

European Union

The World's Carbon Markets: A Case Study Guide To Emissions Trading

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Brief History and Key Dates:

The EU Emissions Trading System (ETS) was the first multi-national installation-level cap-and-trade program that limits carbon dioxide (CO₂) emissions, as well as emissions of other greenhouse gases (GHGs). In 2011, trading volumes within the EU ETS reached 7.9 billion tons of CO₂ equivalent (tCO₂e), which was 77% of the 2011 global trading volumes of 10.3 billion tCO₂e. In monetary terms, the EU ETS market's 2011 value was EUR \$106 billion, which was 84% of the 2011 global carbon market value of EUR \$126 billion.¹ The 30 countries covered by the EU ETS account for 20% of global gross domestic product (GDP) and 17% of world energy-related CO₂.² The EU ETS was established by Directive of the European Parliament and the Council of the EU in October 2003. In 2004, the Directive was amended to include flexibility measures that linked the EU ETS to the international carbon market before the EU ETS market became active in 2005. A 2008 Directive stated that the EU ETS would cover CO₂ emissions from aviation beginning in 2012,³ and a 2009 Directive established annual emissions reductions for a post-2012 phase of the EU ETS without a sunset clause.⁴ The EU ETS's implementation is divided into three phases; the first phase spans 2005-2007, the second 2008-12, and the third 2013-20. While the EU ETS regulations include continuing declining emissions caps beyond 2020 as an automatic default, the emissions reduction targets required to meet the EU's stated emissions reduction goal of 80-95% below 1990 levels by 2050 will not be reached by the current codification of the ETS. By implementing the ETS, the EU has pioneered a cap-and-trade system without comparable action by its major trading partners.

Summary of Key Policy Features:

CAP/TARGET: The EU *Kyoto Protocol (KP) commitment* aimed to reduce economy-wide greenhouse gas (GHG) emissions to 8% below the 1990 level by 2012. As part of the EU's strategy to reach this target, firms covered by the EU ETS cap were to reduce their emissions 6.5% below 2005 levels.⁵ The Phase II (Kyoto period) ETS emissions cap was 2,083 metric tons of carbon dioxide equivalent per year (MtCO₂e/year). However, excluding the countries and installations added in Phase II, the comparable ETS-wide cap would have been 1,909 MtCO₂e/year, 8% below the Phase I cap of 2,181 MtCO₂e/year.⁶ All covered EU installations must submit EU allowances (EUAs) to meet cap compliance with each EUA allowing a firm to emit one ton of carbon dioxide equivalent. While the EU15, which includes all EU member states as of 1997, is considered a single regional bubble under its Kyoto commitment, EU nations have built a burden sharing agreement that has assigned each member state a portion of the region's KP commitment.⁷

The EU economy-wide *target for GHG emissions reductions by 2020* is 20% below 1990 levels (or 13% below 2005 levels). Spearheading this effort, the EU ETS target for capped installations is 21% below 2005 levels by 2020. In 2020, ETS-covered installations will be allowed to emit an estimated maximum of 1,777 million MtCO₂e.⁸ The

2009 Directive that established Phase III of the EU ETS includes provisions to adjust the stringency of the economy-wide cap from -20% to -30% in the event that other developed countries commit themselves to comparable emission reductions.⁹ In a 2010 Communication, the European Commission (EC) advocated for tightening the cap, arguing that the recent contraction in GHG emissions due to the recent economic crisis has made the cost of achieving the -30% target only slightly more than the costs estimated in 2008 for the -20% target.¹⁰ The EC estimates that tightening the EU ETS cap for 2020 for capped firms from -21% to -34% relative to 2005 levels would help to meet the -30% economy-wide target.¹¹ The **long term objective** is to reduce domestic emissions 80-95% below 1990 levels by 2050, though this covers the entirety of European emissions and not just sectors covered under the EU ETS.¹²

