

Architecture of the EU Emissions Trading System in Phase 3 and the Distribution of Allowance Asset Values

Discussion Paper

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Abstract

Recent changes to the EU Emissions Trading System introduce structural changes regarding the initial distribution of emissions allowances, which are worth tens of billions of euros. A key change is the expanding role for auctions, which account for about half of the allowance allocation now and will be a growing share going forward. The use of revenue from auctions is a decision left to EU Member States and appears increasingly important. Well over half of auction revenue to date has been directed to energy and climate related purposes. Further, we do not find evidence that Member States have used state aid to electricity-intensive firms to strategically support domestic industry. The trading system is evolving in a way that is likely to improve its performance, but there remain important questions related the future price of allowances and the distribution and use of asset value created under the trading system.

Key Words: auction, cap and trade, European Union, EU ETS, allocation, climate change, policy

JEL Classification Numbers: H23, N5, P48

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1. Introduction

Administrators of the EU Emissions Trading System (ETS) recently introduced changes to the system that affect the initial distribution of emissions allowances. A key change is the expanding role for auctions, which will yield billions of euros in revenue. From a policy perspective, understanding the potential consequences of various approaches to the use of the auction revenues is critical because this has distributional and strategic impacts both within and between Member States. The trading system is evolving in a way that is likely to improve its performance, but there remain important questions related the future price of allowances and the distribution and use of asset value created under the trading system.

The introduction of a cap assigns a scarcity value to the opportunity to emit and thereby has created an asset in the form of emissions allowances. Each EU allowance (EUA) enables the holder to emit one metric tonne of carbon dioxide (CO₂). The total value of allowances has varied with their price, approaching 10 billion euros in 2013 and 2014 and more than 30 billion euros in some previous years. Using auctions to initially distribute emissions allowances has the potential to collect large financial value for EU Member States. In phase 1 (2005–2007) and phase 2 (2008–2012) of the ETS, about 97% of emissions allowances—and the associated financial value of those allowances—were distributed for free to incumbent firms. That has changed in phase 3 (2013–2020), when roughly half of the allowances will be distributed through an auction. Although free distribution is still substantial, auctioning is the default allocation method and will have an expanding role going forward.

Important changes that were made to the EU ETS before the third phase of the program (2013–2020)¹ include the following:

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¹ These changes result from amendments to the ETS Directive 2003/87/EC.

- the introduction of a centralized system for setting the annual cap on the number of new emissions allowances to be issued;
- an expansion of the scope of the scheme to include more industrial activities and other greenhouse gases apart from CO₂;
- an expanded role for auctions and the identification of auctions as the default way of distributing emissions allowances;
- the elimination in principle of free allocation to electricity production, with exceptions discussed below;
- the implementation of harmonized system-wide rules based on product-specific emissions rate benchmarks for free allocation of emissions allowances to industry;
- set aside of 300 million allowances in the New Entrants Reserve (NER) to fund the deployment of innovative renewable energy technologies as well as carbon capture and storage, known as the NER 300 program;² and
- changes in the allowed use of international credits for compliance.

The next section of the paper addresses the basic architecture of the program, including the determination of the cap on the annual distribution of emissions allowances. Section 3 describes the magnitude of financial value created under the trading program and how the initial distribution of that value has changed in phase 3. Section 4 describes in more detail the growing role of auctions. Section 5 reviews how Member States have used the revenue from auctions. Section 6 outlines state aid measures introduced to reduce some of the indirect costs that the system imposes on large electricity consumers. Section 7 concludes.

2. The Basic Architecture of the EU ETS in Phase 3

During phase 1 and phase 2 (2005 to 2012), the emissions cap was established in an indirect manner based on decentralized decisions taken by individual Member States. Each Member State was required to draw up a national allocation plan (NAP) containing a list of all stationary installations to be included in the ETS and the proposed allocation of emissions allowances to each installation for each year. The NAPs constituted the aggregate cap over

² European Commission, 2015a.

covered facilities and were reviewed by the Commission in each phase to verify that they were consistent with the emissions reduction targets for the EU and the criteria established in an annex to the Emissions Trading Directive, as well as with the EU rules on state aid and competition.³ As a result of the phase 1 review, the Commission requested that some Member States make changes to their NAPs because it was concerned that their proposed allocation plans would jeopardize the achievement of the Kyoto targets and allow the Member States to intervene in the market after the allocation was done to redistribute allowances. The Commission also made an effort to make the process of creating NAPs simpler and more transparent in phase 2.⁴

2.1 The Introduction of a Centralized System for Setting the Cap

A major change in phase 3 was the replacement of the NAP process with a centralized system for setting the emissions cap. In July 2010, in its Decision 2010/384/EU, the Commission determined the cap for 2013 based on the current scope of the EU ETS—that is, the installations covered in the 2008–2012 period.⁵ The determination of the number of allowances issued in 2013 applied an annual factor for reducing the cap to an amount determined by a calculation based on the following elements:⁶

- the ETS-wide average annual quantity of allowances that have been issued from 2008 to 2012;
- the average annual quantity of allowances issued to installations that opted in to the trading system from 2008 to 2012;⁷
- the quantity of allowances that accounts for the extended scope of the ETS to include additional installations in 2013 that emitted the following greenhouse gases:
 - CO₂ emissions from petrochemicals, ammonia, and aluminum;

³ European Commission, 2015b.

⁴ European Commission, 2015b.

⁵ European Commission, 2015c.

⁶ European Commission, 2015c.

⁷ Article 24 of the EU ETS Directive enables Member States to expand the coverage of the ETS by exercising an option to include in the trading program activities, greenhouse gases not originally covered by the scheme, installations in sectors covered by the ETS that operate below defined capacity limits, and installations in sectors not covered by the EU ETS. See Ellerman et al. (2010a) for a detailed discussion of how the opt-in provision was used in phase 1 and early in phase 2.

- N₂O emissions from the production of nitric, adipic, and glycolic acid; and
- perfluorocarbons (PFCs) from the aluminum sector; and
- a deduction of the quantity of allowances associated with emissions from installations that opted out from the ETS.⁸

Because the cap for 2013 is calculated from the midpoint of the period 2008 to 2012 (i.e., 2010), the annual emissions cap reduction factor of 1.74 percent (in absolute figures, 38,264,246 allowances per year) was applied three times (for 2011, 2012, and 2013) to arrive at the total ETS-wide quantity of allowances (cap) for 2013 of 2,084,301,856 allowances.⁹ If this linear reduction factor is applied to the cap in each year in phase 3, as required by current regulations, then by the end of phase 3 in 2020, this process will result in a 21 percent cut in emissions from installations in the EU ETS compared with 2005 levels.¹⁰ At the start of phase 4 in 2021, the annual linear reduction factor will increase to 2.2 percent, as agreed upon by EU leaders in October 2014 as part of the 2030 policy framework for climate and energy.¹¹

2.2 Expansion of the Scope of the ETS

When the ETS started in 2005, it covered only CO₂ emissions and the 25 EU Member States. In 2008, additional installations from participating Member States were covered by the scheme, due to the termination of the Article 27 temporary opt-out provision and to the clarification of the definition of combustion installations. Further, a number of countries decided to opt in N₂O-emitting installations.^{12,13} In addition, a range of new sectors and source categories

⁸ Article 27 of the first 2003 EU ETS Directive allowed Member States to exercise an option to exclude certain installations from the ETS during phase 1. Originally, this temporary opt-out provision was meant to give installations that were subject to specific constraints more time to transition to the ETS scheme. However, Article 27 in the amended 2009 Directive also allowed for the exclusion of small installations and hospitals subject to the same measures from the ETS in order to help those installations avoid administrative burdens and costs (Climate Policy Section Department of the Environment, Heritage and Local Government, and Environmental Protection Agency, 2011).

⁹ Note that the absolute number of allowances established in the Commission Decision 2010/634/EU was 2,039,152,882 allowances. It was later updated to 2,084,301,856 allowances (European Commission, 2015d).

¹⁰ European Commission, 2015c.

¹¹ European Commission, 2015e.

¹² European Parliament and Council, 2003, Article 9a(1).

¹³ European Parliament and Council, 2003, Article 24(1).

have been added, as listed in Table 1, including in particular installations emitting N₂O and PFCs.^{14,15}

Table 1. Expansion of Program Scope in Phase 3

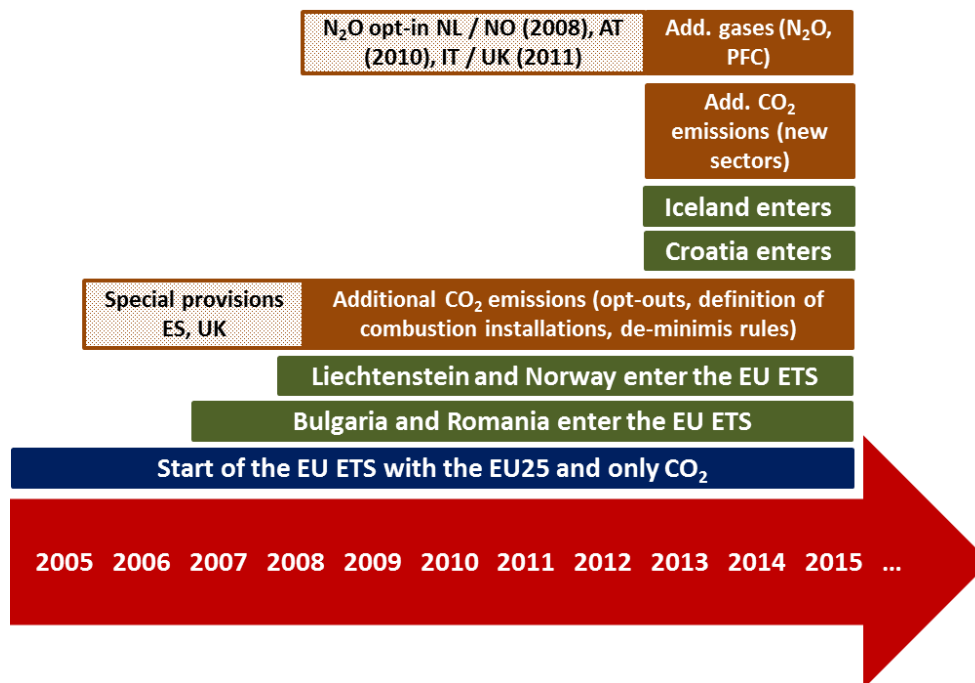
New regulated activity	Regulated greenhouse gases
Production of primary aluminium	CO ₂ and perfluorocarbons
Production of nitric acid	CO ₂ and nitrous oxide
Production of adipic acid	CO ₂ and nitrous oxide
Production of glyoxal and glyoxylic acid	CO ₂ and nitrous oxide
Production of ammonia	CO ₂
Production of bulk organic chemicals by cracking, reforming, partial or full oxidation, or similar processes	CO ₂
Production of hydrogen (H ₂)	CO ₂

The geographic scope of the ETS has also changed. In 2007, the last year of phase 1, Bulgaria and Romania joined the 25 EU Member States. At the beginning of phase 2, in 2008, Liechtenstein and Norway were added. At the beginning of phase 3, in 2013, Croatia and Iceland entered the EU ETS. Thus, the EU ETS currently covers 31 countries in the European Economic Area, including 28 EU Member States and 3 Members of the European Free Trade Association (Iceland, Liechtenstein, and Norway). This sequence of changes in coverage and scope is illustrated in Figure 1.

¹⁴ European Environment Agency, 2015a.

¹⁵ European Parliament and Council, 2003, Annex I.

Figure 1. Scope of the EU ETS since 2005



Source: European Environment Agency, 2015a.

2.3 Regulation of the Aviation Sector

The European Commission set a separate cap on emissions from the aviation sector that is equivalent to 97 percent of historical aviation emissions in 2012, declining to 95 percent starting in 2013. The annual average of CO₂ emissions in the years 2004, 2005, and 2006 forms the baseline for “historical” aviation emissions in the European Economic Area.

Eighty-two percent of aviation emissions allowances are granted for free to aircraft operators, and 15 percent are auctioned starting in 2013, with the remaining 3 percent set aside for new entrants and fast-growing airlines. The free aviation allowances will be distributed by a benchmarking process that accounts for the activity of each operator in 2010 measured in tonne-kilometres (distance × payload) using a formula that accounts for the total distance traveled and the total mass of freight, mail, and passengers carried.^{16,17} The benchmark (emissions per tonne-kilometer) is calculated by dividing the total annual amount of free allowances available by the

¹⁶ European Commission, 2015f.

¹⁷ European Parliament and Council, 2008.

independently verified sum of tonne-kilometer data included in applications from aircraft operators to the Commission. In phase 3, the aviation sector cap does not decrease, and aircraft operators will also continue to receive the large majority of their emissions allowances for free in the manner described.¹⁸ The number of aviation emissions allowances in phase 3 (210 million/year) is relatively small compared with the total number of allocated EUAs (over 2 billion in 2013). Moreover, through a series of amendments to the original decision, such as changing the scope to include only domestic EU flights and exclude flight operators with annual emissions below 1,000 tonnes/year, the number of allowances that have actually been allocated is even lower—only some 38 million allowances/year. Of these, 6 million are auctioned; the remainder is allocated free of charge.

Aviation allowances cannot be held or surrendered by stationary installation operators and are issued to aviation operators only. However, aviation operators can hold and surrender both aviation allowances and general allowances if necessary for compliance. In addition, they are entitled to use international credits up to a maximum of 1.5 percent of their verified emissions during the period from 2013 to 2020.¹⁹

3. Distribution of the Allowance Value

The introduction of the cap on emissions and the transferability of emissions allowances in a market create economic value that flows to the holder of the allowances. In phase 1 and phase 2, the asset value was initially distributed almost entirely to incumbent emitting firms. Although firms received allowances for free, the market value of allowances was expected to be apparent in changes in the prices paid by energy consumers, yielding additional revenue to these firms. Firms charge their consumers for the use of allowances because they face an opportunity cost in using the allowances for production and forgo the opportunity to sell the allowances in the market. In effect, the cost of allowances translates a firm's emissions into a variable cost of production, resembling other factor inputs such as labor and other resources. When allowances are distributed for free, the change in revenues from higher product prices will typically be greater than the change in costs from reducing emissions and complying with the program, resulting in extra-normal or "windfall" profits. Several studies by banks, governments, and

¹⁸ European Commission, 2015g.

¹⁹ Environment Agency, 2014a; Environment Agency, 2014b; European Commission, 2015g; and European Commission, 2014a.

academic teams have found that free allocation led to windfall profits, especially in the electricity sector (Nicolai and Zamorano 2014, Laing et al. 2013, Veith et al. 2009, Woerdman et al. 2009, Sijm et al. 2006, Bovenberg and Goulder 2000, Burtraw and Palmer 2008) but also among industrial firms (Martin et al. 2014).

Phase 3 marked an important transition by directing the initial distribution of emissions allowances away from firms and instead to Member State governments, which can then sell these allowances into the market using auctions (Figure 2). The magnitude of that value is illustrated in Table 2, which describes the value of allowances that have entered the market, the percentage that have been auctioned and the revenues directed to Member States. It is important to note that this is a lower bound on the value that will be distributed through an auction because it is anticipated that not all allowances set aside for allocation to industry and new entrants will be used.²⁰ According to independent market analysts, some 500-900 million allowances are expected to be left over by the end of phase 3.²¹⁻²² The cumulative volume left over will be transferred to the market stability reserve (MSR) at the end of phase 3 in accordance with the MSR regulation.²³ However, it is not known what happens to these unallocated allowances after they are placed into MSR; several alternative policy options are currently being considered.²⁴ In addition, auction shares in Figure 2 and Table 2 do not include an important portion of allowances directed to the electricity sector. Although these allowances are distributed to power generators in the eligible Member States for free, their value should be directed to modernization of the electricity sector, which could be viewed as an auction with revenues earmarked to this purpose.²⁵ The European Commission takes these aspects into account in estimating that 57 percent of the total allowances introduced in phase 3 will be distributed through an auction or its equivalent.²⁶ This includes back-loaded allowances that are placed into MSR.

