The European Union Emissions Trading System: Ten Years and Counting

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Introduction

The European Union (EU) Emissions Trading System (ETS) is the world's largest cap-and-trade program and arguably the most important market-based application of economic principles to the climate problem. From its inception, the EU ETS has drawn attention and been the subject of vigorous debate in the public arena. In fact, in 2007, it was the topic of the symposium in the inaugural issue of this journal. The articles in that symposium discussed the unusually decentralized nature of the EU ETS (Kruger, Oates, and Pizer 2007) and provided an initial assessment of its performance during its first two years (Convery and Redmond 2007; Ellerman and Buchner 2007). In 2015, the EU ETS started its eleventh year, having completed its second phase (2008–2012) and begun its third phase (2013–2020) under an EU-wide cap on emissions that is declining indefinitely at an annual rate of 1.74 percent.

The objective of this journal's second symposium on the EU ETS is to review and evaluate the literature on the EU ETS (as of 2014), to draw some conclusions about the performance of the EU ETS, and to suggest a research agenda to address unresolved issues. In this introductory article, we provide an overview of the EU ETS to serve as background for the topics discussed in the other two articles. In the first article, Hintermann, Peterson, and Rickels (2016) examine market and price behavior in the EU ETS. The second article, by Martin, Muûls, and Wagner (2016), addresses the effect of the EU ETS on the behavior of regulated firms with respect to abatement, competitiveness, and innovation.

The remainder of this article consists of three sections. The first section describes the history and structure of the EU ETS. The second section reviews the performance of the EU ETS over its first ten years, focusing on emissions, allowance prices, and the use of offsets.[1] The final section

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[1]Offsets are emission reductions accomplished outside of the system that can be used to substitute for reductions that would otherwise occur within the system. In the EU ETS, the only offsets allowed are those certified under

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discusses the continuing debate about the design of the EU ETS and the recently adopted and proposed changes to that design.

History and Structure of the EU ETS

The EU ETS is a classic cap-and-trade system.[2] As of 2014, the EU ETS covered approximately 13,500 stationary installations in the electric utility and major industrial sectors and all domestic airline emissions in the EU's twenty-eight member states, plus three members of the closely associated European Economic Area: Norway, Iceland, and Liechtenstein. Approximately two billion tons of carbon dioxide (CO_2) and some other greenhouse gases (GHGs) are included in the system, together accounting for about 4 percent of global GHG emissions in 2014 (Olivier et al. 2014). Aside from its sheer size in terms of geographic scope, number of included sources, and value of allowances, another distinguishing feature of the EU ETS is its implementation through a multinational framework, namely the EU, rather than through the action of a single state or national government, as assumed in most theory and as has been the case for most other cap-and-trade systems.[3] We turn now to the process by which this multinational system was adopted.

Legislative Development

The first clear signal that the EU might implement an emissions trading system was in 2000, when the European Commission issued the *Green Paper on Greenhouse Gas Emissions Trading within the European Union* (European Commission 2000). This paper discussed whether the EU should implement an EU-wide cap-and-trade system to limit GHG emissions (initially CO_2) to complement other policies and measures, chiefly concerning energy efficiency and renewable energy, implemented primarily at the member-state level. Such a cap-and-trade system was also viewed as a means to ensure achievement of the targets to which the EU and its member states had committed in the Kyoto Protocol (KP). The green paper laid out the essential features of the system that would become the EU ETS: a trial period to run from 2005 through 2007, followed by full implementation over the 5-year period corresponding to the First Commitment Period of the KP (2008–2012). Following extensive debate, the ETS Directive was unanimously adopted by the European Council of Member States in October 2003 (OJEU

the Kyoto Protocol through the Clean Development Mechanism (Certified Emission Certifications [CERs]) and Joint Implementation (Emission Reduction Units [ERUs]).

[2]In a cap-and-trade system, a constraining quantitative limit is placed on the aggregate emissions of a specified set of plants, and trading of implied emission reductions is allowed among these plants in order to minimize cost. Such trading is conducted through the sale and purchase of allowances, which are issued in an amount equal to the aggregate cap. Regulated plants are required to surrender an amount of allowances equal to their emissions. Allowances can be acquired either through free allocation or by purchasing through auctions or from others through trading.

[3]When the EU ETS was created, the main example of cap-and-trade was the U.S. Sulfur Dioxide Trading Program, which was implemented as a federal program. Other smaller cap-and-trade systems existed at the subnational level in the United States and in some European nations, but all were smaller and under a single jurisdiction. Since the creation of the EU ETS, other multijurisdictional cap-and-trade systems have been created, including the Regional Greenhouse Gas Initiative in the Northeastern United States and the linked system of California and Quebec.

2003). And, as initially proposed in the green paper, the EU ETS went into effect on January 1, 2005, 15 months later.

In October 2004, the ETS Directive was amended by the Linking Directive (OJEU 2004), which allowed the owners of affected facilities to substitute a yet-to-be-specified number of offsets (i.e., credits from the KP's Clean Development Mechanism [CDM] and Joint Implementation [JI]) to fulfill their obligation to submit EU allowances (EUAs) equal to their annual emissions.

In keeping with the spirit of an initial trial period, the ETS Directive called for the European Commission to review the first years of experience and to propose appropriate changes to the ETS. This review led to the adoption of significant revisions to the EU ETS in late 2008 (OJEU 2009b), which would govern the system from 2013 on. The most important changes in this Amended Directive were the following:

- adoption of a single EU-wide cap declining at 1.74 percent per annum;
- adoption of auctioning as the basic allocation principle, to be fully applied to the electric utility sector in 2013 and to be phased in by 2027 for the remaining industrial sectors;
- continued free allocation for industrial facilities according to centrally determined benchmarks during the transition to full auctioning; and
- changes in offset provisions that further limited their use while expanding the scope for linking with GHG cap-and-trade systems that might develop in other parts of the world.[4]

The significance of the single EU-wide cap can only be appreciated by recognizing the considerable decentralization of cap-setting and allocation of allowances that existed under the initial ETS Directive.

