

# **Accounting for carbon emission allowances: An empirical analysis in the EU ETS phase 3**

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## **Accounting for carbon emission allowances: An empirical analysis in the EU ETS phase 3**

This investigation studies the accounting treatment of the carbon emission allowances of by EU Emissions Trading System participants to explore whether the auctioning allocation system implemented in 2013 led to changes in accounting practices. This investigation adds to Allini et al. (2018) by performing a comparative study of how emission allowances are recorded in the 2011 and 2016 financial statements of a large sample of the highest emitters in the system that operate in eight different industries. We also update the analysis of the role of local standards in shaping carbon accounting practices in a context characterised by the lack of IFRS prescription. We found that auctioning did not modify accounting practices as they continue to be ‘messy’ and often absent. The high level of non-disclosure and the prevailing use of the ‘net method’ conceal the burden of allowances from users of financial statements. Additionally, we report that firms’ carbon accounting practices are more aligned with their local standard when it allows a limited representation of the financial impact of allowances. Therefore, current accounting practices are far from enabling an adequate assessment of the financial impact and risks resulting from carbon markets.

**Keywords:** Carbon accounting, carbon markets, emission allowances, European Union Emissions Trading System (EU ETS)

## 1. Introduction

Climate change is one of the most significant sustainability problems, with possibly irreversible consequences for the world (Rockström et al. 2009). Climate change has an anthropogenic origin as it is mainly driven by greenhouse gas (GHG) emissions resulting from human and corporate actions (Heede 2014). In 1997, based on the success of the US sulphur dioxide trading market, the Kyoto Protocol introduced and legitimised carbon emission trading markets as a policy mechanism for fighting climate change by setting a cap for GHG emissions (MacKenzie 2009). At the EU level, the European Union Emission Trading System (EU ETS) started operating in 2005. This study maps the financial accounting treatment for recording carbon emissions allowances (EUAs) in financial statements applied by companies under the EU ETS. We explore the change in financial reporting practices to account for EUAs throughout the transition from Phase 2 (2005–2012) to Phase 3 (2013–2020) of the EU ETS.

MacKenzie (2009) frames the EU ETS as an attempt to shape capitalism by modifying the calculative mechanisms that support it. The EU ETS distributes the cap of GHG emissions that can be produced in a year among participants through EUAs<sup>1</sup>. According to Callon (2009), the EU ETS constitutes a socially constructed market that provides a unique setting wherein a new commodity, the EUA, is enacted. By creating a scarcity of EUAs, the cap puts a price on GHG emissions, which were free for emitters until then. Firms owning installations subject to the system must deliver a number of EUAs equal to their total emissions in a year. Otherwise, they face an economic penalty while they must still surrender the EUAs. Before Phase 3, most EUAs were freely allocated to firms. Since this phase began in 2013, more than half of EUAs have been allocated through an auctioning system (European Commission

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<sup>1</sup> An EUA gives its holder the right to emit GHG emissions equivalent to the global warming potential of one tonne of CO<sub>2</sub> per EUA. The EU distributes the total number of EUAs among member states, which allocate their assigned EUAs among the installations operating within each country.

2020). The functioning of the EU ETS enables pollution to influence companies' financial situation and requires them to record EUAs in their financial statements (Bebbington and Larrinaga 2008; MacKenzie 2009).

Investigating carbon accounting offers an opportunity to foster the engagement between accounting researchers and policymakers, notably the Intergovernmental Panel on Climate Change (IPCC), in addressing climate change (Charnock and Thomson 2019). Carbon accounting represents an instrument that mediates between climate change and organizational activities by making GHG emissions governable through 'economizing', that is, by constituting them as 'economic entities' participating in the economic activity and influencing actors' decisions (see, Miller and Power 2013, p. 560). Although the term 'carbon accounting' can be used in other frames of reference related to carbon issues, such as physical, political, market-enabling and social and environmental modes of carbon accounting (see Ascuri and Lovell 2011), in this study 'carbon accounting' will be used specifically to refer to the recording of EUAs in financial statements.

