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The EU's Emissions Trading Scheme: A Prototype Global System?

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A Prototype Global System?

Denny Ellerman*

Abstract

The European Union's Emission Trading Scheme (EU ETS) is the world's first multinational cap-and-trade system for greenhouse gases. As an agreement between sovereign nations with diverse historical, institutional, and economic circumstances, it can be seen as a prototype for an eventual global climate regime. Interestingly, the problems that are often seen as dooming a global trading system — international financial flows and institutional readiness — haven't appeared in the EU ETS, at least not yet. The more serious problems that emerge from the brief experience of the EU ETS are those of (1) developing a central coordinating organization, (2) devising side benefits to encourage participation, and (3) dealing with the interrelated issues of harmonization, differentiation, and stringency. The pre-existing organizational structure and membership benefits of the European Union provided convenient and almost accidental solutions to the need for a central institution and side benefits, but these solutions will not work on a global scale and there are no obvious substitutes. Furthermore, the EU ETS is only beginning to test the practicality of harmonizing allocations within the trading system, differentiating responsibilities among participants, and increasing the stringency of emissions caps. The trial period of the EU ETS punted on these problems, as was appropriate for a trial period, but they are now being addressed seriously. From a global perspective, the answers that are being worked out in Europe will say a great deal about what will be feasible on a broader, global scale.

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1. INTRODUCTION

The European Union's Emissions Trading Scheme (EU ETS) can claim to be first in many respects. It is the first cap-and-trade system for greenhouse gases (GHG) and it is by far the largest emissions trading market yet created. These attributes alone make the EU ETS worthy of

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study, but it is another first that provides the motivation for this paper: The EU ETS is the world's first multinational cap-and-trade system. As such, it can be seen as a prototype of the multi-national GHG emissions trading system that is advanced as a possible architecture for an eventual global climate regime (Aldy and Stavins, 2008). While the EU ETS is in only its fourth year of existence, the experience to date provides a preview of the issues that are likely to appear in a global system, some useful precedents, and evidence that some problems may not be so difficult after all.

1.1 Two Important Similarities

Two features make the EU ETS appropriate for study as global prototype: the weak federal structure of the European Union and the significant disparities in economic circumstance, institutional development, and political will among the Member States. The European Union is not a strong federal union like the United States of America. The constituent Member States are independent nations that display and exercise the principal attributes of sovereignty. While some authority in some domains has been ceded to central European institutions, the basic decision-making entity in the EU remains the Council of Ministers, which consists of the relevant ministers of the Member States with carefully negotiated voting rights. The ETS Directive (European Council, 2003), which provides the legal basis for the EU ETS, can be seen, like all EU directives, as a specialized multi-national agreement within the broader framework of the Treaties that have established the European Union. Although surely different in many particulars, a global trading regime will exhibit a similar high degree of decentralization.

Just as the European Union can mistakenly be seen as a stronger federal structure than what political realities allow, so can the common adjective, European, mask a significant degree of diversity. The demarcation between East and West in Europe is not as marked as that between North and South globally, but there are instructive similarities. The difference in per capita income between the richest and poorest nations in the EU spans a significant part of the difference that would exist among the major emitting countries of the world. The per capita income of Romania and Bulgaria is only a third higher than that of China and one-fifth that of Europe's most well-off European nation, Ireland, which has per capita income five percent higher than that of the United States.[1]

More than a decade of concerted efforts to transform institutions to conform to Western European norms has diminished East-West disparities, but the success in the effort has been uneven and the remaining differences make participation in the EU ETS more of a challenge for some than for others. Even greater differences exist in political will as expressed in the priority given to climate measures, not only between East and West in Europe, but perhaps also between

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[1] In contrast, the difference between the U.S. states with the lowest and highest gross state product (Mississippi and Connecticut) is a factor of two. Luxembourg is excluded in the EU comparison because of the high concentration of corporate and financial activity that causes that country's per capita GDP to be 75% higher than that of Ireland. Delaware is excluded from the U.S. comparison for the same reason. These comparisons are based in IMF statistics for 2005 using purchasing power parity exchange rates.

the southern and northern members of the fifteen West European nations. How all of these nations came to adopt a mandatory cap-and-trade system makes the EU ETS of great interest in considering how to bridge the differences in economic, institutional and political circumstance that will characterize a global regime.

1.2 A Brief Recap of the EU ETS

The EU ETS is a classic cap-and-trade system in that there is an absolute limit on covered emissions and rights to emit those emissions are conveyed by tradable permits, called European Union Allowances (EUAs), which are almost entirely distributed freely to affected installations that are obligated in turn to report their emissions and to surrender an equal number of allowances annually. The coverage of the EU ETS is partial in including only CO_2 and only electricity generation and most industrial activities. Notably, transportation, buildings, the service sector, and agriculture are not presently included, although it was envisaged from the beginning that additional GHGs and sectors would be incorporated over time. As it now exists, the EU ETS includes about 45% of the CO_2 emissions and a little less than 40% of the GHG emissions of the EU.

The EU ETS was conceived in the late 1990s as a means of ensuring that the then fifteen members of the European Union (EU15) could meet their commitments under the Kyoto Protocol in the First Commitment Period (2008-12). In surprisingly short time, this idea matured into a cap-and-trade system featuring a three-year “trial” period from 2005 through 2007 and a subsequent “real” five-year trading period that coincided with the First Commitment Period and that was to be followed by subsequent five-year trading periods.

More significantly, the EU ETS has grown from the original fifteen Member States to include thirty countries. This expansion was accomplished in three steps: the accession of ten mostly East European Member States to the European Union on May 1, 2004; the subsequent expansion of the EU to include Romania and Bulgaria at the beginning of 2007; and the inclusion of three of the four nations constituting the European Economic Area (Norway, Iceland, and Liechtenstein) beginning in 2008.

The choice of a cap-and-trade system in Europe and the particular structure that it assumed are the result of four factors. First, it came to be recognized in the late 1990s that something more would be needed if the EU15 were to meet their common Kyoto obligations and that this additional measure would need to be adopted at the European level. Second, an EU-wide carbon tax was off the table since the proposal to enact one had failed in the 1990s in part because fiscal matters, unlike regulatory measures, require the unanimous agreement of all Member States. Third, the early experience with the U.S. SO_2 trading system and the embrace of trading in the Kyoto Protocol made trading a logical approach. Fourth, the recognition of the lack of trading experience and the requisite trading infrastructure in Europe prompted the adoption of the trial period to provide these prerequisites.

There is now an abundant literature that reports, analyzes, evaluates, and criticizes the performance of the EU ETS.[2] For the purpose of this paper, the key results are that a uniform price for CO_2 exists across the system, that this price is taken into account in operating and investment decisions by most of the owners of affected facilities, and that the requisite trading infrastructure consisting of registries and procedures for monitoring, reporting, and verification are in place. In short, an effective mechanism for limiting GHG emissions in the covered sectors exists and it is being used to effect progressively more significant emission reductions.

