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Europe's Emissions Trading System

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Europe's Emissions Trading System

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This paper describes and evaluates the system for trading CO2 emission permits introduced by the European Union to encourage the reduction of greenhouse gas emissions to help abate climate change. This system represents a live example of a functioning trading system under the so-called cap-and-trade approach to limiting greenhouse gas emissions. Data are fully available for only one year (2008) of the fully functioning system, and that year was influenced by a sharp economic recession in the final months of the year, making evaluation difficult. Preliminary analysis suggests, however, that the trading system made only a limited contribution to reducing CO2 emissions.

In November 1997 the Kyoto Protocol to the UN Framework Convention on Climate Change was negotiated, setting binding targets on greenhouse gas (GHG) emissions by the rich countries (enumerated in Annex B) for the years 2008-2012. A five year period centered on 2010 was chosen to iron out the economic idiosyncrasies of any particular year, which turned out to be wise given the unexpectedly deep world economic recession of 2009. The European Union, then fifteen members, negotiated as a single entity, accepting a targeted reduction by 2010 by eight percent from its level of GHG emissions in 1990, which was the base year in the Kyoto Protocol for most countries and the main gases. Targets were also accepted by Australia, Canada, Japan, the USA, most

of the then eastern European countries (most of which formally joined the EU in 2004 or 2007), and by Russia and Ukraine.

Australia and USA declined to ratify the Kyoto Protocol, which nonetheless came into force in 2005 for those who did accept its terms, following the ratification by Russia under strong encouragement by the EU. Russia's agreement put the ratifiers over the dual threshold of 55 countries accounting for at least 55 percent of emissions in 1990. Australia subsequently ratified in 2007 after a change in government.

For reasons having to do with the complex internal politics of decision-making within the EU, it promptly allocated to its then 15 member countries its internationally agreed target, ranging (relative to the 1990 base period) from cuts of 28 percent (Luxembourg) to an allowed increase of 27 percent (Portugal) – a range much wider than the EU was willing to accept among Kyoto's Annex B countries – those that had specific quantitative targets.

The Kyoto Protocol contemplated the possibility of international markets arising to trade emissions permits (article 17). The EU embraced this possibility and soon began planning for an allocation of tradable emission permits within the EU, which was enlarged to 27 countries by 2007. Twenty-five of the 27 countries (all except tiny Cyprus and Malta) had emission targets under the Kyoto Protocol, and the European project envisioned covering several non-EU countries as well. (Iceland, Liechtenstein, and Norway subsequently joined.)

An explicitly experimental permit allocation system with allowable trading covered the period 2005-2007 (called phase 1 in European lingo), before the formal 2008-2012 "commitment period" (called phase 2) of the Kyoto Protocol. Permits were

allocated to energy-intensive firms, especially in the power-generating sector, but also including oil refining and seven energy-intensive manufacturing sectors. Provision was made for auctioning some permits up to a maximum of five percent for each country, but that option was little used and over 99 percent of the permits were given out at no charge to the designated firms.

Trading began almost at once, as financial institutions servicing the relevant firms, and others, offered to broker the sale of permits, or even to buy them outright, as permitted under the scheme. The EU permitted trading and holding of the permits by any party, but did not itself create the market. The trading price began at around 7 Euros per metric ton of carbon dioxide in early 2005, rose to a peak above 30 Euros in 2006, and subsequently collapsed to zero in early 2007 when it became clear that more permits had been issued than required to cover emissions during phase 1. (The excess issuance turned out to exceed five percent for the EU-15, and more than 20 percent for the ten new members of 2004.)[calculated from Ellerman and Joskow, 2008, Table 3].

The 2005-2007 pilot period provided valuable lessons for the phase 2 that was to follow – as well as the provision of accurate firm level data on emissions for the year 2005, which provided the basis for permit allocations (proposed in 2006, approved in 2007) for the period 2008-2012.

The tradable permits were allocated to the electricity generating sector (including some sources of power not connected to the electricity grid, such as emergency generators in hospitals), to the petroleum refining sector, and to selected energy-intensive industries including iron and steel, cement, glass making, bricks and ceramics, and pulp and paper making. Coverage of the system was focused almost entirely on emissions of

CO2 (plus some nitrous oxide emitted in the Netherlands), even though the Kyoto Protocol covers six greenhouse gases or classes of gases. Thus the EU emission trading system (hereafter ETS) covered only 41 percent of the emissions of GHGs by the EU [Economist, 12/5/09].