This study contributes to this issue in two ways. First, Working Group III of the IPCC has been interested in emission trading as a mechanism for mitigating climate change (Somanathan et al. 2014). To facilitate the functioning of carbon markets, accounting should provide a complete representation (Lovell et al., 2013) of the financial implications of EUAs to inform market participants and policymakers (Haupt and Ismer 2013; Lovell et al. 2013). This study explores the existing interplay between the functioning of carbon markets and accounting in visualising the financial impacts of and risks stemming from EUAs by analysing whether the EUA accounting treatment has changed after the auctioning allocation regime. This analysis highlights the relevance of considering the role of carbon accounting in facilitating or impeding the operation of carbon markets by policymakers and calls for the

development of adequate accounting guidance aligning with the regulatory framework of carbon markets to promote the achievement of their objective.

Second, '[I]ntegrating climate concerns into investment and financing decisions' (Charnock and Thomson 2019, p. 196) requires translating ecological concerns into economic terms (Bebbington and Larrinaga 2008) through accounting, which is usually conceived as the language of business and finance. Carbon accounting creates connections between the environment, markets, governments, and science (Lovell et al. 2013). However, specific configurations of carbon accounting can 'hide' the impact of carbon emissions in financial statements (MacKenzie 2009). This possibility could make climate change invisible (Haupt and Ismer 2013), limiting the prospects of mobilising finance to fight climate change. When concerns about the quality of climate change information that is available in financial markets are growing and initiatives are created (e.g., Task Force on Climate-related Financial Disclosures) it is somehow paradoxical the low profile of the conversation about carbon accounting in carbon markets. This investigation contributes to assessing the extent to which firms' carbon accounting practices offer a complete representation of the financial impacts of EUAs to evaluate the financial risks within the scope of carbon markets.

Despite the relevance of carbon accounting, no compulsory international standard prescribes how firms must account for EUAs in financial statements. Some national accounting standard setters have proposed their standards (Allini et al., 2018). However, most EU ETS installations belong to listed firms that must apply IFRS in their financial statements and are not obliged to comply with their local standards. Indeed, Allini et al. (2018) concluded that, up to 2013, firms did not consider domestic proposals to record EUAs.

Contrary to the vast literature on voluntary carbon disclosure (e.g., physical units), few studies have examined the accounting treatment of EUAs in financial statements (Allini et al. 2018; Lovell et al. 2013; Lovell et al. 2010; Warwick and Ng 2012). Research on this

topic agreed on (i) the diversity of practices among firms, (ii) their tendency to follow a treatment offsetting the assets and liabilities related to EUAs, and (iii) the high level of non-disclosure explaining their EUA accounting treatment (Allini et al. 2018; Black 2013; Lovell et al. 2013; Lovell et al. 2010; Warwick and Ng 2012). These studies have explored periods before the auctioning system implementation in 2013<sup>2</sup>.

Lovell et al. (2013) argued that auctioning was expected to modify carbon accounting practices due to the resulting increase in the impact of EUAs on firms' financial position. Therefore, this study investigates whether the auctioning regime changed how companies account for EUAs in their financial statements by comparing carbon accounting practices before and after that regime shifted. Additionally, we explore the application of domestic standards in a context characterised by the absence of IFRS prescription. We analysed the accounting treatment of the 107 and 122 highest-emitting EU ETS firms in 2011 (Phase 2) and 2016 (Phase 3), respectively representing the 62% and 68% of the total verified emission in the EU ETS in those years. In addition to identifying the specific technicalities of the EUA financial reporting, we categorised firms' overall accounting treatment of the EUAs based on two contrasting approaches: the gross and the net methods.