The rest of this paper addresses five important aspects of the EU ETS as a multinational system. In each section, the experience of the EU ETS is explained and the implications for constructing a global trading system are discussed. The first aspect concerns a novel contribution of the EU ETS, the partial and time-limited, first or "trial" trading period from 2005-07. The second aspect is the role of a central coordinating entity. The third and fourth aspects concern the related issues of club benefits and appropriate differentiation in the face of increasing stringency. The fifth and last aspect concerns a problem that hasn't appeared: cross-border financial flows. The final section of the paper concludes.

2. THE TRIAL PERIOD APPROACH

The trial period of the EU ETS is a novel feature of cap-and-trade programs and it is one that commends itself for a gloal system. The prospect of a trial period and its rationale was stated in the EU Green Paper on greenhouse gas trading (European Commission, 2000).

> "As emission trading is a new instrument for environmental protection within the EU, it is important to gain experience in its implementation before the international emissions trading scheme starts in 2008."

Although formulated for the EU in the context of the Kyoto Protocol, this statement could apply equally to any nation that is adopting a cap-and-trade system as an instrument for limiting greenhouse gas emissions as part of a larger global system. Conversely, those already in a broader system might also consider a trial period advantageous for ensuring that the requisite infrastructure and experience are in place before an acceding country becomes a fully participating member.

The trial period of the EU ETS is defined by two key characteristics. First, it precedes a more serious commitment and as the name suggests it is a rehearsal for the real thing. For the EU, the real thing was the First Commitment Period of the Kyoto Protocol, but in a broader context, the rehearsal could be for subsequent, full fledged participation in a global system. Second, the trial period was self-contained in that there could be no banking of allowances into the following period or borrowing of allowances from that period. The inability to bank or borrow between two periods virtually assured that the end of period price would be either zero, if abatement were

[2] For more comprehensive reports, the reader is referred to the Symposium on the EU ETS in the initial issue of the Review of Environmental Economics and Policy (Ellerman and Buchner, 2007; Convery and Redmond, 2007; and Kruger *et al*., 2007); Convery, Ellerman and De Perthuis, 2008; and Ellerman and Joskow, 2008.

more than required to meet the trial period cap, or the penalty price in the opposite case.[3] Generally, such a feature would be considered a serious defect; however, if a trial period is needed to gain experience and to put the requisite monitoring, reporting, and enforcement infrastructure in place, restricting trading with what follows is more understandable.

The problems that are likely to be encountered in setting up a cap-and-trade system should not be minimized. Institutionally, the Member States of the European Union must be considered more prepared and capable of implementing such a system than many of the prospective participants in a global system. Yet, there was no end of difficulties in setting up the system in Europe. The biggest problem was data at the installation level which was needed both for the allocation of allowances to covered installations and more importantly for setting an appropriate cap (Ellerman, Buchner and Carraro, 2007). For instance, the EU ETS turned out to have a surplus in the trial period largely because the baseline from which projections of business-as-usual emissions were to be made was highly uncertain. In fact, an important benefit of the trial period was providing more reliable data on actual emissions for included installations. In the EU ETS, the verified emission reports for the first year, 2005, became the baseline by which the Commission judged the acceptability of proposed caps for the ensuing 2008-12 period.

The trial period was even more important for the new East European Member States where the institutional preparation was arguably not as complete as among the EU15. This has been rightly raised as an important issue in considering the feasibility of a global trading system (Kruger *et al*., 2007). The data deficiencies in Eastern Europe were greater than they were for the EU15 and most of the East European governments required more time to set up the requisite infrastructure for trading and enforcement. Poland's registry did not go on line until eighteen months after the start of the EU ETS; and Romania and Bulgaria, who became participants in the trial period in its last year, did not have everything in place in time to participate effectively in trading in 2007.

One of the most encouraging aspects of the trial period has been the evidence that participants and governments in countries with less institutional capacity can acquire the requisite infrastructure and become full fledged participants in a few years. Trial periods would seem to be a good way to develop the requisite infrastructure and procedures for later full-fledged participation in a global system and to reassure existing participants that the acceding country has this capability.

The importance of the EU ETS' trial period concerns not only the creation of the requisite trading infrastructure, but also coverage. While an economy-wide, comprehensive system that would include all sources is an ideal that may be practicable in some instances, the reality is more likely to be that the power sector and large industrial facilities are the most promising candidates for early inclusion in a global system.

[3] Recall that the final net position is known with certainty only after it is too late to correct any imbalance. The requirement to cover and the incentive to sell non-bankable surpluses will ensure a price discovery process between the end of the compliance period and the surrender date that will reveal this binary outcome.

This was the case in the EU ETS. In keeping with trial period thinking and the recognition of the problems involved in setting up a system, it was proposed from the beginning to start with those sectors where a trading system could be most easily implemented. The already existing Large Combustion Plant and Integrated Pollution Prevention and Control Directives provided a regulatory framework that could be used (European Commission, 2000) and those directives already implied control of GHGs and energy efficiency, albeit by other means.[4] This is not unlike the situation in developing economies where power plants and large industrial facilities are invariably those first subject to pollution controls.

Moreover, for those already in a global system seeking to extend its reach and to reduce global GHG emissions, the arguments for initial partial coverage will be strong. The power sector is often the largest source of emissions in a country and inclusion of large industrial sources will be highly desirable to avoid leakage and to lessen competitive concerns on the part of nations already participating in the global system. Initial partial coverage need not preclude a later more comprehensive system, although the issue will be whether an initial partial approach makes it more difficult to arrive ultimately at comprehensive coverage.

Expansion of coverage over time is clearly foreseen in the EU ETS and it has occurred. Opt-in provisions were included in the original Directive and a number of sources and even some other gases have been opted in, although the numbers are small. A more significant inclusion is aviation. The Commission's proposal of 2006 to include the aviation sector in the EU ETS has been substantively approved by the necessary EU institutions. As of 2012 the EU ETS will expand to include in-flight emissions for all flights originating or terminating in the EU, including those for which the origin or destination is a non-EU country. In addition, the proposed post-2012 amendments to the ETS Directive would include chemicals and aluminum, two industrial sectors initially excluded, and there are provisions for domestic projects.[5] Finally, the proposed mandatory, separate national caps over non-ETS emissions have led to proposals for EU-wide trading in the non-ETS sectors (Point Carbon, 2008).

The trial period of the EU ETS has demonstrated once again that rehearsal for the real thing has merit. Although not envisaged as a feature of a global trading system, similarly constructed trial experiences would seem to be a desirable feature, particularly when questions exist concerning the institutional readiness of newly acceding nations. For many of the same reasons as prevailed in the EU ETS, initial coverage would seem likely to be partial for newly participating members of a global system. Expanding sectoral coverage will be no easier than

[4] The ETS Directive explicitly amends the Integrated Pollution Prevention and Control Directive to prohibit any Member State from establishing a GHG emission limit for any plant included in the EU ETS and it states that Member States are allowed to forego imposing energy efficiency requirements on plants included in the EU ETS.

