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THE IMPACT OF POLICY ANNOUNCEMENTS BY THE EUROPEAN COMMISSION ON PRICE FORMATION IN THE EU ETS

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The Impact of Policy Announcements by the European Commission on Price Formation in the EU ETS

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Abstract

This paper explores the effect of climate and energy regulatory announcements by the European Commission (EC) on carbon certificate returns. We use an event study to examine the impact of 94 announcements under 13 categories, giving particular interest to announcements about the Market Stability Reserve (MSR) and EU Green Deal revisions. We show that during the period studied, 33% of the total EC announcements have significant Cumulative Abnormal Returns (CARs); out of these, 60% have significant CARs after the event compared with 30% before the event. Additionally, announcements regarding the MSR resulted in non-significant CARs. We attribute these results to the progressive adjustment to balance this oversupply, which continues to experience a surplus. The EU Green Deal announcements showed price relevance with significant CARs and Abnormal Returns (ARs).

Keywords: EU ETS, Carbon price, Emissions Trading, Regulatory policy announcements.

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I. INTRODUCTION

A CO2 trading scheme encourages economic actors to reduce their emission of carbon dioxide equivalent (CO2e) by distributing tradable permits to emit CO2e. The idea behind this system is to limit, or "cap," the number of permits and thereby control the emissions produced. In the context of the EU ETS, the world's first carbon market, these permits take the form of allowances that give the holder the right to emit one metric tonne of CO2e.

The EU ETS covers 27 European Member States plus Iceland, Liechtenstein, Norway, and Northern Ireland and controls around 36% of total European Carbon emissions. The system limits the number of CO2 allowances produced by power plants, manufacturing installations, and flights within the European Economic Area (EEA).[1] A proportion of the total emissions is free allocated (currently 43%), and the rest are auctioned on the carbon market.

Since its creation in 2005, the system has gone through 4 trading phases. Each phase has improved its implementation compared to the preceding one. Between 2005 and 2007, the first phase was implemented and called the "learning by doing" phase because it was planned to improve its operation by learning from weaknesses and mistakes. Phase I ended in 2007 when the oversupply of allowances caused prices to plunge to 0. Since 2012, the problem has been addressed by changing the system's regulatory framework, first, by "back-loading" the supply of some auctions and, later, by creating the Market Stability Reserve (MSR) —a reserve that controls the number of excess and shortage of carbon allowances.

This paper investigates the impact of announcements made by the European Commission (hereafter EC) on carbon allowance returns. Understanding the impact of announcements is of utmost importance as they influence the market players' expectations and could reinforce or undermine its price. Additionally, the role of the EC is singular, as it is not only the entity that issues announcements but also the one that controls the supply of allowances. This supply control results from a negotiation process with member countries, in which the EC receives their National Allocation Plans (NAPs) and decides to approve them or request changes based on the EU´s overall CO2e reduction targets. Given the critical role of the EC, their announcements should impact returns more than in other markets where the regulator does not control the supply.

We place particular interest in the effects of announcements related to the new operating cycle following the MSR creation. In 2019, the EC designed this mechanism to control the surplus of allowances arising from the 2008 financial crisis, the oversupply of international credits, and, later, the COVID-19 recession. Since then, announcements related to the number of allowances in circulation are included. Allowances in circulation do not necessarily equal the number of allowances auctioned, as the system allows to bank them. Based on these announcements, the EC decides the number of allowances

[1] It also includes flights from the EEA to the UK and Switzerland.

that should enter or exit the MSR to balance the supply. One of the objectives of this paper is to explore whether introducing this balancing mechanism has succeeded in controlling the downward trend of CO2 prices.

Our paper emphasizes the last phase of the market, Phase IV, as it is in this phase that a series of legislative proposals have been made to achieve EU climate neutrality by 2050. This phase is particularly relevant as it comes with several revisions to the EU climate legislation under the European Green Deal. Given this, we would expect the EC's announcements to have increasing importance on the decisions of market participants. Some of the critical changes in this phase are the MSR creation, a more severe cap limit, and the ban of CER/ERUs certificates (i.e., the previous EU ETS substitutes).

This paper uses an event study to assess the impact of announcements. We classify them into 13 main categories and study their impact from 2010 to 2022. These categories are: auction, auction adjustment, free allocation, Total Number of Allowances in Circulation (TNAC), Measurement, Veri- fication and Reporting of emissions (MVR), MSR, aviation, cap, CERs/ERUs, NER program, back-loading, merge markets, and the European Green Deal. The first six categories pertain to the annual operational process that regulates the number of existing allowances and monitors the accountability of polluting entities. The remaining categories are related to various factors that influence the system's configuration in one way or another, and will be explained with more detail in the following sections.

Our methodology calculates the impact of these categories on both abnormal returns (ARs) and cumulative abnormal returns (CARs). Intuitively, ARs refer to the percentage of returns on CO2 allowances that exceed the expected return on a given day, while CARs result from the cumulative sum of ARs over a specified period. This excess return is typically associated with the impact of a specific event (in this case, EC announcements). A positive CARs indicates that CO2 allowances performed better than expected, whereas a negative CARs indicates underperformance. Thus, when an announcement shows significant ARs that exceed CARs, the effect can be attributed to a market reaction that dissipates within one day. Conversely, when significant CARs exceed ARs, it suggests that the market initially underestimated the impact of the announcement and, over time, adjusted its expectations and incorporated the new information into CO2 prices.

Our findings show that 33% of the total EC announcements have significant cumulative returns abnormal returns (CARs). Of these, 30% have significant CARs before the event compared with 60% after the event, where the third day after the announcement has the highest number of significant CARs. This shows that market participants are more reactive once the EC publicly releases the announcement, especially on the third day after the release of the announcement but also points to information leakage. This information leakage became more significant during phase IV, where the number of announcements with significant CARs before the event day increased by 3% (from 64% to 69%). We also find a widespread negative impact on returns for all announcements. Since this generalized trend appears before the official disclosure of information, it leads to short-term profits from insider trading, which continue until

the event window's last day.[2]

Regarding the announcement categories, we found that Monitoring, Reporting and Verification of emissions (MVR) has the most significant CARs events, followed by "free allocation" and "auction" events. Surprisingly, out of the new categories included in the operating cycle (i.e., TNAC, auction adjustment, and MSR), only the TNAC in 2021 reached significant CARs. This finding is likely due to the post-COVID recovery; as of 2022, the market still had a surplus of 1579 million allowances, giving little incentives to respond to this balancing mechanism. However, the 2019 and 2020 "auction adjustments" show significant abnormal returns before the event. Hence, even though the market is aware of the oversupply of allowances, it continues to react speculatively in the days leading up to the official adjustment date. The non-CAR significance of the 67% of the announcements could be attributed to the following reasons. First, market participants often have lowered expectations of the European Commission (EC) announcements, viewing them as overly ambitious or dependent on political resolutions. Second, the lengthy approval process and ongoing adjustments to the number of allowances cause these announcements to be overlooked at various stages. Third, many announcements are related to administrative or protocol-related matters that do not significantly change the system. Fourth, some measures are considered long-term initiatives, reducing their immediate significance. Last, some policies are perceived as not robust enough to address existing system issues or to promote the adoption of clean technologies.

The structure of this paper is the following: section two discusses the previous literature review in the field of event studies in carbon and energy markets, section three describes the EU operating cycle, section four explains the types of regulatory announcements that we evaluate,the methodology and data, and in the last two sections we report our results, and conclude.

II. LITERATURE REVIEW

Although many event studies have been used in the energy sector, very few have focused on studying carbon prices. Within this literature, most have focused on assessing the effect of National Allocation Plans (NAPs), Verification Announcements, Verified emissions and CAPs. NAPs were annual announcements issued by each member state during phases I and II. These announcements stated the total number of allowances each country issued. However, during phase III, NAPs announcements were replaced by a centralized allocation plan controlled by the EU. Verification are announcements issued by the EC stating whether the NAPs were approved or had to be modified. Verified emissions are announcements in which facilities report their emissions for the previous year. CAP announcements relate to the limit of allowances the EC sets for emissions.

[9] study the effects of these announcements during phases I and II using two differ-

[2] According to the European Energy Exchange (EEX), EU Allowances (EUAs) can be short-sold. However, sales are only permissible provided the seller has sufficient EU emission allowances in its internal delivery account at the European Commodity Clearing house (ECC).

ent methodologies, a regression and a truncated mean return model. The authors find significant abnormal returns up to three days before the event, as well as an absence of volatility on the announcement day. According to the authors, these findings suggest information leakage before the official release. [8] study the effects of these announcements during phase II. The authors use the same methodology as [9] but complement the analysis by looking at the date the media began to cover the potential release of the official announcement. With this, the authors measure the potential effects of information leakage prior to the official release. [8] find the same results as [9], i.e., there are significant abnormal returns up to three days before the NAPs events and no volatility effects when the information is published.

[6] investigate the impact of verified emission announcements from 2007 to 2012 on the absolute abnormal returns of EUA futures, trading volume, and realized and implied volatility. To do this, they use a regression where they define a dummy variable for the day of each announcement. The authors find significant abnormal returns, as well as an increase in trading volume and intra-day volatility on the day of the event. [7] examine the impact of two types of political announcements: 'backloading' and CAP. To examine this, the authors use an event study in which they estimate normal returns using a Dynamic Model Selection. This means that from a set of models estimating normal returns, the process selects the best fit and uses it to predict the normal returns for each event. The authors find that 2 out of the 4 'backload' events cause a price drop, while the others cause a price increase. Only two events related to the CAP impact prices. The authors attribute the varied effects to a lack of credibility regarding the EC's commitment to stabilize prices.

Few studies document the effects of other types of announcements that could potentially impact carbon prices. [14], besides studying the impact of NAPs and verifications announcements, also covers news related to the scope of the EU ETS, the CITL–ITL linkage, CERs availability, Germany and UK targeted emissions and COP annual meetings for phase I, II and early III. They employed a standard OLS regression model (univariate and multivariate) to study the effects on prices and volatility. According to the authors, verifications events strongly impact carbon prices, while CITL–ITL and CER events do not result in abnormal returns. Also, COP events are associated with negative market responses, while they do not find evidence of variance returns affected by announcements. One of their most interesting results is that in the context of the 2008 financial crisis, all advertisements became less responsive to the disclosure of institutional information. Additionally, the study by [5] measures the effect of 50 regulatory events in phases I, II, and III. The authors classify these events into six categories: cap set, aviation sector, use of Carbon Emission Reductions (CERs) and Emission Reduction Units (ERUs), free allocation of allowances, auctioning allowances, and the measurement, reporting, and verification of CO2e. Their results show no aggregate effect per category, while 24 individual events have significant cumulative abnormal returns. Additionally, announcements made more than once and those that do not directly impact the amount of CO2e in supply and demand are non-significant.

Notably, our paper revisits and extends the classifications proposed by [5]. That way, we can compare and update the carbon market's response to disclosing new institutional information. Several reasons justify and call for the study of the effect of new

categories on the EUA returns. Since the publication of [5] paper, the carbon market has gone through significant changes. These changes notably revolve around three points: 1.- The EC has redesigned the system's operational cycle to include new mechanisms to balance supply and demand allowances. 2.- Numerous carbon systems, inspired by the EU ETS, have been established globally in countries like Canada, China, Japan, New Zealand, South Korea, Switzerland, and the United States ([3]). Since carbon emissions are a global problem, decisions on their control by non-EU countries could impact prices within the EU ETS 3.- New programs and policies, such as the Green Deal and the REPower EU, are being introduced with a strong objective on promoting renewable energy adoption and accelerating the energy transition. Since carbon pricing is one of the most critical tools to abate carbon emissions and achieve carbon neutrality, it is essential to have a more comprehensive understanding of the factors influencing their prices, as ignoring some of them could lead to an incomplete or misleading picture of the market dynamics.

III. EU ETS OPERATING CYCLE

As a result of the 2008 financial crisis, the COVID-19 recession, and the excess of international credits imports, the EU ETS has built up a surplus of emission allowances. This led to a decline in allowance prices, which reduced the system's effectiveness in cutting emissions. The excess of allowances entails both short and long-term consequences. In the short term, it prevents the correct operation of the market. In the long run, it prevents the system from achieving its goals of faster reductions via annual emissions caps. For this reason, the EC established a series of short- and long-term measures to remove the surplus of allowances gradually. The short-term measure involved the "back-loading- of 900M allowances during phase III, while the long-term measure was the creation of the MSR.

The establishment of the MSR brought significant changes to the operational rules of the system. The new rules have been designed to prevent the intervention of both the Commission and the Member States in its functioning. Hence, in the context of the European Green Deal and its revision of the EU ETS, Phase IV is one of the most relevant phases as it aims to stabilize the price through the MSR and hence achieve the medium- and long-term climate goals. In this section, we provide a detailed description of the functioning of this new operational cycle. As a reference, Figure 1 shows the current EU ETS cycle. Below we explain each of the stages in detail.