SCOPE/COVERAGE: The EU ETS covers around 50% of EU CO₂ emissions and **40% (43% in Phase III) of total EU GHG emissions**.¹³ In addition, the EU ETS covers approximately **11,500 installations**, which are owned by **5,000 companies in 30 countries**.¹⁴ Specifically, it covers the electricity sector, part of the industrial sector, and, since the beginning of 2012, emissions from the aviation sector. Covered installations are grouped into the following **sectors**: power combustion (by far the largest emitting sector), oil refining, coke and steel, cement and lime, glass, bricks and ceramics, pulp and paper, and miscellaneous.¹⁵ Installations below sector-specific **thresholds** can opt out of the program if they are covered by equivalent measures. For example, installations under the power combustion sector fall under the EU ETS if they exceed 20 megawatt thermal (MWth) of total capacity while the lime, glass, and mineral wool insulation industries have daily GHG emissions thresholds of 50tCO₂e/day, 20tCO₂e/day, and 20tCO₂e/day, respectively.¹⁶ Covered **gases** include CO₂ and, for Phase III, industrial gases, such as perfluorocarbons (PFCs) from aluminum and N₂O from Nitric Acid.¹⁷ The **point of obligation** is at the point of emissions.¹⁸

Implementation has been divided into **three phases** to date. **Phase I** (2005-2007) was designed as a learning-by-doing test aimed at getting the system started and ready for KP commitment years. The foremost goals of Phase I were to establish proper infrastructure for trading and to achieve significant emissions reductions. Phase I successfully established a price for carbon, trading in emissions allowances across the EU, and the necessary infrastructure for monitoring, reporting, and verifying emissions.¹⁹ Nevertheless, the European Commission lacked accurate information about member states' actual GHG emissions. As a result, the stage was set for national allocation plans (NAPs)²⁰—official national plans that specified the amount of allowances that each installation would receive each year and the amount of offsets that they were permitted to use to satisfy their compliance obligation—during Phase I, in which only a few member states created scarcity of allowances relative to demand. The majority of member states did not create the necessary scarcity of allowances, and this overallocation of allowances led to a sharp drop in the price of Phase I allowances in April 2006 when the lack of scarcity became apparent (see the “Allowance Distribution” and “Results” sections for more details).²¹ Additionally, inter-phase banking was not permitted and therefore excess allowances had no value beyond Phase I. This prevented entities from holding on to allowances for use during a later phase which further depressed prices during Phase I.

Phase II (2008-12) covered the five years of the KP first commitment period. The EC based its verification of the second round of NAPs on data revealed from Phase I, and it made sure that the aggregate quantity of allowances was below the 2005 level of verified emissions. The emissions information generated during the pilot phase was thus vital to the design of Phase II.²² Five countries were also added to the program in Phase II: Bulgaria, Romania, Liechtenstein, Iceland, and Norway.²³

For **Phase III (2013-20)** the starting point of the new cap for the covered sectors is calculated from 2008-2012 median emissions, and this cap will linearly decrease by an annual rate of 1.74% to reach 21% below 2005 emissions levels in 2020.²⁴ Although the annual 1.74% cap decrease will begin in 2013, the extrapolated initial year, or base year, for this reduction rate will be 2010, so 2014 cap will be more than 5% below the 2010 cap, not 1.74%.²⁵ The third phase of the EU ETS included the following changes in design:

- A harmonized single EU-wide cap instead of national caps previously established by national allocation plans.²⁶
- Full auctioning of allowances for the power sector in most member states²⁷ starting in 2013 and progressively more auctioning for the remaining sectors. These remaining sectors will receive up to 80% (100% for sectors exposed to carbon leakage²⁸) of the required allowances for free, based on a sector-specific carbon intensity benchmark. Free allocation decreases to 30% by 2020.²⁹ With the exception of the manufacturing industry and power sector in certain member states, auctioning is the default method for allocating allowances within the EU ETS after 2012.³⁰
- The use of certified emissions reduction units (CERs) and emission reduction units (ERUs) is harmonized across periods—covered entities are allowed to use the same proportion of ERUs and CERs for compliance in Phase III (a ceiling, independently decided upon by member states, of no less than 11%) as in Phase II—which allows operators to use these offsets during the period 2008-2020. In addition, the percentage of CERs and ERUs permitted for compliance will increase slightly.³¹ More specifically, during Phase II, European member states allowed the aggregate use of around 1,400 million tCO₂e in CERs and ERUs. The use of CERs and ERUs has been allowed in each individual member state and calculated as a percentage of the allocation to each installation—11% on average.³² Installations that were previously not allowed to meet up to 11% of their compliance with these offset credits during 2008-2012 are now allowed to use up to 11% until 2020. As a result the total amount of available credits from ERUs and CERs increased to just above 1,600 million tCO₂e, which equates to approximately 50% of projected abatement required by the EU ETS, for 2008-2020.³³ Furthermore, after 2012 valid CERs must be sourced from Least Developed Country's (LDCs), meaning the CERs from China and India will not be allowed in the EU ETS. Phase III CERs may not derive from industrial gas projects,³⁴ and the acceptance in the EU ETS of credits from Clean Development Mechanism (CDM) or Joint Implementation (JI) hydroelectric projects exceeding 20 MW of installed capacity is subject to certain conditions.³⁵
- Harmonization of monitoring, reporting, and verification provisions.³⁶