[5] "Domestic projects" is the term that has evolved in the EU ETS to designate emission reduction projects within the EU but in sectors not included in the EU ETS. These would be analogous to the "external" projects now covered by the Clean Development Mechanism and be identical to the Joint Implementation projects that now exist in the New Member States in sectors not included in the EU ETS.

expanding geographic scope, but in both instances failing to obtain the ideal initially is no reason not to achieve what is practicable.

3. DEFINING THE CENTER

Kruger *et al*. (2007) note that "the model of decentralization in the EU ETS has broken new ground in our experience with emissions trading regimes across multiple jurisdictions." Cap-setting, allocation, monitoring, reporting, verification, registries, and enforcement are all the responsibilities of the constituent Member States, albeit with varying degrees of guidance, review and approval by the European Commission. Among the most important issues is the role and identity of the center in such systems. The EU ETS during the trial period offers one example of what can work.

In considering the role of the center in the EU ETS, it is important to avoid the caricature of the European Commission as the over-staffed and over-bearing bureaucracy that is slowly but surely snuffing out national prerogative and diversity. While the Commission enjoys the power of initiative with respect to EU legislation and the duty to ensure that the existing EU laws are observed by Member States, the ultimate decision-making institution is the European Council of Ministers, which represents the governments of the Member Nations.[6] In the end, the Commission is the agent of the whole and its success depends on both the powers granted to it by the still sovereign Member States and the manner in which those powers are exercised. In the case of the EU ETS, a careful distinction must be made between the role played by the Commission in the just completed trial period and the ongoing evolution and debate over that role.

3.1 The Commission's Role in the Trial Period

The ETS Directive is unusual as an EU directive in endowing the Commission with specific and carefully circumscribed functions that are additional to its general powers as an executive agent under the European Treaties.[7] The most important of these specific functions concerns the National Allocation Plans (NAPs) in which Member States determine the total number of allowances to be created and how they will be distributed. The Commission is given the power to review and to reject NAPs within a limited period of time after their notification to the Commission. This power proved to be important. Without it, the final EU-wide cap in both periods would have been higher by about 15% in the first period and 10% in the second period. Not surprisingly, the Commission's power to review and to reject is carefully circumscribed. NAPs are to be assessed against specific provisions and a set of criteria in the ETS Directive, which is to say, as agreed previously by the Member States meeting in Council. A committee of Member State representatives was also established in the Directive to provide their opinion to the Commission on the NAPs submitted by Member States.

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[6] A succinct summary of the roles of EU institutions and how decisions are made in the European Union can be consulted at: http://europa.eu/institutions/decision-making/index_en.htm.

[7] Most directives are simply 'transposed' into national law with the Commission's role limited to ensuring conformity of the national laws with the EU directive.

The Commission exercised its power to review and to reject with considerable discretion. In practice, it focused on three criteria (out of eleven): the Member State total (to guard against cap inflation), the list of installations with their allocations (to ensure inclusiveness), and the absence of ex post adjustments in allocation.[8] Equally important was what the Commission chose not to insist upon. Despite appeals for a more "harmonized" approach, allocation to installations was left sensibly to the individual Member States. The committee process established by the Directive also proved useful in letting Member States know how others viewed its NAP and thereby enabled the Commission to perform its role as agent of the whole more effectively (Zapfel, 2007). Finally, no NAP was formally rejected. Instead an expedient of "conditional approval" and "approval with technical changes" was devised whereby the NAP was approved conditional on the adoption of certain changes, which usually had been previously negotiated out-of-sight. When the process for the first period was over, all of the Commission's required changes had been accepted; and only two Member States, Germany and the UK, took the Commission to court on relatively technical matters.

The assessment of National Allocation Plans of Member States was not the only significant function that the Commission performed in the trial period. Equally important were its efforts to educate, facilitate, and coordinate participation by Member States. Zapfel (2007) describes the "active role" that the Commission took "to assist and guide" Member States in the preparation of their NAPs and in eliminating "know-how gaps" in order to make informed decisions on technical issues. This involved commissioning studies on various aspects of allocation, issuing a non-paper elaborating how to prepare an allocation plan, and developing amplifying guidance on the review criteria. In addition, the Commission was always available and frequently sought after as a source of information, expertise, and informal guidance. The frequency and intensity of these bilateral contacts provided a means for sounding out various NAP features, narrowing differences, and facilitating final agreement.

3.2 The Evolution of the Commission's Role

The first round of cap-setting could best be described as a negotiation between individual Member States and the Commission in which both sides were trying to agree on a mutually agreeable cap in the face of the large data uncertainties and some confusion over what installations met the definition for inclusion. Moreover, the absence of any international obligation to limit GHG emissions in these years allowed a more relaxed approach to cap-setting.

All of this would change in the second round of NAP submissions for 2008-12 corresponding to the First Commitment Period under the Kyoto Protocol. Things were more serious with what the EU regarded as a legally binding obligation; and the definitional issues concerning who was in and out had been largely resolved by the time the NAP notifications were due in June 2006.

[8] What became the Commission's effective ban on ex post adjustment presents an interesting use of discretion. At best, this ban is implicit in the ETS Directive. Ex post adjustment would have frustrated the creation of an efficient EU-wide emissions market by substituting an administrative redistribution of allowances within each Member State for trading among installations.

But the most important factor in changing the Commission's approach was the release in May 2006 of the verified emissions data for 2005, which revealed lower emissions than had previously been thought to be the case. Despite the significant reductions in proposed totals that the Commission had required, it became evident that the totals for some Member States, mostly in Eastern Europe, had involved significant errors in assumed baseline emissions. As a result, the point of reference for Member State caps in the 2008-12 would no longer be the first period totals but 2005 verified emissions. And, in response to criticism of inconsistency and lack of transparency in the negotiation of Member State caps in the first round, the Commission adopted a single and carefully calibrated emissions model to project BAU emissions in 2010, the midpoint of the second trading period, based on the 2005 verified emissions data and expected rates of economic growth and of improvement in carbon intensity (European Commission, 2006).

The interaction between the Commission and the Member States assumed a different tone. Cap-setting was no longer a negotiation, but an evaluation of whether the totals proposed by Member States were consistent with the model's projections based on the 2005 verified emissions. If they were not, the totals were adjusted downward absent a good reason and evidence concerning an error in the Commission's calculations. In so doing, the Commission effectively determined Member State maximum allowed caps and thereby the EU-wide cap. Member States might challenge the Commission's decision of what the cap should be, but the burden of proof was shifted heavily against the Member State. This approach did yield more legal challenges to the Commission's NAP decisions. Nine of the ten East European countries have sued the Commission over the caps imposed on them, although one, Slovakia, withdrew its suit after a slight upward adjustment in its total.

The trend to greater centralization was taken much farther in the post-2012 amendments that were proposed in January 2008 and are now under active debate. The whole NAP process is to be abandoned and the EU-wide cap will be determined in the Directive. Auctioning will become the standard for distribution of the cap with 100% auctioning to occur for the electric utility sector starting in 2013 and free allocation to the industrial sources to be phased out by 10% increments from 80% in 2013 to none in 2020. The only exception will be for sectors exposed to international trade that might receive a continuing free allocation if serious trade effects or leakage can be demonstrated.

