barriers to entry for new firms. Given that all 25 Member States have set up provisions to give allowances to new sources, allocation to new entrants is clearly a political priority. Thus, we propose allowing (but not requiring) new entrant reserves, but enforcing a standardized approach to allocation from these reserves. Standardized requirements on closures and new entrants would eliminate competitive distortions between Member States and help achieve more efficient investment and retirement decisions within Member States.

5 The Need for Harmonization among Member States

The preceding discussion has examined the issues associated with closures and new entrants within a single domestic system. However, as discussed, Member States currently have the autonomy to set their policies on new entrants and closures as they see fit. In fact, there has been considerable variation among these policies.

Decisions about allocations, in particular those on closures and new entrants, involve considerations about national competitiveness. The government of a Member State may be faced with incentives that lead to a decision that is not the efficient solution for the trading program as a whole. The possibility that Member States could obtain a better outcome by individual action that undermines the outcome for the broader ETS constitutes the well-known “prisoner’s dilemma.”

For instance, under the current system where each Member State may decide on the rules for closures, the efficient solution for the EU collectively may not be the most rational option from an individual Member State’s perspective. Since each Member

State wishes to keep the tax base and the job opportunities that installations provide, it does not want to provide less incentive to keep an installation in operation in its own country than those that exist in other Member States. Thus it may seem rational from a Member State point of view to take allowances away from installations that close, or at least condition a retained allocation on a transfer to a new installation in the country, in order to create incentives for continued operation in one's own country. Similarly, in the interest of attracting new investments that hopefully will result in a larger tax base and increasing job opportunities for its own citizens, it is rational from a Member State perspective to be generous to new entrants, regardless of the effect on the system as a whole.

For a politician it is hard to introduce policies that would be more favorable to the closure of installations in one's own country and make new investments less attractive than in neighboring Member States. Yet this is what is currently asked of the regulators in the EU Member States.

Consider the case of the energy sector regulations in two neighboring Member States connected by electricity transmission lines, for instance Denmark and Germany or Sweden and Finland. All these Member States apply benchmarking as a base for allocation to new entrants, but the emission factors used for the allocation differ significantly. This means allocation to a new entrant will be more favorable in one Member State than another, leading to new investments to occur in that Member State.

Similarly, imagine two Member States that both withdraw allowances upon closure, but the formula imposes a greater penalty in one country than another. In this case the adjusted going forward total cost will be less in the country with the greater penalty. If a firm were otherwise indifferent between closure of installations in these two countries, it would choose to keep open the installation in the country with the greater closure penalty. The setting creates a contest between Member States to provide favorable incentives to retain and attract investment. The ultimate outcome may be economically inefficient and politically undesirable.

Table 1 provides examples that give these scenarios meaning. For instance, imagine the proposed new wind installation, which has the lowest social cost, would be built in a Member State that does not offer allowances to entrants but the proposed new natural gas installation would be built in a Member State that does award allowances to entrants. The firm would choose the latter place for new investment. Indeed, the other Member State might have an incentive to initiate allocations to new entrants benchmarked to the level for a new natural gas installation.

The above discussion raises a broader issue about when there should be EU-wide mandatory policies for harmonization of design elements in the EU ETS.[17] Although a full discussion of this issue is beyond the scope of this paper, we suggest the following general rule. If a Member State decision affects the overall efficiency of the EU ETS, then a directive is useful because the paramount role for the Commission is to encourage efficiency in the trading system. This is a function that cannot be achieved without an EU-wide perspective.

In other cases it may be that one design approach is as effective as another, and the issue is simply one of coordination. In this case, the most efficient outcome is achieved when the Commission ensures that all Member States use the same approach, whatever it is. For example, the design of registries is one such issue. Finally, when there is no efficiency issue, then whenever possible discretion should be preserved for the Member States.

Applying this guidance, our conclusion is that the best solution would be to regulate the treatment of closures at the EU level. Thus, Member States should be required to let installations keep their allocation even in the event of closure. We believe that this is clearly an efficiency issue that justifies consistent treatment across Europe. The case for allocating to new entrants is somewhat less convincing. If existing installations are no longer penalized for shutting down, this removes the subsidy for continued operation of these sources, which negates the best justification for providing allowances to new sources.

6 Advice on Closures and New Entrants

For three reasons we do not offer advice to prohibit entirely the adjustments for closures and new entrants. One is that it is plain to see that Member States and affected constituencies are strongly interested in making such adjustments. There must exist political and policy considerations guiding this decision. Second, we identify some compelling reasons for adjustments. Fundamentally, it may be that competitive conditions do not apply in capital markets. Third and, perhaps more importantly, at stake is the assignment of assets of significant value and a fairness perspective critical of indefinite allocations holds great influence. Again, however, we suggest that if adjustments are made, an effort should be made to treat technologies in a symmetric way.