This paper responds to Lovell et al.'s (2010) call to (i) study carbon accounting practices of a larger sample of companies, (ii) examine the differences between countries, and (iii) explore the implications of auctioning for the accounting treatment of EUAs. Thus, our investigation extends the findings of previous studies in several ways. First, Allini et al. (2018) concur with Lovell et al. (2013) and suggest that 'auctioning is likely prompting a

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<sup>2</sup> The paper using the latest sample is Allini et al. (2018) that studied the 2013 financial statements of 94 firms participating in the European Energy Exchange that operate in the energy, oil and gas, utilities, and metals and steel industries. Phase 3 started in 2013, and since then, the auctioning system has started to operate gradually; thus, companies may not have adjusted their accounting treatment yet. In this regard, Lovell et al. (2013) note that accountants of firms operating in the EU ETS 'appear not to be thinking ahead about this issue' (p. 7) as they were unaware of the implications of the auctioning system for the accounting practice.

review of accounting practices by preparers' (p. 2196). To evaluate this possibility, we conduct a comparative study of carbon accounting practices before and after the implementation of the auctioning allocation regime in 2013. Second, we map firms' accounting treatment for both assets and liabilities arising from the functioning of the EU ETS. By focusing on both elements, we determine the overall accounting method (net vs. gross) that companies applied to study the extent to which they provide a complete account of the EUA impact on their financial statements. Third, Allini et al. (2018), the most recent article analysing carbon accounting practices, studied whether firms followed the accounting treatment of their domestic standards in 2013. We update their analysis by considering a broader set of domestic standards<sup>3</sup> to study the alignment of companies' carbon accounting practices with the overall method of their corresponding local standard. Fourth, we explore the accounting practices of the EU ETS largest emitters, representing 229 firm-year observations and covering around two-thirds of the total verified emission produced within the system in the years analysed by installations operating in a wider range of industries. Finally, we include companies disclosing no information on the accounting treatment of EUAs, allowing us to observe high levels of non-disclosure among market participants.

Our findings show that carbon accounting practices are characterised by their 'messiness' due to the limited standardisation among companies and the high number of firms lacking information on how EUAs are considered in their financial statement. Although auctioning increased the financial impact of EUAs, our results indicate that the shift to auctioning did not change how companies record them in financial statements. We also found that the high level of non-disclosure and the prevailing use of the net method are the most widespread practices, which make the EUAs' burden invisible to the users of financial

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<sup>3</sup> In addition to considering the Austrian, German, Italian, Dutch and Spanish domestic standards, we also covered the domestic standards of Portugal, France, and Poland. The inclusion of the last two countries is particularly relevant to analysing EU ETS firms' accounting treatment because they represent the second and third largest emitting countries in the system, after Germany.

statements. Additionally, we report that the alignment of accounting practices with local standards has increased over time and tends to be higher when they prescribe a net method approach. Overall, the study provides evidence of the failure of carbon accounting to provide users of financial statements and society in general with complete and comparable information representing the actual impact of EUAs on their financial position. This aspect is critical for enabling the adequate functioning of carbon markets and fostering the integration of environmental issues in investment decisions.

This paper is structured as follows. After this introduction, Section 2 describes the accounting implications of the EU ETS functioning for recording EUAs in financial statements by reviewing prior literature and the guidance of domestic standards. Section 3 explains the research method. Section 4 presents the results, and Section 5 concludes.

## **2. Accounting for EUAs in the EU ETS setting**

### ***2.1. Accounting standards and technical aspects for recording EUAs***

The EU ETS implementation created the need to record EUAs in financial statements (MacKenzie 2009). The direct accounting implications of the EU ETS functioning is that firms should register assets (i.e., EUAs) and liabilities (i.e., the obligation to deliver EUAs) (Lovell et al. 2013). Specifically, the accounting treatment of EUAs revolves around three issues: the type of asset they represent, its value, and the recording and measurement of the liability stemming from the obligation to surrender EUAs (Bebbington and Larrinaga 2008).

To guide firms in recording EUAs, the IASB published IFRIC 3 in 2004, which was grounded on existing standards at that time (Haupt and Ismer 2013). However, IFRIC 3 was withdrawn in 2005 due to strong criticism from firms and other professional bodies (Cook 2009), and the EFRAG's recommendation to not endorse it due to measurement and reporting mismatches (Bebbington and Larrinaga 2008) that caused structural contradictions among its

prescriptions (Moore, 2011). Since then, the interest of the IASB in EUAs had its highs and lows, without delivering any proposal since it considered that the issue was not urgent and required a more comprehensive assessment (Allini et al. 2018).