²⁰ There is one additional source of unallocated allowances. According to the European Commission, “A third category of de facto “unallocated” allowances stems from the application of a carbon leakage factor for sectors not on the carbon leakage list, which the legislator has not directed to the MSR” (European Commission, 2015h).

²¹ International Emissions Trading Association, n.d.

²² Note that the European Commission cites a narrower range of 550-700 million (European Commission, 2015h).

²³ European Parliament, 2015a. Market stability reserve is discussed in more detail in section 3.4.

²⁴ European Commission, 2015h.

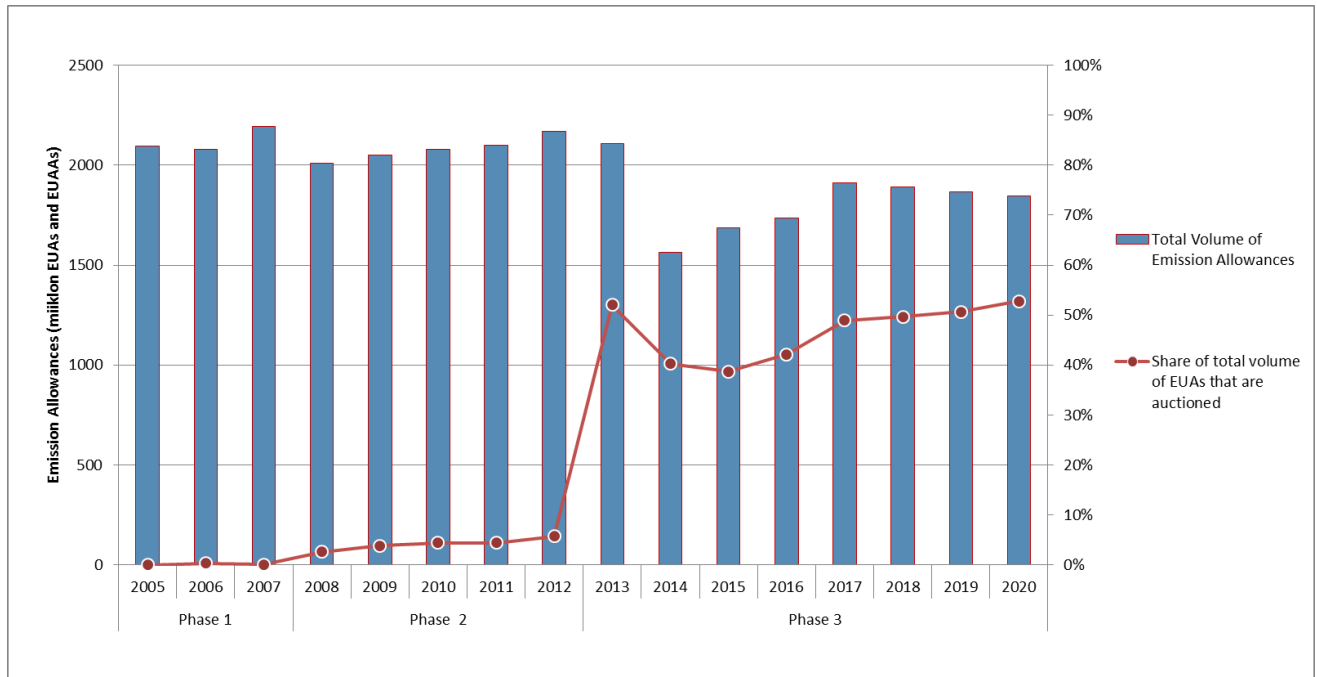
²⁵ These allowances are also subtracted from auction volumes of the eligible Member States (European Commission, 2015h).

²⁶ European Commission, 2015h.

A large drop in the total volume of emissions allowances can be noticed between the years 2013 and 2014, due primarily to the decision of back-loading allowances (see section 3.4 for more details). Historical EUA prices were computed as annual averages of December futures contract prices. In phase 1 through the beginning of phase 2, most of the reported transactions were December futures, but there is little difference between these prices and spot prices over this period.²⁷ The table reports projections starting in 2015. Based on projected prices and volumes (see section 5 for details of the calculation of the projected prices) in 2018, the auction revenue directed to Member States will exceed 50 percent of total asset value of allowances that have entered the market, finally overtaking the share that has been directed to free allocation. It is noteworthy that the total asset value of allowances continues to increase through 2020, and will continue to do so for years thereafter. Even as the quantity of allowances is reduced each year the price is expected to increase at a greater rate, so that total asset value of emissions allowances grows over time. Further, as noted earlier, some allowances from those intended for free allocation to new entrants, industry and efforts to mitigate carbon leakage are expected to remain unallocated, and these allowances are likely to ultimately enter the market through an auction or distributed for earmarked purposes.

²⁷ Ellerman, Convery, and de Perthuis, 2010b.

Figure 2. Share of Auctioned Allowances in the Total Volume of Allowances that Have Entered the Market



Source: Table 2, below.

Table 2. The Financial Value and Initial Distribution of Emissions Allowances that Have Entered the Market

	Total volume of emissions allowances (million tonnes)	Average price (2014 €/tonne)	Total asset value (billion 2014 €)	Auction revenue portion of total asset value (%)	Auction revenue directed to Member States (billion 2014 €)
Phase 1					
2005	2,096	27	56.65	<1	<0.01
2006	2,079	21	43.46	<1	0.14
2007	2,195	<0.5	0.61	<1	<0.01
Phase 2					
2008	2,011	25	49.29	3	1.30
2009	2,049	15	29.90	4	1.16
2010	2,081	16	32.90	4	1.45
2011	2,101	14	29.50	4	1.30
2012	2,170	8	16.75	6	0.97
Phase 3					
2013	2,109	4	9.28	52	4.83
2014	1,562	6	9.15	40	3.68
2015	1,686	8	13.15	39	5.09
2016	1,737	11	19.11	42	8.05
2017	1,913	13	24.87	49	12.16
2018	1,892	14	26.49	50	13.16
2019	1,867	14	26.14	51	13.24
2020	1,844	15	27.66	53	14.60

Notes: Prices and calculated values are based on the weighted average of the observed futures price for December of the year in which the futures mature through 2014 and projections starting in 2015. See Appendix 1 for detail. As discussed above, the auction share estimated by the European Commission over the entire phase 3 is larger because the European Commission includes unallocated allowances, back-loaded allowances, and allowances set aside for allocation to power generators in the eligible Member States in the auction share.

3.1 Auctioning is the Default Mechanism Beginning in Phase 3 but Free Allocation Remains Important

Before phase 3, the ETS prescribed a maximum on the volume of emissions allowances that Member States could distribute through an auction. In phase 1 the maximum was 5 percent, and in phase 2 it was 10 percent of the total national volume of allowances to be issued. The actual share of allowances auctioned was less than 1 percent in phase 1 and varied between 2.6

percent and 5.8 percent during phase 2. Beginning in phase 3, the use of auctions was adopted as the default way of initially distributing emissions allowances.²⁸ The share of allowances auctioned amounted to 52.1 percent in 2013, falling to 40.2 percent in 2014 due to back-loading, and hence substantial quantities of allowances are still allocated free of charge. Most of these flow to industry, but some electricity-producing installations also receive free allowances. These shares are summarized in Table 3.

By an amendment to the Auction Regulation adopted in November 2011, the Member States agreed to the Commission's proposal of "early auctions" of a portion of EU ETS phase 3 allowances by holding auctions beginning in 2012.²⁹ One of the motives for "early auctions" was the perceived need for entities to hedge costs, particularly in the power sector, due to the common practice of selling electricity forward and at the same time buying the inputs needed for electricity production, including emissions allowances.³⁰ The allowances auctioned in 2012 were divided among the Member States as set out in Annex I of the Auction Regulation. The volume of "early auction" allowances does not constitute extra allowances for EU ETS phase 3, but is instead deducted from the total amount of allowances for the years 2013 and 2014. The volume of early auctions was only 90 million allowances.

²⁸ European Parliament and Council, 2003, Article 10(1).

²⁹ European Commission, 2011a.

³⁰ European Commission, 2011a, Recital (2).

Table 3. Total Initial Distribution of Allowances in Phase 3 (million tons CO₂ equivalent)

	2013	2014	2015	2016	2017	2018	2019	2020	Total	Cumulative percent of the cap
Auction not including back-loading	898	928	952	932	936	940	946	973	7,505	42.3 (56.6) ^a
Back-loading^b		-400	-300	-200					-900	5.8
Targeted allocation to electricity	136	97	115	98	81	63	42	0	632	4.1
Free allocation to industry	760	732	758	756	752	752	749	747	6,006	38.5
Free allocation to district heating^c	104	94	84	76	68	61	54	48	589	3.8
New entrants reserve	10	11	76	76	76	76	76	76	477	3.1
NER 300^d	200	100							300	2
Total for stationary installations	2,108	1,562	1,686	1,737	1,913	1,892	1,867	1,844	14,609	
Cap for stationary installations^e	2,084	2,046	2,008	1,970	1,931	1,893	1,855	1,816	15,603	99.6 ^e
Auctioned to aviation	6	6	6	6	6	6	6	6	48	
Free allocation to aviation	32	32	32	32	32	32	32	32	256	
Total allocation to aviation	38	38	38	38	38	38	38	38	304	
Grand Total	2,146	1,600	1,724	1,775	1,951	1,930	1,905	1,882	14,913	

Notes: Values for 2013 and 2014 are reported, other values are projected.

^aThe auction share of 56.6 percent includes 700 million unallocated allowances, 632 million allowances allocated to power generators in eligible Member States in 2013-2014 or set aside for this purpose for 2015-2020, and 900 million back-loaded allowances in accordance with European Commission's methodology (European Commission, 2015h).

^bThese amounts were withdrawn from the amounts to be auctioned in accordance with the Commission Regulation (EU) No 176/2014 (European Commission, 2014b) and will be managed in accordance with the market stability reserve provisional regulation discussed in section 3.4.

^cIncludes high-efficiency cogeneration.

^dThe NER300 program has the aim of funding innovative low-carbon energy demonstration projects.

^eThe difference between the total and the cap over phase 3 is due to back-loaded allowances and some unallocated allowances left over in 2013 and 2014 from targeted allocation to electricity, industry, and new entrants reserve. Source: Authors' calculations. See Appendix 2 for detail.

3.2 The Dominant Approach in the Electricity Sector: Auctioning

In principle, there should be no free allocation to electricity producers.³¹ However, the provisions of the amended ETS Directive allow some Member States to deviate from this principle. Member States with national electricity networks that are poorly connected to the international interconnected system for transmission of electricity and with a high dependency on a single fossil fuel for their electricity generation were given the option to allocate allowances for free to such installations, with an expectation about how the allowance value will be used (see “Targeted Electricity Allocation” in Table 2, also known as “optional derogation”).³² The so-called “Eligible States” that have this opportunity are Bulgaria, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, and Romania. All of the eligible States except Malta and Latvia have applied to the Commission for such targeted allocation. Hungary stopped using this option after 2013.³³ However, the revised ETS Directive stipulates that even when the derogation is granted, the level of targeted allocation in 2013 should not exceed 70 percent of the allowances needed in a Member State to cover emissions for the supply of electricity to domestic consumers.³⁴

Across the eight eligible Member States that took advantage of optional derogation, 133,059,430 allowances were allocated for free to power generators in 2013, and 100,474,443 allowances were allocated to the same Member States minus Hungary in 2014.³⁵ Over the period 2013–2020, the total amount of allowances available for free allocation to power generators in the eligible Member States amounts to close to 680 million. The number available will be reduced each year, reaching zero in 2020. However, the actual allocated amount might be smaller because the eligible Member States can decide to distribute fewer free emissions allowances than the maximum amount permitted by the Commission decisions.³⁶ The number of allowances allocated in 2013 and 2014 was about 14 percent and 29 percent smaller than the maximum amount available in 2013 and 2014, respectively.³⁷ The remaining allowances are to

³¹ European Parliament and Council, 2003, Article 10a(3).

³² European Parliament and Council, 2003, Article 10c(1).

³³ European Commission, 2015i.

³⁴ European Commission, 2011b.

³⁵ Authors’ calculations.

³⁶ European Commission, 2015j.

³⁷ European Commission, 2015j.

be issued through auctions by 2020.³⁸ The eligible States are expected to make an investment in modernizing their electricity generation that is at least as great as the economic value of free allowances to electricity producers.³⁹ Because the allowance value is linked to specific investment priorities, one might conclude this allocation is not free, but is earmarked allowance value.

3.3 Free Allowances for Industry Based on Performance Benchmarks

The primary logic underlying the use of free allocation to industry is to avoid “carbon leakage.” This term describes a situation where costs related to the trading system make businesses transfer production to other countries that have laxer constraints on greenhouse gas emissions.⁴⁰ Such transfer of production can lead to decreased economic activity in the EU, which in turn could result in higher overall emissions of greenhouse gases if the activities are transferred to countries with higher emissions intensity (Fischer and Fox 2012). The risk of carbon leakage is highest for energy-intensive industries that face competition from non-EU firms.

Sectors and subsectors that are judged by the Commission to be at a significant risk of carbon leakage receive a more generous allocation of free allowances than sectors and subsectors not deemed to be exposed to the risk for carbon leakage. The Commission is required to determine an official list of the sectors and subsectors deemed to be exposed to a significant risk of carbon leakage every five years. The first carbon leakage list was adopted at the end of 2009 and is applicable for the free allocation of allowances in 2013 and 2014.⁴¹ The list was amended in 2011, 2012, and 2013; it was ultimately adopted in October 2014 and applies for the years 2015–2019. The criteria used to determine these lists are based on the additional direct and indirect costs to be induced by the regulation and the trade intensity of the sector or subsector.^{42,43}

³⁸ European Commission, 2015j.

³⁹ European Commission, 2012b.

⁴⁰ European Commission, 2015k.

⁴¹ European Commission, 2015k.

⁴² European Commission, 2010a.

⁴³ European Commission, 2015k.

All free allowances set aside for non-electricity-producing manufacturing industries are allocated on the basis of product-specific benchmarks. The product-specific benchmarks were developed to reflect the most efficient techniques, substitutes, and alternative production processes available for reducing greenhouse gas emissions.⁴⁴ The benchmarks are calculated for products rather than for inputs.⁴⁵ The benchmark methodology does not differentiate according to technology or fuel, the size of an installation, or its geographic location.⁴⁶ The starting point for establishing benchmarks was the average performance of the 10 percent most efficient installations in a sector or subsector in the EU ETS in the years 2007–2008.⁴⁷

There are four methods for calculating the allocations based on benchmarks: product benchmarks (estimated to cover around 75 percent of eligible emissions) and three fallback approaches: heat benchmark (estimated to cover around 20 percent of eligible emissions), fuel benchmark (estimated to cover around 5 percent of eligible emissions), and process emissions (estimated to cover less than 1 percent of eligible emissions).⁴⁸ Each installation that is eligible for free allocation will receive allocation based on at least one of these methodologies.⁴⁹ However, emissions can be covered by only one methodology.⁵⁰ Table 4 provides additional information about each of these benchmarks.

⁴⁴ European Parliament and Council, 2003, Article 10a(1), 3rd subparagraph.

⁴⁵ European Parliament and Council, 2003, Article 10a(1), 4th subparagraph.

⁴⁶ European Commission, 2015l.

⁴⁷ European Parliament and Council, 2003, Article 10a(2).

⁴⁸ European Commission, 2015m.

⁴⁹ European Commission, 2011c.

⁵⁰ ECOFYS, 2011.

Table 4. Alternative Methods for Assigning Benchmark Allocations

Methodology	Value	Unit	Conditions	Relevant emissions
Product benchmark	There are 52 product benchmarks	tCO ₂ / unit product	- Product benchmark available	Emissions within system boundaries of product
Heat benchmark	62.3	tCO ₂ / TJ	- No product benchmark available - Heat is measurable	Emissions relating to production of the consumed measurable heat, not covered by a product benchmark
Fuel benchmark	56.1	tCO ₂ / TJ of fuel	- No product benchmark available - Heat is not measurable - Fuel is combusted	Emissions originating from the combustion of fuels, not covered by product or heat production benchmark
Process emissions approach	97% of historical emissions	tCO ₂	- No product benchmark available - Heat is not measurable - Emissions are not resulting from combustion of fuel - Emissions are "process emissions"	All emissions within installation not covered by previous approaches, but not including noneligible emissions

Source: European Commission, 2011c.