3.3 Questions for a Global System

The experience with the EU ETS suggests that over-arching treaties and agreements, such as the Kyoto Protocol and the European Burden-sharing Agreement, may not be enough to create an effective cap-and-trade system. Assuming the political will or other motives supporting action, some entity must act as agent for the whole and educate, facilitate, and coordinate, hopefully with the vision, ability and political realism that have characterized the Commission's role in the development of the EU ETS. That experience also raises two questions: Is the greater degree of centralization now being pursued necessary in a global system? And who would play the role of the center on a global stage?

Within Europe, the view is that the trial period was deeply flawed and that greater centralization is the remedy. In part this view reflects a vision of a more unitary state that could avoid the messiness of decentralized structures, but it also reflects some of the real problems of the trial period. Yet, despite the high degree of decentralization, the trial period did succeed in imposing a price on CO_2 emissions over about half of the emissions in Europe and in creating a mechanism for effecting greater reductions in the future. The question for a global system, as well as for the EU ETS, is not so much what degree of centralization is desirable, but what is politically feasible. What may be possible in the European Union will not likely be so for a broader global system in which participating nations will retain significant discretion in deciding national emission caps, separate national registries will be maintained, and monitoring, reporting and verification procedures will be administered nationally. For this, the trial period of the EU ETS provides a good precedent

The more difficult question is: What institution could assume on a larger global stage the functions that the Commission performed in the trial period? In many ways, the Commission's role in establishing the EU ETS was accidental. It was not set up for this purpose; yet it was there when the occasion demanded and it played the role brilliantly. It can do so for further accessions within Europe and it would likely represent the EU in any future negotiations with trading systems in the United States or elsewhere. Nevertheless, the European Commission cannot serve as the center for a system that extends beyond Europe. Perhaps some entity will emerge out of negotiations to link the EU ETS with other systems, much as the WTO grew out of the expansion of trade, but there should be no doubt that some center will be needed. Otherwise the result will be a far more disjointed and dysfunctional system than what the trial period of the EU ETS is sometimes portrayed as being, or none at all.

4. IMPORTANCE OF CLUB BENEFITS

It is not the case that all Member States of the EU were equally resolved to address climate change from the beginning and that all are happy with the resulting EU ETS. The UK and Germany, the two largest members of the EU, advocated a voluntary trading system for the trial period in order to preserve the precursor voluntary arrangements in these countries. Spain, Italy, and some other EU15 states committed to targets in the European Burden-sharing Agreement that seem to have been viewed as aspirations and not as hard numbers to be achieved by later climate policy. Finally, the East European Member States, who joined after the system had been designed, had other priorities and with the exception of Slovenia faced no problems in meeting their commitments under the Kyoto Protocol. That the final result should be a mandatory trial period with all participating is surprising, not least in the European Union where various forms of exception are the rule. Club benefits, the advantages that go along with membership in some group, largely explain the result.

The story behind this surprising result has been told elsewhere (Skaerseth and Wettestad, 2008), but several elements are important from the standpoint of constructing a larger global system. The story is a little different for the EU15 and the New Member States. For the EU15, a longer experience of working together and a set of prior commitments were important in shaping the result. The EU had taken a prominent position in favor of action on climate change at and subsequent to the Rio de Janeiro Conference in 1992 and a leadership position in global climate change policy had wide-spread public support, especially after the withdrawal of the U.S. from the Kyoto Protocol in 2001. The governments of the UK and Germany might advocate voluntary participation in the trial period, in large part due to the strong positions taken by their respective industries, but neither government would have been willing to scuttle the deal given their existing positions on climate change and their broader interests in the EU. As it was, agreement on mandatory free allocation and a temporary opt-out provision (and additionally on pooling for Germany) made mandatory participation by industry more palatable and gave the governments the excuse they needed to drop their insistence on a voluntary trial period.[9] Southern Member States (Spain, Portugal, Italy, and Greece), who could be best characterized earlier as going along with the climate policy advocacy of their more northern neighbors, were too enmeshed in the broad benefits of the EU to give serious consideration to ignoring the EU ETS Directive, although for a while it looked as if Greece and Italy might do so.

The situation was quite different for the New Member States. They were not part of the Burden Sharing Agreement and, with the exception of Slovenia, none faced any problems in meeting its Kyoto Protocol obligation. They had lower per capita income and lower demand for environmental protection, especially for a global problem. Finally, they were not present at the table as voting members when the ETS was negotiated and agreed. When accession became a reality, the common East European reaction to the EU ETS was that it was designed by and for the EU15 and that its provisions did not really fit the circumstances of the New Member States (Jankowski, 2007; Chmelik, 2007; Bart, 2007). The Directive was, as characterized by Jankowski, “an ill-fitting suit,” which all agreed nonetheless to wear amid much and continuing protest.

Notwithstanding this discontent, none of the unhappy New Member States has pursued their differences to the point of withdrawing from the EU ETS. The first period NAP cuts were accepted without more than complaint; and, while the second period cuts have been followed by serious legal challenges to the Commission, the appeal for equitable treatment is being pursued through common European institutions and the plaintiff countries are participating in the trading scheme on the Commission’s terms pending the outcome of their legal challenges. How these challenges will play out is anyone’s guess, but it is hard to imagine any of the plaintiffs leaving the trading system in the event of an adverse decision. Too much would be called into question.

[9] Pooling refers to an arrangement whereby individual installations would joint together to form an entity that would be collectively responsible for reporting emissions and receiving and surrendering allowances on their behalf. It was anticipated that this arrangement would accommodate voluntary agreements in some sectors. In fact, there was little pooling.

More importantly, the continuing Eastern discontent will have some influence on the proposed amendments for the post-2012 system. The new Member States are now voting members and a solid phalanx of Eastern opposition would complicate obtaining a qualified majority in the European Council. But even here, the options are not exiting the system or seeing it collapse since the failure of the January 2008 amendments would mean only that the existing Directive continues without amendment.

The dissonance between the official positions of the governments of the New Member States and their actions can only be explained by the broader benefits of belonging to the European Union. Whatever the perceived disadvantages of mandatory participation in the EU ETS, they pale in significance when compared to the benefits of free flows of labor and capital and access to broader markets that come with being a member of the club called the European Union. As stated perceptively by Bart (2007), the EU ETS was "just another obligation in the long march to the EU." The club benefits of the EU cannot be extended to the world, but similar side benefits are likely to be needed to induce and to maintain participation in a global system.

5. STRINGENCY, DIFFERENTIATION & HARMONIZATION

Club benefits largely explain how the EU ETS has grown from the initial fifteen Member States to the thirty that now participate. The continuing challenge will be to keep everyone in the system with the increasing stringency that would characterize any serious policy that attempts to deal with climate change. In particular, a conflict between two reasonable objectives—differentiation and harmonization—has emerged and it will get worse with increasing stringency. This conflict will surely arise in a global system and that prospect imparts more than the usual interest to the resolution being attempted in the EU ETS.