The inclusion of international aviation emissions, for flights that depart or arrive from the European Union, has been criticized by other nations. In November 2012, the European Commission (EC) proposed a derogation, whereby flights that go outside of the European Union would not be covered until 2014. However, internal EU flights are still covered. Alongside this, international negotiations through the International Civil Aviation Organization (ICAO) to reach a global agreement to reduce aviation emissions continue to take place.

Currently the EU is exploring a number of options for long-term reform of the EU ETS. In December 2012, the European Commission released [The State of the European Carbon Market in 2012](#). The report provided a number of recommendations for structural reforms, such as:

- Increasing ambition to achieve 30% emissions reduction by 2020 compared to 1990 levels
- Retiring a certain number of phase three allowances permanently
- Revising the 1.74% annual reduction factor before 2020
- Bringing more sectors into the EU ETS;
- Limiting access to international credits;
- Introducing discretionary price management mechanisms such as a price management reserve.

The European Commission is currently undertaking consultation in 2013 to define what options it will bring forward to propose for EU ETS reform.

AUCTION OVERVIEW: As mentioned above, the power sector is scheduled for full **auctioning³⁷ of allowances** by 2013. Because the power sector makes up a high percentage of the total emissions covered by the EU ETS, it is projected that entities covered by the EU ETS will need to acquire over 50% of total EU ETS allowances via auctions in 2013. Non-power sectors will auction 20% of allowances in 2013, and they will progressively auction a higher percentage of allowances over time. Auctioned allowances are estimated to gradually increase and could reach

100% auctioning by 2027.³⁸ By contrast, in Phase II, only 3% of allowances were set aside for auctioning.³⁹ In Phase III, allowances to be auctioned will be distributed to member states based on emissions histories; specifically, 88% will be distributed based on emissions history, 10% based on wealth, and 2% based on emissions reductions achieved prior to 2005.⁴⁰ One impact of this will be that countries with lower income will receive a greater amount relative to high-income member states. Auctions are conducted by national governments, but buyers are located worldwide. European Commission estimates from 2009 suggest that auctions could raise EUR \$30-50 billion/year by 2020,⁴¹ but more recent estimates are lower due to unexpectedly low allowance prices during the past few years.⁴²

It is recommended that half of **auction revenues** fund complementary GHG reduction measures in the EU and developing countries. Such measures can include renewable energy investment and energy efficiency (to meet EU targets), adaptation, minimizing the economic impact on low to middle income households from higher electricity rates, reduced deforestation, and carbon capture and storage (CCS) projects.⁴³

ALLOWANCE DISTRIBUTION: During both the pilot phase and Phase II, allowances were primarily freely allocated. Although the EC allowed member states to **auction** a maximum of 5% of their cap during the pilot phase (up to 10% for Phase II), this option was rarely exercised.⁴⁴ For Phase I and II, **free allocation** implied that each member state developed and made public its own NAP that specified the amount of allowances that each installation would receive each year and the amount of offsets (within the scope of EU-wide provisions, as outlined in the “Flexibility Mechanisms” section) that they were permitted to use to satisfy their compliance obligation. NAPs were submitted to and evaluated by the EC.⁴⁵

In the short term, the EU expected to rely on fuel switching to significantly reduce its GHG emissions. The power sector’s significant mitigation potential coupled with its ability to pass on the associated costs to end-consumers—including the industrial sectors covered under the EU ETS—contributed to the power sector receiving fewer free allowances relative to other sectors. The greater share of free allocation for non-power sectors was intended to compensate these sectors for the likely increase in electricity tariffs as a result of the ETS. This distribution of allowances generated more trading across sectors, adding liquidity to the market.⁴⁶