The absence of international accounting standards created a setting where firms following IFRS can freely decide their accounting treatment, if any, to register EUAs (Allini et al. 2018; Giordano-Spring and Rivière-Giordano 2018; Warwick and Ng 2012). In this context, several national accounting standard setters have issued their standards and recommendations. This situation is the case for Austria, France, Germany, Italy, Poland, Portugal, The Netherlands, and Spain (see Table 1).

*[Table 1 near here]*

A small number of accounting papers have surveyed companies' carbon accounting practices. Overall, they found that (i) many firms lacked information on how they register them, and (ii) those that explained it differed in how their accounting treatments (Allini et al. 2018; Black 2013; Lovell et al. 2013; Lovell et al. 2010; Warwick and Ng 2012).

The following paragraphs review the different alternatives for the three accounting implications of the EU ETS functioning by (1) describing the prescriptions of IFRIC 3 and domestic standards, as well as by (2) considering firms' practices according to prior studies.

Regarding the accounting element EUAs represent, Lovell et al. (2013) argue that they can be classified as 'incommensurable' (Bowker and Star 2000) due to the complexity arising from their different uses<sup>4</sup>. The most common approaches are recognising EUAs as either intangible assets or inventory. The Austrian, Dutch, Portuguese, and Polish standard setters, and the withdrawn IFRIC 3 consider EUAs intangible assets. In contrast, the German,

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<sup>4</sup>Some local accounting standards (e.g., France, Italy, or Spain) proposed an activity-based model suggesting specific treatments for the different uses of EUAs: production (when used to justify the emissions made) and trading (when traded for generating financial profits). Provided that production is the main use of EUAs, we focus on the treatment of production EUAs.

Spanish, and French standards characterise EUAs as part of production costs and suggest registering them as inventory. Prior studies show that recognition as intangible assets was the most widespread option among companies (Black 2013; Lovell et al. 2010; Warwick and Ng 2012). When this is the case, firms should not amortise EUAs as they have an indefinite life (Black, 2013). Along with the recommendation of specific local standards, more companies have been recording EUAs as inventory lately (Allini et al. 2018). Alternatively, Giner (2014) suggests recognising EUAs as payment instruments to avoid volatility in income arising from their other uses, but no firm applied this treatment up to 2013 (Allini et al., 2018).

Concerning their initial valuation, purchased EUAs are generally recorded at their cost (i.e., the price that firms pay for them). The debate arises when registering freely allocated EUAs. IFRIC 3 required firms to measure them at fair value upon reception (i.e., the price firms would have paid had they acquired them) by recognising a government grant that should be treated as deferred income. While the Austrian, Spanish, and Portuguese standards also suggest valuing granted allowances at fair value, the Polish standard recommends recording them at their cost (i.e., nil value). Prior studies reported that most companies followed the latter approach (Allini et al. 2018; Black 2013; Lovell et al. 2010; Warwick and Ng 2012). In the German and Dutch settings, firms can choose between recording granted EUAs at cost or fair value. Finally, the French and Italian standards only recognise an asset if firms have a surplus of EUAs to justify their emissions. This excess is recorded at cost.

In relation to the liability stemming from the obligation to deliver EUAs, it is important to consider that it accrues during the lag between the period in which emissions are made (period ending the 31st December) and the delivery of EUAs (30th April of the following year). IFRIC 3 suggested that companies record the liability as emissions were made at fair value at the reporting date against an expense directly affecting the income statement. This prescription, combined with the valuation of granted EUAs (as explained

above), created measurement mismatches between the valuation of the asset and the liability. This issue was one of the reasons leading to its withdrawal (Bebbington and Larrinaga 2008). Domestic accounting standards measuring granted EUAs at fair value follow a ‘cost with balance at market value’ approach to address that concern. This approach links the liability valuation to that of the asset by measuring the former at the carrying amount of the EUAs they already own. If there is a shortfall, the unsettled EUAs are measured at market value at the reporting date. Austria, Germany, The Netherlands, and Spain follow this treatment. Most firms valued the liability following a ‘cost with balance at market value’ approach (Black 2013; Lovell et al. 2010). However, other local standards (e.g., France, Italy, Poland, Portugal) only require firms to record a liability when they have a shortfall compared to already-owned EUAs. This approach implies that the expense of emissions is offset by EUAs held.