5.1 Differentiation and Harmonization Defined

Differentiation is a well-established concept in climate policy originating with the reference to the "common but differentiated responsibilities" of nations in the UN Framework Convention on Climate Change. "Responsibilities" refers to the burdens, generally understood as costs, that would be assumed by countries of differing economic and historical circumstances. In a multinational trading system, differentiation would be expressed by the allowances assigned to a nation, as in the Kyoto Protocol or the EU ETS. Since these allowances are tradable and emission reductions will reflect marginal abatement costs that will tend to be equal for all, nations assuming greater responsibilities (*e.g.*, lower caps) will typically incur a greater cost burden than nations with less demanding caps.

Harmonization has entered the climate policy lexicon only with the implementation of the EU ETS, but the issue will occur in any global system. Harmonization is the proposed remedy—presumably through a benchmarked allocation—for what is perceived as the unequal treatment of like facilities as the result of the decentralized free allocation of allowances. The allegation is that the award of more allowances to an installation in one country than to an identical installation in another is at least unfair and that it may create a competitive distortion. The call for harmonization, which implicitly presumes equality of treatment, calls the whole concept of differentiation into question. If all facilities are to be treated equally, how can countries be differentiated? And, even if harmonization could be achieved for some particular sector, as several industries argue should be done in a global system, the burden of differentiation would then fall more heavily on the non-harmonized sectors.

5.2 The Current and Proposed Evolution in the EU ETS

The EU ETS is evolving from a trial period that could be characterized as little stringency, no differentiation and no harmonization to a post-2012 system that would feature increasing stringency, significant differentiation, and near complete harmonization. The lack of stringency in the trial period is well-known but the lack of differentiation is not. In theory, the trial period caps were to reflect the lesser of predicted business-as-usual emissions or a "Path to Kyoto" that was consistent with the Member State's achievement of its emissions commitment under the European Burden-sharing Agreement (BSA). In reality, the absence of relevant data, the inherent difficulties of prediction, and the pressing deadlines for implementation frustrated any differentiation in the trial period as shown by **Figure 1**.

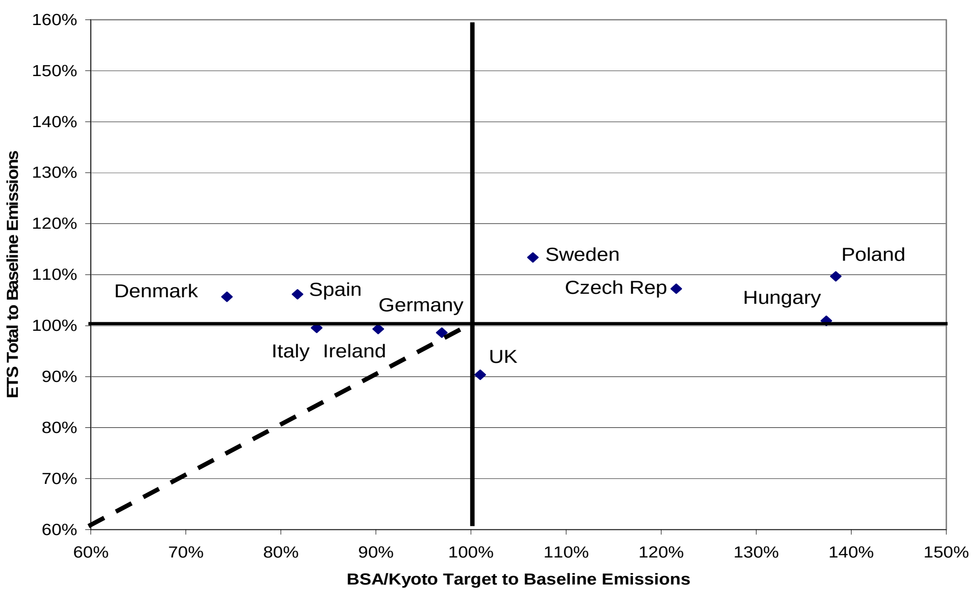

Figure 1. Relation of NAP1 Totals to Baseline Emissions and the Kyoto/BSA Targets. Source: Ellerman, Buchner, and Carraro (2007).

This graph plots the trial period caps for ten representative Member States in relation to their Kyoto/BSA targets (horizontal axis) and to baseline or recent historical emissions for the ETS sectors (vertical axis). Countries to the left of the vertical axis, that is, those with a constraining Kyoto/BSA target, might be expected to have an EU ETS cap that would place them in the lower left-hand quadrant along the dashed diagonal. In fact, the caps of these countries look no different than those of the countries to the right of the vertical axis.[10] Recent emissions were a more important determinant of cap levels for the trial period of the EU ETS than the country's prospective Kyoto/BSA targets. There was no systematic differentiation.

This circumstance would change with the second NAP round (NAP2) that set caps for the 2008-12 period. The over-all annual EU cap for 2008-12 was set at a level for the EU25 that was 5% lower than 2005 verified emissions and 12% lower than the first period cap. **Figure 2** shows the relationship between 2005 verified emissions (horizontal axis) and the second period caps (vertical axis) both expressed as ratios of the first period caps.

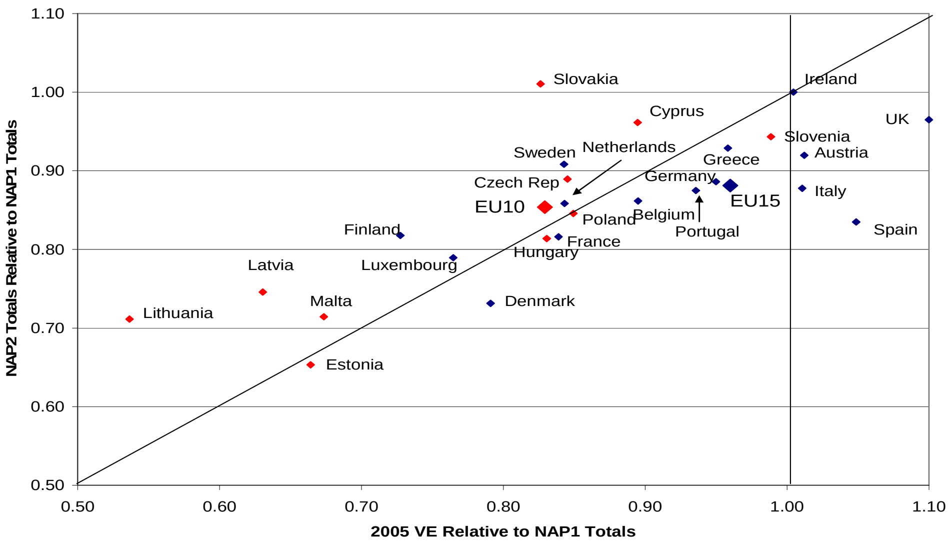

Figure 2. NAP2 caps in relation to NAP1 caps and 2005 emissions. Note: NAP1 and NAP2 refer to the total EUAs that each Member State could allocation in the first and second trading periods. VE refers to verified emissions.
Source: Compiled by the author.