The EU has three channels through which it can meet its commitment to reduce GHG emissions to 92 percent of 1990 levels: reductions in the sectors covered by the initial ETS; reductions in sectors not covered by the initial ETS, which include transportation, commercial buildings, households, agriculture, and other industrial sectors ; and by investing in certified, GHG emission reduction activities outside the EU and receiving credits towards meeting the EU targets for "Joint Implementation" activitities (investments in other Annex B countries) and Clean Development Mechanism operations (CDM, investment in developing countries). As we will see below, CDM credits (certified by a special UN organization to produce incremental reductions in GHG emissions in developing nations) have been a non-negligible activity both by EU governments through their foreign aid programs and by European firms. Such credits (CERs in European lingo) can also be traded, so investors are not obliged to use CDM credits which they earned themselves.

National governments were given substantial discretion in determining the level and distribution of free emission permits to over 11,000 installations, subject to general guidelines by the Brussels-based European Commission, which in turn was charged with designing and approving the policies to reduce GHG emissions. In particular, each country's "National Allocation Plan" could implicitly decide the proportion and distribution of the targeted emission reduction that would be born by the ETS-covered

sectors, compared with the non-covered sectors. Most of the initial National Allocation Plans for phase 2, submitted to the Commission in 2006 and 2007, required significantly less commitment to emission reduction by the ETS-covered sectors (with the exceptions of Denmark, France, Slovenia, and the United Kingdom), despite general agreement that these sectors could more easily reduce emissions during the commitment period than most of the non-covered sectors. The Commission pared back the proposed total allocations in virtually all member countries, such that the revised allocations were more or less in line with the share of emissions by the covered sectors. All of the central European new members (except Slovenia and Slovakia) challenged the Commission's revisions in the European Court. Poland and Estonia won their case in September 2009, on the grounds that the Commission had not followed proper procedures. The Commission appealed that decision, requiring these countries to submit new allocation plans, and suggested that since actual 2008 emissions were roughly in line with the Commission's revised allocations, little or no change would take place in their overall allocations.

As we shall see below, the national allocations also significantly distorted the allocation of permits across industries.

Once approved, the allocated permits were made available to the eligible firms for use during 2008. Subsequent allocations were to be made at the same level for each of the years 2009, 2010, 2011, and 2012. Firms that closed would lose their allocations; and special provision was made for allocating emission permits to new entrants in the covered industries, with about 4 percent of the allotted permits initially held back for this purpose. Unused emission permits (except for firms that closed) could be carried forward for

future use within the phase 2 period; and subsequent provision was made for carrying them forward into phase 3, covering the years 2013-2020, on which more below. Each firm receives its permits for the year in February and has until the end of April the following year to surrender the permits required to cover its actual emissions. Since by that April deadline, permits will have already been issued for the new year, a firm is able to draw on its new allocation to cover any excess of the previous year's emissions over its allocation for that year. This allows implicit borrowing in the system, a useful feature to provide temporal flexibility.

Given the lags in reporting and record-keeping, we have full information only for the first year (2008) of phase 2; definitive information for 2009 will not be available until May 2010. Thus, the remainder of this paper will focus mainly on the experience of 2008, plus 2009 for trading volumes and prices. These years were complicated by a world financial crisis in the fall of 2008, leading to a deep world recession in late 2008 and 2009 with weak signs of recovery by the European economies in late 2009. The recession depressed production, and hence CO2 emissions, especially in the manufacturing sectors.

Table 1 provides verified emissions for 2005, 2007, and 2008 for members of the EU-25 (comparable data for Bulgaria and Romania were not available), along with the free allocation of permits made to installations in those countries for 2008, including allowances to new installations but excluding the small numbers of permits auctioned by governments. It shows the extremely wide range of ETS-covered emissions per capita in these countries, from 1.3 tons in Latvia to 9.7 tons in Estonia, its neighbor to the north. These variations reflect not only latitude but also industrial structure, local generation (as

opposed to imports) of electricity, and the fuels used for electricity generation, e.g. mainly coal in Poland, hydro in Sweden, nuclear in France and Latvia.

The total allowable (ETS-covered) emissions for 2008 were 5.9 percent below the verified emissions for 2005, the first year of phase 1 [Ellerman and Joskow, 2008, Table 3], and 13 percent below emissions projected in 2006 for 2010 [Schleich et al., Figure 4]. As can be seen in Table 1, verified emissions in 2008 exceeded the free emission permit allocation by about 200 mmt, or just over 10 percent. This excess was covered in part by purchases of auctioned permits (about three percent of the total), and in part by purchase and surrender of CERs covering 82 mmt, which as explained above can be credited against emission targets. By inference, the remainder was covered by drawing on the allocation for 2009, which as noted above was made before the surrenders for 2008 were required. Thus ETS emissions for 2008, even after allowing for CDM investments, exceeded the target by about 1.5 percent. Since the annual allowable emissions were to be the same through 2012, this shortfall could have grown larger if normal growth of the European economies occurred, unless more vigorous action to reduce emissions were taken.