Evolution from a Highly Decentralized Structure to an EU-Wide Cap

In its early years, the EU ETS can be best understood as a system for the mandatory linking of twenty-five member-state systems, each of which set its own cap and determined the distribution of allowances to affected facilities, subject to a 90-day review by the European Commission. More specifically, each member state developed a National Allocation Plan (NAP) stating the total number of allowances to be created and how they would be allocated to affected installations in the member state. These NAPs would go into effect unless the commission rejected the NAP because it failed to comply with certain criteria in the ETS Directive. In effect, the EU-wide cap was the sum of the member-state caps, and it would not be known definitively until the last NAP had been reviewed and not rejected.[5]

[4]Among other notable changes were the inclusion of the chemical and aluminum sectors beginning in 2013. A separate Aviation Directive (OJEU 2009) further expanded the scope of the ETS to include aviation emissions starting in 2012. Inclusion of emissions over non-EU airspace for flights originating in the EU and terminating elsewhere (and vice versa) proved to be controversial internationally and led to later amendment to limit included emissions to those over EU airspace. In addition, the global system being developed by the International Civil Aviation Organization (to take effect in 2020) is expected to supersede the EU ETS with respect to these emissions.

[5]The commission was empowered to reject NAPs only if they did not meet the criteria for cap-setting and allocation agreed by the member states in the ETS Directive. Nonrejection constituted implicit approval, but in the multinational context of the EU, it is considered beyond the capacity of the commission, a mere secretariat, to "approve" the actions of a sovereign state. This may be a distinction without a difference, but it was important in terms of respecting national sensibilities.

The NAP process proved to be long, laborious, and unrewarding for all concerned. In both the 2005–2007 and 2008–2012 periods, the commission rejected many NAP submissions, and several member states subsequently challenged these rulings before the European Court of First Instance.[6] It was not until 18 months into phase I that the last NAP cleared the commission's review. The second NAP cycle started at this time, 18 months before the start of 2008, but member states were often late in submitting, and the final NAP to clear review without being rejected did so 1 month before the start of phase II. A year later, the member states agreed unanimously to abandon the NAP process and instead to adopt a system-wide cap to take effect in 2013. The single cap required a new set of principles for distributing allowances, which we explain next.

Auctioning and Centralized Allocation Rules

The two greatest criticisms of the first phase were the "windfall profits" from free allocation and the alleged competitive distortions resulting from different member-state rules for allocation. Despite strong arguments in the European Parliament for significant auctioning of allowances, the directive finally agreed upon in 2003 required that at least 95 percent of allowances be allocated freely in the first phase and 90 percent in the second phase. In effect, decentralized free allocation was the political price for ensuring the participation of all member states in this multinational trading system.[7] Auctioning addressed both criticisms of the NAP process in one fell swoop. That is, windfall profits would be eliminated, as would the possibility of competitive distortions within the single EU market. However, auctioning would be phased in, which meant that EU-wide, sector-specific standards would have to be developed to avoid distortions from the remaining free allocation.

The timing by which auctioning would be introduced and free allocation phased out varied according to sector, perceived loss of competitiveness in international (non-EU) trade, and when the member state joined the EU. For example, free allocation ended abruptly in 2013 for the electric utility sector, which accounts for about 50 percent of EU ETS emissions (Trotignon and Delbosc 2008, p. 23) and was deemed not to face any competitive threat internationally. Some exceptions were allowed for coal-dependent new member states in Eastern Europe, which have more time to phase out free allocation, provided that they make investments in the modernization of the electricity sector.

The nonelectric industrial sectors, which face varying levels of non-EU competitive pressures, were allowed a more gradual phase out of free allocation beginning in 2013. Allocations to affected facilities were to follow EU-wide sector standards—called benchmarks—to be developed during phase II. For these industrial facilities, free allocation would start at 80 percent of the full benchmark in 2013, be reduced to 30 percent by 2020, and then phased out completely by 2027. In addition, if certain sectors continue to face competitive threats internationally, they will receive free allocations at the full benchmark level so long as the threat is determined to exist. The development of these sector-specific, EU-wide standards for free allocation was no small achievement.

[6]See Ellerman, Convery, and de Perthuis (2010), pp. 42–60, for the details of these rejections and legal challenges.
[7]For a detailed discussion of the debate leading up to the adoption of the EU ETS, see chapter 5 of Skjaerseth and Wettestad (2008).

Benchmarking

Perhaps no concept had been more advocated and less practiced during the NAP process for the first and second trading periods than benchmarking (Ellerman, Buchner, and Carraro 2007). The basic problem was the lack of agreement on a suitable benchmark, which, when combined with the rushed conditions under which the NAPs were developed, made it inevitable that the basis for allocation would be historical emissions. The Amended Directive resolved this issue by requiring the EU-wide benchmarks to be the average emission rate per unit of output for those installations in each ETS sector constituting the 10 percent with the lowest CO_2 emission rates in 2005. Although defining sectors was a challenge, benchmarks were established for some fifty sectors before the end of phase II. Finally, these benchmarks were subject to an initial 6 percent reduction to reconcile the resulting free allocations with the previously decided EU-wide cap and amounts to be auctioned, and they will decrease by the same annual 1.74 percent factor that now governs the whole EU ETS (OJEU 2013a). With benchmarking resolved, the only remaining issue was deciding what to do with the revenue from auctioning.