For nearly all Member States, both 2005 verified emissions and the second period caps are less than the first period caps. As is clearly evident from the plots and the diagonal, the lower a Member State's 2005 verified emissions were from its first phase cap the lower its second phase cap would be. However, differentiation is starting to appear, as indicated by the perpendicular distance from the diagonal. Spain has the most demanding cap with 2005 emissions 6% above and a NAP2 total 17% below its first period total. Slovakia and Lithuania are those with the least demanding caps. More generally, New Member States are mostly to the northwest of this line, indicating less of a burden, while EU15 Member States are to the southeast indicating more of a burden. The separation between the two groups is not complete; however, there is differentiation as indicated by the larger diamonds marking the positions of the 10 New Member States (EU10) and the EU15, each taken as a whole. On average, the second period caps for the EU10 are 3% higher than 2005 emissions, while those for the EU15 are 7% less.

[10] The UK took an explicit leadership position in the trial period by adopting early in the process a more demanding cap that it hoped would set an example for others.

Still greater stringency and greater differentiation is foreseen by the proposed post-2012 amendments (European Commission, 2008). Starting in 2013 the cap is to be set at a level that it would decline by 1.74% annually indefinitely so that by 2020, it would be 21% below 2005 verified emissions. At the same time, greater differentiation would be achieved by the apportionment of auctioned allowances to participating Member State governments according to a proposed formula. Ninety percent of the allowances to be auctioned would be allocated to Member States in proportion to their 2005 verified emissions. The remaining 10% would be distributed for the purpose of "solidarity and growth within the Community" to certain Member States in amounts that would increase the allowance allocation by percentages that range from 2% for Italy to 56% for Latvia.

As stated in the proposed amendments, the basis for this differentiation is GDP per capita: the same as has been proposed globally (Jacoby *et al*., 1999) and as noted in Frankel (2007) as underlying the targets in the Kyoto Protocol. **Figure 3** shows the proposed post-2012 allocation of EU ETS allowances, assuming full auctioning, in relation to per capita income on a purchasing power parity basis.

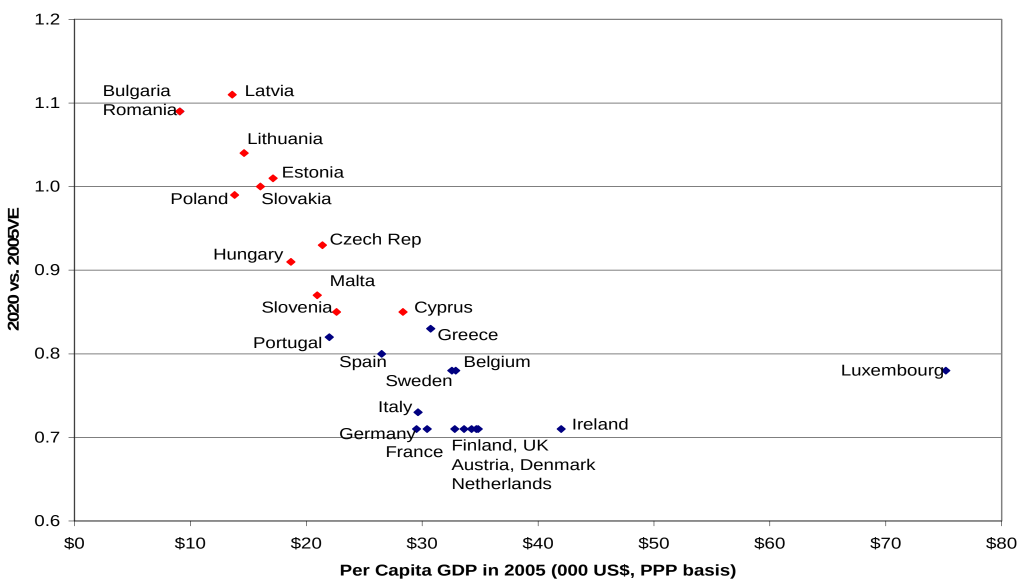

Figure 3. 2020 auction rights in relation to 2005 emissions and per capita GDP. Source: Compiled by the author.

The poorer East European countries—Bulgaria, Romania, Latvia, Lithuania, Estonia, Slovakia and Poland—would receive an allocation that would be equal to or greater than their level of 2005 emissions. In effect, the post-2012 cap would be little changed from the current 2008-12 cap. Relatively better off New Member States would receive fewer allowances, but still more than any of the EU15. Among the latter, Luxembourg must be set aside because of the tax-advantaged activity that gives it an artificially high per capita GDP. Otherwise, a clear leader group among the EU15 is evident: relatively high-income Member States that would receive allowances equal to 71% of their 2005 emissions (90% of their share of a 2020 cap that would be 21% below the 2005 level).

The proposed post-2012 amendments also present a coherent attempt to deal with harmonization: 100% auctioning. When completely phased in, all will be treated alike with zero free allocation. This is not the benchmark that those advocating harmonization had in mind, but it is an easy and obvious one to administer. In this case, the auction advocates won the day, at least at the Commission, and among the benefits they could claim is the elimination of the alleged competitive distortions due to free allocation.

Whether this approach will prevail is yet to be seen since the post-2012 amendments are still in the co-decision process. Nevertheless, the direction is clear. Harmonization will be achieved by doing away with free allocation. Perhaps there will not be 100% auctioning by 2020, or 100% in the power sector in 2013, but there will be significantly more from 2013 on and the share will likely continue to increase. In effect, French, German, or British installations will be buying some allowances (but not all) from Bulgaria and Romania, but the transfer will be well hidden by the intermediary of the market. This could work, even on a global scale, since all Member States would be auctioning a quantity of allowances that would constitute a significant share of their emissions. The real issues are whether 100% auctioning is politically feasible and if so, whether the better-off countries, which will be disadvantaged by differentiation, are willing to forsake the additional revenue.

An equally important feature of the observed and proposed changes in the EU ETS is the coupling of increasing differentiation with increasing stringency. If a global approach is to be “broad then deep” (Schmalensee, 1998), the participants may find themselves in a situation not unlike that of the EU Member States. An initial broad phase, like the trial period of the EU ETS, will not require much differentiation; however, as the system enters the deep phase, differentiation will become an increasingly important issue. The EU ETS is attempting to work out the differentiation that will accompany greater stringency and to reconcile that solution with the demand for harmonization. How these difficult and interrelated issues are resolved in the EU ETS will provide a preview of the challenges awaiting a global system.

6. FINANCIAL FLOWS

Before concluding, note should be taken of the absence of a problem that is commonly thought to be one in a global trading regime. A trading system implies trade among participating entities and accompanying financial flows. And these flows are likely to be larger to the extent that differentiation creates differences in the apportionment of the system-wide cap that go in the same direction as comparative advantage in abatement. For instance, modeling exercises commonly predict that the cheapest abatement will be found in the same developing countries that most analyses assume will be the beneficiaries of global differentiation. These two factors would combine to create large international flows the feasibility of which can be doubted. A remarkable feature of the EU ETS is that there has been virtually no notice of the comparable cross border flows.