These are aggregates. Of course, any particular firm whose allocation of permits failed to cover its emissions could purchase the required extra permits in the ETS. Most of the large emitting countries were net purchasers of permits; among them only France had an excess of permits over emissions, as did several of the smaller and newer members of the EU. Thus for 2008 there were significant inter-country transfers, with Slovakia and Lithuania receiving the largest relative gains from free allocations in excess of emissions (26 and 23 percent, respectively), followed by Luxembourg (19 percent), the

Czech Republic (7 percent), Latvia (6 percent), France (5 percent), Malta (4 percent), and Sweden (4 percent). The two newest members of 2007, Bulgaria (10 percent) and Romania (11 percent) also had an excess of permits over actual emissions in 2008. As is evident, inter-country transfers did not go only to the poorest members of the EU. These inter-country transfers were notional, in that some installations may have kept their 2008 permits for future use; and they were carried out through the market in permits. Except for France, Luxembourg, and Malta, all of these countries had caps that exceeded their actual emissions in 2005. In financial terms, France was the largest beneficiary.

A striking feature of the permit allocations for phase 2 is how much they varied across industry, relative to their historical emissions, in most countries. In general, manufacturing sectors were favored at the expense of the power-generating sector, which was far the largest emitter among the sectors covered by the ETS.

Table 2 summarizes some of these results for nine large emitting countries. For these countries, as for the entire EU, verified emissions exceeded free permits allocated by about 10 percent. But relative to emissions, the industry allocation strongly favored the manufacturing sectors, especially steel (which here includes coke making) and bricks and ceramics. The latter had an excess of permits over emissions of nearly 40 percent. The shortfall was absorbed overwhelmingly by the power sector, and to a lesser extent by oil refining.

A rationale offered for this distribution was that the power sector could more easily pass on its increased costs to customers than could manufacturing firms, which were subject to international competition. (Of course, to the extent that power generators raised their prices to cover increased marginal costs for the extra permits they had to

purchase, the free distribution of permits to them would simply represent a corresponding transfer of wealth to the power companies and their shareholders.) However, the excess allocation of permits to manufacturing firms was not uniform across countries. Germany and Spain strongly favored their steel industries, Britain and Italy less so, Poland not at all. Britain, Italy, and Spain strongly favored their brick and ceramic sectors; France, its pulp and paper sector. (See Appendix Tables for the industry allocations by six major emitters.) Thus these differential allocations could lead to a serious distortion of competition within the EU, and to effective subsidies to firms exporting from the EU to the rest of the world. Firms could sell their excess permits into the market for cash, and apparently did so in the fall of 2008 to improve their cash flow when credit was tight [World Bank, 2009].

It is worth noting that all firms, whether or not they were allotted excess permits, would have an incentive to cut CO2 emissions, since they could sell excess permits at the going price in the market. Emissions thus had an opportunity cost, which shrewd financial managers would build into their operations and investment planning. But opportunity costs and actual outlays are two different things, and the latter typically catches the attention of managers much more readily than the former. Firms with excess allocations would be under little direct pressure (as distinguished from financial incentive) to cut emissions at all, and the data suggest that in the aggregate they did not do so.

In reviewing the national allocation plans in 2007, the Commission evidently focused more on the totals (which were typically revised downward) than on the distribution of permits across industries. As the extent of the differential allocations

became known, there were calls for "harmonization" of allocations in phase 3, to remove distortions to manufacturing competition across countries [Ellerman, 2010].

The world, including Europe, fell into a deep and unanticipated economic recession in 2008-2009, which no doubt led to a shortfall of both production and emissions relative to expectations in 2006 and 2007, when the allocations were planned and revised, respectively. In mid-2007, GDP growth in 2008 in the Euro area (then encompassing 13 members of the EU) and Britain was expected to be 2.3 percent [Economist poll of forecasters, reported in 8/4/07], compared with actual growth in 2008 of 0.6 and 0.8 percent, respectively. However, the recession did not produce a sharp downturn in industrial production until the fourth quarter of 2008; so the recession is likely to have affected emissions much more in 2009 than it did in 2008. Industrial production declined in the Euro zone by 1.8 percent in 2008, by 3.0 percent in Britain, and by 3.6 percent in Sweden. However, it grew slightly in Germany and the Netherlands, and by 2.7 percent in Poland. The declines are not nearly large enough to explain the discrepancy between the allocated permits and the actual emissions in the manufacturing sectors for that year, even after allowing for the fact that positive growth was expected when the permits were allocated.