Revenues from allowance auctioning

A long-standing fiscal rule for the EU made revenues from allowance auctioning a nonissue. Brussels is to have no independent sources of revenue other than as provided by the member states through the 7-year budgets. Accordingly, revenues from the allowance auctions will be distributed to member states as "auction rights" established by a formula that is inversely, but loosely, related to per capita income (Ellerman 2010).

In less than 10 years, the EU ETS evolved from a trading system in which largely sovereign nations initially demanded and received considerable discretion in cap-setting and allocation to one in which those decisions are system-wide, although still negotiated among the participating member states. In the end, national caps mean little in a system with full trading, and arguably what matters most to the participating governments is the equitable distribution among themselves of the value created by the constraint on emissions. The experience of the EU ETS shows that, although free allocation may be needed to gain initial buy-in of participating nations and their affected facilities, the initial allocation to the private sector of the value created by the cap is not forever and can be remarkably brief.

Thus far, we have discussed the EU ETS as if it were a stand-alone system without relation to international agreements or trading with other GHG systems. However, it is embedded in an international framework, and the international aspects of the EU ETS are a source of continuing change.

The Relationship to the KP and Linkage

The EU ETS was proposed and justified as a means for the EU and its member states to meet their Kyoto obligations, but implementation was not made contingent on the KP entering into force, despite the considerable uncertainty surrounding that issue when the initial ETS Directive was adopted in 2003. Moreover, implementation of the EU ETS beyond 2012 (when Kyoto obligations ended) does not depend on other international agreements, although its implementation is often justified on the basis of the EU's contribution to such agreements.

The EU's evolution toward independent action can also be observed in the provisions for linkage, a generic term that refers to both the acceptance of international credits and mutual recognition with other cap-and-trade systems. Reliance on an international agreement is explicit in the Linking Directive's effective delegation of the certifying authority for determining acceptable international offsets to the KP's CDM and JI crediting procedures. Nevertheless, the EU retained its prerogative (as a buyer of credits) to impose a system-wide quantitative limit on their use and to prohibit the use of credits from certain types of projects, such as large hydro installations and nuclear-generating plants. Subsequently, the Amended Directive of 2009 stated that credits from new projects (those certified after 2012) would not be accepted absent a post-2012 international agreement to which the EU and the host country adhered or a bilateral agreement between the two. Moreover, credit use within phase III (2013–2020) was limited to about 300 additional credits beyond the 1.3 billion limit imposed in phase II.[8] Finally, the European Commission unilaterally announced in 2010 that CDM credits generated by industrial gas projects with high global-warming potential would not be accepted for compliance beyond 2012 under any circumstances (OJEU 2011).

These tightened restrictions on credit use were coupled with provisions that make mutual recognition (unrestricted trading between two systems) easier. Whereas the 2003 ETS Directive limited mutual recognition to parties to the KP (i.e., national systems), the Amended Directive dropped all mention of the KP (or any international agreement), thereby clearing the way for bilateral agreements. In addition, it explicitly mentions potential linkage to subnational systems, as long as they have an absolute cap.

To date, there are two examples of mutual recognition, one with Australia, announced and subsequently abandoned, and the other under negotiation with Switzerland.[9] The distinguishing feature of these two examples of potential linkage by mutual recognition is that they are bilateral—that is, negotiated between the parties directly and not as part of a larger international agreement. The EU is also watching developments in the South Korean system and the pilot or national systems in China with an eye to eventual linkage.

These developments in restricting the use of project credits and opening up the potential for mutual recognition with other cap-and-trade systems reflect not only the willingness of the EU to act independently of international agreement but also an unstated policy of "graduating" countries that demonstrate the ability to generate project credits to full-fledged cap-and-trade programs that can be linked to the EU ETS, thereby forming the basis for an eventual global system of GHG emissions trading.

Before leaving the historical and contextual background of the EU ETS, we turn to the relationship of the ETS to other climate and energy policies in the EU.

Relationship to Other EU and Member-State Climate and Energy Policies

Although the EU ETS has been heralded as the centerpiece of the EU's climate policy, it is not the EU's only climate policy instrument. In fact, the slogan for the EU's present comprehensive

[8]To the extent that the phase II limit of 1.3 billion credits was not used, the CDM's Certified Emission Certifications (CERs) equal to the difference could be converted into phase III allowances.
[9]The intended Australian linkage will not occur because the Australian cap-and-trade system was repealed when the government changed in 2013.

climate policy is "20-20-20 by 2020," which refers to the three targets to be achieved by 2020: a 20 percent reduction of GHG emissions from 1990 levels, a 20 percent share of total energy consumption from renewable energy, and a 20 percent improvement in energy efficiency. While the 20-20-20 slogan suggests that equal weight is being placed on achieving each of the three goals, their legal statuses vary. The GHG emissions-reduction and renewable energy–share targets are binding, whereas the energy-efficiency target is effectively aspirational, with no sanctions for noncompliance.[10]

It is important to note that the measures adopted by member states to achieve the renewable-energy and energy-efficiency targets affect the 40 percent of EU GHG emissions that are covered by the EU ETS. In particular, several member states, notably Germany and Spain, have provided strong incentives to develop wind and solar energy capacity within the electricity sector, such that the generation of electricity from renewable sources in these member states has had a demonstrable effect on the generation of electricity from CO_2-emitting, fossil fuel–generating plants. For instance, in 2014 electricity generation from wind and solar accounted for 24 percent and 16 percent of total generation in Spain and Germany, respectively (ENTSO-E 2015). What remains to be seen is whether the concomitant reductions in demand for allowances will have a large or small effect on allowance prices.[11]

EU-level climate policy is not the only potential source of overlap with the EU ETS. Member states can adopt their own energy or climate policies, which may also affect that member state's ETS emissions and thus affect the EU ETS-wide allowance price and distribution of abatement. For example, following the Fukushima accident in March 2011, the German government accelerated its policy to phase-out nuclear power by immediately shutting down eight reactors and directing the others to close down by 2022. Although one can debate how much zero-emission renewable energy can substitute for nuclear generation during and after the nuclear phase-out, the nuclear phase-out is likely to cause some increased reliance on fossil generation, both natural gas and coal-fired, and thus an increase in the demand for allowances and an increase in the EUA price.