A number of additional factors may be applied to the benchmark value to determine the actual allocation, including a carbon leakage exposure factor (CLEF) and either a linear reduction factor (LRF) or a cross-sectoral correction factor (CSCF):

$$\text{Allocation} = \text{Benchmark} \times \text{Historical activity level} \times \text{CLEF} \times (\text{LRF or CSCF}).^{51}$$

The carbon leakage exposure factor used for allocation to sectors included on the carbon leakage list is 1.00 for all years. For allocation to sectors not on this list, the carbon leakage exposure factor is 0.80 in 2013, declining to 0.30 in 2020, with a view to reaching no free allocation in

⁵¹ ECOFYS, 2011.

2027.⁵² It should also be noted that due to a special provision, district heating installations that have high emissions will be provided with a temporary and declining extra allocation.⁵³

Finally, the linear reduction factor, as discussed in section 2.1 of this paper, describes the rate (1.74 percent) at which the total amount of allowances issued for free shall decrease each year from 2013 to 2020. For installations that are identified as electricity generators, as well as new entrants, the preliminary total annual amount of free allocation should be reduced each year by this factor. For other installations already part of the scheme eligible for free allocation (non-electricity-producing manufacturing industries), as discussed above, a so-called cross-sectoral correction factor can be applied. This is uniform factor, used to ensure that the total amount of free allocation to non-electricity-producing manufacturing industries and other relevant generators does not exceed the maximum amount of free allocation as determined by the ETS Directive.⁵⁴ Further, an amount less than 5 percent of the cap to be issued for the entire period from 2013 to 2020 is set aside as reserve for new entrants.

3.4 The Structural Surplus of Allowances

Since 2009, the EU ETS has experienced a growing supply of allowances and international credits, which has resulted in surplus of emissions allowances and significantly weakened their price.⁵⁵ By the end of 2013, the surplus had grown further, to over 2.1 billion allowances. The low demand for EUAs has been caused by several factors, principally high imports of international credits, which currently constitute more than half of the surplus, as well as the economic crisis and the associated reduction in economic activity.⁵⁶⁻⁵⁷ Other contributing reasons for the low demand include overlapping policies by EU Member States to promote renewable energy and energy efficiency, which substitute for fossil generation, and the fact that the electricity industry demand for allowances to hedge emissions associated with existing power contracts is limited.⁵⁸

⁵² European Commission, 2011c.

⁵³ European Commission, 2015m.

⁵⁴ European Commission, 2011c; European Commission, 2013a.

⁵⁵ European Commission, 2015n.

⁵⁶ European Commission, 2015n.

⁵⁷ Carbon Market Watch, 2014.

⁵⁸ Burtraw, 2015.

Under the EU ETS, existing operators are entitled to use international credits associated with the Kyoto mechanism—certified emissions reductions (CERs) under the Clean Development Mechanism (CDM) and emissions reductions units (ERUs) under Joint Implementation (JI)—for compliance with EU ETS during the 2008 to 2020 period, with some qualitative and quantitative limitations.⁵⁹

Credits are accepted from all types of projects except nuclear energy projects, afforestation, or reforestation activities. In phase 3, however, credits from projects involving the destruction of industrial gases are no longer accepted.⁶⁰ In addition, newly generated (post-2012) international credits may only come from projects in Least Developed Countries, and credits issued for emissions reductions that occurred in the first commitment period of the Kyoto Protocol were accepted only until 31 March 2015.⁶¹

Beginning with phase 3, international credits are no longer eligible to be used directly as compliance instruments but can be exchanged one-for-one for emissions allowances and used for compliance.⁶² On 22 January 2014, the Commission proposed to exclude international credits from the EU ETS starting in phase 4.⁶³

Table 5 illustrates the surplus buildup since the start of phase 2. It is not anticipated that the overall surplus will decline significantly during phase 3. The European Commission and many observers are concerned that the surplus and associated low allowance prices risk undermining the function of the carbon market to promote innovation and investments in low-carbon technology. This may affect the ability of the EU ETS to meet more demanding emissions reduction targets in the long run.^{64,65}

⁵⁹ International Carbon Action Partnership, 2015.

⁶⁰ European Commission, 2015o.

⁶¹ International Carbon Action Partnership, 2015.

⁶² Głowacki Law Firm, 2014.

⁶³ International Carbon Action Partnership, 2015.

⁶⁴ European Commission, 2015n.

⁶⁵ Burtraw, 2015.

Table 5. Buildup of the Surplus of ETS Allowances

(million EUAs)	2008	2009	2010	2011	2012	2013	2014	Total
Total allocation	2,011	2,049	2,081	2,101	2,170	1,818	1,462	13,692
Surrendered CERs and ERUs	84	81	137	254	493	133 ⁶⁶	*	1,182
**NER 300						200	100	300
Early auctions					90			90
Total supply	2,095	2,130	2,218	2,355	2,753	2,151	1,562	15,264
Verified emissions from stationary installations	2,120	1,880	1,939	1,904	1,867	1,908	1,812	13,430
Cumulative surplus	-25	225	504	955	1,841	2,084	1,834	1,701
<i>Surplus as share of current year verified emissions</i>	-1%	12%	26%	50%	99%	109%	101%	14%

*Not known.

**The NER300 program has the aim of funding innovative low-carbon energy demonstration projects.

Source: European Environment Agency, 2015c.

⁶⁶ European Commission, 2013b.

As a short-term measure, the Commission postponed the auctioning of 900 million allowances (referred to as back-loading) from its initially proposed dates in 2014, 2015, and 2016 until 2019–2020 (see Table 3). However, a recent regulation cancelled the reintroduction of back-loaded allowances to the market in 2019 and 2020.^{67,68}

The European Parliament has recently approved in first reading the Commission's proposal to establish a market stability reserve with the aim of addressing the allowance surplus and adding stability to the system.⁶⁹ Before coming into force, however, the legislation is to be approved by the council of ministers in September 2015.⁷⁰

Starting in 2019, the MSR will adjust the auction volumes by automatically placing or releasing allowances from the reserve. Whether the reserve is absorbing or releasing allowances will depend on the number of allowances in circulation in any given year. If the total number of allowances in circulation is fewer than 400 million, then 100 million allowances will be released from the reserve and added to the volume of allowances to be auctioned by the Member States. In addition, the MSR regulation mandates that allowances that were to be reintroduced into the market in 2019 and 2020 in accordance with the 2014 regulation on back-loading and allowances that were not allocated to new entrants and installations that ceased or reduced the scope of their operations be placed in reserve.⁷¹

4. The Design of the Auction Mechanism of the EU-ETS

Throughout each element of the ETS there is a growing role for the use of auctions. Member States (not the European Union) are responsible for conducting the auctions.⁷² The distribution of the total quantity of allowances to be auctioned among the Member States follows these rules:

- a) 88 percent is distributed according to each Member State's respective share of verified emissions in 2005 or the average of the 2005–2007 period, whichever is higher;⁷³

⁶⁷ European Commission, 2015n.

⁶⁸ European Parliament, 2015a.

⁶⁹ European Commission, 2015n.

⁷⁰ European Parliament, 2015b.

⁷¹ European Parliament, 2015a.

⁷² European Parliament and Council, 2003, Article 10(2).

⁷³ European Commission, 2015p.

- b) 10 percent is distributed among the least wealthy Member States for the purpose of solidarity and to enhance their prospects for economic growth;⁷⁴ and
- c) 2 percent is distributed to those nine Member States that in 2005 had reduced their emissions of greenhouse gases by at least 20 percent compared to their respective base year under the Kyoto Protocol (the “Kyoto bonus”).⁷⁵

Member States determine the use of the revenue generated from the auctioning of their allowances, subject to constraints.⁷⁶ At least 50 percent of the revenue from the auctioning of allowances distributed according to (a) and 100 percent of the revenue generated from the auctioning of allowances distributed according to (b)–(c) should be used for the purpose of combating climate change. Hence, across the ETS, at least 56 percent of the total allowance value should be directed to this purpose. The ETS Directive lists policies toward which this part of the revenue could contribute, including the following:

- reductions of greenhouse gas emissions and adaptation to the impacts of climate change;
- development of renewable energies and increase in energy efficiency; and
- implementation of measures to avoid deforestation and promote reforestation in developing countries that have ratified the international agreement on climate change.

The Member States are expected to report to the Commission on their use of the revenue. Most Member States have adopted earmarking practices that link specific expenditures to auction revenues. In section 5, we summarize these practices.

4.1 Auction Platforms

Regulations implementing the use of auctions are directed to ensure that EU ETS participants have harmonized, nondiscriminatory, and cost-efficient access to the primary market for emissions allowances. Auctions take place only on authorized trading platforms that are bound by EU financial market legislation.⁷⁷

⁷⁴ European Parliament and Council, 2003, Annex IIa.

⁷⁵ The Member States that had achieved this are Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, and Slovakia. The exact division of these allowances is given in Annex IIb of the ETS Directive (European Parliament and Council, 2003).

⁷⁶ European Parliament and Council, 2003, Article 10(3).

⁷⁷ European Commission, 2015p.

Member States may consign their allocations to the common auction platform. However, Member States also may appoint their own auction platforms, which has been exercised by Germany, the United Kingdom, and Poland.⁷⁸ Opt-out auction platforms must conform to the framework set out in the Auctioning Regulation, which provides for further rules to ensure adequate coordination between the opt-out auction platforms and the common auction platforms.

The *transitional* common auction platform currently used by 25 Member States (Croatia is yet to join the platform) is the European Energy Exchange (EEX) in Leipzig; in this capacity, EEX also conducts emissions auctions for Poland during a transitional period. Additionally, EEX serves as Germany's *permanent* opt-out auction platform;⁷⁹ the United Kingdom's opt-out platform is ICE Futures Europe (ICE) in London. The 3 European Free Trade Association states and Croatia were expected to start auctioning in 2013, but the arrangements with the auction platform were not complete. They will begin to auction their cumulated allowances in 2015 on the common auction platform as well.^{80,81}

The transitional common auction platform will be succeeded by a common auction platform, to be appointed by tender procedure carried out under the joint procurement agreement by the Commission and the 25 participating Member States (Poland and Croatia not included).⁸² The maximum appointment duration for any auction platform is five years. The contract for EEX as a joint auction platform runs until August 2016.⁸³

4.2 Auction Design

The minimum volume exchanged in the auction is labeled one lot. This term has two definitions. On a transitional auction platform (see section 4.1), one lot is either 500 or 1000 allowances, with an allowance enabling emissions of one ton of carbon dioxide. On a permanent auction platform, one lot is 500 allowances.⁸⁴

⁷⁸ European Commission, 2015q.

⁷⁹ European Energy Exchange, n.d.

⁸⁰ European Commission, 2015p.

⁸¹ European Commission, 2015q.

⁸² European Commission, 2015p.

⁸³ European Commission, 2015p.

⁸⁴ European Commission, 2010b, Article 6(1).

According to the Auction Regulation Chapter II, the allowances shall be offered for sale on an auction platform in the form of standardized electronic contracts. It is expressly stated that the Member States shall auction the allowances in the form of either “two-day spot” or “five-day futures.”⁸⁵ A two-day spot transaction means allowances are auctioned for delivery at an agreed date no later than the second trading day after the day of the auction.⁸⁶⁻⁸⁷ An auction platform offers allowances through its regularly recurring bidding window that opens for at least two hours and closes on the same trading day. Bidding windows of any two or more auction platforms may not overlap, and there must be a two-hour delay between consecutive bidding windows.⁸⁸ Allowances for stationary installations (EUAs) on a common auction platform are auctioned at least on a weekly basis.

The volume of allowances to be auctioned on a common platform is spread evenly over the auctions held by that auction platform during a given year, except that the amount of allowances auctioned in the month of August is half the amount of allowances auctioned in any other month.⁸⁹ Table 6 shows the timing of auctions for general allowances on all auction platforms.

Table 6. Auction Schedule for General Allowances

Auction platform	States	Details
EEX	Participating European Economic Area Member States*	Weekly auctions on Mondays, Tuesdays, and Thursdays
EEX	Germany	Weekly auctions on Fridays
ICE	United Kingdom	Fortnightly auctions on Wednesdays
EEX	Poland	Once every two months in 2015

*Excluding those listed below

Source: European Commission, 2015p.

⁸⁵ European Commission, 2010b, Article 3(3) and 3(4).

⁸⁶ European Commission, 2006, Article 38(2)(a).

⁸⁷ European Commission, 2006, Article 38(3).

⁸⁸ European Commission, 2010b, Article 8(1).

⁸⁹ European Commission, 2010b, Article 8(5).

4.3 Determination of Auction Clearing Price and Resolution of Tied Bids

Auctions are carried out through a single-round, sealed-bid, and uniform-price format whereby bidders submit bids within a specified window of opportunity (single-round), without knowing the bids offered by other bidders (sealed-bid).⁹⁰ Directly following the closure of the bidding window, the auction platform determines and publishes the clearing price at which demand for allowances equals the number of allowances offered for sale in the auction concerned.⁹¹ Successful bidders are the ones who have placed bids for allowances at or above the clearing price, and they pay the same price for each allowance regardless of the price bid (uniform-price).^{92,93} This is the design used in emissions allowance auctions in the subnational programs in North America, including the Regional Greenhouse Gas Initiative, California, and Quebec.

The auction clearing price is determined by the minimum bid at which demand for allowances exhausts supply in the auction.⁹⁴ To determine this price, all submitted bids are ordered in descending willingness to pay (bid). Bids are fulfilled starting with the highest bid. The price of the bid at which this accumulative sum is equal to or larger than the amount of allowances auctioned shall be the auction clearing price.⁹⁵ In case several bids have the same price, these bids are ordered through random selection according to an algorithm determined by the auction platform before the auction.⁹⁶

5. The Use of Auction Revenues

Member States determine the use of revenue generated from auctions; however, they face expectations embodied in the Directive of the European Parliament and of the Council that articulates the guideline in phase 3 that at least 50 percent of the revenue should be allocated

⁹⁰ European Commission, 2010b, Recital (17) of the preamble.

⁹¹ European Commission, 2015p.

⁹² European Commission, 2010b, Article 5.

⁹³ European Commission, 2015p.

⁹⁴ European Commission, 2010b, Article 7(1).

⁹⁵ European Commission, 2010b, Article 7(2), 2nd subparagraph.

⁹⁶ The motivation for ordering tied bids according to a random process is that “this generates uncertainty for bidders making collusion on the price they are bidding unsustainable.” Source: European Commission, 2010b, Article 7(2), 1st subparagraph, and Recital (17) of the preamble.

toward “energy and climate related” purposes.⁹⁷ This guideline is applicable for the 88 percent of allowances that are distributed according to a Member State’s respective average share of verified emissions for the period from 2005 to 2007. In other words, 44 percent of the total auction revenue is expected to go to these purposes. Note that this does not include the targeted free allocation to electricity in eligible Member States (optional derogation), which also yields energy related investments. The definition of energy and climate related purposes includes the following items:

- funding of research and development and demonstration projects for reducing emissions and for adaptation;
- funding of initiatives within the framework of the European Strategic Energy Technology Plan and the European Technology Platforms;
- development of renewable energies to meet the commitment of the Union to using 20 percent renewable energies by 2020;
- development of other technologies contributing to the transition to a safe and sustainable low-carbon economy;
- development of technologies that help meet the commitment of the Union to increase energy efficiency by 20 percent by 2020;
- forestry sequestration in the Union;
- environmentally safe capture and geological storage of CO₂;
- encouragement of a shift to low-emission and public forms of transport;
- finance research and development in energy efficiency and clean technologies;
- measures intended to increase energy efficiency and insulation or to provide financial support in order to address social aspects in lower and middle income house-holds;
- coverage of administrative expenses of the management of the ETS;
- other reduction of greenhouse gas emissions;
- adaptation to the impacts of climate change;

⁹⁷ European Parliament and Council, 2009, Article 10(3).