Trading in Emission Permits

Thanks to the earlier experimental period, the institutional framework for trading permits had been well developed by 2008, and trading commenced with the beginning of phase 2. Prices of emission permits had fallen to zero in 2007, when investors became aware that permits had been issued in excessive amounts and would all expire at the end

of 2007, with no carry over into phase 2. Following the issuance of new permits, more restricted in total amount, prices commenced at over 20 Euros per metric ton of CO2, and rose irregularly to a peak of 29 Euros ($46) in July 2008. Oil prices reached their peak of $147 per barrel at the same time. Russian gas prices are linked to oil prices, and higher gas prices would slow the substitution of gas for coal in power generation, and thus increase future demand for permits. As with oil and other commodities, the high prices may have been supported by speculative purchases.

As the financial crisis became conspicuously worse, permit prices declined sharply (as did oil and other commodity prices), reaching a low of 8 Euro per ton ($10) in February 2009, before recovering into a range of 12-14 Euro per ton ($18-21) at the end of the year. Thus, the value of free allocations at end of 2009 prices was roughly $39 billion a year.

Even with recession reducing the need for permits, they retained value because they could be carried forward in time. The final EU decision in April 2009 assured that permits issued during phase 2 could be used in phase 3, a period during which (unlike phase 2) allowable emissions would be reduced from year to year, and an increasing share of permits would be auctioned by governments rather than allocated for free. Thus phase 2 permits have future value and, hence, present value despite the deep recession.

In addition to supporting spot trading in emission permits (called EUAs), markets have developed several derivatives of emission permits, especially options and futures. Thus, it is possible to buy (or sell) permits for delivery in December 2010, 2011, and even 2012. These have their own prices, but the prices of futures will tend to track spot prices, because investors can buy permits and hold them for future use. Forward prices at

the beginning of 2010 rose gradually from 13 Euro per ton for delivery in 2010 to somewhat over 14 Euro per ton for delivery in 2012.

The volume of trading of EUAs (both on exchanges and over the counter) rose steadily from 570 million metric tons in the first quarter of 2008 to 941 mmt in the fourth quarter, then rose sharply and abruptly to 1607 mmt in the second quarter of 2009 before falling back to 1125 mmt in the fourth quarter. The sharp rise in permit trading in early 2009 was no doubt driven in part by a desire for cash combined with the realization that not all of the permits would be used during 2009, especially by the manufacturing sectors. These increases in trading volume were accompanied, as noted above, by a sharp decline in prices. But the high volume was also apparently influenced by a scam involving differences across countries in the treatment of the value-added-tax on traded emission permits, which allowed arbitragers to capture the tax on trans-border trades, operating mainly through the French-based Bluenext exchange. This problem was recognized and corrected by the French authorities in June, but only after they had lost substantial revenue. Total traded volume in 2009 exceeded 5000 mmt, roughly 2.5 times the permits allocated for that year.

Preliminary analysis has estimated that in 2009, ETS-covered emissions declined by 12 percent from 2008, mainly as a result of the decline in industrial production. Preliminary estimates for 2009 suggest that real GDP fell by 4.3 percent from 2008. Electricity generation is estimated to have fallen by more than 4 percent from 2008, and steel production by an astonishing 33 percent, due to a significant drawdown in stocks. But prices of natural gas also fell sharply, relative to price of coal, inducing power generators where possible to shift from high-emitting coal to low-emitting gas. Increased

wind generation contributed modestly to the reduction in emissions. By one estimate, the ETS also contributed to the reduction, by seven percent below what they otherwise would have been (Bloomberg New Energy Finance, 15/1/10). However, the basis for this estimate is not explained, and it seems high on the basis of the pre-ETS declining trend in the carbon intensity of European production, amounting to 1.8 percent a year over the period 1990-2005. A further reduction by two percent was projected for 2010, as continued emissions reductions in the power-generating sector, reflecting low natural gas prices, more than offset an expected rise in emissions by the industrial sectors, especially steel.

ETS Phase 3: 2013-2020

To provide a high degree of certainty to the on-going effort, the EU has agreed on a post-Kyoto trading regime, definitively announced in April 2009, although certain details have yet to be made final. To address the problems of over-allocation, the national allocation plans will be abandoned in favor of an overall EU limit, an allocation principle for all member states, and standards harmonized by the Commission, all to be announced by the end of 2010. The next period will last eight years, rather than five, and will include annual reductions in emission allowances. The overall objective is to reduce GHG emissions to at least 20 percent below their 1990 base (or more, in the context of an international agreement). This overall objective has been divided between ETS-covered sectors, which are to reduce their emissions by 21 percent from their 2005 levels by 2020, and other sectors, where the reduction target will be approximately 10 percent below 2005 emissions. The ETS sectors, however, will be expanded to include aviation and

some other manufacturing sectors, and for administrative reasons will drop emitters with CO2 emissions below 25,000 metric tons a year and power plants with a capacity below 35 MW.