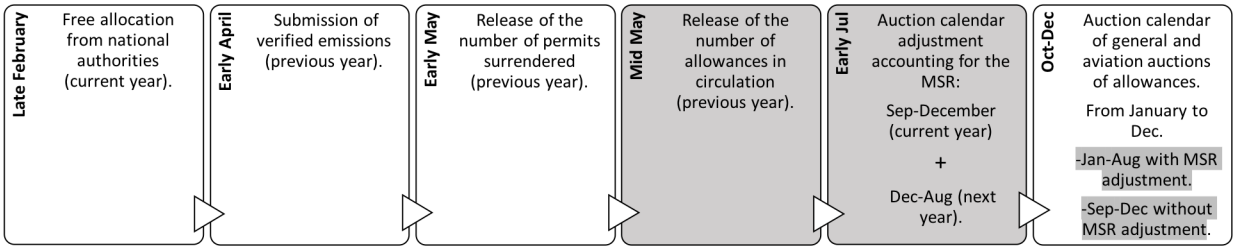


Figure 1: EU ETS operating cycle

Figure 1 presents the annual operating cycle of the EU ETS. This cycle underwent modifications starting from 2019 with the implementation of the Market Stability Reserve (MSR). The gray boxes denote the stages that were introduced since 2019. Source: Own elaboration.

At the end of February, the national authorities allocate free allowances to those sectors at risk of carbon leakage (i.e., sectors that could move their production to other countries to avoid paying for allowances). Sectors at risk of carbon leakage are published in a carbon leakage list, which is normally updated at the beginning of each new phase. These sectors receive free allowances according to benchmark values based on the average emission intensity of the 10% most efficient installations within each sector in the EU. Additionally, since 2013, a portion of the free allowances, 5% during phase III, has been allocated to the New Entrants Reserve (NER), a reserve created to reward new installations and those that significantly increase their capacity. Figure 2 shows the total annual allowances free-allocated evolution. As can be seen, the number has been decreasing. First, until 2020, at a constant rate of 3% and, from 2020 to 2021, it dropped sharply by 24%. The outlook until 2025 remains constant at approximately 540M annual free allowances.

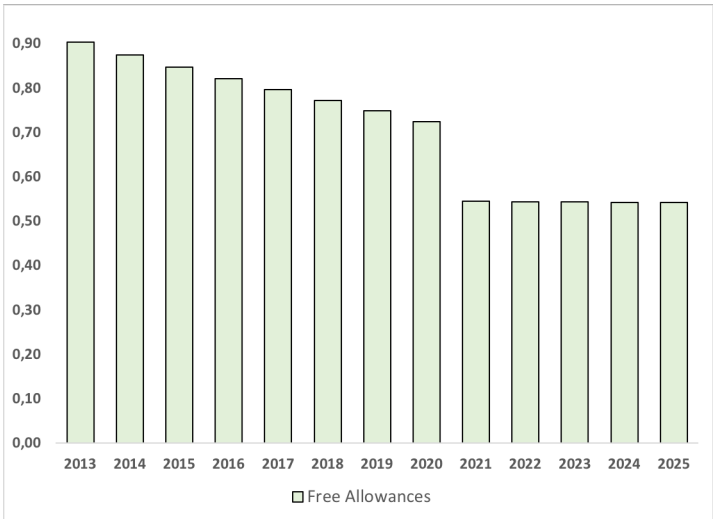


Figure 2: Annual levels of free allowances in billion tonnes of CO2e

Figure 2 presents the yearly evolution of free-allocated allowances. The Figure clearly illustrates a downward trend in the number of these allowances. Initially, there was a steady decrease of 3% per year until 2020, followed by a precipitous drop of 24% between 2020 and 2021. The projection for the years up to 2025 indicates a plateau, with an estimated annual allocation of around 540 million free allowances. Source: [12] and [13].

By early April, both installations and aircraft operators must disclose the number of emissions produced in the previous year. Currently, aviation allowances are managed apart from general allowances. However, aircraft operators can hedge their emissions with general or aviation allowances, but installations can use only general allowances. In early May, the EC releases the total number of allowances each installation surrendered. Until phase III, emissions could be covered by EUAs, CERs, and ERUs. As from phase IV, only EUAs are accepted. If total emissions are not entirely covered, the entity must pay a 100 euro fine for uncovered ton emissions. Figure 3 shows the evolution of the number of verified emissions. The Figure depicts a generalized decreasing trend, being 2020 the year that experienced the largest drop. Moreover, it also shows that stationary installations account for the largest share of verified emissions, followed by electricity and industrial production.

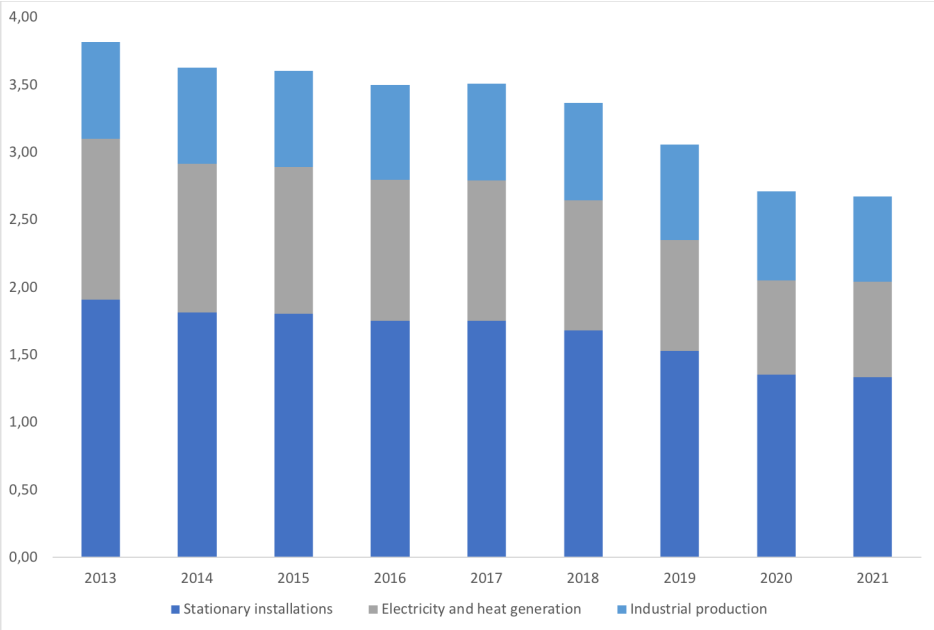


Figure 3: Verified emissions in billion tonnes CO2e

Figure 3 displays the total volume of verified emissions broken down by sector. The Figure highlights that stationary installations contribute the most significant portion of verified emissions. Subsequently, the electricity and industrial production sectors follow in terms of emission levels. Source: [13].

As of 2017, the Total Number of Allowances in Circulation (TNAC) for the previous year is published in mid-May. Allowances in circulation do not necessarily equal the number of allowances auctioned annually, since the former represent the total allowances stocked for a future use while the latter represent the new allowances created. This release is essential to determine the number of allowances entering or exiting the MSR. According to the MSR rules, if the TNAC exceeds an upper threshold (currently, 833M allowances), 24% of the TNAC is stored in the MSR. However, if the number is below a lower threshold (currently, 400M allowances), the MSR releases 100M allowances to the market. If there is an adjustment to the MSR, an announcement regarding those modifications is made in early July. This adjustment is given for auctions offered between September of the current year to August of next year. Based on the information retrieved from the EC announcements, we produced Figure 4, showing the evolution of the TNAC since 2017, when MSR trials started. From 2016 to 2018, the allowances in circulation remain relatively stable at 1.6B. In 2019, there was a 16% reduction in TNAC, mainly linked to the COVID-19 crisis. Thus, in 2020, there was a 13% increase in the TNAC derived from the post-COVID recovery, and by 2021 the TNAC declined by 8% from the previous year. However, since the implementation of the MSR in 2019, there has been a surplus of allowances in circulation concerning the pre-defined threshold (upper bound of 833M of allowances).

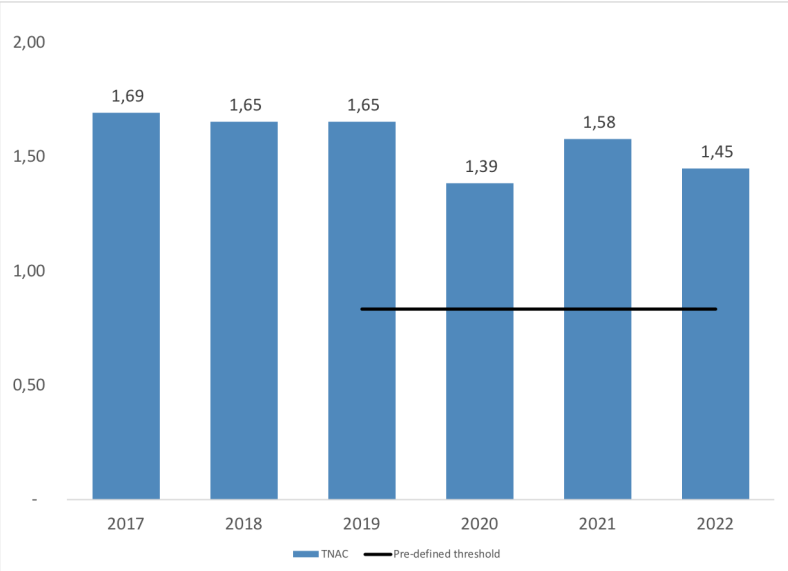


Figure 4: TNAC in billion tonnes of CO2e

Figure 4 presents the Total Number of Allowances in Circulation (TNAC). The black line represents an upper limit of 833M imposed on these allowances. The Figure displays that the TNAC volume has exceeded this upper limit annually, resulting in 24% of these allowances being transferred to the Market Stability Reserve (MSR). Source: Announcements from the EC Climate Action website.

Finally, the calendar of general and aviation allowances is published between October and December. This calendar gives the total number of allowances to be auctioned in the following year. The calendar is published already with the MSR adjustment between January and August. But the correction from September to December is given at the beginning of July of the following year. The following Figure displays the annual allowances auctioned in the general and aviation calendars. There is an upward trend between 2014 and 2018. In the year of MSR implementation, we notice a drop in the total number of allowances auctioned, which increases again in 2020 and then falls in 2021. Finally, the operating cycle is repeated every year.

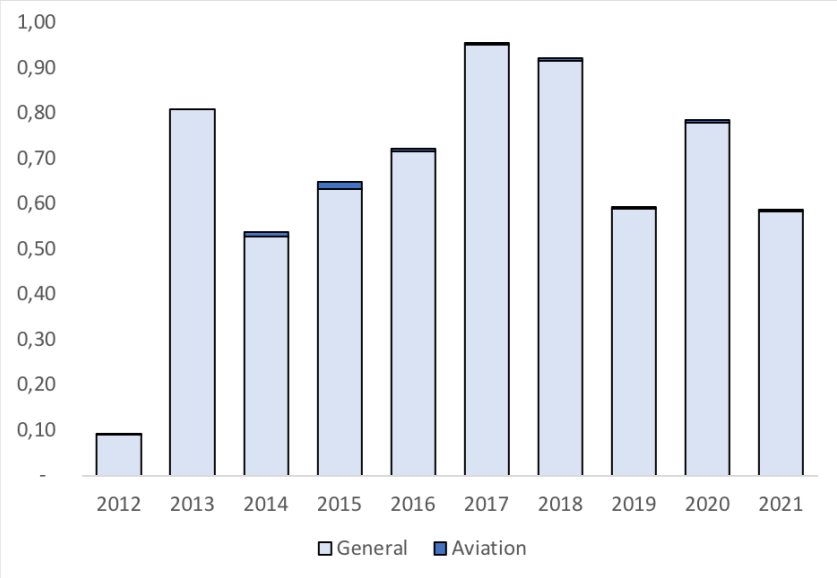


Figure 5: Total number of allowances annually auctioned in billion tonnes of CO2e
Figure 5 displays the total number of allowances auctioned yearly, containing the general and aviation schedules. Source:[13].

IV. WHICH EVENTS COULD AFFECT THE EU ETS MARKET?

To test the following hypotheses, we classify the EC announcements into 13 categories and identify for each whether they relate to an increase/decrease in supply/demand. Specifically:

H1.-Announcements pointing to an increase (decrease) in the supply of allowances will cause a fall (rise) in prices.

H2.-Announcements pointing to an increase (decrease) in demand for allowances will cause a rise (drop) in prices.

Next, we explain our hypotheses by dividing the categories into those that directly affect the supply and the demand of allowances.

4.1. Supply Categories

Auction This category refers to events concerning the general and aviation auction calendar and those related to off-calendar auctions. The impact of scheduled announcements will depend on comparing the amount announced the previous year vs. the current year. A negative change in the number of auctions represents a decrease in supply, and therefore, a positive impact on returns is expected. Conversely, if there is a positive change from one year to the next, the opposite effect is anticipated. The

off-calendar auctions should have the same effect.[3]

Free allocation This category includes announcements about free allocations for various sectors. It features events associated with updating the list of facilities eligible for free allocations. As this list has become more restrictive, it could potentially drive up prices. The category also includes announcements about exceptional free allocations granted to lower-income countries' power sectors within the EU. Such announcements could decrease CO2 returns as more allowances are given for free.