In contrast, the UK's carbon price floor is likely to have the opposite effect. In order to encourage investment in low-carbon generating capacity, the United Kingdom imposed a tax on fossil-fuel supplies to electricity-generating facilities in April 2013. Known as a carbon price support, the tax is supplementary to the EUA price and set at a level that will yield a carbon price of £16/ton CO_2 in 2013 and £30/ton CO_2 in 2020 (approximately €19/ton and €35/ton) when the EUA price and the UK price support will be combined. Given the current EUA price of around €8/ton, this measure imposes a significantly higher carbon cost on fossil-fuel electricity-generating facilities in the UK than in other EU member states. Thus, the UK carbon price floor can be expected to reduce coal and natural gas generation in the United Kingdom and hence the demand for allowances. As is the case for the other examples of overlapping policies, the direction of the effect on the EUA price is clear, but the magnitude is not.

[10]In the EU context, "binding" means that the commission can bring member states before the European Court of Justice for failure to comply with EU directives. In addition to the ETS, for which the requirements upon affected installations are enforced by member states, the latter are also obligated to achieve agreed aggregate limits for non-ETS emissions, principally transportation and residential emissions.

[11]Martin, Muûls, and Wagner (2016) discuss the ongoing research on this issue in more detail.

Performance of the EU ETS

With this background on the initial design, development, and implementation of the EU ETS, we now turn to a discussion of its performance through the end of phase II and into the first years of phase III.

Emission Reductions

The first and most important measure of performance for any cap-and-trade system is emissions: that is, are emissions being reduced? Answering this question requires that we look at some of the determinants of CO_2 emissions, among which the level of economic activity is perhaps the most important.

Recent trends in emissions and economic activity

Figure 1 compares the evolution of EU ETS emissions between 2004 and 2014 with the evolution of two measures of economic output: real gross domestic product (GDP) for the twenty-five EU member states that were initially part of the EU ETS (EU25) and the industrial component of real GDP—gross value added (GVA). GVA includes electricity generation and most closely approximates the underlying economic activity of the sectors included in the EU ETS. All three indices are normalized to the year 2004, the year preceding the start of the EU ETS.

As can be readily seen, the financial crisis of 2008 and the ensuing recession had a noticeable effect on levels of economic activity and CO_2 emissions. And indeed the reduction of GVA in the industrial sector surely accounts for most of the reduction in ETS emissions observed between 2007 and 2009. However, since the low points in 2009, EU25 GDP has returned to its earlier level, and the corresponding GVA has recovered to within 5 percent of its earlier peak. CO_2 emissions have followed a different path. There was a 3.3 percent rebound in 2010 (compared with a 7.7 percent gain in industrial output), but since then, CO_2 emissions have continued to decline, and since 2012 have been lower than in 2009 despite the recovery in economic activity. Over the 10-year period (2004–2014), GDP and industrial output have

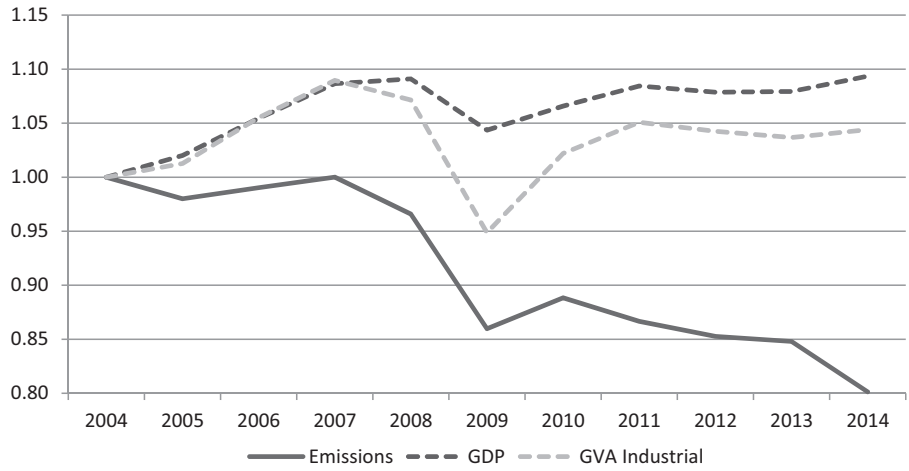

Figure 1 Evolution of EU ETS emissions and economic output, 2004–2014
Sources: Derived from Herold (2007), Eurostat (2015a, 2015b), and European Commission (2015b).

increased at average annual rates of 0.92 percent and 0.55 percent, respectively, whereas CO_2 emissions have declined by an average annual rate of 2.1 percent. The ratio of ETS emissions to GDP has declined at an average rate of 3.0 percent, compared with a rate of decline of about 1 percent between 2000 and 2004 (Ellerman, Convery, and de Perthuis 2010, p. 164). These data suggest that there has been some decoupling of emissions and economic activity in recent years.

It is important to clarify that the line for emissions in figure 1 indicates CO_2 emissions from those installations participating in the ETS in 2005 and 2006. It does not account for the addition of new countries (Romania, Bulgaria, Croatia, Norway, Iceland, and Liechtenstein) and sectors (aviation, chemicals, aluminum, and some non-CO_2 GHGs) since 2006. Over the years, these additions have expanded the coverage of the EU ETS by about 10 percent.