## ***2.2. The gross and the net methods to record EUAs***

The three implications described above are vital for understanding how the EUA accounting treatment shapes the representation of the financial implications of the EU ETS because, under certain conditions, their specific combination can allow firms to hide the impact of GHG emissions driven by the EU ETS functioning in financial statements (MacKenzie 2009). Based on the combination of the different accounting choices described above, prior literature has identified two main overall accounting methods to register EUAs: the gross and the net methods (Allini et al. 2018; Black 2013). The main difference between them is the extent to which they represent the impact of EUAs in their financial statements.

The gross method attempts to capture the full financial impact of EUAs. This method records EUAs as assets as soon as they are granted or purchased. Granted EUAs are recorded at fair value upon reception, while purchased EUAs are recorded at cost. According to Wambsganss and Sanford (1996), aligning the valuation of granted and purchased EUAs is

more representative of the economic consequences of polluting. Also, Allini et al. (2018) highlight that this treatment allows firms to consider the opportunity cost of holding EUAs. Under the gross method, the liability should cover the entire amount of emission at the reporting date and translate its total value to the profit and loss statement through an expense. The IFRIC 3 and the Austrian and Spanish standards are aligned with the gross method.

The net method allows firms to offset EUA assets and liabilities. Their compensation can be done in two ways. One option is to recognise EUAs as assets only if they exceed the emissions made during the period. Thus, either an asset (in case of surplus) or a liability (in case of shortfall) shall be recognised at the reporting date, never both. Another treatment aligned with the net method results from measuring granted EUAs at nil value, which makes them invisible in the balance sheet (Haupt and Ismer 2013). In this case, even if the liability considers the entire obligation to deliver EUAs through a ‘cost with balance at market value’ approach, its value will show the net effect as if only a shortfall compared to granted EUAs was recognised (Bebbington and Larrinaga 2008; Haupt and Ismer 2013). The accounting treatment prescribed by the French, Italian, Polish and Portuguese standards is aligned with the net method. The Dutch and German standards suggest both methods simultaneously as they permit firms to choose between valuing granted EUAs at cost or fair value.

Both the net and gross methods lead to the same impact on the profit and loss statement. In the case of the gross method, part of the liability expense is compensated by the deferred income of granted EUAs. Nevertheless, the gross method is presumed to produce more transparent financial statements than the net method. The gross method requires recording and displaying the total amount of EUA assets and liabilities of firms in their financial position. Thus, it offers a more accurate account of the financial impact of EUAs and provides a more comprehensive representation of firms’ environmental harm by not reducing the cost of GHG emissions by offsetting assets and liabilities (Black, 2013). In

contrast to this, by enabling such treatment, the net method offers a reduced and biased representation of the financial impact of EUAs and allows firms to omit the societal cost of polluting (Allini et al., 2018).

This study examines the extent to which the change in the EU ETS functioning towards an auctioning allocation system has impacted the accounting treatment of firms and possibly increased the overall visibility of EUAs in financial statements. Although auctioning was also allowed for up to 10% of allocated EUAs for each country in Phase 2; the number of auctioned EUAs remained relatively low during that period (Black 2013). However, since Phase 3, auctioning has become the default allocation method, resulting in about 57% of the EUAs being auctioned (European Commission 2020). Free EUAs are still handed out; but, they are provided based on a benchmarking method for promoting GHG emission reduction and for industries subject to carbon leakage<sup>5</sup>.