In addition, a substantial fraction–at least half--of the emission permits will be auctioned rather than given away. In principle, all permits for electricity generators are to be auctioned starting in 2013, although provision is made for derogations under certain conditions (it is assumed that among large emitters Poland will take advantage of this possibility). For industrial installations, 30 percent of permits are to be auctioned in 2013, rising to 70 percent in 2020 and 100 percent by 2027, subject to review in 2025. However, industries that are subject to strong international competition will be eligible for free permits, provided they use the most efficient technology, and up to a limit of their share of emissions in 2005-2007, declining year by year in line with the decline in overall targets. In September 2009 the Commission identified 164 industrial sectors and sub-sectors that possibly would be subject to "carbon leakage" through changes in foreign trade, and therefore were eligible for continued free allocations of permits. ("Carbon leakage" refers to the substitution for EU production by imports from countries that do not have an effective scheme to reduce GHG emissions.) Of these, 77 percent were in manufacturing, and covered about a quarter of total ETS-covered emissions. Significant risk of carbon leakage was considered to arise for any sub-sector if the sum of its exports plus imports (presumably extra-EU trade) exceeds 30 percent of the subsector's gross value added, or if direct and indirect emission costs exceed 30 percent of gross value added. "Indirect" emission costs refer mainly to the expected increase in electricity

prices arising from the permit trading scheme, based on an EU-wide coefficient of 0.465 mt of CO2 per MWh of electricity (from par. 13 of EU decision of 12/24/09).

The overall ETS target for 2020 based on phase 3 coverage will be 1,720 mmt, compared with 2,083 mmt in phase 2 (including allowances for new entrants) and actual emissions of 2,123 mmt in 2005. Also, allocations to firms are to be based on coefficients based on best performers (called benchmaking), applied to historical production, rather than to each firm's historical emissions of CO2. This will encourage firms to move toward best practice.

The EU will also deliberately favor its poorer members with permits in excess of what would be allocated to them under normal guidance – 12 percent of the EU total is to be used in this way. They are enjoined to introduce improved technology.

Credits and Offsets

It was envisaged in the Kyoto Protocol that Annex B countries could make investments in GHG-reducing activities in other Annex B countries (called Joint Implementation or JI) or in developing countries without Kyoto targets (called the Clean Development Mechanism, or CDM) and receive credit for these investments towards meeting their own Kyoto targets. (Obviously, under JI the host country could not count the same GHG reduction toward its own target.) The rationale was that GHG reductions could often be achieved at lower cost in another country; and from a global perspective, it is desirable to exploit these low-cost opportunities to reduce emissions.

A key issue, of course, is determining when a given investment reduces GHG emissions, relative to what they otherwise would have been without the Kyoto-based

investment. This issue of "additionality" is non-trivial, since new investment is constantly taking place in growing economies, technology is constantly advancing, and some of these new technologies will be energy-conserving, thus reducing CO2 emissions relative to earlier vintages of technology. An international review process has been established to certify new investments in developing countries for the contribution they make to reducing GHG emissions. However, controversy surrounds this process, with some arguing that it is too lax (there were some early examples of laxity involving industrial gases, or at least of inadequate attention to efforts by investors to game the system), and with others claiming that it is too rigorous. The certification process is lengthy and complicated (see World Bank, 2009).

Members of the EU have so far been the major sources of demand in this certification process. The World Bank (2009, p.55) estimates that nearly three-quarters of the demand for "Kyoto mechanisms" over the 2008-2012 period, amounting to 1,635 mmt CO2 equivalents, will come from the EU (the other major buyer is expected to be Japan). Both governments and private parties are expected to be buyers. A secondary market has developed in fully-certified projects deemed acceptable for meeting ETS targets. As noted, 82 mmt in certified emissions reductions (CERs) were surrendered for 2008, with 94 percent of the projects originating in China, India, South Korea, and Brazil, in that order.

Although acceptable, CERs trade at a (modest) discount to EUAs, presumably for two reasons. First, there are country-by-county limits to the use of CERs in meeting targets. While actual use remains well below these limits, they could become binding in the future, thus reducing the potential value of CERs relative to EUAs.

Second, while in practice the EU has accepted certification by the CDM process, it reserves the right to impose additional criteria for acceptability within the EU. Concretely, it has expressed strong reservations about any credits arising from projects involving forestry or changes in land use. The future acceptability of outstanding CERs seems secure; but new CERs beyond 2012 may be subject to additional requirements or exclusions (for example, projects from countries such as South Korea, which should "graduate" from developing country to developed nation status).

Joint Implementation has so far played a negligible role; but deals covering 18 mmt are reported to have been consummated in 2008, involving Hungary and Slovakia as sellers (of which 8 mmt was purchased by other EU members). These reports also foresee further 75 mmt in JI deals in the first half of 2009, with the Czech Republic and Ukraine being the major sellers, to Japan (World Bank, p.56).