Cap This category encompasses all announcements related to setting a limit on allowance supply. During the analysis period, there were three significant changes: 1) The emission cap was set for the entire EU from the beginning of Phase III instead of the previous approach, which involved setting a cap for each EU member country. 2) In Phase III, the cap was reduced annually by a linear reduction factor of 1.74%. 3) In Phase IV, the cap was adjusted by a yearly linear reduction factor of 2.2%. A stricter limit translates into a decrease in the supply of allowances, increasing their returns and vice versa.[4]

New Entrants Reserve (NER) The NER program, which started in Phase III, distributes free allowances to new and existing facilities that upgrade their capacities. Notifications related to this program reveal the proportion of allowances allocated for this reserve. An increase in allowances for the NER reserve would likely negatively influence its returns, as facilities receive allowances for free, reducing the need to purchase them on the market.

Total Number of Allowances in Circulation (TNAC) Refers to announcements that report the total number of allowances banked for future use. Thus, announcements where the TNAC exceeds the upper threshold (833M allowances) should represent a decrease in supply and, thus, an increase in returns. We expect the opposite when allowances in circulation are below the lower threshold (400M allowances) and the supply difference is stored or removed from the MSR. During the study period, all announcements in this item exceeded the upper threshold, and we expect them to affect returns positively.

Auction adjustment These announcements refer to the adjustment in the schedule of allowances after the TNAC is published. Within our study period, the adjustments permanently reduced the supply of allowances and, therefore, are expected to impact returns positively. However, since these announcements are simply official confirmations of oversupply or undersupply based on the TNAC, their impact might be minor.

[3]Our study does not include the 2016, 2017, and 2018 auction calendar announcements because the percentage changes for general and aviation allowances occurred in opposite directions on the same day, making it difficult to differentiate the impact of both events using our methodology. However, we kept 2017 in the study as the announcements for the two markets were made on different dates. Also, we had to exclude 2020 because the event window for that year overlapped with another event.

[4]In comparison with Fan et al. (2017), this paper makes a distinction in the announcement of January 22, 2014, which we classify under the heading of MSR since it is on this date that the legislative proposal for the creation of the MSR was presented. Given that the paper by Fan et al. (2017) ends before this proposal adopts the name and all the operating mechanisms of the MSR, the authors limit themselves to classifying it as Cap.

This is because the market might have already adjusted its expectations based on the TNAC information.

Back-loading This category comprises announcements around the decision by the EC to postpone the auction during Phase III of 900M allowances until 2019-2020. Back-loading is the precursor to the MSR. Thus, we expect that announcements supporting the Back-loading would decrease the supply of allowances and, therefore, increase their returns.

4.2. Demand Categories

Market Stability Reserve (MSR) This category covers all announcements related to the negotiations and discussions around the creation of the reserve. These announcements indicate a potential restriction on future allowances supply, which could influence the current decisions of facilities. If the future scenario is perceived as having fewer allowances, the market is incentivized to buy now and store allowances for future use. Therefore, we expect announcements favoring the creation of the reserve to have a positive impact on returns.

Aviation This category pertains to announcements related to the aviation sector, which joined the system in 2012 and issues its own allowances. Although airlines can use both aviation and general allowances to offset emissions, other installations cannot. Initially, the legislation intended to include flights from all over the world that entered or exited the European Economic Area (EEA); however, in support of a global allowance market organized by the International Civil Aviation Organization (ICAO), the scope of this category was limited to flights that traveled exclusively within the EEA, regardless of the airline's nationality. Announcements in this category cover negotiations within the sector, talks with the ICAO, and adding new aircraft operators to the system. The 2021 carbon report indicates that the aviation sector usually needs to purchase general allowances to offset emissions, suggesting that the sector's inclusion increases demand for general allowances and, therefore, their return. As a result, any announcements that delay or suspend the sector's inclusion could negatively impact returns, and vice versa.

Certified Emission Reductions (CERs) and Emission Reduction Units (ERUs) This category accounts for the announcements connecting the carbon credits created under the Kyoto Protocol (CERs and ERUs) and the EU ETS. During the analysis period, there were important changes within this category: 1) During phase II, international credits were surrendered directly within the EU ETS 2) During phase III, credits needed to be exchanged for EU allowances 3) From phase IV, onwards the use CERs/ERUs is banned. Given that our analysis covers Phases II, III, and IV, our hypothesis is that announcements that increase the use of international credits decrease the demand for EU allowances, which in turn lowers their returns.

Monitoring, Reporting, and Verification (MRV) This category consists of all revisions to system regulations to improve the MRV of emissions. It also includes legislative proposals, agreements, regulations, law revisions, and amendments to the system. All modifications that improve the system's operation will increase its confidence and,

therefore, its demand. Thus, we expect an increase in returns.

Merge Markets This category includes announcements regarding the potential addition, collaboration, or split countries and regions within the EU ETS. We anticipate that announcements supporting the establishment of new markets or their integration into the European system will boost market confidence, increase demand for allowances, and enhance returns. Conversely, when regions or countries leave or condemn the system, it can create uncertainty, reducing both the demand for allowances and their returns.

European Green Deal This category encompasses policy proposals within the Green Deal that could influence the EU ETS. The Green Deal, launched on December 11, 2019, aims to achieve EU carbon neutrality by 2050. As a component of this deal, the EC adopted the "Fit for 55" on July 14, 2021, which contains a series of measures designed to reduce greenhouse gas emissions (GHG) by at least 55% by 2030 compared to 1990 levels. These initiatives can affect current and future allowances demand decisions, as they aim to limit coal use, encourage renewable adoption, or look for gas substitutes. Thus, depending on the specific announcement, it can either positively or negatively impact the demand for allowances, thereby influencing the returns on CO2e.

V. METHODOLOGY

Event studies are the commonly used methodology in finance and accounting to assess the impact of an event on stock prices, the value of a firm, or a merger and acquisition. Since the seminal work of [4], this methodology has slightly changed.[5] Thus, given its acceptance, simplicity, and relevance, we use this methodology to evaluate the impact of the EC announcements. To do so, we calculate abnormal returns within an event window that includes five days before and after each announcement, t=-5,…,5. That way, we can gauge the expectations and the progressive market reaction before and after the announcement. The abnormal returns are defined as the difference between the realized and the returns that the market would have exhibited in the absence of the event. This means:

$$AR_t = R_t - E[R_t] \tag{1}$$

where,

$$R_t = ln[P_t/P_{t-1}] \tag{2}$$

and,

[5] Perhaps the only significant changes have been using daily and intra-day data and adopting more sophisticated techniques for measuring normal and abnormal returns and significance tests.

$$E[R_t] = \frac{1}{60} \sum_{t=-65}^{-6} R_t \tag{3}$$

We are interested in the abnormal returns because they result from unanticipated events affecting CO2 returns. Thus, our methodology is close to a natural experiment in which we compare such returns to a benchmark of normal returns-also known as expected returns. Commonly, two statistical models define normal returns: the constant mean model return and the market model. In the former, the expected return is a constant average return during an estimation period. In the latter, the expected return results from a linear relationship between the market and the asset returns. However, analyzing a market as particular as the carbon market prevents us from applying traditional pricing models. Therefore, we discard the second option. Hence, we adopt a variant of the constant mean model return: the truncated mean model. We chose the truncated model instead of the constant model because returns in the carbon market are particularly volatile, so including extreme values would bias the expected return upwards or downwards. This is because part of that return would also be explained by unexpected and surprising events. Besides, other event studies analyzing EU ETS prices have also employed this model (see [9]; [8]; [5]); therefore, its adoption will allow us to compare our findings. More specifically, the truncated mean model assumes that, in the absence of an announcement, the expected returns would follow the 60 days before the event window trend after excluding the smallest and largest 5% within the estimation window.

To measure the speed at which information is incorporated into returns, we calculate the Cumulative Abnormal Returns, CARs, over the event window using the following formula:

$$CAR_t = \frac{1}{T} \sum_{t=-5}^{T} AR_t \tag{4}$$

where, T=-5,…,5.

Using this formula, we obtain a sense of the progressive aggregate effect of the abnormal returns from day -5 up to day 5 after the event. CARs are very useful in scenarios where no abnormal returns are found on the specific date of the announcement.

We restrict the event study to a short horizon (i.e., for only a few months) for the following reasons. First, we want to evaluate how fast prices absorb information, and, as such, a short horizon is enough to draw conclusions. Second, the event study methodology is unsuitable for a long-horizon study. On the one hand, longer estimation periods are likely to include structural breaks in their normal returns and, hence, lead to biased estimations. On the other hand, a serial correlation has implications for the estimators in the long term but not in the short term (see [2]). Therefore, we leave aside the long-term analysis as their implications go beyond this paper's scope.

To illustrate our methodology, we use the following Figure with the price of CO2 allowances for April 16, 2013, regarding the back-load of allowances (the event with the highest CARs drop within our sample period). Figure 6 shows the estimated and the event window from which we compute the expected returns and CARs.

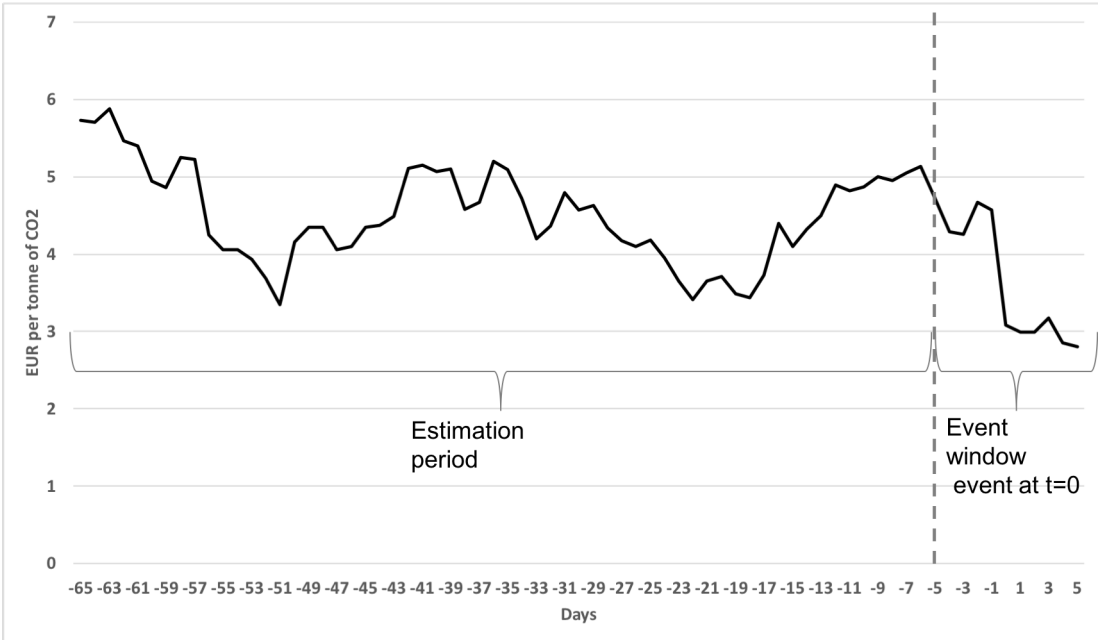


Figure 6: CO2 allowances price for the event on April 16, 2013

Figure 6 illustrates the price of CO2 allowances for the April 16, 2013 announcement. The Figure provides a detailed picture of the 65-day estimation period, as well as the 10-day event window. Source: Own elaboration.

Figure 7 provides the returns for the same event from which we compute both the expected (within the estimation period) and abnormal returns (within the event window). For this event, the truncated mean model gives us an expected return of -0.41% after removing the three highest (i.e., 12.9%, 16.5%, and 21.7%)and the three lowest observations (i.e., -20.6%, -11.7%, and -10.8%).