During **Phase I**, the EC established two main criteria for allocating free allowances: (1) consistency with member states’ targets and their projected progress assessments, and (2) technological potential of abatement.⁴⁷ These criteria provided opportunities for “gaming” the process, which became evident after the fact. According to Aldy and Stavins (2012), the decentralized cap-setting process by member states, “created incentives for individual countries to try to be generous with their allowances to protect their economic competitiveness... Not surprisingly, the result was an aggregate cap that exceeded business as usual emissions.”⁴⁸ Overallocation became less of an issue in **Phase II**, but industrial sites in general, as well as some power producers, still received more allowances than their total emissions. Reduced output during the recession was a major reason for the overabundance of carbon credits. In **Phase III**, auctions and uniform Europe-wide rules for free allocation will determine allocations in order to reduce subjectivity and gaming potential.⁴⁹

FLEXIBILITY PROVISIONS: As soon as the Directive regulating Phase III was finalized, unlimited **banking** in Phases II and III was allowed which linked these (and future) phases. This design feature is proving to be crucial in providing continuing incentives for abatement and maintaining relatively stable prices for EUAs, even though it appears the recession has contributed to an unexpectedly low demand for allowances.⁵⁰

Offset usage for the period 2008-2020 is constrained collectively to 50% of the required aggregate abatement relative to 2005, and member states are allowed to use **flexibility mechanisms established by the Kyoto Protocol**. These measures include the United Nations’ Clean Development Mechanism (CDM) and Joint Implementation (JI), and they increase the diversity and availability of low cost compliance options within the EU ETS. Capped industries were not allowed to use **CERs and ERUs** to meet their compliance goals until Phase II. In

Phase II, CERs and ERUs are allowed to comprise up to 13.4% of the total EU cap, which equates to 1.4 billion allowances in total.⁵¹ For Phases I and II, countries individually specified the offset percentage allowed (domestic and international offsets together as a percent of total allowances) within their own countries; the range varied from 0% (Estonia) and 20% (Spain, Germany, and Lithuania).⁵² Beginning in 2013, new projects to generate CERs must be sourced from Least Developed Countries (LDCs). As a result, post-2012 CERs from China and India—countries that account for 68% of the global CDM market—will not be allowed in the EU ETS.⁵³ In addition, post-2012 CERs may not derive from industrial gas projects,⁵⁴ and the acceptance of post-2012 ERUs and CERs deriving from hydropower projects that exceeding 20 MW of installed capacity is subject to certain conditions.⁵⁵

Borrowing is not technically allowed, but the compliance period submission deadlines follow the issuance of the next year's allowances. Therefore, there is effectively year-ahead borrowing within trading periods (but not across the last year of one period to the first year of the next).⁵⁶

The EU has **linked** its carbon market with programs in other countries. The EU considers linkage an essential step in building a global carbon market.⁵⁷ The EU finalized its link with the Norwegian ETS in early 2009 (after an initial one-way linkage started in 2005, in which Norwegian entities could use EU allowances for compliance but not vice versa), and it is planning to establish a link with the Swiss ETS. A one-way link, in which Australian businesses will be legally allowed to use EU units to meet their Australian compliance obligations, will begin on July 1, 2015. There is an agreement to begin a full two-way linkage, which is to commence no later than July 1 2018, with the Australian ETS after resolving several outstanding issues.⁵⁸ Many other systems have expressed interest in linking with the EU ETS.⁵⁹

COST CONTAINMENT / VOLATILITY MANAGEMENT: Banking between Phases II and III plus Phase III's eight-year trading period are both intended to bolster investment certainty. In addition, the EU ETS linear cap decline persists beyond 2020 in order to provide a stable, long-term policy signal for investors.⁶⁰

In response to low demand for allowances in the EU ETS, and subsequent low prices, the European Commission proposed **'backloading'** a number of allowances during Phase III. The proposed amendment to the ETS Directive would have removed 400 million allowances in 2013, 300 million in 2014 and 200 million in 2015. These allowances would then have been reintroduced in 300 million in 2019 and 600 million allowances in 2020. The Environment committee of the European Parliament approved the measure in March 2013, but in a vote of the full Parliament in April 2013, the Parliament voted to **reject the measure** by 334-315, with 63 abstentions.⁶¹ The Environment Committee is scheduled to vote on backloading a second time on June 19 2013, with the possibility of an amended text since the Parliament vote in April 2013.