Auctioning was expected to increase the financial pressure on EU ETS participants. However, de Perthuis and Trotignon (2014) note that firms created a surplus reserve of EUAs because they were allocated more EUAs than their actual emissions due to the activity reduction during the 2008 financial crisis. This surplus lowered EUA demand in the market, reducing their price from more than 30€/EUA in mid-2008 to less than 15€/EUA in 2010. To correct this issue, the EU decided in 2014 to backload the number of EUAs to be auctioned by 900 million until 2020 and created a market stability reserve, operating since 2019. Table 2 provides the number of auctioned EUAs per year and the year-end market price. Despite the adjustment, the figures indicate that the number of auctioned EUAs has increased yearly since 2014. Nonetheless, the revision of the EU ETS regulation created an important increase in the EUA's market price in 2018.

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<sup>5</sup> This term refers to situations where firms might transfer their installations to other countries with weaker GHG emission regulations.

*[Table 2 near here]*

The change in the auctioning system and the consequent increase in the financial burden of firms may have affected the carbon accounting choices of firms (Lovell et al. 2010; MacKenzie 2009). In addition to analysing the three accounting implications of the EU ETS (type of assets, valuation of EUAs, and liability), we will focus on whether the auctioning regime has led to changes in the application of the net and the gross methods.

### **3. Methodology**

In this section, we explain the sample selection and describe how we conducted the desk survey to categorise companies' accounting treatment to record EUAs.

#### ***3.1. Sample selection***

We used the following four-level process (see Table 3) to identify the highest-emitting corporate groups in the EU ETS and retrieve the financial statements of the parent company to which installations covered by the EU ETS belong. At the first level, we departed from the list of installations subject to the EU ETS<sup>6</sup>. As of March 2018, the EU ETS registry included 13,668 installations and provided information on allocated emission rights and verified emissions since 2008. We aimed to study the accounting treatment of firms before and after the implementation of the auctioning system in 2013. Consequently, we only kept the 10,301 installations that had to verify their emissions either in 2011 or 2016.

At the second level, we merged the installations by considering the legal entities (referred to as account holders in the registry) to which they belong. This process yielded a sample of 6,286 legal entities. We selected only the 317 legal entities that had verified emissions above one million tonnes of CO<sub>2</sub> in 2016. These entities represent around 69% of

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<sup>6</sup> The list is available at: [https://ec.europa.eu/clima/policies/ets/registry\\_en#tab-0-1](https://ec.europa.eu/clima/policies/ets/registry_en#tab-0-1)

the total verified total emissions (65% allocated EUAs) in 2011 and 74% of total verified total emissions (55% allocated EUAs) in 2016.

*[Table 3 near here]*

At the third level, we identified whether the legal entities were owned by a parent company and, if so, the group to which they belong. Five legal entities were excluded at this point as we were unable to retrieve this information. The remaining entities were part of 166 groups. After considering mergers and other corporate changes, we identified 158 groups in 2011 and 156 groups in 2016.

Finally, we searched for their financial statements or annual reports on corporate websites. We were unable to obtain the reports of 35 and 28 groups in 2011 and 2016, respectively. We also removed seven (2011) and six (2016) groups as their report was in a language other than English, Spanish, or French, as well as nine companies in the 2011 sample as they were not subject to the EU ETS then (they were incorporated to the system between 2011 and 2016). After these adjustments, our final sample comprises 107 groups in 2011 and 122 groups in 2016. These, respectively, account for 62% and 68% of the total verified emissions in those years (59% and 49 % of the total allocated EUAs).

Table 4 provides the distribution of firms according to the country where their headquarters were located, their industry, and the standard they applied to produce financial statements. Five countries (Germany, Italy, France, Spain, and Poland) jointly account for 40% of the firms included in the sample. The most populated industries are power generation (39% of firms), followed by oil companies (21%). The commercial aviation industry entered the EU ETS in 2012 and represented 9% of companies in 2016. Finally, most firms followed IFRS, either alone or combined with domestic accounting standards, to elaborate their consolidated financial statements.