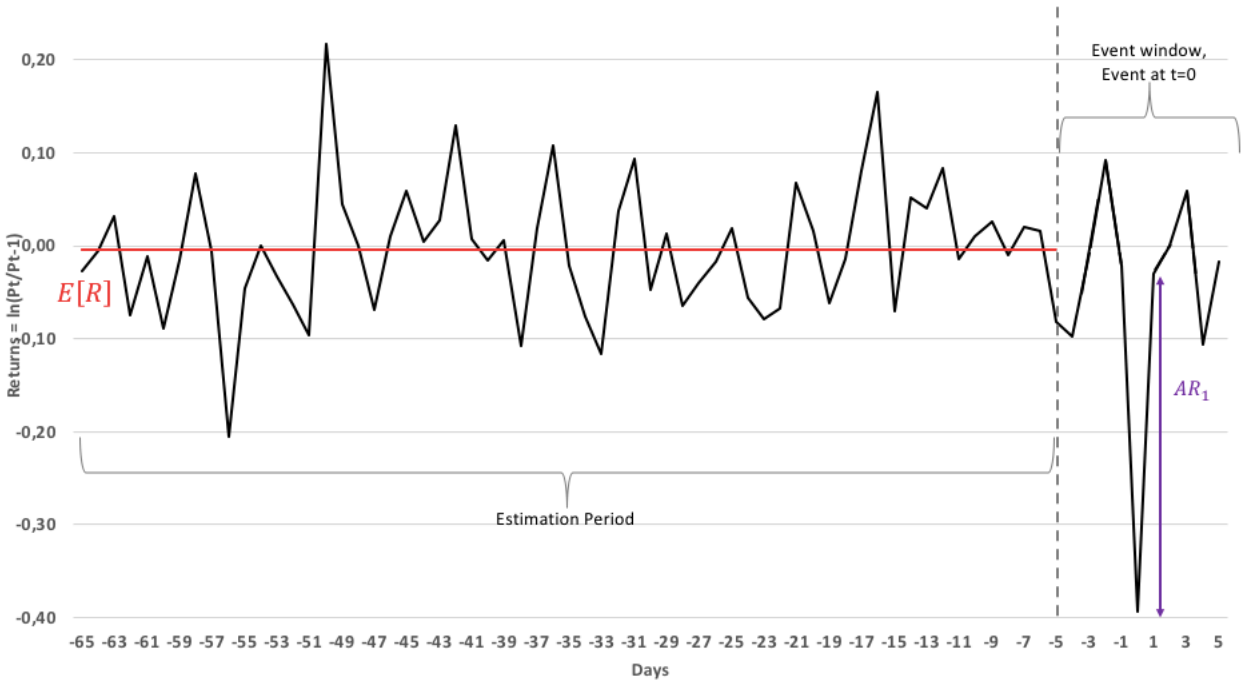


Figure 7: CO2 returns for the event on April 16, 2013

Figure 7 displays the returns for the April 16, 2013 event, both for the estimation period and the event window. The expected return calculated from the 60-day estimation period is depicted in red. This expected return excludes the top 5% and bottom 5% of returns. Additionally, the AR_1 is shown in purple as an example. Source: Own elaboration.

Finally, within the event window, we calculate the daily abnormal returns using equation 1 and the cumulative abnormal returns using equation 4.

VI. TESTING FOR SIGNIFICANCE

We perform a t-test to determine if the abnormal returns at or around the announcement are statistically significant, where the null hypothesis implies that the announcement has no impact on EU ETS returns. The test assumes independent and identically normally distributed returns.

We use the following test for the Cumulate Abnormal Returns:

$$CAR_T = \frac{1}{60} \sum_{t=-5}^{-T} AR_t \underset{H_0}{\sim} N(0, [T+6]\hat{\sigma}^2) \tag{5}$$

then,

$$t_T = \frac{CAR_T}{\sqrt{[T+6]\hat{\sigma}^2}} \sim N(0,1) \tag{6}$$

Where $\hat{\sigma}_2$ is the variance of returns during the estimation window.

We apply the following test for each abnormal return with the event window:

$$t_t = \frac{AR_t}{\hat{\sigma}} \sim N(0,1) \tag{7}$$

Where $\hat{\sigma}$, is the standard deviation of returns in the estimation window and AR_t is any daily abnormal return during the event window. We use the same formula to test for the significance of returns within the estimation window. However, in this case, as we consider these returns as the expected returns in the absence of an announcement, we want to reject the null hypothesis.

To test for significance per event category, we assume that there are N events of a category within the sample. Each event has its respective CARs during the event window with length d. Then the test will be:

$$\frac{1}{N}\sum_{j=1}^{N} CAR_j \underset{H_0}{\sim} N(0, \frac{d}{N^2}\sum_{j=1}^{N}\hat{\sigma}_j^2) \tag{8}$$

Then, the test-statistic is:

$$\frac{\sum_{j=1}^{N} CAR_j}{\sqrt{\frac{d}{N^2}\sum_{j=1}^{N}\hat{\sigma}_j^2}} \underset{H_0}{\sim} N(0,1) \tag{9}$$

VII. DATA

We collect 164 announcements from the official website of the European Commission Climate Action from July 2010 to June 2022 (phases II, III, and IV). However, since the classification and collection of events are more extensive than in previous studies, the likelihood of matching event windows between announcements is higher. Therefore, to avoid the confounding, underestimation, or overestimation of announcements, we removed 70 overlapping announcements and kept 94. Figure 8 shows the 94 announcements we evaluated. Such reduction does not affect the results per event; however, it does affect the conclusions we obtain per event category as it removes relevant announcements. Given that all the announcements categorized under 'verification' and 'allowances surrendered' overlapped with other notices, we excluded these categories. In addition, our events are consistent with the announcements of [5] for those dates where both study periods match. Tables .1 in Appendix show the list of news analyzed

and their expected impact on CO2 returns. Finally, we also collected from Refinitiv the EUA daily spot prices (euros per tonne of CO2e), the API2 Coal price (euros per tonne), the Dutch TTF Natural Gas price (euros per MWh) and the Brent oil price (euros per brent barrel). The following Figure shows the price of CO2 allowances during our analysis period and highlights the dates with the events we study.

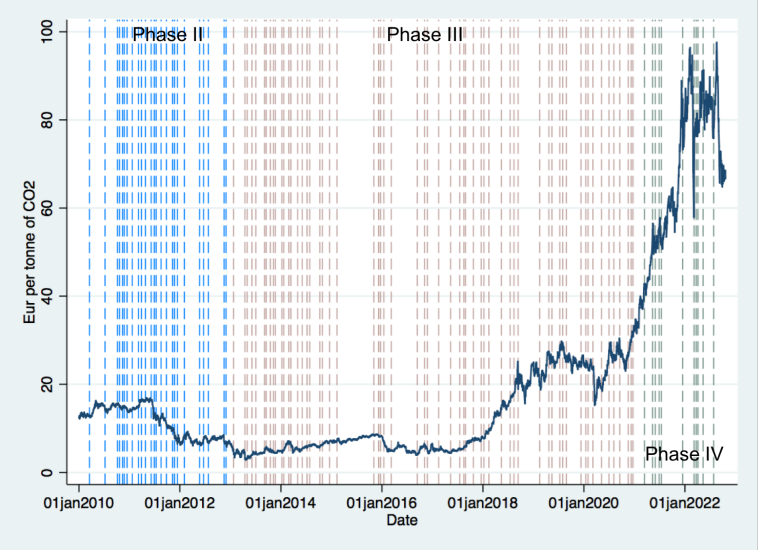


Figure 8: EUA spot prices and EC announcements

Figure 8 depicts the trend of EUA spot prices throughout our study period. Dotted lines represent the analyzed announcements, with blue indicating Phase II, pink indicating Phase III, and gray representing Phase IV. Source: Own elaboration.

Table 1 presents the distribution of announcements by phase, category, and expected impact. The majority of announcements (59) occur during Phase III. The categories "Free Allocation," "CER/ERU," and "MRV" are the most frequent announcements, occurring 15, 10, and 10 times, respectively. Furthermore, the expected positive impact of these announcements exceeds the negative impact, with a ratio of 66 to 28.

Table 1: Event Count Across Different Phases

Table 1 shows the number of news per category and expected impact.

PHASE	TOTAL # NEWS	CATEGORY													EXPECTED IMPACT	
		Auction	Free Allocation	Cap	NER	TNAC	Auction Adjustment	Back-loading	MSR	Aviation	CER/ ERU	MRV	Merge Market	Green Deal	Positive	Negative
II	24	4	5	2	0	0	0	1	0	4	3	5	0	0	14	10
III	59	4	7	1	6	4	2	6	3	4	7	5	8	2	44	15
IV	11	0	3	0	0	2	1	0	0	0	0	0	0	5	8	3

VIII. DESCRIPTIVE STATISTICS

Since the methodology employed is based on the assumption that, in the absence of event, the returns would have followed the same trend as those within the estimation period, we must ensure that returns within the estimaton window are not abnormal. Table **??** in Appendix show the t-test results for these returns. As can be observed, most of the returns are not significantly different from 0. Therefore, our database and study

period is appropriate to perform the event study. Also, table 2 shows the descriptive statistics of average returns. The table shows an average return of 0.08% within the estimation window, indicating on average positive returns. These returns, however, range from a minimum value of -0.90% to a maximum of 0.75%, suggesting a substantial spread between the extreme values. A standard deviation of 0.31% further confirms moderate volatility in these returns.

Table 2: Descriptive Statistics of normal returns over the estimation window

	Mean	Count	Min	Max	Std.
Average Returns	0.08%	94	-0.90%	0.75%	0.31%

IX. RESULTS: WHEN DO CARBON MARKET RESPOND?

9.1. CARs general results

CARs announcements give us an idea of the pace at which market participants react to announcements, as it measures the sum of abnormal return day by day during the announcement window. Out of 94 announcements examined, 31 had significant CARs on at least one day within the event window (14 events out of 24 in phase II, 14 events out of 59 in phases III, and 3 out of 11 events in phase IV). Table **??** in Appendix present these results. Within these 31 events, there are 2 Aviation events, 2 Cap events, 3 CER/ERUs events, 5 MRV events, 4 Auction events, 4 Free allocation events, 1 TNAC event, 1 NER allowance event, 3 Back-loading events, 3 Merge markets events and 3 Green Deal events.

The descriptive statistics of the significant events table (Table 3) display several interesting outcomes. First, the first row shows that when comparing the mean values across the event window, we observe that all CARs are negative, revealing a general decline in returns following significant announcements. The average CAR is -5.28%, suggesting an overall negative influence on allowances' returns. Second, the standard deviation progressively increases within the event window, implying a growing level of volatility in the returns as we move further away from the announcement. This variability is also shown in the considerable range between the minimum and maximum CARs. The minimum values range from -18.00% (CAR-5) to -56.08% (CAR-5), while the maximum CARs span from 6.31% (CAR+5) to 23.40% (CAR+4), indicating a significant variation in the magnitude of the returns.

Table 3: **Descriptive Statistics of significant events**

	CAR-5	**CAR-4**	**CAR-3**	**CAR-2**	**CAR-1**	**CAR0**	**CAR+1**	**CAR+2**	**CAR+3**	**CAR+4**	**CAR+5**	**Average CAR**
Mean	-1.50%	-2.60%	-2.55%	-2.88%	-4.19%	-6.48%	-7.32%	-8.15%	-7.12%	-7.42%	-7.89%	-5.28%
Standard deviation	4.95%	6.74%	8.19%	9.00%	10.25%	12.05%	14.06%	15.14%	14.72%	16.92%	17.16%	10.37%
Minimum	-18.00%	-18.70%	-20.71%	-24.49%	-35.97%	-48.58%	-51.14%	-50.73%	-44.48%	-54.72%	-56.08%	-33.20%
Maximum	6.31%	7.98%	12.48%	20.31%	15.40%	10.87%	18.79%	16.19%	17.62%	23.40%	17.60%	11.35%
Count	31											

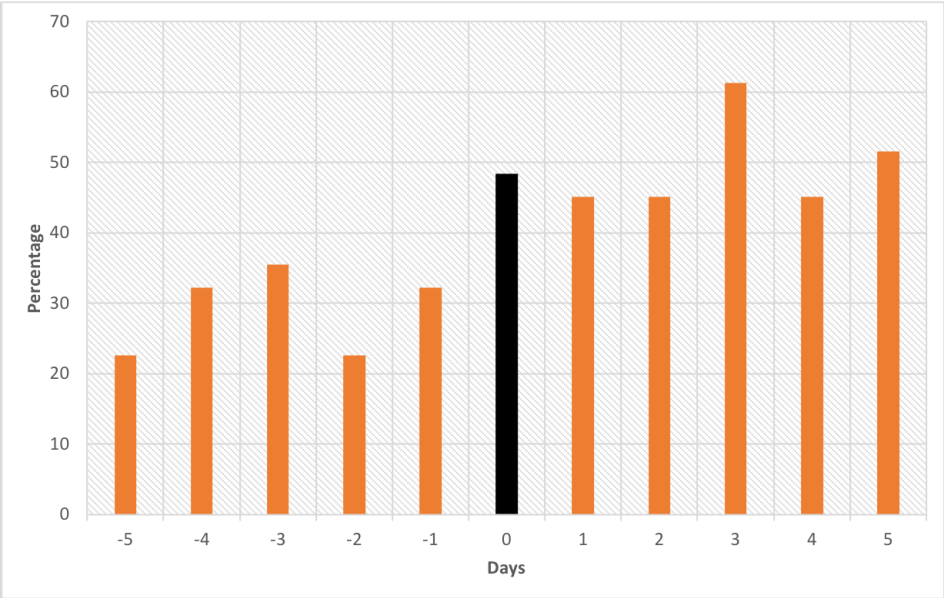


Figure 9: % of significant CARs per day around the event at t=0

Figure 9 illustrates the percentage of significant CARs per day around the announcement at t=0. The figure shows more CARs significant in the days following the official announcement. Source: Own elaboration.

Figure 9 shows that within the significant events, less than 30% have significant cumulative abnormal returns before the announcement, while more than 40% have significant CARs after the event. We also observe that the most significant market reaction happens on the third day after the announcement when around 60% of the events have significant CARs. This indicates that market participants are more reactive once the EC publicly releases the announcement, but it also points to the existence of information leakage.