[17] Kruger and Pizer (2004) address the broader issue of whether the EU ETS strikes the right balance between harmonization and flexibility of design elements.

We find that policies on closures and new entrants interact and have a bearing on retirement and investment decisions. The relative competitiveness of existing can only be preserved if the value of the withdrawal of the allocation is the same for all installations. Balance between existing installations and new entrants can be restored if new entrants receive an allocation, with a value equivalent to that of the withdrawal. However, given the contrasting motivations for making adjustments, a rule constraining adjustments in this way appears unrealistic. Hence, we conclude that any adjustment to allocations for closures and new entrants has an efficiency cost.

As demonstrated, the issues connected to treatment of closures and new entrants are all part of the larger problem of how an allocation may be updated without reducing efficiency of the trading scheme. In the following section, we propose a framework that would integrate our recommendations on closures and new entrants with an overall policy on how allocations might change over time.

7 A Framework for Looking Forward

The preceding discussion on closures and new entrants highlights a fundamental tension inherent in the free allocation of allowances. On one hand, there is the desire to avoid allocation methodologies that provide incentives or disincentives to business decisions. On the other
hand, there is a need for equitable treatment of new and old sources. Although the trade-off is perhaps most explicit in the closure/new entrants issue, it also arises more generally in the question of whether allocations are indefinite property rights or whether they should change over some time period.

In general, the economics literature finds that changing or updating allowance allocations over time may have a distorting effect on company decisions. For example Burtraw (2001) and Fisher (2001) found that updating output-based allocation methodologies serves as an economically inefficient subsidy for production that lowers product prices for consumers. Similarly, in an analysis of a potential emissions trading program in Alberta, Canada, Haites (2003) found that an output-based updating allocation provides an incentive for production.

In the EU context, the European Commission has determined that updating of allocations is not allowed within each phase of the EU ETS. For example, the commission prohibited the use of ex post adjustment clauses in the national allocation plans of **Germany**, **Austria**, **Luxembourg**, **Portugal**, and **Belgium** (EC, 2004a, 2004b). The Commission noted that these provisions, which would allow authorities to confiscate allowances from companies if emissions were lower than predicted, “would create uncertainty for operators and be detrimental to investment decisions and the market" (EC, 2004b).

The commission has noted that the base period for allocation in the second phase of the EU ETS should be no later than 2005 (Vis 2005). This view signals the Commission's desire to avoid providing incentives that distort economic behavior to affect future allocations. Nevertheless, it is not clear whether the initial base year must be kept forever and whether sources should continue to receive allowances in perpetuity based on that base year, as has been the case with the SO_2 trading system in the United States. With a structure that requires new allocations for each new five-year phase, some sort of change in allocations is inevitable in the EU system.

U.S. policymakers have also struggled with these issues as they have developed proposals for further reductions in the SO_2 and NO_x caps. For example, the model rule for the NO_x SIP call, a program that requires regional summertime reductions in NO_x in the eastern half of the United States, presented a sample allocation methodology that updates allocations based on a rolling base period from four years before the year that allowances are allocated.

7.1 The Ten-Year Rule

A delayed updating approach, similar to that proposed in the NO_x SIP call example described above, would be a way to minimize distortions in firm behavior caused by updating. It also would avoid allocating allowances to existing sources in perpetuity. However, unlike the SIP call methodology, we propose a ten-year rule whereby installations would receive allocation based on activities dating ten years back.

Imagine a Member State that has chosen an emission-based allocation with the average of three reference years from 2000-2002. Until 2011, existing installations would receive allocations based on the average of 2000-2002, but in 2012 the allocation would be based on the average of 2001-2003, and so forth. If an installation reduced production or closed it would continue to receive allowances for ten years.

New entrants would first be allocated based on projected output, but after ten years the allocation would be updated. For instance, an installation starting in operation in 2005 would receive allocation based on forecasts until 2014. From 2015 onwards allocation would be based on actual activity ten years previous. Figure 2 illustrates the concept of the ten-year rule schematically.

The ten-year rule introduces updating, which has the disadvantage that it provides an inefficient price signals. However, the ten-year lag weakens significantly the tendency of updating to produce perverse incentives for actors on the market.

The net present value in year *b* of an allowance with price (*P)* in year *n* is given by the simple formula $NPV_b = \left(\frac{1}{1+r}\right)^{(n-b)} * P_n$, where *r* is the real rate of financial discounting. If the allocation decision in year *n* is based on behavior in year *b*, and if the discount rate is 10%, if the ten-year rule were in effect the lag would reduce the incentives provided by updating by 60%. This would diminish significantly the impact of updating on the behavior of firms.