Another caveat is that other policy measures and the long-term trend toward increased energy efficiency have contributed to the reduction in CO_2 emissions within the EU ETS. As emphasized by Martin, Muûls, and Wagner (2016), sorting out the effects of the CO_2 price from other factors is no easy task. Nevertheless, ETS emissions fell by 20 percent over the past 10 years, notwithstanding the recovered, albeit barely growing, levels of economic activity.

The long-term outlook

Whatever the contribution of the EU ETS to the reduction in emissions shown in figure 1, there can be no doubt about the future trend of emissions in the EU ETS. The declining cap will force emissions continually lower over time. And, as can be seen in figure 2, the emissions are on track to meet that declining cap.

As in figure 1, the data in figure 2 exclude the increases in the coverage of the ETS since 2005. Figure 2 also shows the amount by which the cap was increased in phase II through offsets surrendered in each year and the much smaller amount by which offsets will increase the cap in phase III. The area between emissions and the cap plus offsets through 2014 shows the cumulative amount of allowances banked to date. These allowances will likely be used in later years as costs rise, so emissions may rise above the cap for some years. However, there can be no doubt that the long-term trend of EU ETS emissions is downward, even without considering the

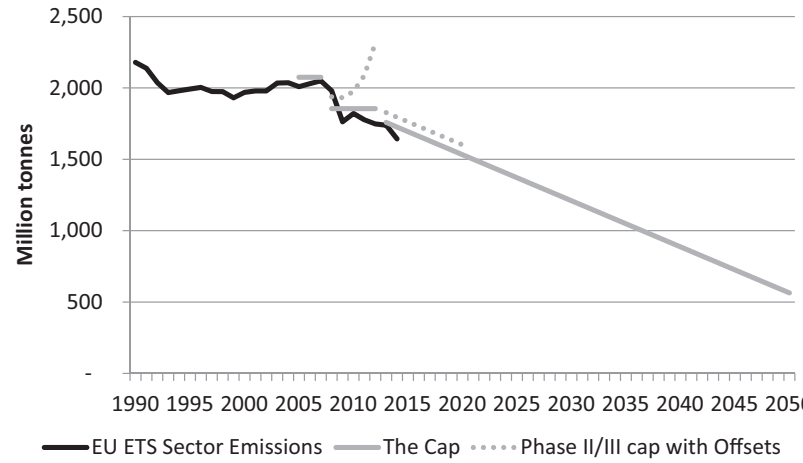

Figure 2 Long-term perspective on EU ETS sector emissions and cap, 1990–2050
Sources: Derived from Herold (2007), European Commission (2015b), and OJEU (2013b).

Figure 3 Next December EUA futures prices in phase I and phases II and III
Sources: Point Carbon (2013a) and ICE (2015a).

increased rate of decline of the cap from 2020 that the commission has recently proposed (European Commission 2014, 2015a).

Allowance Prices

As the most visible manifestation of a cap-and-trade system, allowance prices receive a great deal of attention and are often viewed as indicating how well the system is functioning. We next provide an overview of price trends, a discussion of the effect of banking on price behavior, and data on the volume of emissions trading.

Overview of price trends

As illustrated by figure 3, a highly visible price for EUAs has existed since the beginning of the EU ETS in 2005.[12] This figure shows the prices of the next December futures contracts, which have become the main trading instruments in the EU ETS.[13]

The EUA price has varied considerably over the first 10 years of the EU ETS, particularly in late 2006 and during 2007, when the prices of phase I and phase II allowances also diverged significantly and as it became clear that phase I and phase II constituted separate markets with differing degrees of expected scarcity. When the EU ETS first started, the price of EUAs was expected to be between €5 and €10, and the prices obtained in early 2005 reflected this expectation. Soon thereafter, the EUA price rose quickly, triggering a debate over the reasons for the unexpectedly high price. The debate lasted until late April 2006, at which time several member states reported their emissions for 2005, with all being lower than expected. In response, the price for both phase I and phase II allowances fell significantly: by 50 percent and 30 percent, respectively. During the summer of 2006, the phase I price held at around €15, but as autumn began and as it became increasingly clear that phase I emissions would be below the

[12]We briefly describe (rather than interpret) EUA price movements here. See Hintermann, Peterson, and Rickels (2016) for a review of the voluminous literature on this topic.
[13]These contracts settle in early December, shortly before the close of the compliance year and some 5 months before allowances must be surrendered against emissions.

cap, the price for phase I EUAs fell to a few euro cents, while the price of phase II EUAs remained generally between €15 and €20. As phase II began, the phase II price reached almost €30 before it fell again by about 50 percent as a result of the economic crisis of late 2008. This time, however, the price drop was not specific to the EU ETS; many other asset values (e.g., stocks, bonds, crude oil) experienced similar declines. After recovering somewhat in early 2009, the EUA price experienced a 2-year period of stability—with a price around €15—until the summer of 2011, when it fell again by around 50 percent, to a new low of €7–8 in 2012, before falling yet again, to around €4 as phase III began. Despite predictions by some observers that the price would again fall to zero, it did not, with €3.65 being the lowest price observed. In the 18 months since the all-time low at the beginning of 2013, the EUA price has risen steadily to more than twice the early 2013 low.

The influence of banking on allowance prices

An examination of the price of EUAs at the end of phases I and II and the size of the allowance surplus accumulated in each phase highlights the importance of banking and its role in establishing a floor on prices. More specifically, the surplus was 83 million allowances at the end of phase I and 1.8 billion allowances at the end of phase II (European Commission 2015b), yet the price did not go to zero in 2012 as it did in 2007. This is because the phase I surplus allowances could not be carried over for use in phase II, whereas phase II allowances can be banked for use in phase III and later years when the cap will be even lower and prices are expected to be higher.