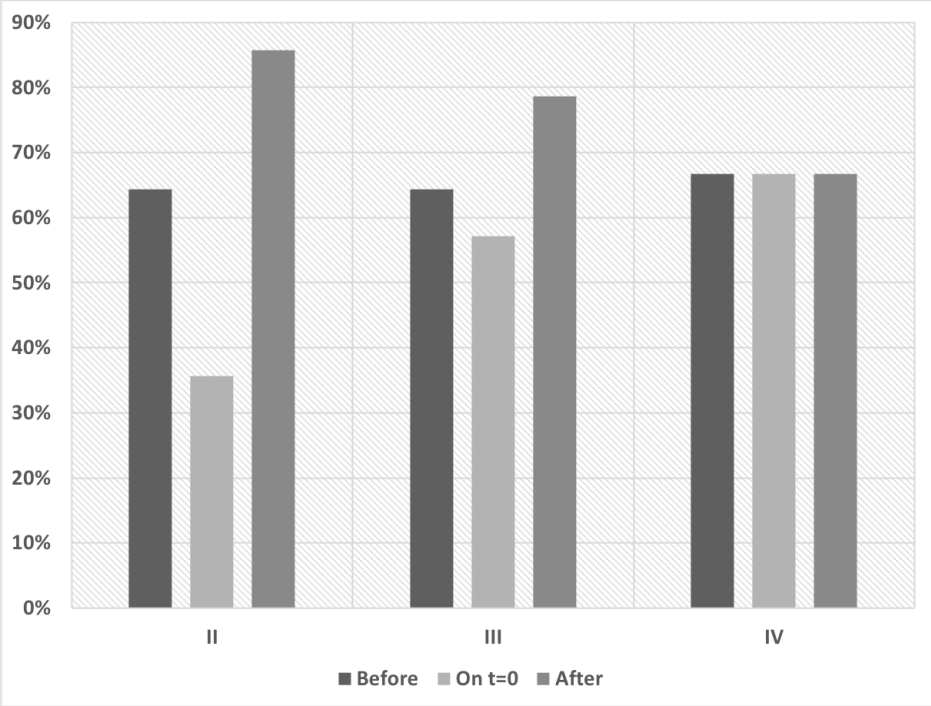


Figure 10: Percentage of events per Phase with significant CARs before, after, and on the announcement day

Figure 10 displays the percentage by phase of significant events before, during, and after the announcement. According to Figure 10, the percentage of significant events before the announcement stayed constant, at 64%, during phases II and III and increased by 3% during phase IV. Additionally, the percentage of significant events on day t=0 date grew per phase, going from 36% to 57% and ending at 67% in phase IV. In contrast, the percentage of significant events after the event's official publication decreased (from 86% to 79% and finally 67%). Based on this Figure, the information leakage and the impact on the day of the event are more significant during phase IV. However, we must not forget that this study covers only the first years of phase IV, and, as such, the number of significant CARs announcements during phase IV used to create this figure is lower than those of the previous phases. Hence, the results for this phase should be viewed with caution and considered preliminary.

During phase III, the market decreased its response to announcements, as fewer announcements significantly impacted the cumulative returns within a year. The latter suggests that the amendments made during that phase strengthened the system, making it less subject to the swings of surprise factors. However, we also notice an increase in the market response during phase IV, which we relate to new regulations that demand extra absorption time for market participants.

To check if there are negative (positive) abnormal returns when there is a negative (positive) CO2e announcement, we divide the announcements between those with positive and negative effects. Figure 11 shows these results. From the Figure, we observe that there is a general negative trend for all the events. Since this generalized trend appears before the official disclosure of information, it points to the possibility of setting a short

trading strategy to benefit from this leakage of information. Second, there is a negative (positive) trend in the days leading up to a negative (positive) announcement, which could be the result of insider trading. Third, given that the upward and downward trends in returns continue increasing throughout the days following the event, there are short-term profit opportunities from the announcements released by the EC.

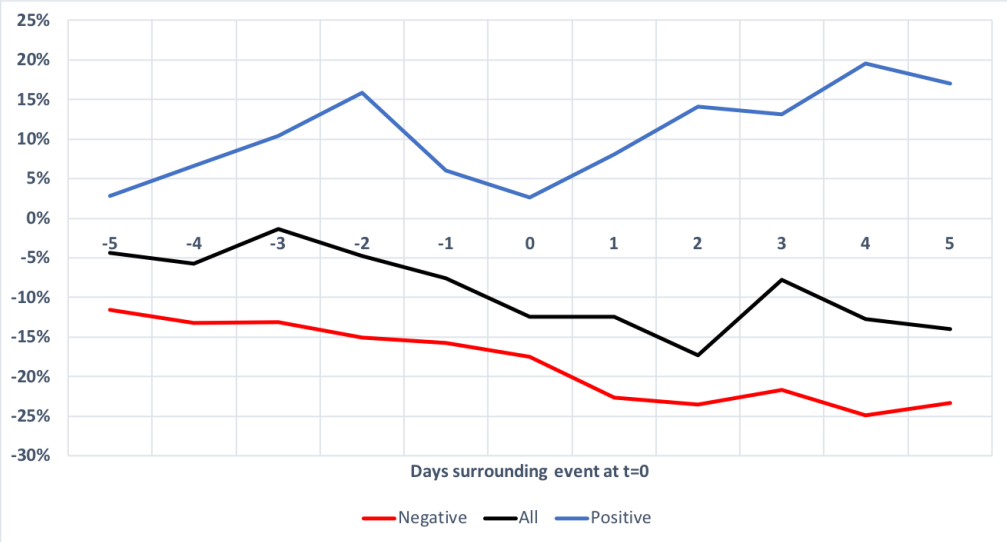


Figure 11: Average of significant CARs around the EC announcement

When comparing the cumulative abnormal returns of those announcements with and without information leakage, out of 21 announcements with significant CARs before the official announcement, 16 remain significant after the event. Moreover, such announcements reach higher CARs (averaging -9.03% on the fifth day) than those significant only after the event (averaging -5.29% on the fifth day). In other words, once outsiders take their post-announcement positions, insiders benefit even more from their pre-disclosure positions and information leakage.

9.2. CARs per event category

In this section, we discuss the significant CARs results by category. Figure 12 presents a graphic representation of each category.

Auction

There are four significant announcements within this category: July 13, 2011, November 23, 2011, November 16, 2012, and November 25, 2016. The two events in 2011 refer to the auction of Phase III allowances in advance, which implied a potential increase in the supply of allowances. Both events resulted in negative CARs impacts of -11.6% (as of the day of the event) and -12.94% (as of the fifth day), respectively. The 2012 event refers to the "stop the clock" proposal to postpone aviation allowances after the fall of 2013, once the ICAO general assembly took place. Although this decision intended to give the ICAO time to organize a global aviation allowance market, market participants perceived the event as a pessimistic decision. As a result, cumulative returns fell by -18.15% up to the fifth day. Finally, the 2016 announcement concerns the release of

the 2017 auction calendar, when allowances grew by 28.5%. As predicted, this release of information caused a drop in CARs by 35.05% up to the fifth day.

Free Allocation

Only 4 out of 15 announcements within this category are significant. From these, 3 have the expected impact. In relation to the announcements with the expected sign, the announcements on September 5, 2013, and September 13, 2016, refer to the Court and Commission decisions on free allocation during phase III, which announced more severe restrictions. Such announcements provoked an increase in cumulative returns of 17% on the fourth and fifth days after the announcement. The other significant announcement relates to the Hungarian power sector's new free allocations (November 30, 2012). This decision led to a significant decline of 15.32% in CARs three days following the announcement. This was largely attributed to the increase in free allocation of auctions to those companies that previously purchased them in the market. Finally, the announcement showing an opposite sign (on February 15, 2019) concerned the adoption of the Delegated Decision on the carbon leakage list for 2021-2030. This decision caused a cumulative fall in returns of 27.6% up to the fifth day after the announcement. This opposite effect on returns could result from market participants expecting a more restrictive list than the one submitted.

CAP

Two of the three events included in this category were significant. Both events relate to the "cap" set for 2013. The first establishes a limit of 1.927 billion allowances, while the second corrects the amount and increases it to 2.039 billion. Both announcements result in a return reduction of 11% and 7.4% (cumulative to the fourth and fifth day after the announcement, respectively). According to [5], the first announcement represents an increase of allowances from a previous initial "cap."[6] Therefore, we can conclude that the negative effects of both announcements come from an upward correction of the number of allowances available for 2013.

NER allowances

Out of 6 announcements in this category, January 15, 2016, is the only significant event. This announcement starts a series of regular publications in which the EC updates the percentage of free allowances still available for this reserve. The fact that the first announcement is the only significant suggests that the market only reacted to releasing new information. Nevertheless, later, as the number of allowances allocated to the New Entrants Reserve (NER) only represented 3% of the total free allocations available, there were no following significant reactions on returns.[7]

Mechanisms for balancing supply and demand allowances

We find that the categories related to measures balancing supply and demand, such

[6]Since we only have access to online news from 2010, we cannot verify this information firsthand.

[7]According to the carbon market report (2021), from 2013 to 2020, 6487M allowances were allocated for free, and only 178M went to the NER reserve.

as Back-loading, the MSR, the TNAC, and the calendar adjustment, yield the following results. For the MSR, no announcements significantly impact as this classification only covers negotiations around the reserve's creation and doesn't directly affect the number of available allowances. Regarding Back-loading, three announcements have significant cumulative returns. Similar to [5], two events exhibit opposite signs than expected: the July 25, 2012, and February 27, 2014 events, both concerning the negotiation on the number of allowances to be backloaded. These outcomes diverge from our predictions because the market anticipated a higher number of allowances for backloading. Furthermore, the announcement on April 16, 2013, when the European Parliament voted against the Backloading proposal, led to a significant drop in cumulative returns, soaring to 56.08% up to five days after the announcement. This was because the market perceived it as an announcement cancelling the Backloading implementation.

For the TNAC, and its MSR implications, although the mechanism was created in 2015 and the TNAC publication began in 2017, it was not until 2019 that the reserve became operational. 2017 and 2018 were trial years to implement the necessary adjustments to ensure a correct operation. Thus, it is normal to find a not significant impact on the 2017 announcement (with a supposed implementation in 2018). However, we also found no significant cumulative returns of the 2018 - 2020 and 2022 TNAC announcements; only the announcement of 2021 had a CARs of 11.04% up to the third day of the event. To provide a correct interpretation of these results, we examine if the market reacted to the subsequent adjustment in the auction calendar. Surprisingly the market did not react to any calendar adjustment either.

Figure 4 shows that since the implementation of the MSR in 2019, the TNAC has exceeded the upper threshold; therefore, 24% of these allowances enter the reserve annually. Hence, although year-by-year allowances enter the MSR, the fact that there is still an oversupply in circulation makes market participants unresponsive to current allowance reductions. Moreover, the fact that market participants have reacted to the 2021 TNAC announcements could be linked to the post-Covid demand recovery. In other words, as the economy began to recover, the market was more sensitive to announcements related to decreased allowances in circulation.

Aviation

Two of the eight events under this category are significant with the expected sign: June 30, 2011, and September 26, 2011. These events relate to the proposals on the number of allowances auctioned and freely allocated once the aviation sector joins the system. The impact on cumulative returns from both events is negative and reaches percentages of -10.25% and -16.63% by the fifth day after the announcement. The inclusion of this sector is associated with delays in its execution and last-minute modifications that restrict its scope. As such, the number of aviation allowances that ultimately gets approved is lower than what the market anticipates, triggering a decline in general allowance returns following the announcement of both events.

CER/ERUs

This category results in three significant events out of ten. January 21, 2011, announce-

ment refers to the European member states' support for the ban on using industrial gas credits instead of EUA allowances.[8] This announcement had a cumulative positive return of 6.54% up to three days after the event as it increased the demand for EU allowances. Another significant event, on January 23, 2013, relates to the approval of the exchange of eligible credits for allowances during phase III. Since this announcement accepts the substitution between instruments, it drops returns by 42.07% up to the 5th after the event. The last announcement, dated March 14, 2014, refers to the approval of the first conversion tables for international credits by EU allowances. These tables formalize the exchange and rate of conversion of both allowances, thus, leading to a fall of 15.81% as both instruments are officially considered substitutes.

MRV

Five out of 10 event under this category are significant. All announcements are in line with our expectations. The announcements on August 18, 2011, November 9, 2011, December 14, 2011, and June 21, 2012, relate to modifications to improve the system's monitoring, reporting, and verification. These improvements guarantee the system's correct operation and positively impact cumulative returns. Finally, the announcement on September 12, 2018, refers to the renewal of the opt-out platform for Germany and the arrangements for monetizing the first 50M allowances to run the Innovation Fund in 2020.[9] This event increase the system's confidence and cause a growth of cumulative returns of 9.77%.