- other domestic uses.⁹⁸

The final text of the Directive contrasts with what was initially proposed in 2008, which would have directed 20 percent of the revenues to this purpose.⁹⁹ In growing the share to 50 percent, the language was inserted that stated the legal and institutional reality that the EU cannot actually determine how Member States spend their revenue.¹⁰⁰ Further, the amended Directive indicates that the goal can be achieved with equivalent financial value, not relying on auction revenues directly, making explicit the possibility that spending of auction revenues crowd out spending that would have occurred anyway, which is an issue we reserve for further investigation.

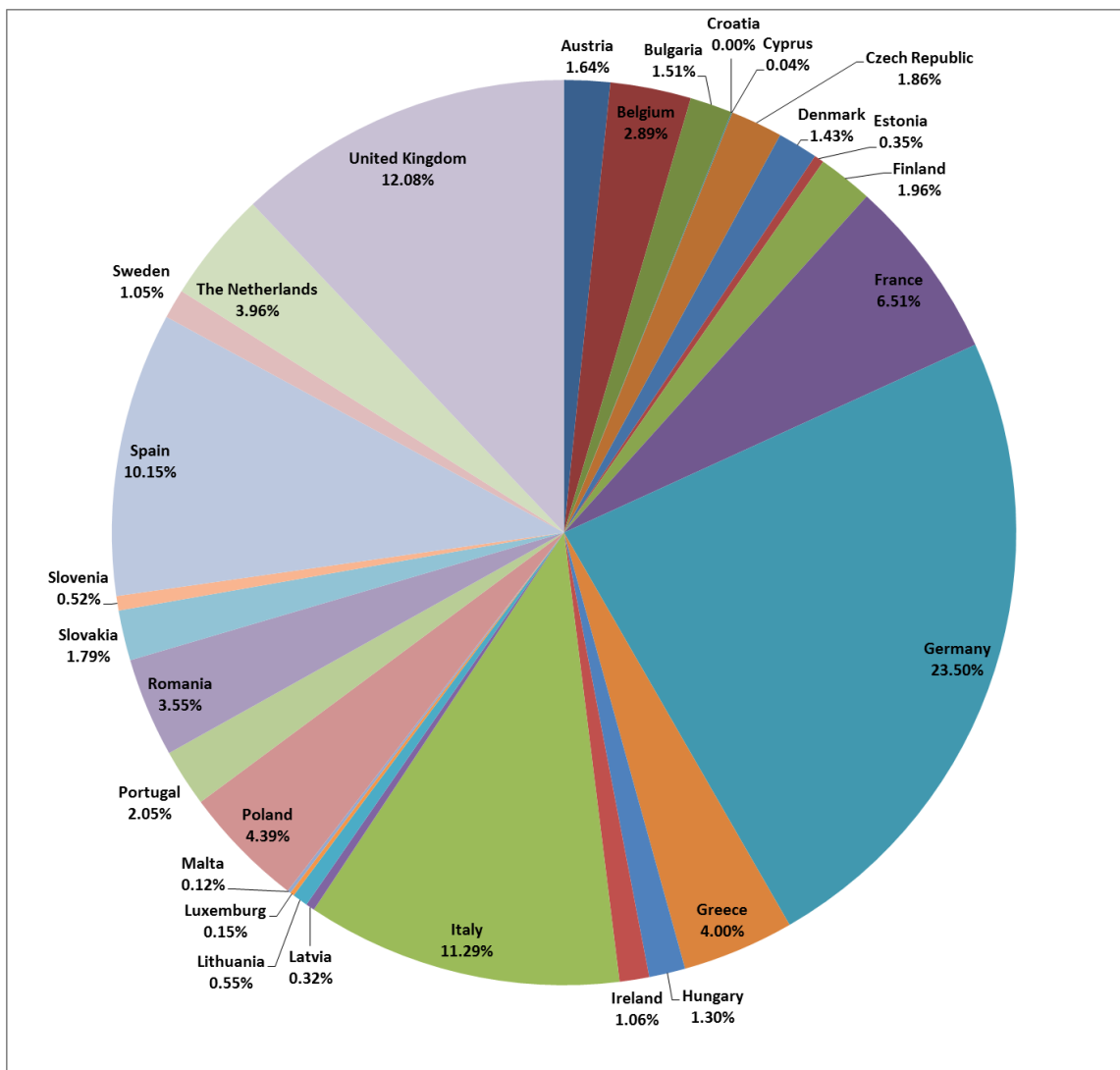
Each country is expected to submit a yearly report on how the country has used its revenues from the auctions. Figure 3 illustrates Member State ownership of total revenues from auctioning of allowances from November 2012 to December 2014.

⁹⁸ European Parliament and Council, 2003, Article 10(3) and 3d(4).

⁹⁹ European Commission, 2008.

¹⁰⁰ We are grateful to A. Denny Ellerman for pointing out the evolution of the Commission's Directive.

Figure 3. Country Shares of Total Auction Revenues, November 2012 to December 2014

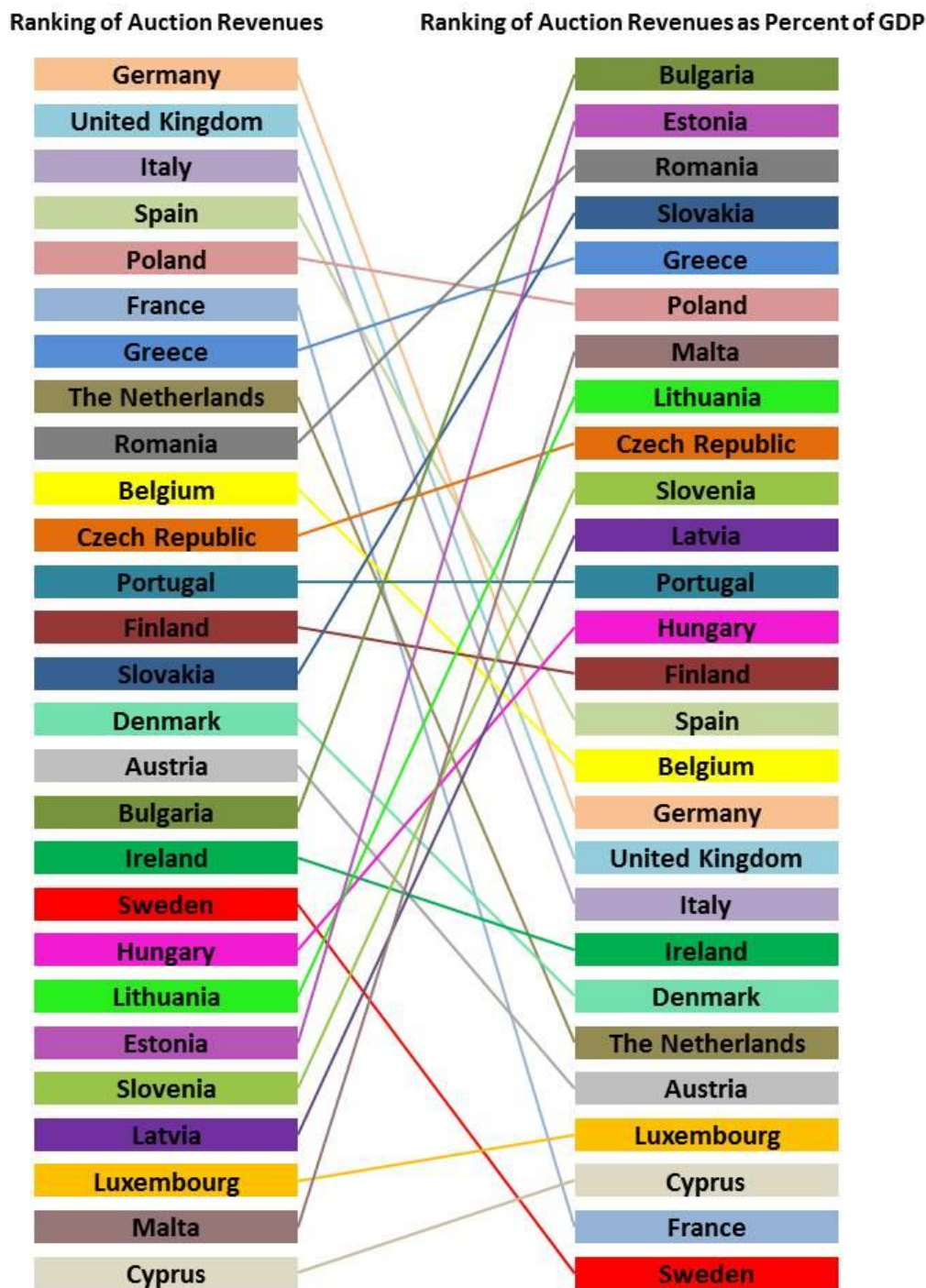


Source: European Commission, 2015r.

Note: This figure does not include the financial value of targeted free allocation to electricity in eight eligible Member States.

Figure 3 shows the distribution of auction revenues in relative terms, led by Germany, the UK and Italy. However, the countries that receive most of auction revenues are not the countries that receive the greatest revenue relative to their GDP in the corresponding year. Figure 4 displays the relative ranking of Member States with respect to auction revenue in absolute terms and as a portion of GDP. Bulgaria, Estonia, and Romania received the greatest amounts compared to the size of their GDP in 2013.

Figure 4. Rankings of Auction Revenues in Absolute Terms and as Percent of GDP by Member State in 2013



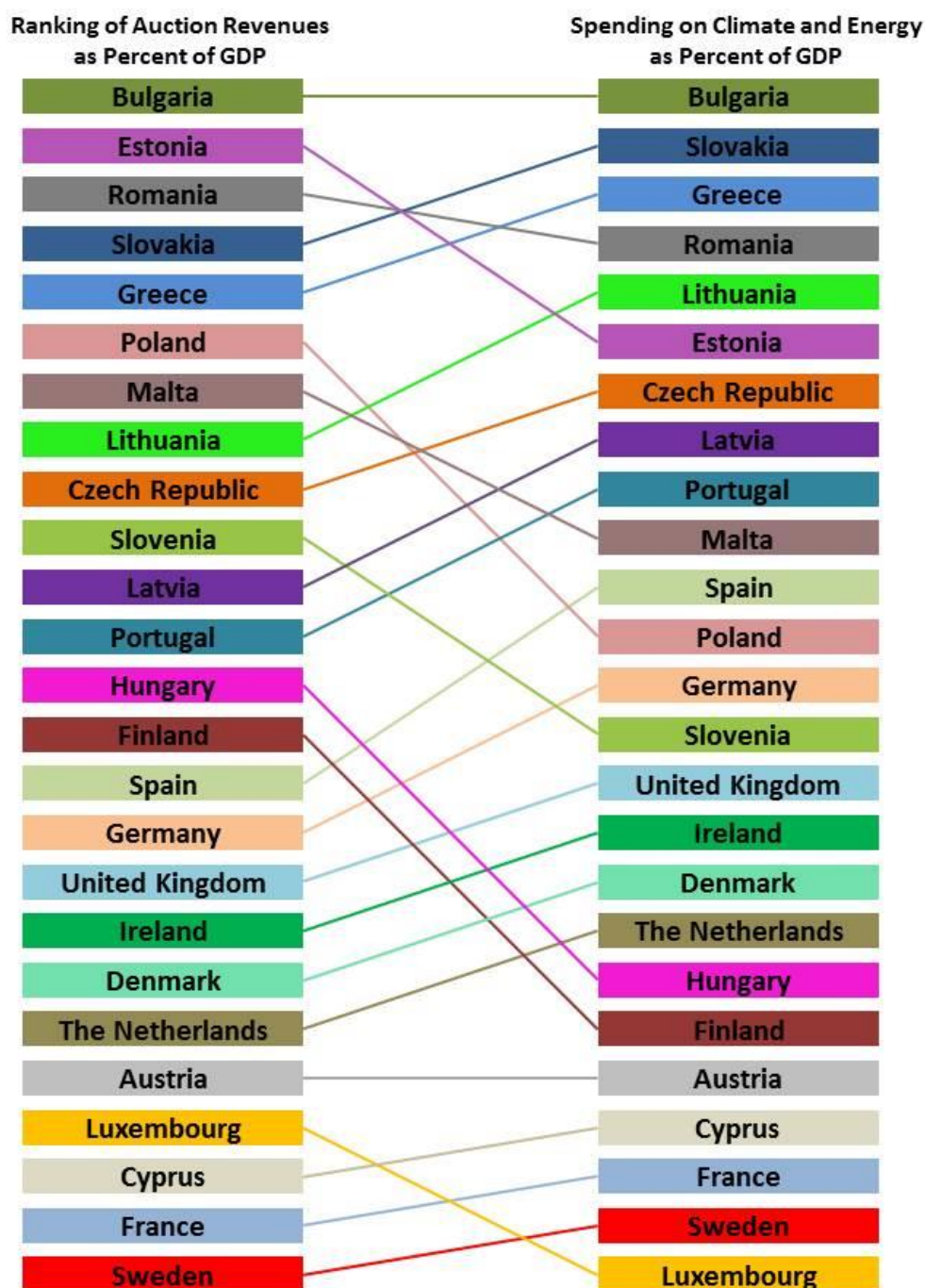
Notes: Croatia was excluded because it did not hold auctions in 2013. Data underlying this figure come from Appendix Table A1. Appendix Figure A1 is an analogous figure for the year 2014. This figure does not include the financial value of targeted free allocation to electricity in eight eligible Member States.

Because the Directive mandates only that countries report how they use the 50 percent of auction revenues that should be directed to energy and climate related spending purposes, only a partial overview of the total spending of auction revenues is possible. The member country reports on the use of auction revenue provide various levels of detail—from Hungary describing one project for the entire amount to Poland detailing over 300 different projects in their 2013 reports. Budget processes and regulations also differ among countries. Countries that do not practice earmarking (Austria, Belgium, Denmark, Ireland, the Netherlands, Poland, Sweden, and the UK) add another layer of uncertainty, since their expenditures are not directly traceable.¹⁰¹ Some of these countries nevertheless provide data on spending of the amount equivalent to at least 50% of their auction revenue that is related to climate and energy purposes as outlined in articles 3d(4) and 10(3) of the Directive; however, it is noted that this amount does not represent all of their spending for such purposes. This suggests the question of whether auction revenue spending is additional to what would have happened anyway, or if instead it is crowding out other sources of spending for these purposes.

There is a large variation from country to country in the share of total auction revenue that is spent on climate and energy related purposes, and the share does not seem to be associated with relative wealth. For example, in 2014, the relatively lower-income countries Lithuania and Cyprus reported spending 100 percent of their revenue for these purposes, while Finland reported spending about 50 percent. The reason may be that relatively rich countries already have a significantly higher baseline level of expenditure on climate and energy related purposes compared with relatively poor ones. Figure 5 examines whether the countries that receive the biggest amount of auction revenue relative to their GDP also spend the biggest revenue amount (relative to their GDP) on climate and energy projects. Indeed, Bulgaria, Romania, and Estonia appear at the top. One hypothesis may be that auction revenue provides a unique source of revenue for countries with a smaller GDP that enables investment in climate and energy projects.

¹⁰¹ European Commission, 2014c.

Figure 5. Rankings of Auction Revenues Relative to GDP and Spending of Auction Revenues on Climate and Energy Projects Relative to GDP by Member State in 2013



Notes: Croatia, Belgium, and Italy were excluded. Croatia did not hold auctions in 2013. Belgium does not earmark auction revenues and does not provide information on spending an amount equivalent to at least 50 percent of its auction revenues. Italy did not report on its auction revenue spending in 2013 for technical reasons. Data underlying this figure come from Appendix Table A1. As noted in text, this information does not include general revenue expenditures on climate and energy programs. Appendix Figure A2 is an analogous figure for the year 2014. This figure does not include the financial value of targeted free allocation to electricity in eight eligible Member States.