Trading of EUAs

Initially, EUA trading was over-the-counter, as it had been for other cap-and-trade programs, such as the U.S. sulfur dioxide (SO_2) Trading Program. However, organized exchanges started

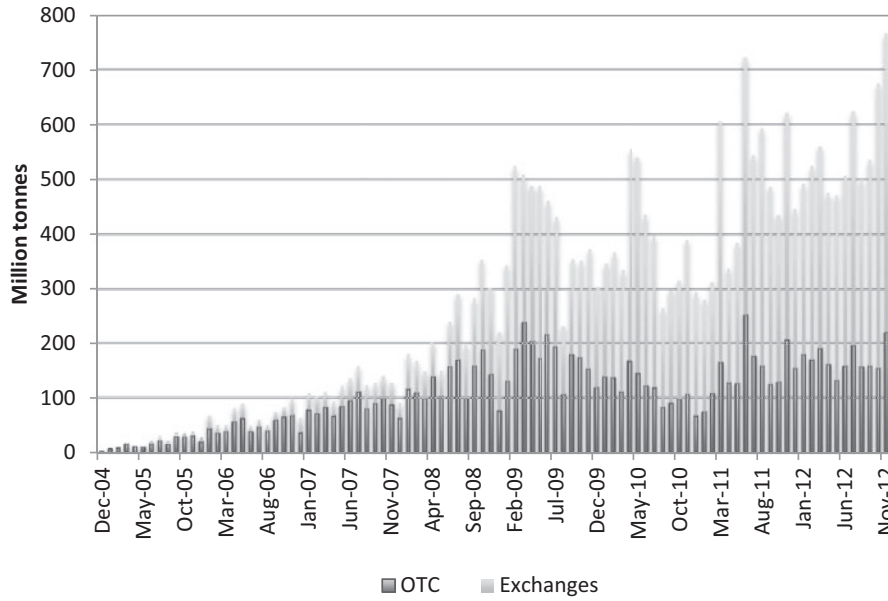

Figure 4 Monthly volume of EUA trading
Source: Point Carbon (2013a).

offering intermediary and hedging services shortly after the EU ETS began, and their share has grown steadily, accounting for as much as 80 percent of the trades in 2012, as shown in figure 4.

Two trends are clear. First, the overall volume of trades involving EUAs has steadily increased over the life of the program. At the beginning, more than a year passed before trading exceeded 50 million allowances (or tons of emissions) a month. Over the next 5 years, trading volumes grew steadily to ten times that amount. The second trend is the already-noted shift in the location of trading (i.e., from over-the-counter to exchanges). While several exchanges offer intermediary and hedging services, such as Nordpool in Norway and EEX in Germany, the most important exchange has been the European Climate Exchange (ECX, now ICE) in London, which accounted for more than 90 percent of the exchange volume in 2012 (Point Carbon 2013a). Most of the transactions on these exchanges are for futures. Spot transactions have accounted for a small percentage of trades, and the leading exchange for spot transactions, BlueNext in Paris, closed at the end of 2012.

Offsets

The EU ETS has conducted the world's boldest experiment to date in the use of offsets. Most cap-and-trade systems (e.g., US SO_2 and nitrogen oxides trading, the Regional Greenhouse Gas Initiative, California CO_2) include provisions for offsets. However, such offsets are little (and often never) used because of the transaction costs of implementing monitoring, reporting, and verification procedures at off-system installations. The EU ETS broke new ground in two respects: it delegated offset certification authority to outside entities (i.e., those that already certify CDM and JI credits under the KP), and it imposed a quantitative limit on their use—approximately 11 percent of the phase II cap (OJEU 2013b). This experiment in offset use provides evidence on the use of offsets, their pricing relative to EUAs, and the origin of these substitute emission reductions, which we discuss next.

Offset issuance and use

The EU ETS was not the sole market for CDM and JI credits; many were produced and bought by national governments throughout the world to satisfy obligations under the KP. However, the EU ETS was the largest single source of demand for these credits and the one with a relatively high price, thus providing considerable impetus for the creation of these credits. Table 1 presents data on the number of offsets submitted in lieu of EUAs to satisfy EU ETS compliance requirements through 2012 and the total number of these credits that were issued under the KP mechanisms (CDM and JI) in those years, including those used in the EU ETS.

Several findings emerge from these data. First, half of the offsets issued under the KP through April 2013 were used for compliance in phase II of the ETS, reflecting the program's status as the preferred, highest-return destination for these credits. Second, offset use started off very slowly, but it increased exponentially in the last three years of phase II, with half of the total offsets surrendered in 2012. Finally, the 1.3 billion phase II cap on offset use was not exceeded. Because unused entitlements to these credits (up to the phase II limit) can be converted to phase III allowances, the cumulative phase III cap will be higher by at least 240 million tons, and perhaps more, to the extent that credits from new projects are allowed within the additional 300 million limit for phase III.

Table 1 Trends in numbers of EU ETS offsets surrendered and KP offsets issued

Year	ETS offset surrenders			KP offset issuance		
	CERs	ERUs	Total	CERs	ERUs	Total
Pre-2008	0	0	0	139	0	139
2008	84	0	84	148	1	149
2009	78	3	81	119	5	124
2010	117	20	137	198	31	229
2011	178	76	254	314	107	421
2012	220	284	504	388	589	977
Total	677	383	1,060	1,308	733	2,041

Notes: Numbers are in millions. KP offset issuances correspond roughly to the compliance years of the ETS—that is, from May of the year indicated through April of the following year.
Sources: UNEP Risø Centre (2013) and European Commission (2015b).