Despite all the birthing problems of the EU ETS, there was a very liquid market for EUAs and there were cross-border transfers among the participating Member States. The 25x25 matrix attached as an appendix provides a table of the country of origin of all the EUAs surrendered during the three years of the trial period. Reading across a row indicates the quantity and origin (by column headings) of all the allowances surrendered in the country listed at the row heading. The row sums indicate the total number of allowances surrendered, or equivalently emissions for that country during the three-year trial period and the percentage following indicates the number of EUAs surrendered in fulfillment of compliance obligations that were issued by other Member States. Reading down columns indicates the registry in which allowances issued by the country shown at the column heading were surrendered for compliance. Column totals indicate the number of issued EUAs that were surrendered throughout the EU ETS and the percentages below each sum indicate the proportion of the total that occurred outside of the issuing Member State. The diagonal entries indicate the number of allowances issued and surrendered in the same Member State. They are by far the largest entries of all cells for every Member State.

Several points are immediately obvious. First, most of the allowances issued and surrendered were not involved in trade among Member States. Of the total 6.15 billion EUAs surrendered, 5.79 billion (94%) were surrendered in the issuing Member State. International flows accounted for only 354 million EUAs or 5.8% of the total. Much of the explanation of this phenomenon reflects what could be expected and is readily observed with free allocation. Most of the allowances issued freely are kept in the installation's account for later surrender against emissions. Typically, only the difference between the installation's allocation and emissions is traded. These differences can now be measured. The sum of the shorts (emissions > allowances) for all installations for the entire trial period was 650 million EUAs and the sum of the longs (emissions < allowances) at installations with surplus EUAs was 810 million (Trotignon and Ellerman, 2008). At a minimum, 650 million allowances were redistributed from longs to shorts. This figure, slightly more than 10% of the total allowance issue, largely explains the relatively small scale of the international transfers.

While the scale of international transfers is very modest in relation to total allowance issue, the scale is large compared to what would have been required to ensure the compliance of the four Member States that were short for the period as a whole: the UK, Italy, Spain, and Slovenia. For all installations to be in compliance in these four countries, at least 88 million tons would have had to flow across EU borders. The actual level was four times higher. Even if the many off-setting flows between trading pairs are eliminated, the sum of net flows is 217 million, some two and a half times the minimum required international transfer. If national preferences had been strictly observed, there would have been only four Member States importing allowances. In fact, 22 of the 25 Member States were importers of EUAs in some amount, although only seven were net importers.[11]

Another way of looking at this phenomenon is counting how many of off-diagonal cells in the matrix at the appendix are filled. There are 600 such cells of which 470 (78%) are occupied indicating a cross border transfer. For most pairings, trade goes both ways and for many Member States the net flows with various trading partners are in opposite directions. For instance, Germany is a net importer in the aggregate and in trading with most partners but it is a net exporter to the UK, Italy, and Spain.

Market intermediaries and institutions largely explain the abundance of cross-border relationships. Installations with a deficit or a surplus looked to market intermediaries to obtain needed EUAs or to dispose of excess EUAs and these intermediaries operated at a European scale. A UK firm that had a surplus would sell to a broker or at an exchange and that surplus was as likely to be sold to a firm that was short in Spain as it was to a firm that was short in the UK. With EUAs good for compliance regardless of origin and zero transportation costs, the surpluses and deficits were as likely to cross a border as not.

The absence of any concern about international flows can be largely attributed to their small scale relative to the total number of allowances and to the indifference that buyers and sellers exhibited concerning national origin. The UK was by far the largest importer of EUAs with a net import of 107 million for the period as a whole, which was equal to 14% of verified emissions. Placing a value on these imports is difficult given the variability in EUA prices and the observed timing of imports, but the year of greatest import in value terms was 2006 when EUA imports would seem to have created a £350 million pound (≈ €500 million) outflow of funds from the UK. While this might be seen as a large amount, it pales in comparison to the payments for imported goods and services by the UK in 2006 which were about £415 billion.[12] Payments to foreigners for allowances were less than one-tenth of one percent of the total imported goods and services. The amount in future years could be larger due to higher EUA prices and perhaps higher levels of imports, but allowances would still be a small part of total payments abroad for goods and services. One euro-skeptic organization in the UK, for which the EU ETS is emblematic of all that it dislikes about Brussels, has consistently criticized the transfers to the rest of the EU that are implied by the UK's short position (Open Europe, 2006), but this complaint failed to find any traction either with the public or the government. Several other aspects of the EU ETS have caught the attention of the public and governments—windfall profits, over-allocation, high initial prices—but not international flows.[13]

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[11] The net importers were the UK, Spain, Italy, Germany, Austria, Ireland, and Slovenia. Germany, Austria and Ireland were net importers despite being long for the period as a whole due to a phenomenon that occurred in all Member States: some surplus allowances at long installations appear never to have entered the market. See Trotignon and Ellerman (2008) for a more complete discussion.

[12] Given as U.S. $768 billion in IMF Statistics.

[13] For a more complete discussion of these other controversies, see Ellerman and Joskow (2008).

7. CONCLUSION

Europe has demonstrated that a multinational trading system, consisting of sovereign nations with considerable disparities in economic circumstance and in willingness to adopt climate change measures, can be constructed. At the same time, that experience has identified the problems that exist in multinational systems and in so doing it has revealed the distance to be traveled in replicating something similar on a global scale.

The encouraging aspect of the experience to date with the EU ETS is the evidence that some of the problems often cited as impeding a global system may not be that serious. The institutional disparities between East and West in Europe are not as great as those between North and South on the global scale, but they are still large. It took more time to put the necessary regulatory infrastructure of trading in place in Eastern Europe than it did in the West, but it was done and the companies in the New Member States are complying and increasingly learning to price CO_2 into their operational and investment decisions Although the EU ETS was not intended as an experiment for a global system, its adoption of a multi-year trial period has set a useful precedent. It provided a dress rehearsal that could be employed in a global system where the institutional readiness of new participants is a concern.

Another problem that didn't appear is concern over the financial flows that accompany international trading. Most of the allowances issued by individual Members States were surrendered in the same country and the international transfers were a small percentage of the total, but they were larger than what might have been expected based on national preference. The widespread use of cross-border transfers for compliance reflects the role of intermediaries in an EU-wide market in redistributing the differences, which existed for all installations, between the allocations and their emissions. Surplus allowances were as likely to end up in another Member State as in the one in which the selling installation was located, and similarly allowances purchased to cover emissions were as likely to come from surpluses in other Member States as from other installations in the same country.

The more discouraging aspect of the EU ETS as the prototype for a global system is how to reproduce what was essential for success in Europe, namely, a pre-existing central structure and a well established set of powerful side benefits. The European Commission cannot perform the same role, nor can the benefits of participation in the European Union be extended beyond Europe. One can imagine that a central institution could emerge out of bilateral agreements that might link the EU ETS with comparable systems outside of Europe. Something will be needed to coordinate regulatory actions, to review periodic cap adjustments, and to negotiate with new participants. It is harder to imagine what might be the side benefits. They need not be as powerful as those associated with becoming a member of the European Union, but the experience in Europe suggests that something more than over-arching treaty and common concern will be needed. This is however not a unique challenge. In diplomacy, issues are inevitably linked and the same will have to be done if there is to be a global climate regime.