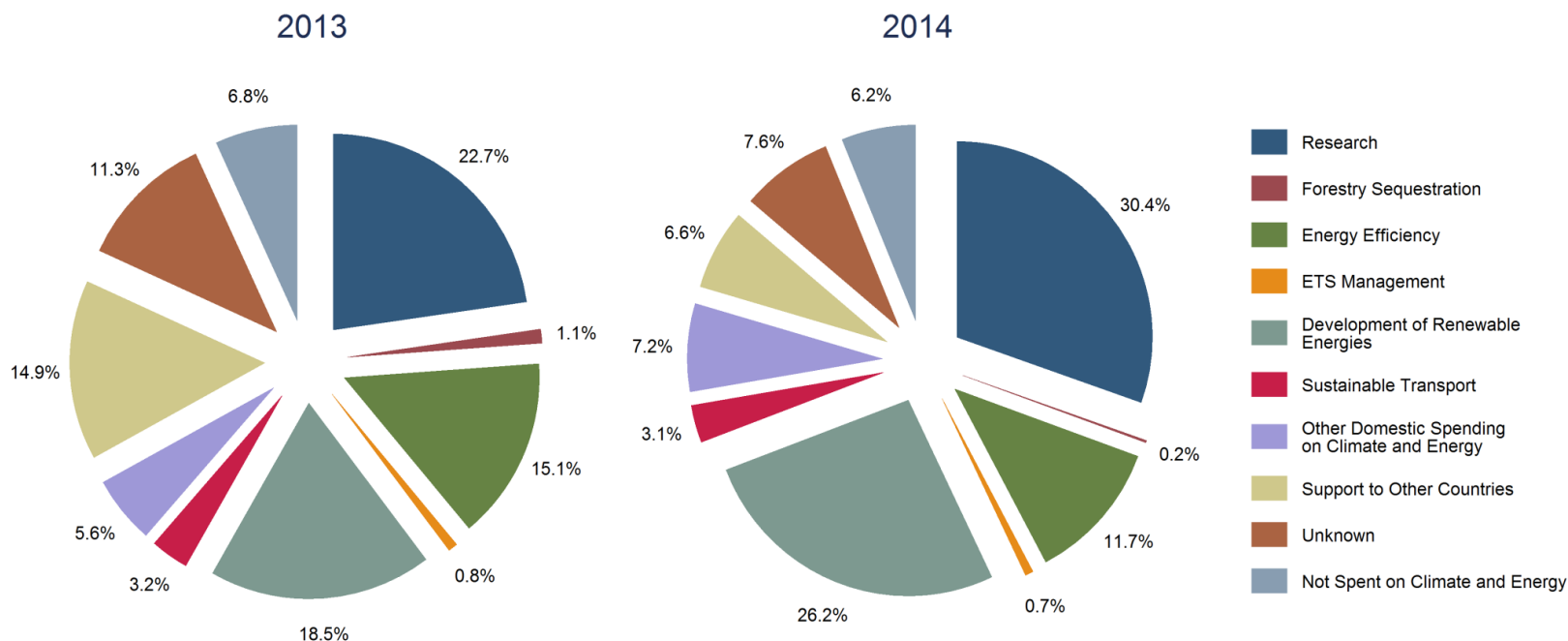
A large share of climate and energy spending by Member States is related to energy efficiency improvements and investments in renewable energy sources. Energy efficiency improvements are primarily focused on renovations of both private and public buildings to decrease energy costs. France is an example of a country that has allocated 100 percent of its revenues toward this purpose in 2013 and 2014. Spain and Bulgaria allocated most of their revenues to renewable energy investments in both years.

International aid directed toward climate and energy related purposes, although not as common as domestic spending, amounted to 15 percent of the total Member States' climate and energy related spending in 2013 and 7 percent in 2014. The countries that used a portion of their auction revenue to provide support to other countries in 2013 or 2014 are Denmark, Estonia, Finland, Germany, Ireland, Portugal, Spain, Sweden, and the UK. This aid was split between bi-lateral and multilateral aid. Estonia, Sweden, and the UK directed all of their aid to developing countries through multilateral channels, while Portugal used only bi-lateral channels. Interestingly, the Member States providing support to other countries are not the ones for which the auction revenue was the biggest relative to their GDP with the exception of Estonia.

A small part of the total expenditure, but common among member countries, is the use of part of the revenue to cover expenses associated with administrating and managing the EU ETS. Figure 6 presents the information aggregated for a selection of Member States. Figure 7 presents in more detail how the spending on climate and energy related purposes varies across categories and Member States.

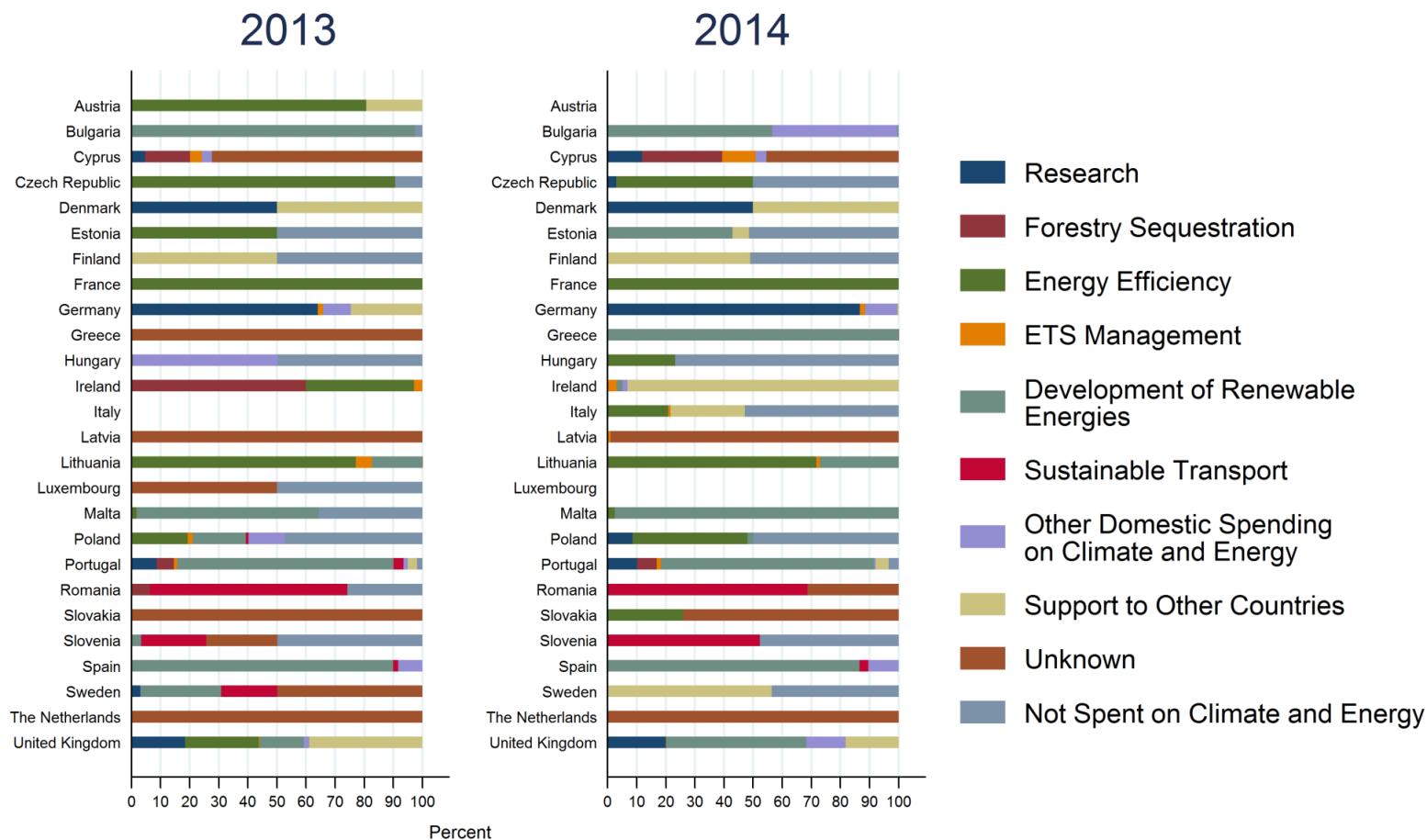
Figure 7 indicates there appears to be little change from 2013 to 2014 in spending priorities in this area; most countries used their auction revenue to support the same climate and energy related projects in 2014 that they financed in 2013.

Figure 6. Use or Planned Use of Auctioning Revenues for Climate and Energy Related Purposes (based on data availability)



Notes: This figure includes participating Member States with the exception of Austria, Belgium, Croatia, Italy, and Luxembourg. Carry-over amounts from previous years spent in the current year are not included. “Unknown” means spent on climate and energy programs, but specific spending category is not known. “Research” includes 1) funding of research and development and demonstration projects for reducing emissions and for adaptation and 2) finance research and development in energy efficiency and clean technologies. “Energy Efficiency” includes 1) measures intended to increase energy efficiency and insulation or to provide financial support in order to address social aspects in lower and middle income households and 2) development of technologies that help meet the commitment of the Union to increase energy efficiency by 20 percent by 2020. “Other Domestic Spending on Climate and Energy” includes 1) funding of initiatives within the framework of the European Strategic Energy Technology Plan and the European Technology Platforms; 2) development of other technologies contributing to the transition to a safe and sustainable low-carbon economy; 3) environmentally safe capture and geological storage of CO₂; 4) other reduction of greenhouse gas emissions; 5) adaptation to the impacts of climate change; 6) other domestic uses. Data come from Appendix Table A2 and A3. This figure does not include the financial value of targeted free allocation to electricity in eight eligible Member States.

Figure 7. Use or Planned Use of Auctioning Revenues for Climate and Energy Related Purposes by Member State.



Notes: Croatia did not hold auctions in 2013 or 2014. Belgium does not earmark auction revenues and does not provide information on spending an amount equivalent to at least 50 percent of its auction revenues. Italy did not provide data for the year 2013 for technical reasons. Austria's and Luxembourg's reports on their use of auction revenues for the year 2014 are not available as of September 2015. Data come from Appendix Table A2 and A3. This figure does not include the financial value of targeted free allocation to electricity in eight eligible Member States.

Looking ahead, the stated intentions of countries with respect to the use of revenues may vary from the outcome due to policy changes or market changes, including changes in the realized price of emissions allowances. However, thus far the ex ante intentions typically have been realized. Germany provides an interesting example because it followed through on its announced intention to contribute revenues to a climate fund, even supplementing revenue when the price of allowances fell and allocating greater than 100 percent of its auction revenues to the fund.¹⁰²

5.1 Future Auction Revenues and Price Volatility

The commitment to emissions reduction goals through 2030 provides an indication of the future quantity of allowances in the ETS. However, approval of the market stability proposal by the European Parliament in July 2015 introduced important changes to the volume of allowances that will circulate on the market in the remaining period of phase 3 and in phase 4.¹⁰³ One of the provisions of the new regulation mandates that 900 million of the back-loaded allowances be put into the reserve instead of being reintroduced into the market later in this trading period as was planned earlier in accordance with the back-loading regulation of 2014. In addition, the mechanism of the market stability reserve introduces uncertainty about the annual introduction of allowances because the issuance of allowances will depend on the number of unused allowances remaining in circulation (as discussed earlier), but when they enter the market they will expand the portion that are auctioned compared to free allocation.

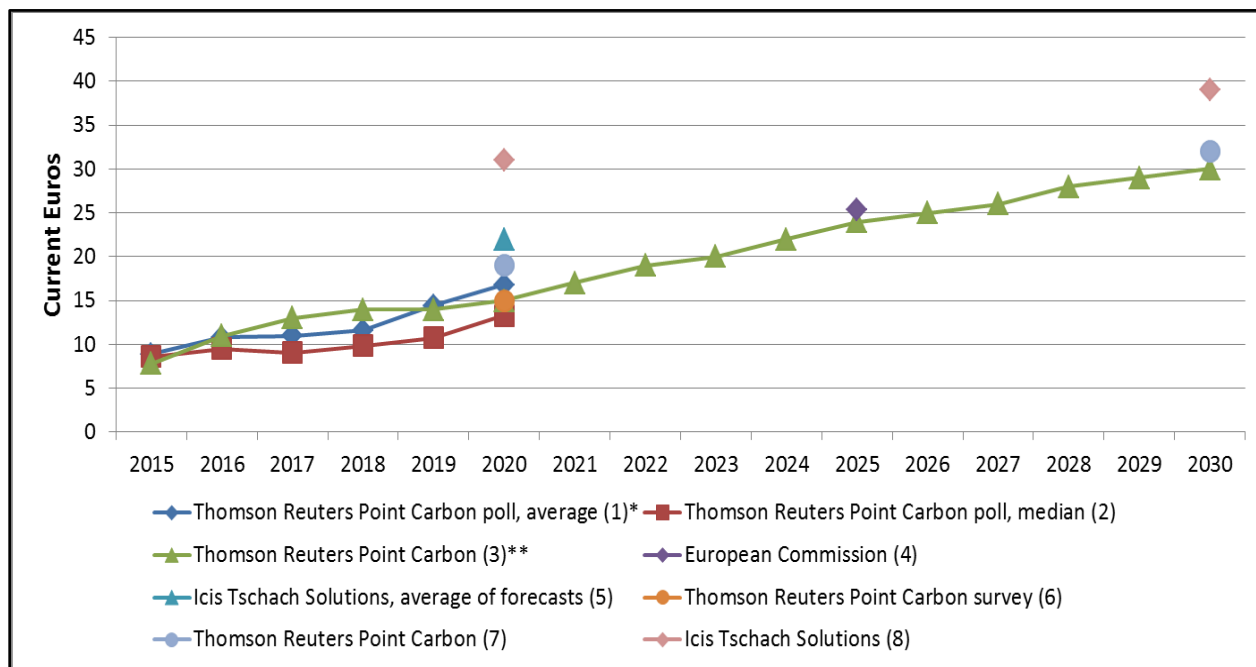
These new developments prompted traders, market analysts, and participants to adjust their price expectations. However, the adjusted price forecasts differ significantly among different analysts. Figure 8 shows price forecasts by two major energy market analytics companies—ICIS Tschach Solutions and Thomson Reuters Point Carbon—as well as by the European Commission, that were released after 25 February 2015, when the market stability reserve proposal was approved by the environment committee of the European Parliament and was finally taking its current shape. Appendix Table A4 provides more information about the price forecasts presented in Figure 8. As the figure illustrates, there is substantial uncertainty about the price of allowances in the future. Hence, our estimates of total asset value and auction revenues directed to Member States for the period 2015–2020 presented in Table 2 in section 3

¹⁰² Li and Griebhaber, 2013.

¹⁰³ European Parliament, 2015b.

need to be interpreted with caution because of uncertainty about both the quantity and the price of allowances in the future.

Figure 8. Forecasts of Allowance Prices



Source: Appendix Table A4.

*These values provide a connection between this figure and entries in Appendix Table A4.

**This forecast was used in Table 2 in section 3.

6. Industry Compensation for Indirect Costs

Member States are authorized to compensate the most electricity-intensive sectors through the national state aid schemes for increases in electricity costs relating to ETS.¹⁰⁴ Unlike facilities that incur direct costs for their own emissions, which can be compensated through free allocation of allowances, facilities that incur indirect costs can receive compensation as a share of auction revenue. If a Member State wants to compensate its sectors, it is obliged by law to notify the Commission and approval is necessary.¹⁰⁵⁻¹⁰⁶ To be considered for compensation, a company must be in one of the sectors listed in Table 7.

¹⁰⁴ European Parliament and Council, 2003, Article 10a(6).

¹⁰⁵ European Union, 2007, Article 108(3).

¹⁰⁶ The Commission has published guidelines to guarantee that actions are adopted in conformity with the EU's state aid rules (European Commission, 2012c; European Commission, 2015k).