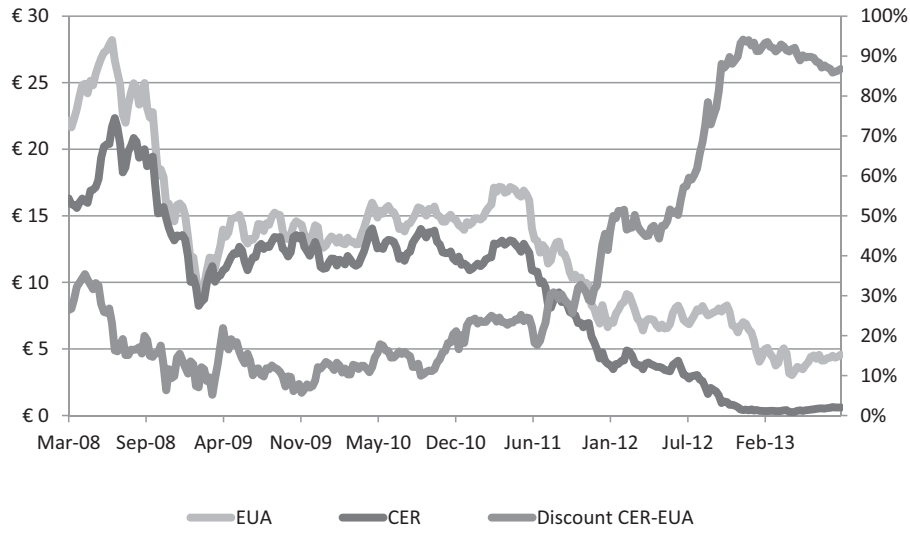

Figure 5 EUA and CER pricing
Sources: Point Carbon (2013a, 2013b) and ICE (2015a, 2015b).

Pricing of CERs versus EUAs

Although the use of offsets (which were equal to about 10 percent of the phase II ETS cap) had some effect on the EUA price, the feature that has caught the most attention is the continual discount at which CERs (the primary source of credits until 2012) sold relative to EUAs despite being almost perfect substitutes for EUAs.[14] As shown in figure 5, this discount ranged from 10 percent to 30 percent during the early years of phase II before increasing to 90 percent and higher in the final year of phase II.

It is clear from figure 5 that the CER price tracked the EUA price for most of phase II, albeit with a widening discount. However, since the beginning of 2013, that relationship appears to

[14]See Hintermann, Peterson, and Rickels (2016) for a discussion of the considerable literature on this topic.

Table 2 Project categories for issued CERs and ERUs

Project Category	CERs	ERUs	Total
HFC & N_2O reduction	761	114	875
CH_4 reduction	107	405	512
Renewable energy	321	14	335
Energy efficiency	66	161	227
Fuel switching	46	19	65
Afforestation and Reforestation	6	0	6
TOTAL	1,308	733	2,041

Notes: Numbers are in millions.
Source: UNEP Risø Centre (2013).

Table 3 Country of origin for issued CERs and ERUs

Country	CERs	ERUs	Total
China	807	NA	807
India	177	NA	177
South Korea	109	NA	109
Brazil	84	NA	84
Russia	NA	227	227
Ukraine	NA	448	448
Others	131	58	189
TOTAL	1308	733	2,041

Notes: Numbers are in millions.
Source: UNEP Risø Centre (2013).

have ended. Contributing factors undoubtedly include the very limited acceptability of CERs in the EU ETS after 2012 and the absence of demand in the alternative Kyoto market.[15]

We next turn to an accounting of the types of projects undertaken to generate these offsets and the countries in which these projects were located.

Project categories and countries of origin

The most notable feature of table 2 is the predominance of projects reducing non-CO_2, high-global-warming-potential (GWP) greenhouse gases. Industrial gases (hydrofluorocarbon [HFC] and nitrogen dioxide [N_2O]) have GWPs that are thousands of times higher than that of CO_2 (=1), whereas methane (CH_4) reductions have a value that is twenty times higher than that of CO_2. This means that although the costs of reducing a ton of emissions from these non-CO_2 projects may be higher than those from CO_2 reductions, the evidence suggests that the size of the GWP, which determines how many credits are issued (with each credit equal to 1 ton of CO_2-emission reduction), more than makes up for the cost difference.

[15]CERs and ERUs were also used by national governments, notably Japan and Spain, as well as others, for compliance with obligations under the KP. In this market, as well as in the EU ETS, the economic crisis of 2008–2009 and its aftermath reduced demand for compliance instruments.

As shown in table 3, the national origin of offset credits is also concentrated, with emerging economies, especially China, accounting for the bulk of the CERs issued and the Ukraine and Russia accounting for most of the ERUs issued. There is no overlap in the issuance of CERs and ERUs because ERUs could be issued only by nations listed in annex I of the KP (generally Organization for Economic Co-operation and Development (OECD) and former Soviet Union countries) and CERs could be issued only by countries that, unlike annex I signatories of the KP, were not obligated to limit GHG emissions. Although the "Others" category in table 3 includes many countries in both the CER and ERU categories, they constitute a small percentage of the totals.

Summary and Conclusions: Whither Phase III?

The great surprise of the second phase of the EU ETS was that, as phase III started in 2013, the price paid to emit carbon was less than €5, not the €30 or more that had been indicated by 2013 futures prices in 2008 and that was generally expected at that time. This development has created a lively debate about the future of the EU ETS and its role in climate policy. This debate can be summarized as being between those who view the current, much-lower-than-expected price as indicating serious flaws in the EU ETS and those who argue that the low price shows that the system is working exactly as it should given all that has happened since 2008 (i.e., reduced expectations for economic growth in the Eurozone, increased electricity generation from renewable sources, the significant use of offsets), including the possibility that abatement may be cheaper than initially expected. Fundamentally, this debate reflects differing views of the objectives of climate policy itself: whether the objective is solely to reduce GHG emissions or also (and perhaps principally) to transform the European energy system. Although no one is suggesting that emissions have exceeded the cap, or that they will do so, current prices do not seem likely to lead to the kind of technological transformation that would greatly reduce Europe's reliance on fossil fuels. Since mid-2012, the debate about the future of the EU ETS has focused on three issues—back-loading, restructuring, and the 2030 targets.