COMPETITIVENESS PROVISIONS: Under certain conditions, firms in sectors that are 'at risk' of carbon leakage may receive free allowance allocations based on industry best-practice benchmarking – measured as the best 10% of performers in the sector - but the total free allocation to benchmarked industries decreases linearly with the overall cap. Non-power sectors receive 80% of their benchmark for free, but this free allocation decreases to 30% in 2020 and 0% in 2027. Until 2020, **emissions-intensive trade exposed (EITE)** firms receive up to 100% of their benchmark via free distribution.⁶²

MARKET REGULATION, COMPLIANCE, AND OVERSIGHT: Capped firms must have their emissions independently verified and are required to annually report on these emissions. Firms whose emissions are not independently verified are not allowed to sell allowances until an independent verifier approves their reports.⁶³

Transaction **registries** track the ownership of allowances. Allowances are held in registries via electronic accounts, and the EU registry system is linked to the Kyoto national registry system. **Electronic security** has strengthened over the course of the ETS, especially in 2011. In January 2011, thieves stole approximately USD \$65 million (EUR

\$50 million) of EU allowances from some member states' carbon registries.⁶⁴ When the thefts were discovered, the EU quickly shut down the registries and conducted an investigation. New registry regulations, which implemented a series of important reforms to improve regulatory oversight and market security, were adopted in November 2011.⁶⁵

In Phase II, operators of any installation that has emitted GHGs in excess of submitted allowances are subject to a **penalty** of EUR \$100/tCO₂e. In Phase I, this penalty was EUR \$40/tCO₂e, and in Phase III this penalty will increase with the EU consumer price index.⁶⁶ Companies that fail to comply with their respective caps also have their names publicly published, thereby shaming a non-compliant entity into compliance. Member states have also established other penalties at the national level.⁶⁷

COMPLEMENTARY AND SUPPLEMENTARY MEASURES: Individual member states and the EU have implemented a range of complementary domestic climate policies in addition to the EU ETS, including 20% targets for **energy efficiency** and **renewable energy**. Emissions from **non-ETS sectors**, which comprise approximately 60% of EU GHG emissions, will decrease to 10% below 2005 levels by 2020.⁶⁸

ECONOMIC PROJECTIONS: In 2012, Barclays, Bloomberg New Energy Finance, and Thomson Reuters Point Carbon projected that 2020 emissions permit prices would be EUR \$10/tCO₂e (USD \$12.91, according to the May 25 2013 exchange rate⁶⁹), EUR \$29.20 (USD \$37.70), and EUR \$12 (USD \$15.49), respectively.⁷⁰ A 2010 EC cost projection for the current, 20% target policy package was EUR \$48 billion (USD \$61.97 billion), down from its initial estimate of EUR \$70 billion (USD \$90.37 billion). This projection increases to EUR \$81 billion (USD \$104.57 billion) under the 30% economy-wide target.⁷¹ These estimates indicate that the EU ETS reduces EU 2020 GDP by 0.32% for the current scenario and 0.54% for the -30% scenario.⁷²

RESULTS: In **Phase I**, the EU ETS reduced **emissions** by an estimated 2-5%,⁷³ and allowance **prices** were volatile. At the outset of Phase I, allowances were EUR \$8/ton in January 2005. By early 2006, the price exceeded EUR \$30/ton, only to fall back to EUR \$8/ton by April 2006. According to Aldy and Stavins (2012), "This volatility was attributed to the absence of transparent, precise emissions data at the beginning of the program, a surplus of allowances, energy price volatility, and a program feature that prevents banking of allowances from the first phase to the second."⁷⁴ In **Phase II**, **emissions** were on track to be below the cap. Phase II **allowance prices** began relatively high; they rose to above EUR \$20/ton in the first half of 2008, and they averaged EUR \$22/ton in the second half of that year. However, prices fell in the first half of 2009 when they reached EUR \$13/ton only to further fall to EUR \$10/ton by the fall of 2011. Aldy and Stavins (2012) primarily attribute this Phase II allowance price decline to the recession.⁷⁵ Another contributing factor to the price decline in Phase II is the slow pace of global climate policy developments, notably the failure of the US to enact federal cap-and-trade and of UNFCCC to reach a global climate change deal at Copenhagen.⁷⁶

The European **carbon market** has grown rapidly since 2005, with market volumes increasing from 300 MtCO₂e in EUAs exchanged in 2005 to 6,300 MtCO₂e in 2009.⁷⁷ In 2011, trading volumes within the EU ETS reached 7.9 billion tons of CO₂e, which was 77% of the 2011 global trading volumes of 10.3 billion tons of CO₂e. In monetary terms, the EU ETS market's 2011 value was EUR \$106 billion, which was 84% of the 2011 global carbon market's value of EUR \$126 billion.⁷⁸