Table 7. Sectors and Subsectors Deemed Ex Ante to Be Exposed to a Significant Risk of Carbon Leakage due to Indirect Emissions Costs

<i>Description</i>
Aluminium production
Mining of chemical and fertilizer minerals
Manufacture of other inorganic basic chemicals
Lead, zinc, and tin production
Manufacture of leather clothes
Manufacture of basic iron and steel and of ferro-alloys
Seamless steel pipes
Manufacture of paper and paperboard
Manufacture of fertilisers and nitrogen compounds
Copper production
Manufacture of other organic basic chemicals
Preparation and spinning of cotton-type fibers
Manufacture of man-made fibers
Mining of iron ores
Plastics in primary forms
– Low-density polyethylene
– Linear low-density polyethylene
– High-density polyethylene
– Polypropylene
– Polyvinyl chloride
– Polycarbonate
Manufacture of pulp
– Mechanical pulp

Source: European Commission, 2012c.

The maximum aid that is payable per facility is calculated according to two formulas. The first formula applies where electricity consumption efficiency benchmarks have been published for a given product:

$$B_a = A_{ia} \times C_a \times P_a \times BM \times PM$$

Where:

B_a is the maximum aid amount per facility in year a.

A_{ia} is the aid intensity in year a.

C_a is the applicable CO₂ emissions factor at year a.

P_a is the EU ETS allowance forward price for year a.

BM is the applicable product-specific electricity consumption efficiency benchmark.

PM is the installation's relevant output.

The second formula applies when no product-related electricity consumption efficiency benchmarks have been published:

$$B_a = A_{ia} \times C_a \times P_a \times EF \times SV$$

Where:

EF is the applicable fallback electricity consumption efficiency benchmark, and
SV is the installation's relevant electricity consumption.

The value of the aid that is provided cannot exceed 85 percent of the eligible costs incurred in 2013, 2014, and 2015; 80 percent in 2016, 2017, and 2018; and 75 percent in 2019 and 2020. Furthermore, Member States are obliged to demonstrate that the aid is necessary to prevent environmental harm—that is, that the aid helps avoid leakage of economic activity that might result in emissions increases (carbon leakage). The compensation should further provide an incentive for the beneficiary to attempt to reduce emissions and should be essential for the beneficiary in order to undertake investment. In addition, it is of high importance that Member States demonstrate that the aid does not adversely affect trading conditions to an extent contrary to the common interest, especially where the aid is focused on a restricted number of beneficiaries or where the aid is likely to reinforce the beneficiaries' market position.

As of September 2015, only six Member States—Belgium, Germany, Greece, the Netherlands, Spain, and the United Kingdom—have been granted permission to compensate specific industries. The amount of compensation is unpredictable because it varies with the allowance price. For instance, in Belgium the total compensation budget from 2013 to 2020 was estimated to be from 7 million to 113 million euros, depending on the market price of allowances, which was expected to range from 1 to 15 €/ton.¹⁰⁷ Moreover, there is interaction between the incentive to compensate and the allowance price, since one will affect the other. Belgium has tied the compensation budget to the revenue from the auctioning of emissions allowances.

Germany expects to deliver the greatest amount of compensation, with a total budget of 756 million euros from 2013 to 2015, with the program continuing thereafter until 2020. Eligible beneficiaries have to bear a share of their indirect costs for which no aid will be paid out, corresponding to the CO₂ costs of 1 GWh of electricity consumption per year per installation,

¹⁰⁷ European Commission, 2013c.

which means that beneficiaries with small installations of less than 1 GWh of consumption per year will not receive any aid. Based on the 2012 allowance price, 1 GWh represents a cost of about 4,000 euros.¹⁰⁸

Greece, like Belgium, has also tied the budget available for compensation to the revenue coming from the auctioning of the emissions allowances; the annual budget is expected to range from 14 to 20 million euros (estimated at a price of 5 and 7.5, respectively).¹⁰⁹ In the Netherlands, the budget was planned to be 78 million euros per year for 2014 and 2015. The 2014 budget was based on the 2012 CO₂ price of 8 EUR/ton; however, the actual price in 2014 was lower.¹¹⁰ Spanish authorities planned to spend 1 million euros per year in 2013 and 2014 and 3 million in 2015.¹¹¹ Finally, the United Kingdom scheme will have a GBP 13 million in 2013 and GBP 50 million in 2014 and 2015; however, the scheme was expected to extend beyond 2015.¹¹²

Table 8 presents information regarding the amount of money spent on compensation for indirect costs by Member States (note that these data are based on decision texts and are therefore “ex ante” data. Data on actual spending on compensation for indirect costs in 2013 are not yet available). The mechanism for compensation for indirect cost is not tied to auction revenues (although Greece and Belgium have implemented such a link); Member States can finance the compensation from any sources in their budgets. This arrangement will remain through phase 3. Even after 2021 it seems likely that any link between auction revenues and compensation will be voluntary, but there is a proposal to amend the ETS Directive and encourage Member States to use auction revenues as the source for compensation.

The compensation spending as a share of auction revenues varied greatly from a meager 0.29 percent in Spain to 52.17 percent in Belgium in 2013. However, while the compensation schemes are designed to last for a number of years, the actual or planned compensation for specific years varies, and hence the figures in Table 8 should not be used as an indicator for compensation for other years.

¹⁰⁸ European Commission, 2010c.

¹⁰⁹ European Commission, 2014d.

¹¹⁰ European Commission, 2013d.

¹¹¹ European Commission, 2013e.

¹¹² European Commission, 2013f .

Table 8. Member State Spending on Climate and Energy and Provision of Compensation for Indirect Costs Using Auction Revenue in 2013

	EU-ETS auction revenue	Climate and energy spending anticipated*	Anticipated compensation industry spending**	Anticipated climate and energy spending as percent of auction revenue	Anticipated compensation spending as percent of auction revenue
	(million €)	(million €)	(million €)	(percent)	(percent)
Belgium	115	58	60	50	52
Germany	790	790	350	100	44
Greece	148	148	17	100	12
Netherlands	134	134	0	100	<1
Spain	346	346	1	100	<1
United Kingdom	485	485	16	100	3
Total	2,019	1,904	444	94	22

Notes: Since Greece and Belgium intended to use their auction revenues to finance industry compensation schemes, their climate spending might have to be reduced by the corresponding amount.

*Based on data from the countries' reports on their actual and intended use of auction revenues. See Appendix Table A2 for detail.

**These figures represent what was planned to be spent for this purpose by Member States as stated in decision texts and may not represent the final actual amounts spent because the final amount was, in many cases, clearly dependent on carbon price.

Whenever Member States provided an interval for the anticipated compensation to industry, we took the midpoint of that interval.

Source: European Commission, 2014c; European Parliament and Council, 2013; European Environment Agency, 2015b; European Commission, 2010c; European Commission, 2013c,d,e,f; European Commission, 2014d.

7. Concluding Remarks

The expanded role of auctions of emissions allowances in phase 3 of the EU ETS meant that, for the first time, a substantial share of the total allowances value was directed to Member States' governments. Auctions are a new source of revenue for EU Member States, and these revenues, while already worth tens of billions of euros, are likely to grow over time as the cap is tightened and other measures to further increase the scarcity of allowances are introduced. There is, however, great uncertainty over future allowance prices as reflected by the large variations in projections made by commercial market analysts.

Given the significant and growing value of emissions allowances, understanding the effects of how auction revenues are used will be increasingly important. Member States appear to fulfill the legal requirement to direct at least 50 percent of auction revenues to “climate and energy purposes.” However, the extent to which the funds generated by auctions are additional to what otherwise would have been spent on climate and energy cannot be determined from our analysis. This is a key area for further study.

It is not until 2018, however, that auction revenues will exceed 50 percent of the total value of annual allocated allowances that have entered the market, despite the amendments introduced to make auctioning the default allocation mechanism in the EU ETS. Thus, how the remaining (free) allocation is carried out is still important for the performance of the system.

Nevertheless, the move to auctioning as the default allocation mechanism may carry administrative benefits and be more transparent than free allocation. Other changes in the design of the EU ETS implemented as of September 2015 represent an improvement of the system as well. The centralized allocation process introduced in phase 3 removes the possibility for Member States to subsidize domestic firms through over allocation of emissions allowances. The expansion of the trading system to include more activities—notably aviation—and greenhouse gases other than CO₂, also offers potential economic benefits as mitigation costs are equalized across a larger share of the economy.

Perhaps the greatest concern over the EU ETS, at least as expressed in the public debate, is the persistently low allowance price in the last five years. Key reasons for the low prices are poor projections of future industrial production; limited growth of the European economy in general; use of international carbon credits (primarily an unexpected influx of certified emissions reduction credits under the Clean Development Mechanism); and subsidies to renewable energy. The most straightforward way to increase the scarcity of allowances (and hence increase the

price) would be to reduce the cap and consequently the number of allowances available in the market. However, this has proven politically impossible, despite efforts in this direction. Instead, two other principal measures have been introduced: back-loading and the market stability reserve. Back-loading will result in 900 million allowances not entering the market; instead they are being put into the reserve. Those allowances are likely to be auctioned or earmarked. The flow of allowances entering into the market from the reserve will be based on estimated emissions and volumes of allowances in circulation. The extent to which these two measures will reach their objectives is still under debate.

Another concern has been regarding industry compensation. As of 2015, Member States are authorized to use state aid measures to compensate large electricity consumers for indirect costs caused by the EU ETS. Similar to other state aid measures, this opens up the possibility for strategic behavior by Member States to support their own industries. However, only six Member States (as of September 2015) have used the compensation opportunity. We do not find support for concerns of a “race to the bottom” where Member States subsidize domestic industry and as a result increase the total cost of meeting the emissions target. However, since this is a new mechanism and more Member States may make use of it in the future, it is too early to dismiss the issue of strategic behavior altogether.

Looking ahead, the European Commission presented in July 2015 a legislative proposal to revise the EU Emissions Trading System for the period after 2020, with several changes addressing the risk of carbon leakage: revising the system of free allocation to focus on sectors at the highest risk of relocating their production outside the EU; a considerable number of free allowances set aside for new and growing installations; more flexible rules to better align the amount of free allowances with production figures and update of benchmarks to reflect technological advances since 2008 (benchmarks are currently not updated nor output based).¹¹³ In addition, the proposal establishes two new funds:

1. The Innovation Fund, extending existing support for the demonstration of innovative technologies to breakthrough innovation in industry (450 million allowances);
2. The Modernisation Fund, facilitating investments in modernizing the power sector and wider energy systems and boosting energy efficiency in 10 lower-income Member States (310 million allowances).

¹¹³ European Commission, 2015s

Free allowances will also continue to be available to modernize the power sector in the lower-income Member States.^{114·115}

The implemented and proposed changes to the EU ETS expose the continued tension between the desire to reduce emissions at least cost and keep the EU ETS as the cornerstone in EU mitigation efforts on the one hand, and concerns over international competition, carbon leakage, and domestic politics on the other. Although the move to auctioning and the expanded scope of the system are positive steps, other changes complicate the picture. Different allocation methods to industry, state aid measures, and the introduction of a complex market stability reserve may undermine the credibility of the EU ETS. Future adjustments will determine whether it will be a clear, predictable, and efficient policy instrument as it was intended to be, or a complex array of interacting mechanisms, and whether it contributes to achieving important emissions reductions.

¹¹⁴ European Commission, 2015s.

¹¹⁵ European Commission, 2015t.

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Appendices

Appendix 1.

This Appendix explains authors' calculations in Table 2.

Historic values of total volumes of emissions allowances for the years 2005-2014 were copied from European Environment Agency (2015c). No scope correction factor was used for values in phase 1 and 2.¹¹⁶ Thus, what we have in Table 2 are actual values and not what they would have been if EU ETS had had the scope that it has today when it just started. Note that the values for the years 2013 and 2014 were slightly adjusted as explained in Appendix 2.

Values for the years 2015-2020 were copied from Table 3. They represent projected totals based on projected shares, and do not generally equal the caps for the corresponding years. Auction revenue portion of total asset value is based on shares of auctioned amounts in the total volume of allocated allowances, which were also copied from Table 3.

Average annual historical prices for the years 2005-2014 were computed by taking the average of monthly auction prices weighted by monthly auction volumes. The prices are futures prices for December of the same year contract. For example, the annual average price for 2008 represents the weighted average December 2008 futures price in that year. Technically, the average December 2008 futures price could be computed as a monthly average of December 2008 futures prices from the early 2005 up to December 2008. However, we based the average only on the prices in the corresponding year following remarks by Ellerman et al. (2010b). In other words, the December 2008 futures price in this example would be based only on December 2008 futures prices in the 12 months of 2008. The futures prices data come from Quandl (n.d.).

¹¹⁶ Scope correction can be used to make values comparable across phases by taking into account the extended scope of the EU ETS in phases 2 and 3.

Appendix 2.

This Appendix explains authors' calculations in Table 3.

We copied the 2013 cap from European Commission (2015d) and reduced it by 1.74 percent annually to calculate the caps for the years 2014-2020. We know that 1) the base for the 1.74% reduction factor is the historical average of emissions in the years 2008-2012; and 2) the reduction factor is linear, not compound, that is, the reduction factor is the same in absolute terms for all years in phase 3, and it equals 38,264,246.¹¹⁷ For example, to calculate the cap for 2014, we took the 2013 cap and subtracted 38,264,246. Similarly, to calculate the cap for 2015, we took the 2014 cap and subtracted the same number again, and so on.

For the years 2013 and 2014, from European Environment Agency (2015c) we copied the values "1.3 Allowances auctioned or sold (EUAs and EUAAs)" into the "Auction" row, "1.1.1 Free allocation to existing entities (Art. 10a(1))" into the "Free Allocation to Industry" row, "1.1.2 Free allocation from the new entrants reserve (Art. 10a(7))" into the "New Entrants" row, and "1.1.3 Free allocation for modernization of electricity generation (Art. 10c)" into the "Free Allocation to Electricity" row. Then we summed up these four values in the 2013 and 2014 columns that we copied from European Environment Agency (2015c) and verified that they are equal to the values reported in European Environment Agency (2015c) in the column "1. Total allocated allowances (EUAs or EUAAs)".

Allocations to district heating are not reported in a separate column in European Environment Agency (2015c). We copied district heating allocation for the years 2013-2020 from European Commission (2013g). Then, we returned to the row "Free allocation to industry" and modified the values for 2013 and 2014 by subtracting the values for district heating that we had just copied from the decision text.

It is necessary to modify the "Auction" row to account for the NER300 program because the 300 million NER300 EUAs were included into the auction volumes for the years 2013 and 2014 that we copied from European Environment Agency (2015c). This can be confirmed based on the last two rows in Table 8 in European Environment Agency (2015a). We copied the

¹¹⁷ European Commission, 2015d.

NER300 values into the corresponding row in our Table 3. Then we subtracted those values from the values in the “Auction” row.¹¹⁸

There are several other adjustments we could have made to the 2013 and 2014 columns.

In 2012, the so-called “early auctions” of the third trading period were held. The volumes of these auctions were equal to 90 million EUAs and are added to the 2013 auctioning volumes in the data in European Environment Agency (2015c).¹¹⁹ Thus, there was no need to adjust the 2013 auction volume by 90 million.

We filled out the rest of the table with ex-ante values.

We copied the auction volume for the year 2015 from European Commission (2014e). That amount had already been adjusted for back-loading and it does include 11,328,500 and 19,470,500 allowances to be auctioned by Croatia and the EEA-EFTA States, respectively, for the years 2013 to 2015, for which auctioning is still to start.

It is important not to double-count the amount set aside to be auctioned for Croatia in the years 2013-2015. According to European Commission (2014e), the whole Croatia’s 2013-2015 amount was included into the 2015 auction volume. According to European Environment Agency (2015a), even though

“Croatia has been part of the EU ETS since 2013, it only started auctioning in 2015, since the necessary arrangements between the EEX, which serves as the transitional common auction platform, and the Croatian auctioneer had not been in place before-hand. In 2015, Croatia is set to auction a total amount of 11 328 500 EUAs. This amount represents 4 900 000, 3 012 000, and 3 416 500 allowances that were to be auctioned in the years 2013, 2014 and 2015 respectively. Therefore, the data viewer includes those amounts for the years 2013 and 2014 (2015 to be included next year).”