Back-loading

Back-loading refers to changing the scheduled quantities of auctioned allowances so that fewer are auctioned in the early years and more are auctioned in the later years of phase II. After some debate, the decision was made in February 2014 (OJEU 2014) to withdraw 900 million allowances from auctioning in 2014–2016 and to add them back in to auctioning in 2019–2020.[16] The debate about back-loading was, however, not so much about the timing of auctioned quantities and its effect on EUA prices as it was a proxy for the more important issue of restructuring: whether to adopt more significant changes in the design of the EU ETS in order to provide a stronger incentive for low-carbon investment in Europe. Viewed from this perspective, back-loading was only a first step toward reducing the near-term quantity of allowances in order to provide time to build a consensus for taking tougher actions before the withdrawn allowances would be reinjected into the system.

[16]In 2013, 808 million allowances were auctioned. Thus, the quantities auctioned over the 2014–2016 period will be about a third less than in 2013.

Restructuring and Targets for 2030

In November 2012, not long after the formal submission of the back-loading proposal, the commission published a report, *State of the Carbon Market*, in which six alternatives for "restructuring" the EU ETS were presented (European Commission 2012): (1) increasing the EU reduction target to 30 percent in 2020, (2) retiring allowances in phase III, (3) early revision (downward) of the 1.74 percent annual reduction in the cap, (4) extending the scope of the ETS to other sectors, (5) limiting access to international credits, and (6) creating a discretionary price management mechanism.

This report was followed in March 2013 by a green paper on a 2030 framework for climate and energy policies (European Commission 2013), which raised questions for debate about not only the restructuring of the EU ETS but also the post-2020 targets for renewable energy and energy efficiency and the coordination of those targets with the EU ETS. The context for this debate is both the absence of any post-2020 targets for the renewable energy and energy efficiency components of the present 20-20-20 by 2020 policy and the inability of the 1.74 percent annual reduction factor to reduce GHG emissions to 80 percent below 1990 emissions by 2050, the level called for in the 2050 Roadmap (European Commission 2011).

A More Specific Proposal for 2030

In January 2014, the commission followed up on the green paper with a more specific proposal for a comprehensive policy framework for climate and energy for 2020 to 2030 (2014). This proposal was remarkably sparse in recommendations for specific actions: a commitment to reduce EU GHG emissions by 40 percent below the 1990 level by 2030, the adoption of a Market Stability Reserve for the EU ETS that would withdraw and inject allowances after 2020 according to a quantitative formula, and an increase in the annual reduction in the EU-wide ETS cap after 2020, from 1.74 percent to 2.2 percent. The first two actions were presented as actions to be adopted in 2014: the 40 percent target in order to signal the EU's contribution to the Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC) meeting in Paris in late 2015, and the Market Stability Reserve as a technical fix to stabilize EUA prices in the EU ETS. The tightening of the EU ETS cap, as well as other possible measures, was to be decided after the May 2014 elections and the appointment of a new commission in late 2014.

The most remarkable feature of the more specific 2030 proposal is the absence of targets for renewable energy and energy conservation. There is considerable discussion of accompanying policies, but it is general, without proposing the type of specific member-state targets that exist now. A renewable energy target of 27 percent by 2030 is proposed, but it is an EU-wide goal and explicitly not broken down into the member-state targets that would give it legal force. What emerges most clearly from this document is its focus on the ETS, without the accompanying ancillary policies at the EU level that characterize current policy.

Although consideration and adoption of the specific proposals for 2030 have been slower than originally expected, notable progress has still been made. The Ukrainian crisis bumped consideration of the 40 percent EU-wide GHG reduction goal for 2030 from the spring agenda, but it was taken up and approved in October 2014 (European Council 2014). The proposal to establish the Market Stability Reserve could not be considered until the new commission was

appointed, but it was quickly taken up and an amended version was approved by the European Parliament in July 2015 (European Parliament 2015) and expected to receive final approval by the European Council later in 2015. This amended version moves the start of the Market Stability Reserve forward by two years, to 2019, in order to receive the 900 million "back-loaded" allowances. This means that these allowances will not be reinjected into the system in 2019–2020. Finally, in July 2015, the commission forwarded the formal legislative proposal to increase the rate of decline in the post-2020 cap from 1.74 percent to 2.2 percent (European Commission 2015a). Stakeholder consultations and debate in the European Parliament and among member states will now occur as this final concrete proposal from the 2030 package moves toward final adoption.

Concluding Comments

As the broader debate about climate and energy policy continues, it is important to keep in mind what has been achieved by the EU ETS. Absent a decision by the EU to abandon the program, which would require a super-majority, the EU ETS will march on with a continually declining cap, which, under all likely scenarios, will create continuing scarcity, thus virtually guaranteeing that a carbon price will be a permanent feature of the European economic landscape. Although one could question whether the consensus exists to tighten the EU ETS cap, repeal of the EU ETS appears highly unlikely. Moreover, if the current consensus no longer supports enforceable member-state targets for renewable energy, as seems to be the case, the EU ETS will be the only EU climate instrument in force after 2020. Thus, the EU ETS appears to be here to stay, and this remarkable experiment in climate policy will no doubt continue to provide economists and policy makers with fertile ground for research and debate for many years to come.

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