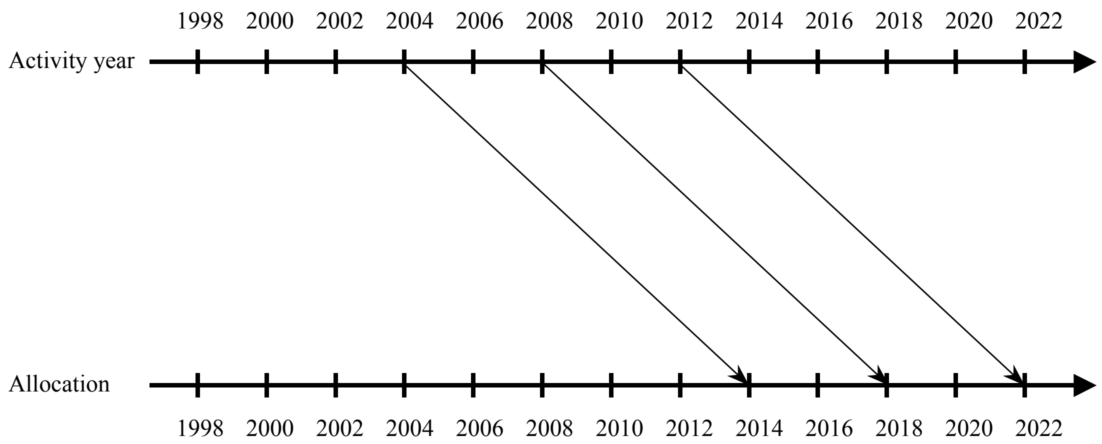

Figure 2. Schematic illustration of the ten-year rule. Allocation is based on activities with a ten-year time lag. Averaging over several years, or whether allocation is based on emissions, output or input will not alter the concept or change the functioning of the rule.

The ten-year rule would provide an automatic remedy to the conundrum of how to treat existing sources that reduce economic activity or close. Sources would continue to receive an annual allocation until they reached a point where they no longer had economic activity in an updated base period. In other words, if existing installation is shut down, it would continue to receive allowances for ten years, thereby diminishing any perverse incentives to continue operation. However, eventually the group of installations receiving allowances would slowly shift, as sources that shutdown would eventually stop receiving allowances.

Under the ten-year rule the treatment of new sources would have parallel incentives. Initially, new sources would receive allowances from a reserve according to emission rate benchmarks that might be standardized across industry sectors in Europe. Preferably, allocations for these installations would be based on installed capacity and standard utilization rates to avoid gaming and inconsistencies associated with case-by-case projections of expected utilization. New installations would continue to receive an allocation on this basis for ten years before allocations would begin to update based on a rolling base period similar that that of existing sources.

7.2 Free Allowances Forever?

The ten-year rule is designed to address the trade-offs between updating and permanent allocations. However, there is a separate set of issues raised about whether sources should receive all of their allowances for free for their entire operational life and beyond. Since the existing fleet of CO_2 emitting installations is likely to be long-lived, the most significant characteristic of the ten-year rule is how it treats currently existing sources.

There is considerable discussion in the economics literature about the advantages of auctions instead of free allocations of allowances. For example, Cramton and Kerr (2002) describe a number of equity benefits from the auctioning of allowances, including providing a source of revenue that could potentially address inequities brought about by a carbon policy, creation of an equal opportunity for new entrants in the allowance market, and avoiding the potential for "windfall profits" that might accrue to emissions sources if allowances are allocated at no charge. In general equilibrium analysis Goulder et al. (1999) and Dinan and Rogers (2002) find that recycling revenues from auctioned allowances would have dramatic economywide efficiency benefits if they were used to reduce preexisting taxes on labor or capital. In partial equilibrium analysis Burtraw et al. (2001) find benefits of comparable magnitude within the U.S. electricity sector that stem from the reduction in the difference between price and marginal cost were an auction used to distribute emission allowances. In the European setting, Böhringer and Lange (2004) argue that a transition to an auction is the only way to achieve efficiency in the apportionment of emission reductions among nations and between the trading system and outside the system.

The ten-year rule is an important step toward efficiency but an auction of allowances is the only approach that would address all of the concerns regarding general or partial equilibrium analyses. The gradual removal of a historic approach under the ten-year rule is consistent with the idea that allocations to incumbent installations should not be free and permanent, and hence the rule provides the foundation for another transition away from free allocation of emission allowances.