Thus, in order to avoid double-counting, we subtracted Croatia's allowances for the years 2013 and 2014 from the auction volumes for 2013 and 2014 that we copied from European Environment Agency (2015c) as those amounts had already been included into the 2015 auction volume. We subtracted 4 900 000 and 3 012 000 from the auction volumes for the years 2013

¹¹⁸ Technically, the first portion of 200 million NER300 EUAs was sold by the European Investment Bank between December 5, 2011 and September 28, 2012 and the second portion of 100 million EUAs was sold between November 14, 2013 and April 11, 2014 (European Investment Bank, 2014).

¹¹⁹ European Environment Agency, 2015a.

and 2014, respectively. We verified that these amounts were included into the 2013 and 2014 auction volumes by examining Table 8 in European Environment Agency (2015a). Then we summed up all values (excluding the annual cap) in the columns for the years 2013 and 2014.

Checking whether we had to make a similar adjustment for the three EEA-EFTA countries, we read in European Environment Agency (2015a) that

"For Iceland, Liechtenstein and Norway, a different approach is suggested. These countries are also set to auction on the transitional common auction platform, but similarly to Croatia, the necessary arrangements have not been in place. However, whilst Croatia has started auctioning in 2015, the three EEA-EFTA states have not done so. This is why their cumulated withheld amount of 19 470 500 is not displayed in the data viewer yet. It will be included – and distributed between years, according to the Croatian case – once these countries have carried out their first EUA auction."

Thus, EEA-EFTA amount of 19,470,500 is counted only once - in the 2015 auction volume. We double-checked by examining Table 8 in European Environment Agency (2015a).

We copied the amounts for the years 2016-2020 into the "Auction" row from European Commission (2015p). Those numbers take into account the back-loading regulation of 2014 but not the market stability reserve regulation of 2015. Thus, we subtracted 300 million from the 2019 auction value and 600 million from the 2020 auction value.

Using Figure 3 in CDC Climat Research (2013) we copied the values from the "Transitional free allocation – 8 countries" row of the figure into the "Free Allocation to Electricity" row of our table for the years 2015-2020. The values for the years 2013 and 2014 as reported in this source are higher than the values we copied from European Environment Agency (2015c). This is because what we copied from CDC Climat Research (2013) represents the maximum amount set aside in the decision text, whereas the European Environment Agency (2015c) values were actual amounts allocated to electricity generators.¹²⁰

Then we copied the values from the "Estimated benchmark allocation" row (from the same Figure 3 in CDC Climat Research) into the "Free Allocation to Industry" row for the years 2015-2020. These amounts include amounts set aside for allocation to district heating, so we subtracted district heating values.

¹²⁰ See European Commission, 2014f and 2015u.

The “New Entrants” row for the years 2015-2020 could be calculated as 5% of the annual cap. (This is what was actually done in Figure 3 in CDC Climat Research, but annual caps in Figure 3 are slightly different). Thus, the total amount set aside for New Entrants for Phase 3 (2013-2020) should add up to about 780 million allowances (which equals 5% of the total emissions cap in phase 3). However, according to the most recent update of July 2015, the New Entrants Reserve for phase 3 originally had only 480.2 million allowances because 300 million allowances were deducted from the original amount for the NER300 program.¹²¹ We subtracted the 2013 and 2014 New Entrants allocations of 10.19 and 11.46 million, respectively, from 480.2 to get 458.55 million allowances available for the years 2015-2020 and divided that number by 6 to get 76.425 million allowances available for New Entrants in each year of the 2015-2020 period. Ideally, New Entrants allocation in phase 3 would start with a higher number and then would be reduced by 1.74% each year; however, what matters is that the total maximum possible New Entrants allocations for the years 2015-2020 add up to 458.55. Also, according to European Commission (2015v), some unallocated allowances will be transferred to the market stability reserve. We did not make adjustments for unallocated allowances in Table 3.

Finally, we summed up the values in each column (excluding the annual cap) to get the totals.

¹²¹ European Commission, 2015v.

Table A1. Auction Revenues and Auction Revenue Spending on Climate and Energy Programs as Percent of GDP by Member State

Country	Auction Revenues as Percent of GDP		Auction Revenue Spending as Percent of GDP	
	2013	2014	2013	2014
Austria	0.010%		0.006%	
Belgium	0.016%	0.014%		
Bulgaria	0.073%	0.049%	0.071%	0.049%
Croatia				
Cyprus	0.006%	0.002%	0.006%	0.002%
Czech Republic	0.029%	0.020%	0.026%	0.010%
Denmark	0.013%	0.011%	0.013%	0.011%
Estonia	0.055%	0.022%	0.027%	0.011%
Finland	0.019%	0.018%	0.009%	0.009%
France	0.006%	0.006%	0.006%	0.006%
Germany	0.016%	0.015%	0.016%	0.015%
Greece	0.046%	0.042%	0.046%	0.042%
Hungary	0.020%	0.031%	0.010%	0.007%
Ireland	0.014%	0.011%	0.014%	0.011%
Italy	0.014%	0.014%		0.007%
Latvia	0.026%	0.024%	0.026%	0.024%
Lithuania	0.032%	0.027%	0.032%	0.027%
Luxembourg	0.006%		0.003%	
Malta	0.035%		0.022%	
The Netherlands	0.012%	0.011%	0.012%	0.011%
Poland	0.035%	0.011%	0.018%	0.005%
Portugal	0.024%	0.022%	0.024%	0.021%
Romania	0.049%	0.037%	0.036%	0.037%
Slovakia	0.048%	0.043%	0.048%	0.043%
Slovenia	0.028%	0.025%	0.014%	0.013%
Spain	0.019%	0.018%	0.019%	0.018%
Sweden	0.005%	0.004%	0.005%	0.002%
United Kingdom	0.014%	0.010%	0.014%	0.010%

Notes: Following a note by European Commission (2014c), we set Finland's spending of auction revenues on climate and energy projects in 2013 equal to 50% of its auction revenues in 2013; and Latvia's and Slovakia's spending of auction revenues on climate and energy programs in 2013 equal to 100% of their auction revenues in 2013. In addition, in this table Latvia's and Slovakia's spending of auction revenues on climate and energy programs in 2014 was also set to 100% of their auction revenues in 2014.

Table A2. Auction Revenues and Auction Revenue Spending by Member State in 2013

Country (numbers indicate a key to notes at the end of the table)	Revenue, 1000s euros				Expenditure, 1000s euros		
	Total Auction Revenue	Revenue from Auctioning of General Allowances	Revenue from Auctioning of Aviation Allowances	Carry-over Amount (1)	Total Amount Spent on Climate & Energy Projects from Total Auction Revenue Received in 2013	Total Amount Not Spent on Climate & Energy Projects from Total Auction Revenue Received in 2013	Additional Amount Spent on Climate & Energy Projects in 2013 not from Auction Revenue Received in 2013 (2)
Austria (4)	55,752	55,752			36,904	18,848	
Belgium (5)	114,992	114,992					
Bulgaria	52,629	52,629		22,138	51,294	1,335	
Croatia (6)							
Cyprus	1,928	1,928			1,928		
Czech Republic (7)	80,686	80,686			73,150	7,536	
Denmark (8)	56,045	56,045			56,045		
Estonia (9)	18,074	18,074			9,037	9,037	
Finland	66,970	66,970			33,485	33,485	
France	219,247	219,247			219,247		
Germany (10)	790,292	790,292		195,000	790,292		195,872
Greece	147,638	147,638			147,638		
Hungary (11)	34,592	34,592			17,296	17,296	168
Ireland	41,677	41,677			41,677		
Italy (12)	385,890	385,890		76,497			
Latvia	10,792	10,792		2,129	10,792		
Lithuania (13)	19,978	19,978		3,286	19,978		
Luxembourg	4,985	4,985		368	2,493	2,493	
Malta (14)	4,466	4,466			2,869	1,597	1
The Netherlands	134,238	134,238			134,238		
Poland	244,022	244,022			128,677	115,345	4
Portugal (15)	72,782	72,782			71,402	1,380	2,421
Romania (16)	122,736	122,736			91,172	31,564	
Slovakia	61,703	61,703		12,183	61,703		
Slovenia (17)	17,739	17,739		3,512	8,889	8,850	
Spain (18)	346,111	346,111		68,533	346,111		68,531
Sweden (19)	35,700	35,700			35,700		
United Kingdom (20)	485,361	485,361			485,361		

Table A2 continued

Expenditure of Auction Revenues by Spending Category, 1000s euros								
Country (numbers indicate a key to notes at the end of the table)	Unknown (3)	Forestry Sequestration	Other Reduction of Greenhouse Gas Emissions	Funding of Research and Development and Demonstration Projects	ETS Management	Measures Intended to Increase Energy Efficiency in order to Address Social Aspects in Lower and Middle Income Households	Finance Research and Development in Energy Efficiency	Development of Renewable Energies
	0	1	2	3	4	5	6	7
Austria (4)						29,804		
Belgium (5)								
Bulgaria								51,294
Croatia (6)								
Cyprus	1,395	300	66	89	78			
Czech Republic (7)						73,150		
Denmark (8)				28,023				
Estonia (9)	1							
Finland								
France						219,247		
Germany (10)				632,000	17,376			
Greece	147,638							
Hungary (11)						168		
Ireland		24,969			1,228	15,480		
Italy (12)								
Latvia	10,779				13			
Lithuania (13)	1				1,092			3,464
Luxembourg	2,493							
Malta (14)								2,789
The Netherlands	134,238							
Poland		157		41	4,091	25,514	18	44,533
Portugal (15)		4,479		5,188	826		1,331	55,900
Romania (16)	3	7,836						
Slovakia	61,641				62			
Slovenia (17)	4,331				4			579
Spain (18)			17,429					373,178
Sweden (19)	17,800			1,100				9,900
United Kingdom (20)				89,517	827	123,368		74,259

Table A2 continued

	Expenditure of Auction Revenues by Spending Category, 1000s euros								
Country (numbers indicate a key to notes at the end of the table)	Other Domestic/EU Uses	Development of Other Technologies	Development of Technologies to Increase Energy Efficiency	Funding of Special Initiatives	Adaptation to the Impacts of Climate Change	Sustainable Transport	Capture and Storage of CO ₂ ;	Support to Developing Countries	Support to Countries Other Than Developing Countries
	8	9	10	11	12	13	14	15	16
Austria (4)								7,100	
Belgium (5)									
Bulgaria									
Croatia (6)									
Cyprus									
Czech Republic (7)									
Denmark (8)								28,023	
Estonia (9)			9,036						
Finland								33,485	
France									
Germany (10)	94,000							240,204	2,584
Greece									
Hungary (11)	17,296								
Ireland									
Italy (12)									
Latvia									
Lithuania (13)			15,421						
Luxembourg									
Malta (14)			81						
The Netherlands									
Poland	219	30,346	21,596			2,166			
Portugal (15)	1,045					2,633		2,421	
Romania (16)						83,333			
Slovakia									
Slovenia (17)						3,975			
Spain (18)		17,182				6,853			
Sweden (19)						6,900			
United Kingdom (20)							9,094	188,296	

Notes: All amounts in columns (1) through (14) are disbursed amounts unless noted otherwise. Austria, Belgium, Denmark, Ireland, the Netherlands, Poland, Sweden, and the UK do not earmark auction revenues. Greece and Luxembourg did not provide data on climate and energy spending by category, but Austria, Denmark, Ireland, Poland, Sweden, and the UK provide data on spending an amount equivalent to at least 50% of their auction revenues.

Following European Commission (2014c), Finland's spending on climate and energy programs was set equal to 50% of its auction revenues; Latvia's and Slovakia's spending on climate and energy related purposes was set equal to 100% of their auction revenues.

(1) Total amount of auctioning revenues generated, or the equivalent in financial value committed in years before 2013, generated and not disbursed in the years before the year 2013, and carried-over for disbursement in the year 2013.

(2) This amount was included by countries in their reported amount in columns 1-16. For Germany and Spain, this amount is almost equal to their carry-over amount from 2012. For other countries it reflects an inconsistency between the sum of the amounts in columns 1-16 and the amount that they reported in the column "Total Amount Spent on Climate & Energy Projects from Total Auction Revenue Received in 2013".

(3) This amount was included by countries into the column "Total Amount Spent on Climate & Energy Projects from Total Auction Revenue Received in 2013" but not in the amounts reported in columns 1-16.

(4) Disbursed: 0.

(5) In accordance with the Belgian special law of January 16, 1989 Art. 65 quarter §7, as modified by the Belgian special law of January 6, 2014, the revenues of the Belgian auctioning must be distributed between the federal government and the Flemish, Walloon and Brussels Capital regional governments in accordance with a cooperation agreement to be concluded between these four governments. As no cooperation agreement on the distribution of the revenues has been concluded so far, the revenues remain blocked on an account and cannot be used for any purpose.

(6) No auctions have been held yet.

(7) Disbursed: 0.

(8) Disbursed: 0.

(9) The amount in column (10) is also associated with column (2).

(10) Disbursed: 649,376,000. The amount in column (3) is also associated with columns (1), (2), (5), (6), (7), (9), (10), (11), (12), (13), and (14).

(11) Disbursed: 0.

(12) Auction revenues were not allocated in 2013 for technical reasons.

(13) Disbursed: 282,000. The amount in column (10) is also associated with column (5). The amount in column (4) is also associated with column (8).

(14) Disbursed: 1,070,000.

(15) The amount in column (3) is also associated with column (11).

(16) Disbursed: 0.

(17) Slovenia claims to have spent 8,889,000 on climate and energy.

(18) Disbursed: 373,556,000.

(19) Sweden claims to have spent 100% of its auction revenues on climate and energy. The amount in column (3) is also associated with columns (7), (9), (10). The amount in column (7) is also associated with columns (9) and (10).

(20) The amount in column (3) is also associated with column (6).

Table A3. Auction Revenues and Auction Revenue Spending by Member State in 2014

Country (numbers indicate a key to notes at the end of the table)	Revenue, 1000s euros				Expenditure, 1000s euros		
	Total Auction Revenue	Revenue from Auctioning of General Allowances	Revenue from Auctioning of Aviation Allowances	Carry-over Amount (1)	Total Amount Spent on Climate & Energy Projects from Total Auction Revenue Received in 2014	Total Amount Not Spent on Climate & Energy Projects from Total Auction Revenue Received in 2014	Additional Amount Spent on Climate & Energy Projects in 2013 not from Auction Revenue Received in 2014 (2)
Austria							
Belgium (4)	97,079	97,079					
Bulgaria	36,415	36,192	223	23,473	36,192	223	
Croatia (5)							
Cyprus	730	730		431	730		
Czech Republic (6)	55,710	55,243	467	69,008	26,925	28,785	
Denmark (7)	48,090	46,927	1,163		48,090		
Estonia (8)	7,447	7,409	38		3,623	3,824	
Finland	63,496	62,683	813		31,113	32,383	
France	215,345	215,345			215,345		
Germany (9)	749,983	749,983		94,149	749,983		96,831
Greece (10)	131,070	129,971	1,098		131,070		
Hungary (11)	56,499	56,210	288	23	13,102	43,397	
Ireland	35,982	35,110	872		35,982		
Italy (12)	408,567	403,318	5,249	428,019	192,767	215,800	
Latvia	10,224	10,083	141	12,897	10,224		
Lithuania (13)	17,340	17,282	58	22,982	17,340		22,982
Luxembourg							
Malta (14)	3,915	3,815	100	1,800	3,915		1,771
The Netherlands	131,101	125,632	5,470		131,101		
Poland (15)	78,010	78,010			39,024	38,986	3
Portugal (16)	67,095	65,822	1,273		64,849	2,246	161
Romania (17)	97,890	97,568	322	23,897	97,890		
Slovakia	57,635	57,591	45	73,824	57,635		
Slovenia (18)	16,642	16,642		8,321	8,321	8,321	806
Spain (19)	330,097	323,532	6,564	26,620	330,097		40,120
Sweden	33,598	32,575	1,023		18,939	14,659	
United Kingdom (20)	401,504	387,425	14,079		401,504		

Table A3 (continued)