Conclusions

The ETS system works from a technical point of view, a considerable achievement. Substantively, however, with a few exceptions, initial proposals for national allocations were too high and had to be reduced by the Commission, suggesting that governments are gaming the system for national advantage. Most accepted the Commission's revisions; but eight countries, most already with excessively generous Kyoto bases, appealed to the European Court, and two of them won their case, albeit on procedural grounds. The industry distributions of the revised national allocations significantly favored certain manufacturing sectors, providing indirect subsidies to these

sectors and thus potentially distorting both internal and external trade. The arrangements for phase 3 (2013-2020) address both of these problems.

There also was high price volatility during the first two years of phase 2 (as during phase 1), preventing the transmission of a consistent price signal to agents to invest in low-carbon technologies, either in power generation or manufacturing. This variation in permit prices in part reflected the sharp decline in economic activity in late 2008 and early 2009, suggesting that the social cost of CO2 emissions varies with the business cycle. In fact, such is not the case. An argument can be made that this holds for industrial air pollutants such as SO2 or particularate matter, which survive in the atmosphere for only a few weeks, and where pulmonary damage rises with concentration. The fallout and the atmosphere's natural dispersal attenuate the social damage when economic activity slows and emissions are low. But CO2 is a colorless, odorless long-lived gas, whose damage through climate change cumulates with its increasing concentration in the atmosphere. The social cost of an additional ton of CO2, in terms of climate change, is as high in recessions as it is during booms. It is inappropriate, therefore, to have the price of CO2 permits vary significantly in the short run. A steady, persistent price signal should be sent to all decision-making agents that they should reduce CO2 emissions at all times.

In 2008, despite the recession, ETS emissions were 10 percent higher than were allocated emission permits (1.5 percent higher after allowing for auctioned permits and CERs). The 3 percent decline in emissions from 2007 was not markedly greater than the 2 percent decline in industrial production. This suggests that emissions were not much reduced by the scheme, at least in its first year. The carbon intensity of industrial

production declined over the period 2005-2008 by nearly 8 percent. That is, while industrial production in the EU rose by 6 percent from 2005 to 2008, ETS-covered CO2 emissions, excluding Bulgaria and Romania, dropped by 1.7 percent (allowing for Britain's increase in coverage). Such a trend in declining carbon intensity, however. began well before the introduction of the ETS, averaging 1.8 percent a year over the years 1990-2005, relative to real GDP. Extrapolation of this trend to 2008 (based on industrial production, similar to ETS-coverage) suggests that a decline in CO2 emissions of two percent could plausibly be attributed to the ETS, and most of this was undoubtedly in the power-generating sector.

Some evidence suggests that little new investment occurred in technologies to reduce carbon emissions [The Economist,.12/5/09, pp.8-13]. On the other hand, we have experience for only two years, and they were terrible ones for new investment from mid-2008 on as credit markets froze and production declined. Switching power generation from coal to natural gas may have been encouraged by permit prices, but that interpretation is confounded by the sharp drop in gas prices from mid-2008. It will take recovery from the recession of 2009 to discover whether the ETS has been markedly successful in its objective to induce power generators and industrial installations to reduce their carbon emissions significantly.

Annex on Reaching Targets

It is difficult to keep track of the numbers on emissions. The Kyoto Protocol covers not just CO2, but also methane, nitrous oxide, and three groups of industrial gases, all converted to equivalents of CO2 by taking into account their absorption of radiation

from the earth and their life-time in the atmosphere (since most degrade through chemical actions long before CO2 does). The Kyoto Protocol itself only reported estimated CO2 emissions for 1990 for most of the countries in Annex B, i.e. those subject to targets. The base year was 1990 for most countries and for several gases, but countries could elect to use (presumably higher) emissions of the industrial gases in 1995 rather than 1990. And several countries of central Europe used base years earlier than 1990, thus inflating the base from which reductions were to take place.

The EU reports that targeted GHG emissions had declined by 3 percent in 2005 and by 5 percent in 2007 relative to base years, thus coming close to the commitment target of minus 8 percent by 2008-2012. The Kyoto target for the EU included only the fifteen members of 1997. Six of the ten new members of 2004, plus Bulgaria and Romania which joined the EU in 2007, also had a reduction target of eight percent. The reduction targets of Hungary and Poland were six percent; Cyprus and Malta did not have targets. The EU assesses that it will meet its Kyoto targets, and that is especially likely given the deep recession of 2008-2009.