*[Table 4 near here]*

### ***3.2. Desk survey***

We performed a desk-based survey of the financial statements and annual reports to identify the key aspects characterising firms' carbon accounting treatment:

- Initial recognition of granted and purchased EUAs – Type of accounting element EUAs are considered.
- Initial valuation of granted EUAs – Value attached to granted EUAs upon reception.
- Amortisation – Whether EUAs registered as intangible assets are amortised.
- Subsequent valuation – Value attached to EUAs at the end of the reporting period.
- Recognition and valuation of liabilities – Amount of EUAs registered as a liability and their recorded value

We further classified the overall accounting treatment of firms based on the two methods described in Section 2 (i.e., gross and net methods). Although some firms provide information on the aforementioned aspects, their accounting treatment could not be neatly classified in any of the two methods. Thus, we also considered the possibility of a 'hybrid' method. Table 5 summarises the key features of each method and provides examples of firms following them. Additionally, we added a category covering firms lacking all the required information to classify their accounting treatment.

*[Table 5 near here]*

## **4. Results and discussion**

### ***4.1. Key aspects of the accounting treatment***

Table 6 shows the percentage of firms following a specific treatment in 2011 and 2016 for

each accounting technicality explained above. To compare the pre- and post-auctioning periods more accurately, we incorporated a column, ‘2016both’, which only considers the firms of the 2016 sample that were also analysed in 2011.

Regarding the initial recognition of granted EUAs (Table 6, Panel A), consistent with previous surveys (Lovell et al. 2010; Warwick and Ng 2012), most companies recorded them as intangible assets in both years. However, there was a decrease in this classification from 2011 to 2016, which was compensated by a higher recognition as inventory. This change towards inventory aligns with the French and Spanish standards, respectively issued and adjusted between 2011 and 2016. A small increase in the percentage of firms lacking information in 2016 was found. This finding is reasonable as some of the firms were already receiving none or very few granted EUAs at that time. The rest of the alternatives were applied by a marginal number of firms. In both years, around 7% of them acknowledged that they received granted EUAs but did not record them in their balance sheets.

The recognition of purchased EUAs (Table 6, Panel B) shares a similar pattern. Intangible assets were the most common accounting item used for registering EUAs (47% in 2011, 44% in 2016), followed by inventory (7% in 2011, 16% in 2016), which increased during the period. Additionally, an important percentage of companies did not disclose how they recognised purchased EUAs. These results are aligned with those of prior studies (Lovell et al. 2010; Warwick and Ng 2012). However, they slightly differ from Allini et al. (2018), who reported higher percentages because they excluded cases of non-disclosure from their analysis; and Black (2013), who found that almost 70% of companies registered EUAs as intangible assets.

*[Table 6 near here]*

Regarding the initial valuation of granted EUAs (Table 6, Panel C), around one-third of the companies measured them at nil value upon reception in both years. The percentage of

firms measuring granted EUAs at fair value declined from 14% in 2011 to 8% in 2016. This reduction is compensated by a higher percentage of companies that did not provide any information on how they measured granted EUAs. As explained above, a higher proportion of non-disclosure on granted EUAs is expected in 2016 as fewer companies were allocated with free EUAs.

Considering only those companies that recognised EUAs as intangible assets, we found that only 32% (2011) and 35% (2016) of the firms amortised them (see Table 6, Panel D). In contrast, around 12% stated that they did not. In this case, the level of non-disclosure is also high (above 50%).

The results on subsequent valuation (Table 6, Panel E) indicate that most companies also failed to offer information on whether and how they valued EUAs at the end of the reporting period (53% in 2011, 47% in 2016). Many firms providing this information performed an impairment test and valued their EUAs at the lowest between cost and fair value (29% in 2011, 31% in 2016). In contrast, very few opted for the revaluation method at fair value, which is allowed under the IFRS. The percentage of companies measuring their EUAs at cost at the end of the reporting period increased. This choice should be analysed considering the initial valuation of granted EUAs. As reported, many companies valued granted EUAs at nil upon reception. Therefore, if the subsequent valuation was performed at cost, they maintained this value in the closing balance sheet, implying they were ‘invisible’ in this statement.