Expenditure of Auction Revenues by Spending Category, 1000s euros								
Country (numbers indicate a key to notes at the end of the table)	Unknown (3)	Forestry Sequestration	Other Reduction of Greenhouse Gas Emissions	Funding of Research and Development and Demonstration Projects	ETS Management	Measures Intended to Increase Energy Efficiency in order to Address Social Aspects in Lower and Middle Income Households	Finance Research and Development in Energy Efficiency	Development of Renewable Energies
	0	1	2	3	4	5	6	7
Austria								
Belgium (4)								
Bulgaria								20,605
Croatia (5)								
Cyprus	332	200	27	87	84			
Czech Republic (6)	1					25,195	1,729	
Denmark (7)				24,045				
Estonia (8)								3,200
Finland								
France						215,345		
Germany (9)				733,874	16,109			
Greece (10)	1							131,069
Hungary (11)						13,102		
Ireland					1,131			699
Italy (12)					2,887	85,300		
Latvia	10,117				107			
Lithuania (13)					455	28,948		10,919
Luxembourg								
Malta (14)						135		5,330
The Netherlands	131,101							
Poland (15)				6,655		30,820		1,552
Portugal (16)		4,500		6,849	975			49,246
Romania (17)	30,573							
Slovakia	42,624				58	14,953		
Slovenia (18)					27			
Spain (19)								320,750
Sweden								
United Kingdom (20)				80,601	547			192,893

Table A3 (continued)

Country (numbers indicate a key to notes at the end of the table)	Expenditure of Auction Revenues by Spending Category, 1000s euros								
	Other Domestic/EU Uses	Development of Other Technologies	Development of Technologies to Increase Energy Efficiency	Funding of Special Initiatives	Adaptation to the Impacts of Climate Change	Sustainable Transport	Capture and Storage of CO ₂ ;	Support to Developing Countries	Support to Countries Other Than Developing Countries
	8	9	10	11	12	13	14	15	16
Austria									
Belgium (4)									
Bulgaria	15,587								
Croatia (5)									
Cyprus									
Czech Republic (6)									
Denmark (7)								24,045	
Estonia (8)								423	
Finland								31,113	
France									
Germany (9)	94,149							1,770	912
Greece (10)									
Hungary (11)									
Ireland		608						33,544	
Italy (12)								104,580	
Latvia									
Lithuania (13)									
Luxembourg									
Malta (14)			221						
The Netherlands									
Poland (15)									
Portugal (16)	419							3,021	
Romania (17)						67,317			
Slovakia									
Slovenia (18)						9,100			
Spain (19)		38,200				11,267			
Sweden								18,939	
United Kingdom (20)							54,567	72,896	

Notes: All amounts in columns (1) through (14) are disbursed amounts unless noted otherwise. Austria, Belgium, Denmark, Ireland, the Netherlands, Poland, Sweden, and the UK do not earmark auction revenues. Austria, Denmark, Ireland, Poland, Sweden, and the UK generally provide data on spending an amount equivalent to at least 50% of their auction revenues. However, Austria and Luxembourg have not submitted their reports on the use of auction revenues in 2014 (as of September 2015).

Latvia's and Slovakia's spending on climate and energy related purposes was set equal to 100% of their auction revenues.

- (1) Total amount of auctioning revenues generated, or the equivalent in financial value committed in years before 2014, generated and not disbursed in the years before the year 2014 and carried-over for disbursement in the year 2014.
- (2) This amount was included by countries in their reported amount in columns 1-16. For Cyprus, Germany, Lithuania, Malta, and Spain this amount is close to their carry-over amount. For other countries it reflects an inconsistency between the sum of the amounts in columns 1-16 and the amount that they reported in the column "Total Amount Spent on Climate & Energy Projects from Total Auction Revenue Received in 2014".
- (3) This amount was included by countries into the column "Total Amount Spent on Climate & Energy Projects from Total Auction Revenue Received in 2014" but not in the amounts reported in columns 1-16.
- (4) In accordance with the Belgian special law of January 16, 1989 Art. 65 quarter §7, as modified by the Belgian special law of January 6, 2014, the revenues of the Belgian auctioning are distributed between the federal government and the Flemish, Walloon and Brussels Capital regional governments in accordance with a cooperation agreement to be concluded between these four governments. As no cooperation agreement on the distribution of the revenues has been concluded so far, the revenues remain blocked on an account and cannot be used for any purpose.
- (5) No auctions have been held yet.
- (6) Disbursed: 1,236,000.
- (7) Disbursed: 0.
- (8) The amount in column (7) is also associated with columns (10) and (2).
- (9) The amount in column (3) is also associated with columns (1), (5), (6), (7), (9), (10), (11), (13), and (14).
- (10) Disbursed: 0.
- (11) Disbursed: 0. Also, there might be a mistake in the carry-over amount. The amount in column (5) is also associated with column (12).
- (12) Disbursed: 2,887,000.
- (13) Disbursed: 2,799,000. The amount in column (4) is also associated with column (8).
- (14) Disbursed: 5,351,000.
- (15) The amount in column (3) is also associated with columns (11) and (12). The amount in column (7) is also associated with column (9).
- (16) The amount in column (3) is also associated with columns (1), (11), and (13).
- (17) Disbursed: 43,399,000. Romania claim to have spent 100% of its auction revenues on climate & energy but it might be a mistake.
- (18) Disbursed: 27,000. Slovenia claims to have spent 8,321,000 on climate and energy but it might be a mistake.
- (19) Disbursed: 308,611,000. The amount in column (9) is also associated with column (12). The amount in column (13) is also associated with column (2).
- (20) The amount in column (3) is also associated with column (6).

Table A4. Forecasts of Allowance Prices (data for Figure 8)

Predicted price and assumptions	Analyst, source, date
<p>The survey responses were received between Feb. 20 and Mar. 15.</p> <p>€8.90 Average, 2015 €10.80 Average, 2016 €11.00 Average, 2017 €11.60 Average, 2018 €14.40 Average, 2019 €16.80 Average, 2020 €8.60 Median, 2015 €9.50 Median, 2016 €9.08 Median, 2017 €9.83 Median, 2018 €10.77 Median, 2019 €13.31 Median, 2020</p>	<p>Thomson Reuters Point Carbon Poll of 10 market analysts, April 15, 2015^{122,123}</p>
<p>€7.80 by 2015 €11.00 by 2016 €13.00 by 2017 €14.00 by 2018 €14.00 by 2019 €15.00 by 2020 €17.00 by 2021 €19.00 by 2022 €20.00 by 2023 €22.00 by 2024 €24.00 by 2025 €25.00 by 2026 €26.00 by 2027 €28.00 by 2028 €29.00 by 2029 €30.00 by 2030</p>	<p>Thomson Reuters Point Carbon, June 18, 2015¹²⁴</p> <p>These prices appear in Table 2.</p>
<p>€ 25.40 "European Commission are expecting an average price in Phase IV of as much as..."</p>	<p>European Commission, as cited in Redshaw Advisors Ltd, July 15, 2015</p>
<p>€22/tCO₂e by 2020 "an average of analyst forecasts..."</p>	<p>European Daily Carbon Markets (EDCM 12 May 2015) by ICIS, June 12, 2015 as cited by Lee (2015)</p>

¹²² Garside, 2015.

¹²³ Szabo, 2015a.

¹²⁴ Szabo, 2015b.

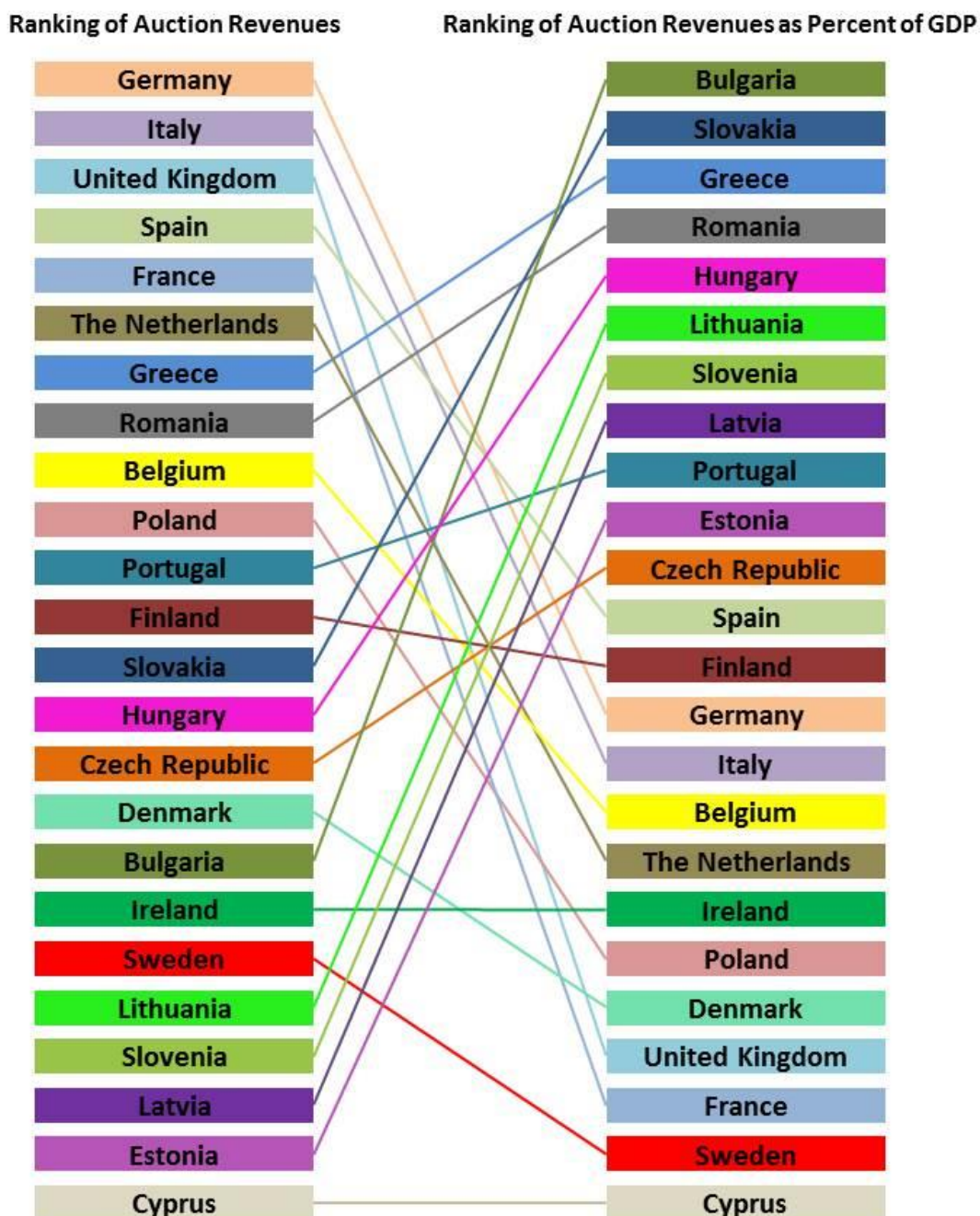
at least €9 by 2020 "76% of 457 respondents said..." above €11 by 2020 "More than 50% predict..." above €15 by 2020 "23% say..."	Thomson Reuters Point Carbon annual survey of European carbon market participants and observers, May 13, 2015 ¹²⁵
€19/t 2020, €32/t by 2030	Thomson Reuters Point Carbon, May 11, 2015 ¹²⁶
€31 in 2020 and around €39 in 2030, taking into account a 2019 MSR start and back-loading in reserve	Icis Tschach Solutions, February 25, 2015 ¹²⁷

¹²⁵ Garside, 2015.

¹²⁶ Climate Policy Observer, 2015.

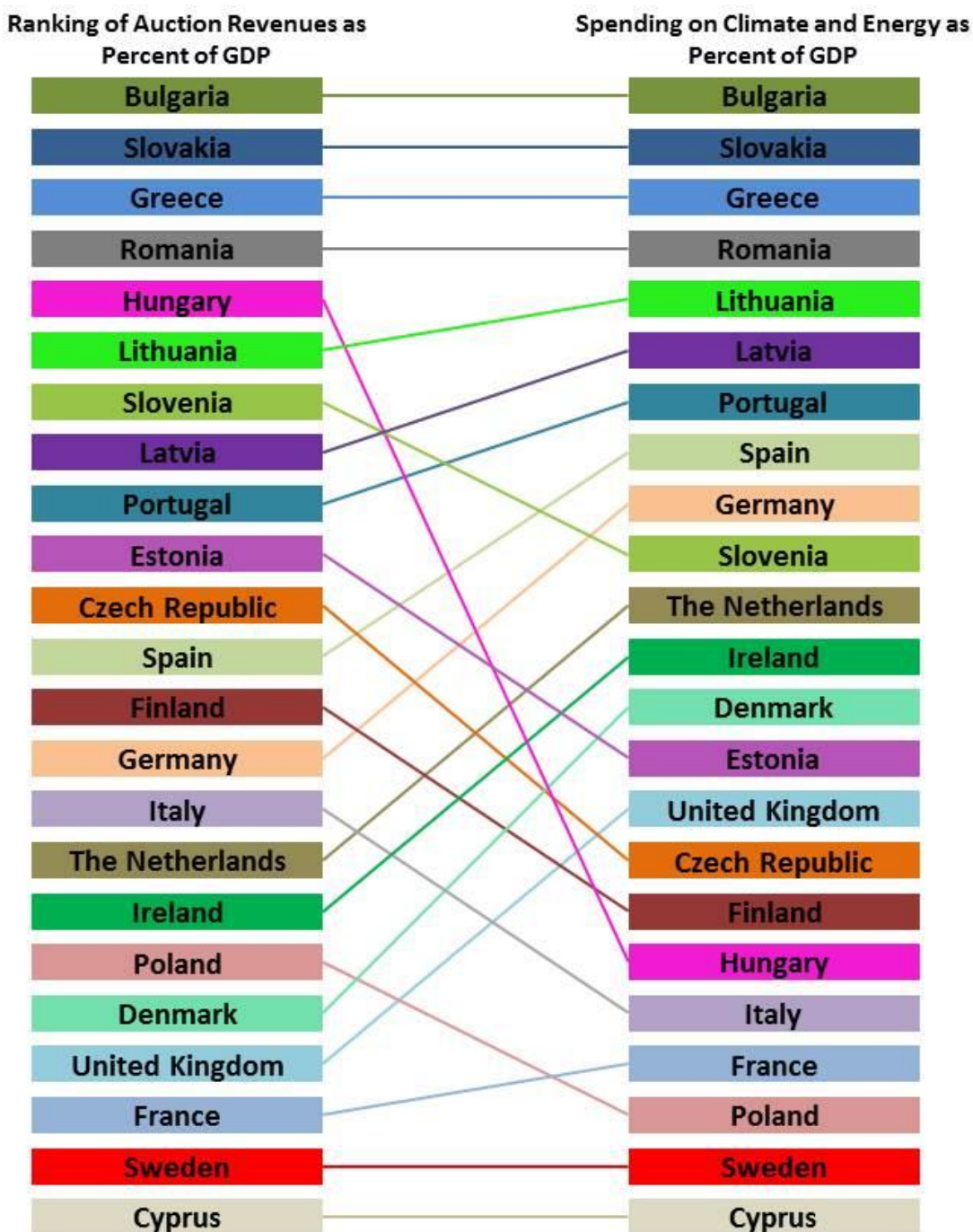
¹²⁷ ICIS, 2015.

Figure A1. Rankings of Auction Revenues in Absolute Terms and as Percent of GDP by Member State in 2014



Notes: Croatia was excluded because it did not hold auctions in 2014. Austria was excluded because it has not submitted its report on the use of auction revenues for the year 2014 (as of September 2015). No GDP data for the year 2014 was available for Malta and Luxembourg from the World Bank (as of September 2015). Data underlying this figure come from Appendix Table A1. This figure does not include the financial value of targeted free allocation to electricity in eight eligible Member States.

Figure A2. Rankings of Auction Revenues Relative to GDP and Spending of Auction Revenues on Climate and Energy Projects Relative to GDP by Member State in 2014



Notes: Austria, Belgium, Croatia, Malta and Luxembourg were excluded. Data underlying this figure come from Appendix Table A1. As noted in text, this information does not include general revenue expenditures on climate and energy programs. This figure does not include the financial value of targeted free allocation to electricity in eight eligible Member States.