Differentiation of responsibilities might provide the extra incentive, but it has not in the Kyoto Protocol and the EU ETS did not operate this way. The first step was to get everyone in and then to increase the stringency of the required emission reductions. A new complicating problem also appeared: harmonization of free allocations. The relationship between stringency, differentiation, and harmonization is the big unresolved issue for the EU ETS. The solution proposed and being debated, full auctioning with differentiation of rights to the auctioned allowances, comes close to being a common tax, but it has yet to be proven politically feasible. As in other aspects, the answers being worked out in Europe will say much about what will be possible on a broader, global scale.

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APPENDIX: ORIGIN AND DISPOSITION OF SURRENDERED ALLOWANCES, 2005-07 (MILLION TONS)

Phase 1	Originating from …																												
	AT	BE	DK	FI	FR	DE	GR	IE	IT	LU	NL	PT	ES	SE	GB	CY	CZ	EE	HU	LV	LT	MT	PL	RO	SK	SI	Total	Imports	%
Surrendered in …																													
AT	91.63	0.20	0.11	0.20	0.52	1.03		0.00	0.05		0.83	0.01	0.03	0.05	0.26		0.30	0.00	0.03	0.14	0.13		0.42		0.31	0.02	96.27	4.64	1%
BE	0.21	148.38	0.17	0.12	0.96	0.80	0.01	0.04	0.95	0.38	0.23	0.08	0.75	0.03	0.08		0.46	0.17	1.49	0.01	0.66		6.89		0.07		162.92	14.54	4%
DK	0.00	0.15	72.62	0.15	0.10	0.65			0.01		0.85	0.11	0.15	0.21	0.37		0.43	0.02	0.06		0.02		0.08		0.11		76.09	3.47	1%
FI	0.20	0.11	0.06	114.34	0.87	0.22	0.25		0.07		0.15	0.14	0.03	0.34	0.78		0.93	0.26	0.02	0.06	0.21		1.09		0.10		120.24	5.90	2%
FR	0.01	0.07	0.04	0.29	379.71	0.15	0.12		0.07		0.13	0.07	0.43	0.02	0.26	0.04	0.25		0.02		0.12		1.73		0.13		383.67	3.96	1%
DE	0.48	4.02	0.87	2.83	6.72	1391.19	0.08	0.86	1.26	0.27	7.34	0.96	0.96	1.21	8.40	0.01	7.06	1.35	2.53	0.28	2.39		5.31		1.67		1448.08	56.89	16%
GR	0.02	0.01			0.06	0.00	212.91				0.01	0.02			0.03				0.01		0.01		0.84		0.02		213.93	1.03	0%
IE	0.08	0.02	0.06	0.29	0.12	0.06		64.04	0.19	0.01	0.09	0.18	0.02	0.00	0.43	0.02	0.06	0.56		0.04	0.03		0.06		0.03		66.38	2.33	1%
IT	0.46	1.18	0.66	1.07	6.45	5.42	0.26	0.09	629.12	0.01	1.16	1.19	1.54	0.57	4.13	0.23	3.68	2.05	1.08	0.85	1.14		6.83		2.84	0.05	672.06	42.94	12%
LU										7.88																	7.88	0.00	0%
NL	0.12	2.98	0.27	0.79	2.30	2.84	0.08	0.02	0.15	0.02	216.80	0.08	0.38	0.23	2.72	0.05	1.79	0.58	0.38	0.23	0.75		2.44		0.93	0.00	236.94	20.14	6%
PT	0.01	0.15	0.01	0.01	0.05	0.06			0.06		0.04	99.44	0.28	0.00	0.46		0.22	0.00	0.00	0.01	0.00		0.01		0.02		100.84	1.40	0%
ES	0.27	1.68	2.47	3.77	5.92	3.47	0.13	0.13	1.05	0.10	3.74	3.32	499.67	0.91	4.69	0.01	3.54	1.06	1.13	0.56	0.74		8.21		1.64		548.22	48.55	14%
SE	0.01	0.03	0.07	0.36	0.09	0.19	0.01			0.01	0.01	0.01	0.00	57.05	0.18		0.08	0.15	0.00	0.01	0.08		0.12		0.01		58.46	1.41	0%
GB	0.41	10.09	4.69	5.11	20.59	11.29	1.17	0.16	3.45	0.26	18.52	1.78	2.60	1.20	619.10	0.14	13.83	5.29	2.81	0.75	5.40		17.76		4.33		750.72	131.62	37%
CY																15.73											15.73	0.00	0%
CZ	0.00	0.08	0.07	0.04	0.07	0.12			0.12		0.26	0.23	0.03	0.07	0.96	0.01	247.03	0.11	0.48	0.01	0.10		2.02		0.61		252.42	5.39	2%
EE		0.02	0.00			0.03								0.02				39.94					0.04				40.05	0.11	0%
HU		0.01			0.14	0.03					0.02	0.00	0.02		0.01		0.15	0.04	78.63				0.24		0.02	0.00	79.30	0.67	0%
LV																	0.03		0.00	8.55	0.06				0.00		8.64	0.09	0%
LT		0.03	0.05	0.00	0.39	0.18	0.00		0.03			0.01			0.01		0.00	0.00	0.03	0.02	17.98		0.39		0.01		19.13	1.15	0%
MT																						3.96					3.96	0.00	0%
PL	0.04	0.18	0.10	0.00	0.26	0.20	0.02	0.00	0.05		0.02	0.02	0.09	0.01	0.62	0.01	0.17	0.00	0.08	0.04	0.02		620.34		0.25		622.53	2.19	1%
RO		0.01		0.03	0.05	0.04	0.18	0.13			0.23		0.01	0.18	0.01		0.74	0.04	0.25		0.07		1.37	55.24	0.03	0.03	58.65	3.41	1%
SK	0.00	0.03		0.00	0.22	0.02			0.08		0.01			0.01	0.05		0.07	0.10	0.01	0.11	0.20		0.17		74.30		75.37	1.07	0%
SI	0.04		0.02	0.00	0.02	0.40	0.00		0.02		0.09	0.02	0.06	0.04	0.19		0.02	0.07	0.01	0.04	0.02		0.19		0.00	25.37	26.61	1.24	0%
Total	93.99	169.42	82.36	129.40	425.61	1418.40	215.23	65.47	636.74	8.94	250.53	107.66	507.06	62.14	643.75	16.25	280.83	51.78	89.05	11.73	30.13	3.96	676.55	55.24	87.44	25.49	6145.13	354.16	100%
Exports	2.36	21.03	9.74	15.07	45.90	27.21	2.32	1.42	7.62	1.06	33.73	8.21	7.39	5.09	24.65	0.52	33.79	11.84	10.42	3.18	12.15	0.00	56.22	0.00	13.14	0.11	354.16		
%	1%	6%	3%	4%	13%	8%	1%	0%	2%	0%	10%	2%	2%	1%	7%	0%	10%	3%	3%	1%	3%	0%	16%	0%	4%	0%	100%		

Source: Trotignon and Ellerman (2008). Note: units in million EUAs

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