By far the biggest demand for CERs is in Europe, and, according to Sandbag (2010), CDM "is serving to reduce prices of compliance and delivering substantial volumes of finance (circa EUR \$860 million per annum, [or about USD \$1.1 billion/year]) to countries outside of Europe."⁷⁹ According to the European Commission (2009), the recognition of international offsets has triggered a **substantial flow of investment and technology to developing countries**, expanding its impact beyond the borders of the EU.⁸⁰ Opinions on the integrity of UN CDM offsets vary amongst analysts of the program.

In its first and second phases, the EU ETS has **learned from and overcome initial problems**, and has made carbon emission management a central part of business planning for EU energy and industrial sectors. The regulation has been tested and its weaknesses revealed and addressed. In sum, the program created the world's first multi-national, firm-level compliance carbon market, without measurably affecting EU competitiveness or constraining growth.⁸¹

What Distinguishes this Policy?

UNIQUE ASPECTS:

1. The EU ETS is the **largest emissions trading system in the world**. In 2011, trading volumes within the EU ETS reached 7.9 billion tons of CO₂e, which was 77% of the 2011 global trading volumes of 10.3 billion tons of CO₂e. In monetary terms, the EU ETS market's 2011 value was EUR \$106 billion, which was 84% of the 2011 global carbon market value of EUR \$126 billion.⁸²
2. The EU ETS was the first **multi-national** installation-level cap-and-trade system that **set up a market for CO₂ and other GHGs**.

CHALLENGES:

1. There is lack of clarity regarding how the EU ETS will continue **post-2020**.
2. For a variety of reasons, **allowances prices** have been low (below EUR \$15/ton) for significant portions of Phases I and II. Ensuring higher allowance value is a challenge that faces the EU ETS.
3. The EU ETS was enacted **without comparable action by the majority of its trading partners**.

LESSONS:

1. **Obtaining verified emissions information at the outset of a cap-and-trade program**, through a pilot phase or other mechanism, is important for setting caps that avoid overallocation.
2. **Long-term policy certainty** is fundamental. A long-term planning horizon creates certainty, allowing companies to make low-cost and customized investments for the future.
3. **Harmonized measuring, reporting and verification and allowance distribution mechanisms** are essential for the cost- and time-efficient continuation of the ETS.
4. **Allowing flexibility between subsequent phases** through banking and borrowing provisions assuages possible problems, such as severe price fluctuations, that can arise from overallocation and can help to manage compliance costs.
5. **Grandfathering of allowances** may have political benefits but can create opportunities for gaming and can lead to sectoral distortions among member states. Full auctioning of allowances, a single EU-wide cap, and harmonization of transitional free allocation schemes at the EU level may correct these distortions.

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Disclaimer: The authors encourage readers to please contact them with any corrections, additions, revisions, or any other comments, including any relevant citations. This will be invaluable in strengthening and updating the case studies and ensuring they are as correct and informative as possible.

¹ Kossoy, Alexandre and Pierre Guigon (May 2012). "State and Trends of the Carbon Market 2012." The World Bank. Available at http://siteresources.worldbank.org/INTCARBONFINANCE/Resources/State_and_Trends_2012_Web_Optimized_19035_Cvr&Txt_LR.pdf

² Aldy, Joseph and Robert Stavins (May 2012). "The Promise and Problems of Pricing Carbon: Theory and Experience." *Journal of Environment & Development*.

³ Europa (May 2011). "Greenhouse gas emission allowance trading scheme." Available at

http://europa.eu/legislation_summaries/energy/european_energy_policy/l28012_en.htm

⁴ European Parliament and the European Council (April 2009). "Directive 2009/29/EC: so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community." Europa. EUR-Lex: Access to European Union Law. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009L0029:EN:NOT>

⁵ European Commissions (EC) (2009). "EU action against climate change." Available at http://ec.europa.eu/clima/publications/docs/ets_en.pdf

⁶ Ellerman, Danny A., Frank J. Convery, Christian de Perthuis. "Pricing Carbon: The European Union Emissions Trading Scheme." Cambridge University Press. 2010. Pp. 54.