Merge markets

Market participants responded to 3 out of 9 interactions with other carbon markets. The first announcement, on December, 8, 2015, relates to negotiations between Europe and Brazil to avoid the double counting of allowances between countries. Double counting occurs when the allowance-issuing country transfers its emissions to a country receiving allowances, and the recipient counts these reductions as part of its effort to reduce CO2e. In this case, emissions were only reduced once but claimed twice. Even when this measure is necessary to obtain real climate gains, it affects market participants' interests, and, therefore, the announcement led to a drop in CARs of 5.42%. The second announcement -on December, 19, 2017- enhances confidence in the system as it welcomes the launch of China's carbon market, and it caused a CARs increase of 12.57%. Finally, the EU and UK split -on January 8, 2018- caused a CARs drop of 7.88% until the announcement's release date.

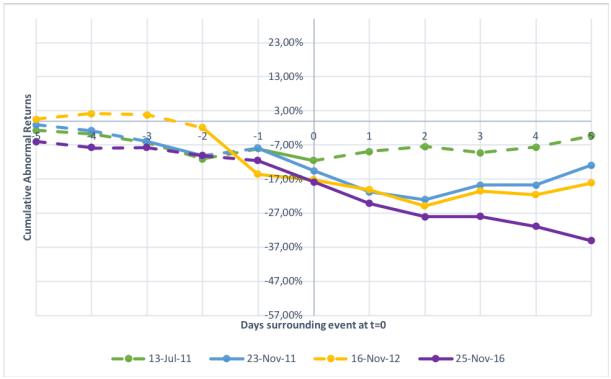
Green Deal

The market reacted to three events within the Green Deal: the 2030 Climate Target Plan presentation on September 17, 2020, the proposals to remove, recycle and store coal on December 15, 2021, and the plan to make Europe independent of Russian fossil fuels

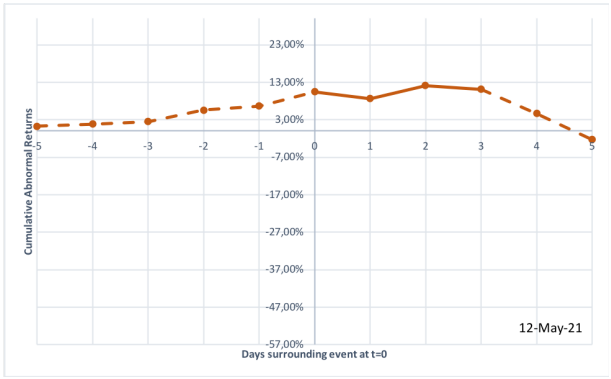
[8]Specifically, JI/CDM credits use in projects destroying the trifluoromethane and nitrous oxide from adipic acid production.

[9]The innovation fund is a program that supports projects that encourage innovative low-carbon technologies, carbon capture and utilization (CCU), innovative renewable energy generation, and energy storage.

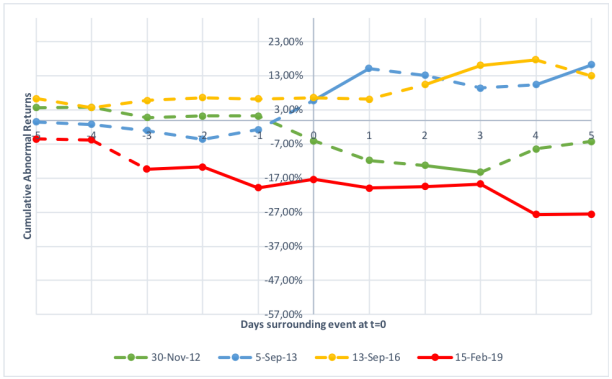
before 2030 on March 8, 2022. The first two events correspond to a decrease in CARs as they represent the transition from coal to less polluting energy sources, leading to a reduction in the demand for allowances. The last event, also known as the REPowerEU policy, is perceived adversely by the market. However, a day before the announcement, it showed incremental increases due to an optimistic view of using other energy sources, including coal, as a substitute for Russian fossil fuels.



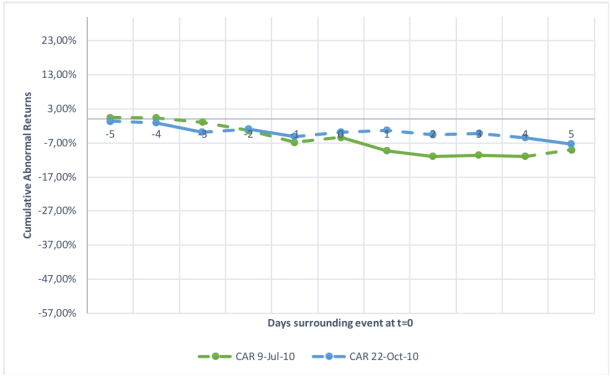
Auction



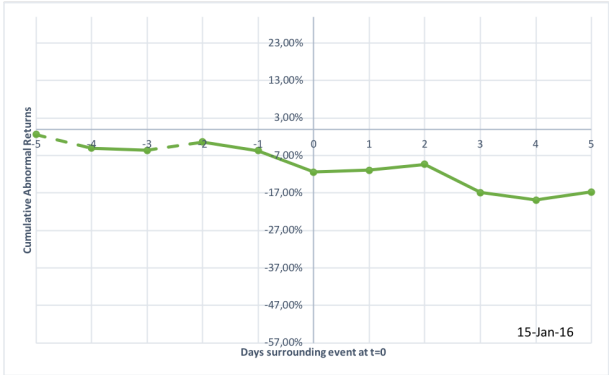
TNAC



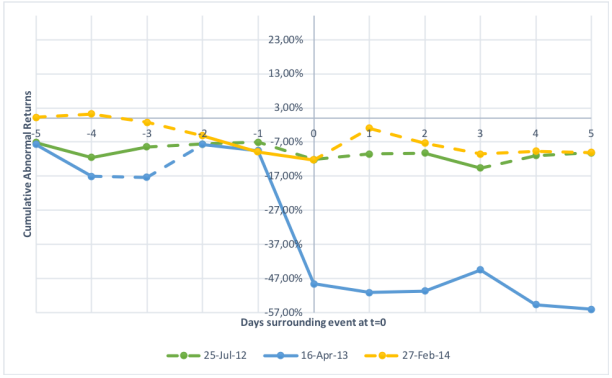
Free allocation



CAP



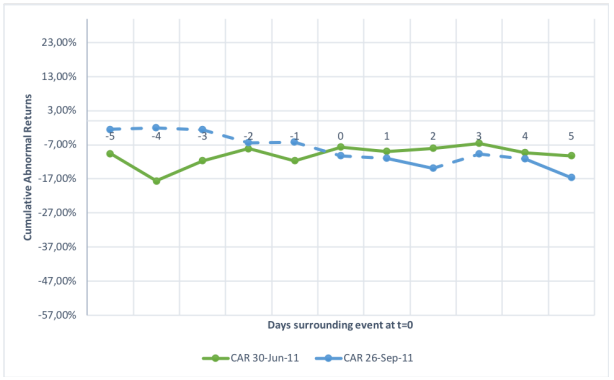
NER



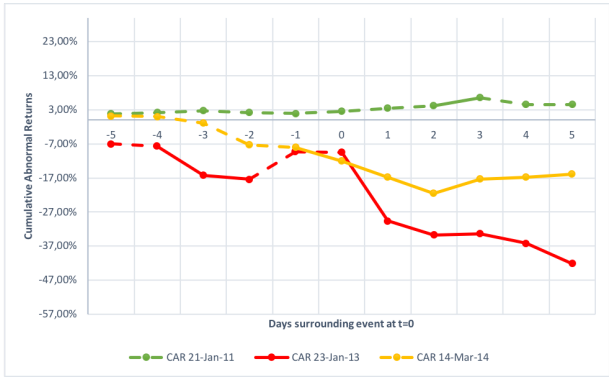
'Back-loading'

Figure 12: Significant CARs for each event category

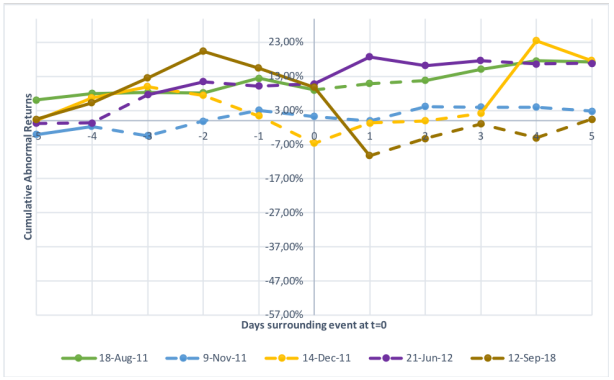
Note: Non-dotted lines denote significant CARs



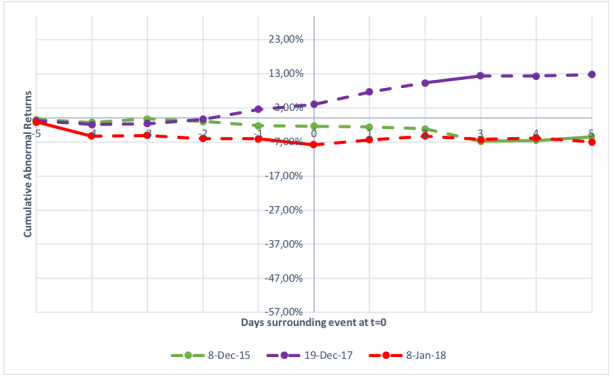
Aviation



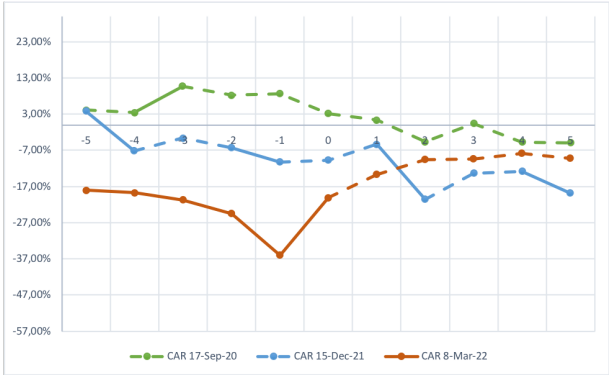
CERs/ERUs



MRV



Merge Markets



European Green Deal

Figure 12: Significant CARs for each event category

Note: Non-dotted lines denote significant CARs

9.3. ARs results

To get a complete picture of the effects of the EC's announcements on CO2 allowance returns, we also need to examine the impact of abnormal returns (ARs). Unlike CARs that measure the impact of an event over the event window, ARs identify the immediate one-day impact. Thus, when an announcement shows significant ARs that exceed CARs, the effect can be related to a market reaction that dissipates within one day. This dissipation may be linked to a market overreaction or new information that corrects the market's expectations within the day. Conversely, when significant CARs are higher than ARs, the market initially underestimated the announcement's impact, and as time passed, it adjusted its expectations and incorporated the new information into CO2 prices. Figure 13 shows the most relevant events with single abnormal returns.[10]

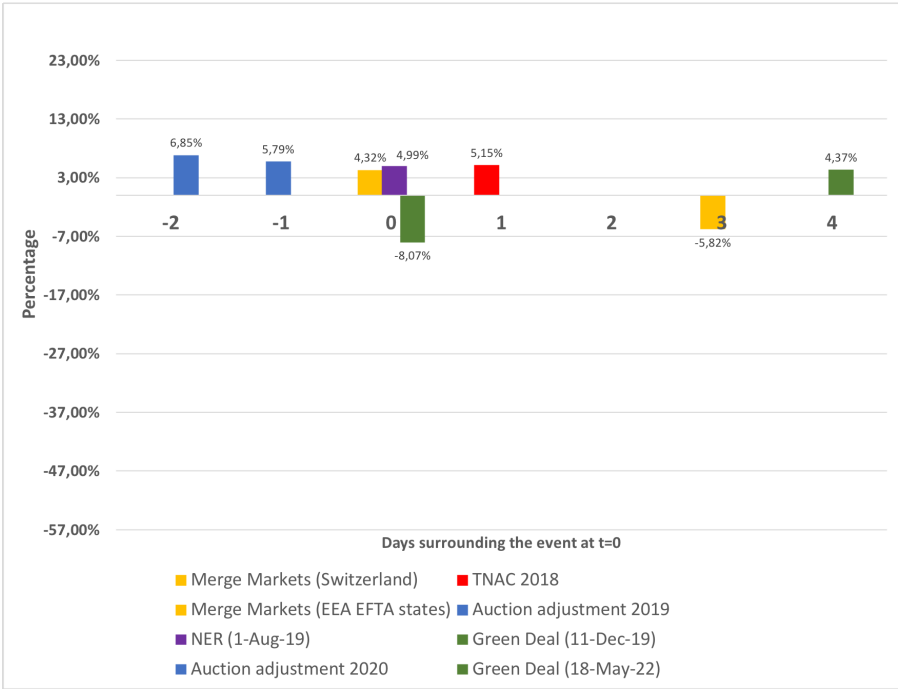


Figure 13: Most relevant events with significant Abnormal Returns

1. **EU and Switzerland join forces (Merge markets – Aug 16, 2017).-** This announcement caused an increase in returns by 4.32% on the day of the announcement. The return increase derives from an optimistic sentiment in the market, as this joint boost confidence in the system.
2. **The EEA EFTA states start auctions on the common auction platform (Merge markets - April 23, 2019).-** This news authorizes using the common platform to auction allowances from the EEA EFTA countries. Even though these countries entered the system in 2013, it was only in 2019 that the EEA agreement allowed them to participate in the Joint Procurement Agreement for the common auction platform. Therefore, this announcement increased the number of allowances, which resulted in an abnormal drop in returns by -5.82% three days after the announcement.
3. **Presentation of the European Green Deal (Green deal - December 11, 2019).-**The deal's announcement came with more restrictive policies for the EU ETS. Thus,

[10]Table **??** in appendix provide a list of all the announcements with a significant abnormal return.

the deal's launch was followed by a bullish market, with an abnormal return increase of 4.37% four days after the announcement.