In seeming contrast, the U.S. Energy Information Agency reports a growth in CO2 emissions from fossil fuels in OECD Europe of 6.7 percent from 1990 to 2005, not a decline as required by the Kyoto Protocol. What explains this apparent discrepancy? It is not likely to be due to measurement errors, since both sources have access to the same information and both reported in mid-2009. OECD Europe is not co-terminous with the EU, but the overlap is very great: OECD Europe includes all of the EU-15 plus new EU members Czech Republic, Hungary, Poland, and Slovakia, plus Iceland, Norway, and

Switzerland. The latter three countries are relatively small CO2 emitters because of their extensive use of thermal and hydro power.

CO2 emitted from fossil fuels is a major source of GHG emissions, but it is not the only source. There have apparently been significant declines in emissions of non-CO2 greenhouse gases, including in industrial solvents, industrial processes, agriculture, and waste management (as reported by the European Commission in IP/09/851, May 2009). There may also have been reductions in emissions of CO2 from non-fossil fuel sources, such as cement making and deforestation. Finally, as noted above, the later base for industrial gases raised the total base, by 0.7 percent, making it easier to reach given target reductions.

Nine of ten post-1997 members of the EU are comfortably within their Kyoto targets (the exception is Slovenia). For several countries, this seeming achievement is due in part to baselines inflated by the choice of a base year of 1990 or earlier. In the early 1990s, energy-intensive industrial production collapsed in these former communist countries, including East Germany, unified with West German in 1990 and included in Germany's base year. There was little prospect of recovery on the basis of the extremely inefficient use of energy that prevailed there, as well as in Russia and Ukraine, also included in Annex B. The choice of 1990 as a base year in negotiations that took place in late 1997 was an exercise in artful diplomacy to produce an agreement that looked substantially stricter for many European countries than it was.

The ETS-covered emissions account for less than half of the total emissions of CO2-equivalent greenhouse gases. The year 2005 is the first year for which solid information is available, firm by firm, on the national registers consolidated into an EU

register. It shows verified emissions of 2,012 mmt of CO2 for 2005, which amounts to nearly 39 percent of base-year GHG emissions for the EU-15.

The numbers published by the EU change from time to time, as some installations are closed (resulting in loss of permits), new installations are opened (or existing installation are significantly enlarged), which result in the issuance of new permits, as well as revisions in emission data and changes in coverage.

The EU reports an annual Kyoto target level of emissions of 3,924 mmt CO2 equilivants for the EU-15, which negotiated at Kyoto as a group. In late 2009, the EU projected annual non-ETS GHG emissions, without changes in policies, at 2,336 mmt during the commitment period 2008-2012 [IP/09/1703, 12/11/09]. By subtraction, that leaves 1,588 mmt for the ETS-covered sectors, before allowing for use of CERs or carbon sink activities. Since ETS-covered emissions for the EU-15 were 1,621 mmt in 2008 (see Table 1), and fell by more than 10 percent in 2009, and since almost all the new members are comfortably within their targets, the EU-27 will certainly meet its Kyoto targets unless there is an extraordinarily vigorous recovery in the next three years and no additional measures are taken.

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Table 1, Allocated Permits and Verified CO2 Emissions

Country	Verified Emissions			Free Allocations[1]	ETS Emissions per capita
	2005	*2007*	*2008 (mmt CO2)*	*2008 (mmt CO2)*	*2005 (mt CO2)*
Germany	474.0	487.1	472.6	388.8	5.7
UK	242.4	256.6	265.0[2]	213.6	4.0
Italy	225.5	226.4	220.7	211.7	3.9
Poland	203.1	209.6	204.1	200.9	5.3
Spain	182.9	186.6	163.5	154.0	4.2
France	131.3	126.6	123.4	129.6	2.2
Czech R.	82.5	87.8	80.1	85.5	8.0
Netherlands	80.3	79.9	83.5	76.8	4.9
Greece	71.3	72.7	69.9	63.7	6.4
Belgium	55.6	53.0	55.5	55.2	5.2
Portugal	36.1	31.2	29.9	30.4	3.4
Austria	33.4	31.8	32.0	30.1	4.0
Finland	33.1	42.5	36.1	36.2	6.3
Denmark	26.5	29.4	26.5	24.0	4.8
Hungary	26.0	26.8	27.2	25.0	2.6
Slovakia	25.2	24.5	25.5	32.2	4.7
Ireland	22.4	21.2	20.4	20.0	5.2
Sweden	19.3	19.0	20.0	20.8	2.1
Estonia	12.6	15.3	13.5	11.9	9.7
Slovenia	8.7	9.0	8.9	8.2	4.3
Lithuania	6.6	6.0	6.1	7.5	1.9
Latvia	2.9	2.8	2.7	2.9	1.3
Luxembourg	2.6	2.6	2.1	2.5	5.6
EU-15	1637.0	1666.8	1621.2	1457.2	
EU-10[3]	374.7	389.2	375.7	380.8	
EU-25	2011.7	2056.0	1996.7	1830.0	
Bulgaria	40.6	39.2	38.3	42.3	5.3
Romania	70.8	69.6	63.6	70.7	3.3
EU-27	2123.1	2164.8	2098.6	1943.0	4.3

[1] Including new installations; excluding auctioned permits.
[2] Includes about 20mmt of emissions from installations that were not covered in 2005.
[3] Including Cyprus and Malta, not shown separately.