⁷ Zetterberg, Lars, Kristina Nilsson, Markus Ahman, Anna-Sofia Kumlin, and Lena Birgersdotter (August 2004). "Analysis of national allocation plans for the EU ETS." IVL Swedish Environmental Institute. Available at <http://www.ivl.se/download/18.7df4c4e812d2da6a416800071796/B1591.pdf>

⁸ European Commission (EC) (February 2012). "Preparing the EU's Quantified Emission Limitation or Reduction Objective (QELRO) based on the EU Climate and Energy Package." Commission Staff Working Document. Available at http://ec.europa.eu/clima/policies/international/negotiations/docs/swd_13022012_en.pdf

⁹ *Supra*, Note 4.

¹⁰ Europa (May 2010). "Climate change: Commission invites to an informed debate on the impacts of the move to 30% EU greenhouse gas emissions cut if and when the conditions are met." Available at <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/10/618>

¹¹ European Commission (2010). "Unlocking Europe's potential in clean innovation and growth: Analysis of options to move beyond 20%." Brussels. pp. 9.

¹² Europa (March 2011). "Climate change: Commission sets out Roadmap for building a competitive low-carbon Europe by 2050." Available at <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/11/272>

¹³ *Supra*, Note 5.

¹⁴ The 27 EU nations, Iceland, Liechtenstein, and Norway. Source: *Supra*, Note 3.

¹⁵ *Supra*, Note 5.

¹⁶ *Supra*, Note 3.

¹⁷ *Supra*, Note 3.

¹⁸ *Supra*, Note 3.

¹⁹ *Supra*, Note 5.

²⁰ The EU's internal burden sharing agreement enabled member states to set their own national caps. While member states had an economy-wide target under the Kyoto Protocol, they were each able to determine which domestic sectors to cap with relatively more or less stringency.

²¹ *Supra*, Note 2.

²² *Supra*, Note 5.

²³ *Supra*, Note 2.

²⁴ *Supra*, Note 4.

²⁵ Dimireva, Ina (July 2010). "Emissions trading: EU ETS cap 2013 – briefing." EU Business. Available at <http://www.eubusiness.com/topics/environ/emissions-trading-2013/>

²⁶ *Supra*, Note 5.

²⁷ Under article 10c of the ETS Directive, ten EU member states have the option to transitionally allocate free allowances to the power sector between 2013 and 2019. Eight of the ten member states have decided to apply for this option.

²⁸ *Supra*, Note 4.

²⁹ The amount of auctioned allowances will gradually increase to 70% in 2020 aiming at reaching 100% auctioning by 2027. Source: *Supra*, Note 8.

³⁰ European Parliament and the European Council (April 2009). "Directive 2009/29/EC: so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community." Europa. EUR-Lex: Access to European Union Law. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009L0029:EN:NOT>

³¹ *Supra*, Note 4.

³² Carbone Tendences (July 2007). "The European carbon market monthly bulletin." Issue 16. Available at <http://www.cedclimat.com/Tendances-Carbone-no16-Lessons.html?lang=en>

³³ *Supra*, Note 4.

³⁴ European Commission (EC) (June 2011). "Commission Regulation (EU) No 550/2011 of 7 June 2011." Official Journal of the European Union. Available at http://emissions-cuets.com/attachments/197_Commission%20Regulation%20No%20550_2011.pdf

³⁵ European Commission (EC) (January 2013). "International carbon market." Available at http://ec.europa.eu/clima/policies/ets/linking/index_en.htm

³⁶ *Supra*, Note 5.

³⁷ With exception of 7 Member States who are entitled to grant free allocation to the power sector for a transitory period and on the basis of real investments in carbon reductions.