4. **2019 and 2020 revised auction calendars published (Auction adjustment – July 11, 2019 and July 1, 2020).-** Following the MSR rules, the publication of the calendar adjustment had an impact of 5.79% and 6.85% one and two days before the announcement, respectively. Both effects align with the calendar adjustment expectations, which reduces allowances' supply during the current year's second half and the first half of next year.
5. **2018 TNAC announcement to send 265M of allowances to the MSR in 2019 (TNAC – May 15, 2018).-** TNAC's first announcement, with actual implications on the supply of allowances, triggered an abnormal return of 5.15% one day after its release.
6. **NER300 funds to support innovative projects in wave energy, offshore wind and charging infrastructure for electric vehicles (NER allowances – Aug 1, 2019).-** The Commission used unspent funds from the NER300 program to support low-carbon innovation projects under InnovFin Energy Demo Projects (EDP), an EU financial instrument managed by the European Investment Bank. The NER 300 program was created in Phase III to allocate 300M of NER allowances for projects of low-carbon technology, Carbon Capture and Storage (CCS), and innovative renewable energy technologies. This announcement raised returns by 4.99% on the day of the event.

Most significant ARs happen the day or days following the official announcement. These announcements do not show significant CARs. Looking at the content of these announcements, we find that they mainly involve news on EU ETS linkages with other markets and announcements on new measures under the Green Deal. This reveals important information about the audience's reactions to these events. They tend to be more varied, influenced by various factors, rather than homogenously driven by a group of investors who are deeply involved in the EU ETS market and need to speculate and make immediate transactions.

The only exception to this trend involves the events classified under "Auction adjustments." Interestingly, these announcements generated significant ARs one and two days before the calendar adjustment for 2019 and 2020, despite having non-significant CARs for both the "TNAC" and "Auction adjustment" categories. This may be due to two reasons. The first is that since the market knew that the adjustment announcement was coming, it reacted in advance and had already incorporated the effect into CO2 allowance prices on the day of the announcement. Second, the initial market reaction reversed over time, resulting in non-significant CARs. In other words, the market initially overreacted to the reduction in TNAC (and its resulting increase in the MSR) and then realized that, given the existence of an excess of allowances in circulation, the impact of the announcement would not be significant as initially thought, leading to a reversal of the initial movement and non-significant CARs over time.

X. RESULTS: WHEN DO CARBON MARKET NOT RESPOND?

This section outlines the main reasons why 67% of the analyzed announcements are non-CAR significant. The fact that this percentage is high has both positive and negative aspects. On the positive side, it restrains factors that increase price volatility, especially those coming from speculation and unsubstantiated rumors about the consequences of political regulations. On the negative side, as [7] mention, it restricts one of the advantages of allowances compared to carbon taxes—i.e., the system's flexibility to respond to diverse factors immediately.

Table 4: Descriptive Statistics of Non-Significant Events

	CAR-5	CAR-4	CAR-3	CAR-2	CAR-1	CAR0	CAR+1	CAR+2	CAR+3	CAR+4	CAR+5	Average CAR
Mean	0.05%	-0.15%	-0.39%	0.10%	0.88%	0.97%	0.89%	1.35%	1.14%	0.91%	1.18%	0.63%
Standard deviation	2.01%	2.67%	3.57%	4.38%	4.55%	4.73%	5.15%	6.74%	6.97%	7.04%	7.40%	4.40%
Minimum	-4.96%	-5.59%	-8.68%	-8.82%	-7.49%	-10.61%	-9.38%	-10.36%	-13.15%	-11.65%	-11.91%	-8.62%
Maximum	6.78%	5.17%	10.35%	16.86%	15.89%	13.63%	15.88%	32.32%	33.88%	28.05%	27.40%	18.01%
Count	63											

Table 4 presents the statistical descriptions of non-significant CARs. When comparing these statistics with the significant ones from Table 3, a noticeable contrast emerges: non-significant CARs exhibit a positive average, while significant events depict negative average returns. Moreover, non-significant events exhibit greater variability, smaller minimum, and larger maximum returns. This indicates that many announcements capable of increasing allowances' returns were indeed disregarded by market participants, leading to a stronger negative market reaction to EC announcements. The higher volatility observed in non-significant events can be seen as a positive aspect, as an increase in return volatility is typically undesirable.

Our analysis reveals that non-significant events stem from lowered expectations regarding the impact of EC announcements. Market participants may perceive these announcements as overly ambitious, with long-term implementation and results, or dependent on resolving political tensions and disagreements. The aviation category is a good example of an ambitious perception with political differences. From the outset of negotiations for its inclusion to the system, divergences arose with the ICAO regarding the scope limits. The initial EU proposal aimed to have all airlines and flights to and from Europe deliver allowances. However, this objective clashed with ICAO's goal of establishing a global market-based approach to regulate worldwide CO2e emissions. Several discussions between ICAO and the EU surrounded this divergence, leading to the EU decision to "stop the clock" on implementing the international aspects of ETS aviation. As a result, market participants adjusted their expectations downward regarding the scope of this policy, making that most of the announcements were non-significant. On the other hand, non-significant announcements under the "Green Deal" category are an excellent example of measures perceived as long-term in nature. This is evident in the case of the presentation of the European Green Deal or the modernization of EU industrial emission rules, as they outline the direction of future policies. For these announcements to be genuinely significant, they need to establish specific and targeted objectives that enhance the credibility of the EC's commitment to long-term policy adoption. This is why the reactions to the presentation of the 2030 Climate Target Plan and REPowerEU have been significant, as they have defined objectives.

Moreover, the lengthy approval process and ongoing adjustments to the number of allowances supplied or exchanged also contribute to the prevalence of non-significant outcomes. Notably, the "cap" and "backloading" categories often yield non-significant cumulative returns even when they are intended to increase prices. Ironically, when they become significant, these CARs contradict the initial expectations and show diminishing returns. We believe that this discrepancy arises due to the long approval process. Market participants know that the outcome can undergo changes at each stage and typically end up in more lenient measures than anticipated.[11] Consequently, market participants tend to overlook these announcements during the various stages. This shows how the disclosure of information before the adoption of the proposal could disadvantage the EU ETS.

Another explanation for our non-significant findings is the perception that specific policies are not sufficiently robust to address existing issues in the system -such as the oversupplied allowances- or to encourage a significant adoption of green technologies. This is particularly evident in the case of the "TNAC/MSR" categories, where announcements related to reducing allowances in circulation are perceived as "weak" in addressing the problem of oversupply. Despite the EU's intention to gradually adjust the oversupply, market participants are conscious that a considerable surplus remains. Another category pointing to this problem is the "NER allowances", where only the initial announcement is significant. The likely reason for this is the fact that only 35% of the NER reserve was allocated during the study period. This circumstance caused market participants to raise doubts about the effectiveness of the reserve.

Many non-significant events are linked to administrative announcements and protocol-related matters that market participants do not perceive as causing significant changes in the system. An example is the non-significant announcements under the "Merge markets" category, which refer to proposals for safeguard measures, transfers of allowances between registries, or simple updates related to the UK's withdrawal. While these announcements are essential for the system's functioning, they do not directly impact the supply or demand dynamics. In comparison, announcements within the same category involving meaningful international collaborations (i.e., with China and Brazil), or separations (like the one with the UK), carry considerable weight. These events are perceived as potential opportunities or losses for system expansion, which could ultimately influence allowances' supply and demand dynamics.

XI. ROBUSTNESS CHECK

Since the methodology applied does not control for changes in energy prices and seasonality, we performed the following regression to check the robustness of our results:

[11] According to the European Parliament, the steps for the EC to implement a regulation are as follows: Commission proposal, first reading in Parliament, first reading in Council, second reading in Parliament, second reading in Council, conciliation, third reading in the European Parliament and Council, and proposal adopted.

$$r_{c,t} = \beta_1 r_{o,t} + \beta_2 r_{g,t} + \beta_3 r_{c,t} + \lambda_t + \varepsilon \tag{10}$$

Where $r_{c,t}$ are the CO2 returns series, $r_{o,t}$ are the oil returns, $r_{g,t}$ are the natural gas returns, $r_{c,t}$ are the coal returns and λ_t are the seasonal and yearly fixed effects.[12] To overcome autocorrelation, and heteroskedasticity, we employed the Newey-West estimator, where the maximum lag order of autocorrelation is given by the following criteria ([11]):

$$m = int\left[0.75 * T^{\frac{1}{3}}\right] \tag{11}$$

Where T is the number of observations, and int(x) refers to the integer obtained by truncating x towards 0.

We show the results of regression 10 in Table 5. The impact of the independent variables on the return of CO2 returns is consistent with what is documented in previous literature (see [10] and [1]). The results show a substitution effect of polluting sources that has a direct impact on the amount of demand for carbon allowances. For oil and gas, we observe that an increase in their returns causes these sources to be substituted by coal; therefore, the demand and price of allowances rise. Conversely, if carbon returns increase, there will be a substitution by lower polluting sources (mainly gas) with a downward impact on the demand and price of allowances. From this regression, we estimate the residuals and take them as the returns to apply the event study. Table **??** in appendix shows the results obtained. Results are very close in sign, magnitude, and event significance to those found by applying our methodology. The only difference is that when applying the residuals, four more events are classified as non-significant, specifically: October 22, 2010 (Cap), September 26, 2011 (Aviation), December 8, 2015 (Merge markets), and March 8, 2022 (Green Deal).

[12] All returns are obtained via the formula $r_{x,t} = ln\left[\frac{P_t}{P_{t-1}}\right]$

Table 5: Impacts on EUA returns from Oil, Natural Gas and Coal returns

	EUA returns
Oil returns	0.131***
	(4.11)
Natural Gas returns	0.0594***
	(3.27)
Coal returns	-0.0317
	(-1.32)
Seasonal FE?	Yes
Yearly FE?	Yes
Adjusted R-squared	0.0293
N	2965

t statistics in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Newey-West standard errors

XII. CONCLUSION

In this paper, we examine the impact on carbon returns of 94 announcements released by the EC during phases II, III, and IV. The overall results show that 33% of the announcements have a significant CARs. Of these, 60% reacted after, while 30% reacted before the announcement. These results differ from those of [9] and [8], who found greater significance three days before the release of the information. As the methodologies are comparable, this might be due to different data sets, due to improved information management practices at the EC or due to a more rational, less rumor-driven, behavior of market participants. The very peculiar price dynamics during Phase I of the EU ETS would point towards the first of these three hypothesis.

However, some information leakage in the market continues to exist. As the analysis by phase suggests, the CAR's significance before the event has increased between phases II and IV, from 64% to 69%. That is, information leakage is becoming more relevant in the carbon market. While between the II and IV phases, events with significant CARs after the event declined from 86% to 79%.

Looking at all significant events, we find a generalized downward trend in returns. This suggests that, in general, the EC's announcements are perceived negatively in the market, which undermines the system's effectiveness in cutting emissions. If we classify all significant events between those with positive and negative impacts, we notice that their returns have a downward and upward trend during the whole event window. Positive CARs reach maximum percentages of 20% and negative CARs minimum percentages of -25% up to the fifth day of the announcement. Hence, inside trading generates increasing profits throughout the event window. Furthermore, keeping in mind the general downward trend in returns, those events showing significant CARs

before the announcement reach lower CARs during the whole event window (averaging -9.03% on the fifth day) than those with significant CARs post-announcement (averaging -5.29%). In other words, information leakage continues to yield additional benefits for insider traders.

Regarding the 13 categories, we can rank, by the number of events with significant CARs, the categories "MRV," "Free allocation," and "Auction" as those causing a more significant impact on CO2 returns. However, ranking them according to the most significant drops in CARs, the categories of "Back-loading," "CER/ERU," and "Auction" report the most significant drops. In contrast, the "MRV" classification reports the most significant increases. Thus, if the EC's ultimate goal is to raise CO2 prices, it should focus on announcements highlighting improvements in the system, as they increase confidence in the system. Also, all announcements related to new regulations (such as the presentation of the 2030 Climate Target Plan) and those that refer to boosting the system's relations with other carbon markets also strengthen CO2 prices.