Thus, in addition to the ten-year updating rule outlined above, there would be a useful role for a comparable rule for transitioning sources away from a 100% free allocation. For example, after ten years of free allocations, there might begin a transition period with a steadily increasing auction of allowances. Similar approaches have been featured in recent allowance allocation proposals in the United States. For example, the original version of the Bush Administration's "Clear Skies" proposal for regulation of SO_2 and

NO_x would have begun with free allocation and would have gradually increased the proportion of allowances auctioned over the course of 50 years until all allowances were auctioned. A recent proposal by the U.S. National Commission on Energy Policy for an economywide greenhouse gas trading program would begin with the auction of 5% of allowances for three years, and would then phase in an increase to 10% over the following ten years. A faster transition may be justified, but that is the subject of separate analysis.

8 Conclusions

The European Commission has discouraged Member States from adopting allocation methodologies that would provide incentives to firms affecting their compliance behavior. In general, these incentives have effects that move behavior away from economic efficiency and thereby raise the cost of the emission-trading program.

In this paper we demonstrate that the negative effects of adjusting allocation become apparent when analyzing the treatment of new entrants and closures in the EU ETS. There is a strong case to be made against withdrawing allocations after closures of installations. Withdrawal of allowances will serve as a subsidy of production, resulting in negative effects on efficiency and higher allowance prices.

However, we also observe that a purely historic approach to the initial distribution of allowances presents a political dilemma. There is an understandable desire to treat participants in a trading scheme in a manner that is perceived as fair. There are also reasons to avoid awarding a perpetual property right to closed installations. This argues for some limits to the indefinite allocation of allowances to closed installations. These concerns seem to have been dominant in the decisionmaking in most of the National Allocation Plans that we have analyzed, as most Member States have decided to withhold or require transfers of allowances from closed installations.

Similar considerations emerge in the consideration of new entrants. A strong argument can be made that in order to preserve economic efficiency new entrants should not receive an allocation because to do so lowers the going forward cost of new entrants and gives them an advantage relative to the going forward cost of incumbents.

However, there are several reasons to award an allocation to new installations. If new installations do not receive an allocation then ultimately the economy will find itself populated with two classes of facilities, those original incumbents receiving an allocation and the entrants who do not. Moreover, since firms are often constrained by capital, and capital markets will anticipate a risk associated with the acquisition of allowances, there may be reason to provide a capital subsidy in order to promote new investment.

Policies on closures and new entrants interact and have a bearing on retirement and investment decisions. The decision to withdraw emission allowances from an installation that closes incrementally adds to the advantage to keeping the installation in operation. Since Member States adjust allocation to closures, incumbent emitters are currently subsidized over new entrants. We conclude that free allocation to new entrants may be justified to some extent, but the regulation currently in place in the EU will have unnecessarily large detrimental effects on efficiency.

In order to obtain a level playing field there is a need for symmetry in the regulation on closures and new entrants. The transfer rules for closures, used in many Member States, can be seen as an attempt to achieve symmetry between existing and new installations, although the policies fall short of avoiding negative effects on efficiency. A potentially better option to achieve symmetry would be to use fuel-neutral benchmarking, e.g. allocating—and withdrawing in the event of closure—a set number of allowances per unit output, regardless of technology.

The suboptimal policies currently used for closures and new entrants emanate from the fact that the interests of the individual Member States are not perfectly aligned with those of the EU as a whole. We find that central regulation of treatment of closures and new entrants seems necessary in the EU.

We propose a ten-year rule to guide a transition from the current set of existing policies to a level playing field for new entrants and closures. The rule would replace an indefinite linkage to a frozen base year or period with a linkage that steadily modernized, but which preserved a sufficient time lag from current decisions (ten years) that incentives affecting current behavior would be affected slightly or not at all.

The ten-year rule captures the lion's share of efficiency gains from a stable system of property rights. Yet it also addresses the perception of fairness by providing a finite horizon for the potentially infinitely lived property rights that could be created under historic allocation and that have been created in previous systems. Moreover, we find that grandfathering (historic allocation) typically overcompensates installations for sunk costs. Further, the justification for compensation decreases as the undepreciated economic value of emitting installations decreases over time. Following the compensation rationale, allocation should thus decrease over time, which creates a need for transitioning away from grandfathering and to updating of the allocation.

The overlapping rules governing allocation to different types of sources has the unfortunate property that it creates incentives that affect economic behavior. For this and a variety of other reasons, an auction approach has appeal. We close with the suggestion that it may be even more desirable to have a second "ten-year rule," which would provide for a gradual transition to an auction over ten years.

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