- ³⁸ *Supra*, Note 4.
- ³⁹ Hood, Christina (November 2010). "Reviewing Existing and Proposed Emissions Trading Systems." OECD/IEA. Available at http://www.iea.org/publications/freepublications/publication/ets_paper2010.pdf
- ⁴⁰ *Supra*, Note 3.
- ⁴¹ *Supra*, Note 5.
- ⁴² For more information on possible proposals for addressing oversupply in the EU ETS, see IETA (October 2012) "Options to Reform the EU ETS" Available: https://ieta.memberclicks.net/assets/EUWG/letter_ieta_ets_reform_options_5-10-2012.pdf
- ⁴³ *Supra*, Note 4.
- ⁴⁴ *Supra*, Note 5.
- ⁴⁵ *Supra*, Note 5.
- ⁴⁶ Based on internal EDF analysis.
- ⁴⁷ Articles 9 to 11, and Annex III of the Directive 2003/87/EC, and communication, COM (2003) 830.
- ⁴⁸ *Supra*, Note 2.
- ⁴⁹ *Supra*, Note 4.
- ⁵⁰ European Commission (EC) (May 2010). "Analysis of options to move beyond 20% greenhouse gas emission reductions and assessing the risk of carbon leakage." Commission staff working document. Available at http://ec.europa.eu/clima/policies/international/negotiations/future/docs/sec_2010_650_part2_en.pdf
- ⁵¹ *Supra*, Note 39.
- ⁵² *Supra*, Note 2.
- ⁵³ *Supra*, Note 2.
- ⁵⁴ *Supra*, Note 34.
- ⁵⁵ European Commission (EC) (January 2013). "International carbon market." Available at http://ec.europa.eu/clima/policies/ets/linking/index_en.htm
- ⁵⁶ *Supra*, Note 3.
- ⁵⁷ *Supra*, Note 5.
- ⁵⁸ Reklev, Stien (August 2012). "Australia to link with EU CO₂ market, drops price floor." Thomas Reuters Point Carbon. <http://www.pointcarbon.com/news/1.1967394>
- ⁵⁹ See, for example, Bloomberg (October 1, 2012): <http://www.bloomberg.com/news/2012-10-01/australia-california-start-talks-to-link-emission-markets.html>
- ⁶⁰ *Supra*, Note 3.
- ⁶¹ http://www.pointcarbon.com/polopoly_fs/1.2301032!16042013_Webinar_16%20April.pdf
- ⁶² *Supra*, Note 3.
- ⁶³ *Supra*, Note 5.
- ⁶⁴ While the sums stolen were not trivial, their scale in light of the annual value of the EU emissions allowance system was small—approximately 0.06%. For comparison, annual credit card fraud in the United States is 50% higher as a fraction of total value, estimated at 0.09% of annual transactions. EU governments lost substantially greater revenues from large-scale fraudulent value-added tax transactions on sales of emissions allowances, but these resulted from a lack of harmonized EU tax structure, not from the design of the ETS itself.
- ⁶⁵ Hanafi, Alex, Lucas Merrill Brown, and Annie Petsonk (2012). "The EU Emissions Trading System: Results and Lessons Learned." Environmental Defense Fund (EDF). Available at http://www.edf.org/sites/default/files/EU_ETS_Lessons_Learned_Report_EDF.pdf
- ⁶⁶ *Supra*, Note 3.
- ⁶⁷ *Supra*, Note 5.
- ⁶⁸ *Supra*, Note 39.
- ⁶⁹ XE – Universal Currency Provider (January 2013). "Currency Converter Widget." Available at <http://www.xe.com/ucc/convert/?Amount=16&From=EUR&To=USD>
- ⁷⁰ http://ec.europa.eu/clima/policies/ets/cap/auctioning/docs/20121112_swd_en.pdf
- ⁷¹ *Supra*, Note 10.
- ⁷² *Supra*, Note 39.
- ⁷³ Ellerman, Danny A., Frank J. Convery, Christian de Perthuis. "Pricing Carbon: The European Union Emissions Trading Scheme." Cambridge University Press. 2010.
- ⁷⁴ *Supra*, Note 2.
- ⁷⁵ *Supra*, Note 2.
- ⁷⁶ *Supra*, Note 65.
- ⁷⁷ Daskalakis, George, Ibikunle, Gbenga and Diaz-Rainey, Ivan, The CO₂ Trading Market in Europe: A Financial Perspective (October 25, 2010). FINANCIAL ASPECTS IN ENERGY: THE EUROPEAN PERSPECTIVE, A. Dorsman, M. Karan, Ö. Aslan, W. Westerman, eds., Springer, 2011. Available at SSRN: <http://ssrn.com/abstract=1689449>
- ⁷⁸ *Supra*, Note 1.
- ⁷⁹ Rob Elsworth and Bryony Worthington (2010), "International Offsets and the EU 2009," Sandbag, July 2010, at 4, available at sandbag.org.uk/site_media/pdfs/reports/offset2009.pdf
- ⁸⁰ European Commissions (EC) (2009). "EU action against climate change." Available at http://ec.europa.eu/clima/publications/docs/ets_en.pdf
- ⁸¹ *Supra*, Note 65.
- ⁸² *Supra*, Note 1.