Nevertheless, the EC must be highly cautious with the announcements about the supply of allowances. Such is the case of the short-term (backloading) and long-term (TNAC and MSR) measures to remove the surplus of allowances. Our analysis shows that, contrary to what we expected, the announcements related to the backloading of the 900M allowances in Phase III had negative results on CO2 returns. This was mainly due to a downward adjustment in market expectations, as the market expected higher allowances to put in backload. Moreover, the announcements regarding the mechanism for balancing the supply and demand of allowances (i.e., TNAC, MSR, and calendar adjustments) produced no CARs response on CO2 returns. This market non-response is due to the progressive nature of reducing surplus allowances. Given that there is still a large surplus and that long-term trends ultimately set the cumulative supply, market participants have no incentive to respond to such shorter-term announcements. Likewise, we assume the positive 2021 TNAC response is due to the post-Covid demand recovery.

Interestingly, however, we find positive abnormal returns in the days before the official calendar adjustment considering the MSR. We suspect that this result is because the market initially overreacted and then realized that, given the existence of a surplus of allowances, the impact of these announcements would not be significant, leading to a reversal of the initial movement and non-significant CARs over time. We expect these outcomes to change when, in the coming years, the oversupply of allowances vanishes and expectations of long-term supply stabilize, so the market will have incentives to respond also to unexpected short-term announcements.

Ultimately, the EC must find the right balance between the frequency, timing, and type of information it publishes. This balance is becoming increasingly important given the current growth and evolution of the European carbon market. The market will undoubtedly continue to be exposed to new risks leading to overreactions or mimetic herd behavior that could diminish the effectiveness of the EC's policies and regulations. It is in the EC's interest to soften the impact of its announcements on carbon prices to minimize abnormal volatility and provide robust incentives for long-term investment decisions in carbon abatement and low-carbon generation technologies. In

the long term, price volatility influences investment decisions in low-carbon vs. fossil technologies. The results of this paper show that the EC's information policy and its management of market expectations have indeed improved. However, they must improve further if the EU ETS is to remain the key instrument to attain the objective of the EU of achieving carbon neutrality by 2050.

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APPENDICES

Phase	No.	Date	Event description	Type	Impact
II	1	9-Jul-10	Commission takes first step toward determining cap on emission allowances for 2013.	Cap	Negative
	2	7-Oct-10	Regulation 920/2010 for a standardized and secured registry.	MRV	Positive
	3	22-Oct-10	Cap for 2013 adjusted and adopted, repealing the first cap.	Cap	Negative
	4	12-Nov-10	Regulation 1031/2010 on the timing, administration and other aspects of auctioning allowances.	Auction	Positive
	5	25-Nov-10	Commission presents a proposal to restrict the use of credits from industrial gas projects.	CER/ERU	Positive
	6	15-Dec-10	The Climate Change Committee supported the proposal for how to allocate emissions rights.	Free allocation	Negative
	7	21-Jan-11	Member states voted to support the ban on the use of certain industrial gas credits.	CER/ERU	Positive
	8	7-Mar-11	Decision 2011/149/EU on historical aviation emissions.	Aviation	Positive
	9	29-Mar-11	Decision on transitional free allocation of allowances to the power sector.	Free allocation	Negative
	10	27-Apr-11	Decision 2011/278/EU on transitional Union-wide rules for harmonized free allocation of allowances.	Free allocation	Positive
	11	7-Jun-11	Regulation 550/2011on restrictions for the use of certain international credits.	CER/ERU	Positive
	12	30-Jun-11	Decision 2011/389/EU on quantity of allowances in Article 3e(3)(a) to (d) of Directive 2003/87/EC.	Aviation	Negative
	13	13-Jul-11	Member States agreed to auction 120 million phase 3 allowances in 2012.	Auction	Negative
	14	18-Aug-11	Decision 2011/540/EU on monitoring and reporting guidelines for new activities and gases.	MRV	Positive
	15	26-Sep-11	Decision 2011/638/EU on benchmarks to allocate allowances free of charge to aircraft operators.	Aviation	Negative
	16	9-Nov-11	Proposal of two draft regulations on monitoring, reporting and verification.	MRV	Positive
	17	23-Nov-11	Regulation 1210/2011 determining the volume of allowances to be auctioned prior to 2013.	Auction	Negative
	18	14-Dec-11	The Climate Change Committee approved two draft regulations on monitoring, reporting and verification.	MRV	Positive
	19	3-Feb-12	Regulation 100/2012 amending Regulation 748/2009 on the list of aircraft operators.	Aviation	Positive
	20	23-May-12	Commission cleared temporary free allowances for power plants in Cyprus, Estonia and Lithuania.	Free allocation	Positive
	21	21-Jun-12	Regulations600/2012 and 601/2012on the monitoring, reporting, verification and accreditation adopted.	MRV	Positive
	22	25-Jul-12	Commission proposed to backload certain allowances from 2013 to 2015 to the end of phase III.	Back-loading	Positive
	23	16-Nov-12	Auctions for 2012 aviation allowances put on hold	Aviation	Negative
	24	30-Nov-12	Commission cleared temporary free allowances for power plants in Hungary.	Free allocation	Negative
III	25	23-Jan-13	The Climate Change Committee approved new EU ETS registry rules	MRV	Negative
	26	16-Apr-13	The European Parliament voted against the Commission's back-loading proposal.	Back-loading	Negative
	27	2-May-13	Regulation 389/2013 establishing a Union Registry.	MRV	Positive
	28	5-Jun-13	Commission submits proposal for international credit entitlements for 2013–2020.	CER/ERU	Positive
	29	3-Jul-13	The European Parliament voted for the carbon market back-loading proposal.	Back-loading	Positive
	30	5-Sep-13	Commission finalized decision on industrial free allocation for phase three.	Free allocation	Positive
	31	16-Sep-13	Union Registry updates regarding international credit exchange and holdings.	CER/ERU	Positive
	32	16-Oct-13	Commission proposed applying the EU ETS to European regional airspace from 1 January 2014.	Aviation	Negative

Table .1: Regulatory policy adjustment events list.

Phase	No.	Date	Event description	Type	Impact
III	33	8-Nov-13	Many member states started negotiations with the European Parliament on the back-loading proposal.	Back-loading	Positive
	34	21-Nov-13	Commission submitted non-paper on back-loading to the EU Climate Change Committee.	Back-loading	Positive
	35	8-Jan-14	The Climate Change Committee agreed the back-loading proposal.	Back-loading	Positive
	36	22-Jan-14	Commission proposed to establish a MSR for phase V.	MSR	Positive
	37	27-Feb-14	Back-loading: 2014 auction volume reduced by 400 million allowances.	Back-loading	Positive
	38	14-Mar-14	Commission approved first batch of international credit entitlement tables.	CER/ERU	Negative
	39	2-May-14	Number of international credits exchanged totaled 132.8 million.	CER/ERU	Negative
	40	4-Jun-14	Auctioning of aviation allowances to restart in September	Aviation	Positive
	41	9-Jul-14	EU Climate Change Committee agrees proposed carbon leakage list for the period 2015-2019	Free allocation	Positive
	42	29-Jul-14	2014 aviation auction calendars published	Auction	Positive
	43	9-Oct-14	2015 auction calendars for general and for aviation allowances published	Auction	Negative
	44	27-Oct-14	EC adopts the carbon leakage list for the period 2015-2019	Free allocation	Positive
	45	19-Dec-14	European Commission starts written consultation on revision of the EU ETS Directive for post-2020	MRV	Positive
	46	10-Feb-15	Aviation/ETS: Update of the aircraft operators list	Aviation	Negative
	47	4-Nov-15	Updated information on Exchange and International Credit Use in the EU ETS	CER/ERU	Negative
	48	8-Dec-15	EU and Brazil agree ground breaking proposal on carbon markets at Paris climate talks	Merge Markets	Positive
	49	22-Dec-15	Consultation on the functioning of carbon allowance auctions	MSR	Positive
	50	15-Jan-16	Commission publishes status update for New Entrants' Reserve	NER allowances	Positive
	51	9-Mar-16	Consultation on market-based measures to reduce the climate change impact from international aviation	Aviation	Positive
	52	13-Sep-16	Court's judgment on free allocation in the EU ETS for the period 2013-2020	Free allocation	Positive
	53	4-Nov-16	Updated information on Exchange and International Credit Use in the EU ETS	CER/ERU	Negative
	54	25-Nov-16	2017 auction calendars for general allowances published	Auction	Negative
	55	15-Feb-17	EU Emissions Trading System: Parliament vote marks major step towards reaching agreement	MSR	Positive
	56	12-May-17	Commission publishes first surplus indicator for ETS MSR	TNAC	Positive
	57	17-Jul-17	Commission publishes status update for New Entrants' Reserve	NER allowances	Positive
	58	16-Aug-17	EU and Switzerland join forces on emissions trading	Merge Markets	Positive
	59	24-Oct-17	Commission proposes safeguard measures for EU Emissions Trading System	Merge Markets	Negative
	60	19-Dec-17	EU welcomes launch of China's carbon market	Merge Markets	Positive
	61	8-Jan-18	Update on safeguard measures for EU Emissions Trading System in 2018 following adoption of UK law	Merge Markets	Negative
	62	13-Feb-18	Update on safeguard measures for EU Emissions Trading System due to the UK's withdrawal from the European Union	Merge Markets	Negative
	63	15-May-18	ETS MSR will start by reducing auction volume by almost 265 million allowances over the first 8 months of 2019	TNAC	Positive
	64	16-Jul-18	Commission publishes status update for New Entrants' Reserve	NER allowances	Positive

Table .1: Regulatory policy adjustment events list.

Phase	No.	Date	Event description	Type	Impact
III	65	13-Aug-18	German auctions on renewed opt-out platform expected to resume in early 2019	MRV	Positive
	66	12-Sep-18	Draft amendment to ETS Auctioning Regulation available for stakeholder feedback: renewed opt-out platform for Germany and arrangements for auctioning of 50 million allowa	MRV	Positive
	67	15-Feb-19	Adoption of the Delegated Decision on the carbon leakage list for 2021-2030	Free allocation	Positive
	68	23-Apr-19	EU Emissions Trading System: Iceland, Liechtenstein and Norway to start auctions on the common auction platform soon	Merge Markets	Negative
	69	15-May-19	ETS MSR to reduce auction volume by almost 400 million allowances between September 2019 and August 2020	TNAC	Positive
	70	11-Jul-19	2020 and revised 2019 auction calendars of the common auction platform published	Auction adjustment	Positive
	71	1-Aug-19	NER300 funds to support innovative projects in wave energy, offshore wind and charging infrastructure for electric vehicles	NER allowances	Positive
	72	28-Aug-19	Commission amends ETS Auctioning Regulation for phase 4	MRV	Positive
	73	11-Dec-19	Presentation of the European Green Deal	Green Deal	Positive
	74	15-Jan-20	Commission publishes status update for New Entrants' Reserve	NER allowances	Positive
	75	31-Jan-20	Lifting the suspension of UK-related processes in the Union Registry of the EU ETS	Merge Markets	Negative
	76	6-Mar-20	Innovative projects in transport sector to benefit from NER 300 funds	NER allowances	Positive
	77	8-May-20	ETS MSR to reduce auction volume by over 330 million allowances between September 2020 and August 2021	TNAC	Positive
	78	1-Jul-20	2020 revised auction calendars published	Auction adjustment	Positive
	79	5-Aug-20	2020 calendar for transfers of allowances between the EU and Swiss emission trading registries	Merge Markets	Positive
	80	17-Sep-20	Presentation of the 2030 Climate Target Plan	Green Deal	Positive
	81	17-Nov-20	Start of phase 4 of the EU ETS in 2021: adoption of the cap and start of the auctions	Cap	Positive
	82	8-Dec-20	Draft implementing regulation determining revised benchmark values for the period 2021-2025 open for 4-week stakeholder feedback	Free allocation	Positive
	83	21-Dec-20	2021 auction calendars published	Auction	Positive
IV	84	15-Mar-21	Adoption of the Regulation determining benchmark values for free allocation for the period 2021-2025	Free allocation	Positive
	85	12-May-21	ETS MSR to reduce auction volume by over 378 million allowances between September 2021 and August 2022	TNAC	Positive
	86	31-May-21	Commission adopts the uniform cross-sectoral correction factor to be applied to free allocation for 2021 to 2025 in EU ETS	Free allocation	Positive
	87	28-Jun-21	Commission publishes the national allocation tables of Member States for EU ETS stationary installations eligible to receive free allocation in the period 2021-2025	Free allocation	Positive
	88	14-Jul-21	Delivering the European Green Deal	Green Deal	Positive
	89	15-Dec-21	Commission proposals to remove, recycle and sustainably store carbon. Proposal of a new EU framework to decarbonise gas markets, promote hydrogen and reduce methane emissions	Green Deal	Negative
	90	8-Mar-22	REPowerEU: Joint European action for more affordable, secure and sustainable energy	Green Deal	Negative
	91	23-Mar-22	Commission outlines options to mitigate high energy prices with common gas purchases and minimum gas storage obligations	Green Deal	Negative
	92	5-Apr-22	Green Deal: Modernising EU industrial emissions rules to steer large industry in long-term green transition	Green Deal	Negative
	93	12-May-22	ETS MSR to reduce auction volume by over 347 million allowances between September 2022 and August 2023	TNAC	Negative
	94	28-Jul-22	Revised 2022 and 2023 auction calendars published	Auction adjustment	Positive

Table .1: Regulatory policy adjustment events list.