Source: EU Commission Press Release IP/09/851, 29 May 2009.
Column 4: calculations by author.

Table 2, Free Permit Allocations and Emissions, 2008

Industry	Allocations (mmt CO2)[4]	Verified Emissions (mmt CO2)[5]	(1)/(2)
1.Power Combustion	928.6	1158.8	.80
2.Oil Refining	123.9	127.1	.97
3-5.Coke and Steel	184.2	134.6	1.37
6.Cement and lime	151.0	135.5-	1.11
7.Glass	20.3	18.3	1.11
8.Bricks and ceramics	13.0	9.3	1.40
9.Pulp and paper	29.4	24.4	1.20
99.Miscellaneous	0.9	0.8	1.10
Total	1451.3	1608.9	0.90

[4] For the nine largest economies, accounting together for 76% of total EU emissions in 2008.
[5] Same as footnote 1.

Spain, 2008

Industry	Allocated Permits (mmt CO2)	Verified Emissions	(1)/(2)
1. Power Combustion	81.20	105.60	.77
2. Oil Refining	15.60	14.40	1.08
3-5. Coke and Steel	12.50	7.94	1.57
6. Cement and lime	31.40	25.30	1.24
7. Glass	2.84	2.32	1.22
8. Bricks and ceramics	5.28	3.51	1.50
9. Pulp and paper	5.15	4.28	1.20
99. Miscellaneous			
Total	154.00	163.50	.94

Italy, 2008

Industry	Allocated Permits (mmt CO2)	Verified Emissions	(1)/(2)
1. Power Combustion	132.8	143.1	.93
2. Oil Refining	19.7	24.7	.80
3-5. Coke and Steel	18.8	15.5	1.21
6. Cement and lime	30.9	28.6	1.08
7. Glass	3.1	2.9	1.04
8. Bricks and ceramics	0.8	0.5	1.61
9. Pulp and paper	5.1	4.8	1.08
99. Miscellaneous	0.4	0.4	1.00
Total	211.6	220.5	.96

Poland, 2008

Industry	Allocated Permits (mmt CO2)	Verified Emissions	(1)/(2)
1. Power Combustion	172.0	176.0	.98
2. Oil Refining	3.1	3.0	1.03
3-5. Coke and Steel	9.4	9.5	.99
6. Cement and lime	13.1	12.5	1.05
7. Glass	1.5	1.5	.97
8. Bricks and ceramics	0.7	0.7	1.07
9. Pulp and paper	1.2	1.0	1.18
99. Miscellaneous			
Total	200.9	204.1	.98

France, 2008

Industry	Allocated Permits (mmt CO2)	Verified Emissions	(1)/(2)
1. Power Combustion	57.6	56.3	1.02
2. Oil Refining	18.3	19.6	.93
3-5. Coke and Steel	26.0	24.5	1.06
6. Cement and lime	18.6	16.8	1.11
7. Glass	3.7	3.3	1.13
8. Bricks and ceramics	1.1	0.9	1.26
9. Pulp and paper	4.2	2.9	1.46
99. Miscellaneous			
Total	129.6	124.3	1.04

Germany, 2008

Industry	Allocated Permits	Verified Emissions (mmt CO2)	(1)/(2)
1. Power Combustion	257.8	368.8	.70
2. Oil Refining	27.4	26.7	1.03
3-5. Coke and Steel	60.4	36.4	1.66
6. Cement and lime	29.9	29.0	1.03
7. Glass	4.4	4.2	1.05
8. Bricks and ceramics	2.0	1.4	1.37
9. Pulp and paper	6.8	6.0	1.12
99. Miscellaneous			
Total	388.8	472.6	.82

United Kingdom, 2008

Industry	Allocated Permits	Verified Emissions (mmt CO2)	(1)/(2)
1. Power Combustion	150.5	210.7	.71
2. Oil Refining	18.6	17.5	1.06
3-5. Coke and Steel	23.6	20.3	1.16
6. Cement and lime	14.3	11.4	1.25
7. Glass	2.4	1.9	1.26
8. Bricks and ceramics	1.6	1.0	1.53
9. Pulp and paper	2.1	1.9	1.14
99. Miscellaneous			
Total	213.6	265.0	.81