Panel F in Table 6 summarises the options firms followed to account for the liability. Like Warrick and Ng (2012), we found that companies applied a great variety of treatments and described them very differently, hampering their codification. For simplicity, we classified accounting treatments into four categories: (i) recognising the liability for the entire amount of emissions, (ii) recognising the liability only in case of EUA shortfalls, (iii) stating

they record the liability but fail to specify its measurement, and (iv) lacking any information on the liability. We observed that most companies lacked information on whether and how they recorded the liability. However, a slight decrease was found between 2011 and 2016. If firms provided information on the liability, the most common approach (almost 40% in 2011 and 2016) is that they only considered shortfalls to calculate it. This result implies that they provided a reduced representation of the financial impact of pollution consequent to their activity before and after the auctioning system was introduced. By contrast, the percentage of firms recognising the entire obligation to deliver EUAs according to the total verified emissions increased from 2011 (20%) to 2016 (23%, 24% in '2016both'). This change was expectable because more firms received no granted EUAs through auctioning in 2016.

To summarise, our results show that the auctioning allocation system did not considerably modify the critical aspects of the EUA accounting treatment. Auctioning increased the financial impact of the EU ETS on companies because more than 50% of EUAs must be bought in Phase 3 rather than being freely allocated. Previous studies suggested that auctioning could modify carbon accounting practices (e.g., Lovell et al. 2013). However, despite the likely increase in non-disclosure on granted EUAs as fewer companies were receiving them for free in 2016, the classification of granted and purchased allowances did not change. In 2016, more companies accounted for the entire extent of their emissions compared to 2011, and they did so by measuring the liability at the cost of those already held with the remaining EUAs valued at market value. Initially, this finding could indicate that these companies provided a more comprehensive representation of the effect of pollution in their financial statement by recording a 'larger' liability. Nonetheless, the final value of the liability hinges on the initial value attached to granted EUAs (Haupt and Ismer 2013). For example, if firms receiving granted EUAs value them at nil upon reception, the value corresponding to the cost of EUAs already held would be zero. Moreover, if found, only the

excess of emissions will be recorded as a liability and as an expense. Consequently, the firm would still be providing a limited account of the financial impact of pollution. As explained in Section 3, the combination of how the asset and liability are measured results in two opposing accounting methods: the net and the gross methods. Therefore, we analysed the overall method firms used to account for EUAs in the following subsection to explore more in-depth the extent to which their accounting treatments provide a complete representation of the financial impact of the EU ETS.

#### ***4.2. Overall carbon accounting method***

Table 7 reports the results regarding the overall accounting method firms applied in 2011 and 2016. Initially, the percentage of firms following each method remains similar in both years, indicating no important changes after the auctioning system was implemented. Nonetheless, when comparing the figures of 2011 and '2016both', some differences arise. More companies applied the gross method in 2016, which means they represented the impact of EUAs more comprehensively. It is also noteworthy the high percentage of firms failing to provide enough or any information for identifying their accounting method in both years.

Table 8 presents changes in accounting methods for the 97 companies on which we had data for both years. We found that 76% did not modify their method. Six companies started applying a gross method when they previously used a net method or did not provide information on the accounting treatment. Companies that moved to the gross method received very few or even no granted EUAs in 2016. This finding indicates that the increased financial pressure stemming from the need to buy EUAs might have fostered the adoption of the gross method. In contrast, ten companies started using a net method, most of which moved from non-disclosure. Thus, we cannot adjudicate the effect of the change as we are unable to

evaluate from which method they moved. Nonetheless, regardless of the firms giving up a hybrid method for a net method, the other firms were still receiving, on average, a substantial amount of granted EUAs.

*[Table 7 near here]*

*[Table 8 near here]*

In a second analysis, we focused on the highest-emitting countries under the EU ETS based on the location of firms' headquarters (see Table 9). We analysed the top five countries considering emissions (Germany, France, Italy, Poland, and Spain), all of which have domestic standards guiding the recording of EUAs. We also studied three other countries with local prescriptions on carbon accounting (i.e., Austria, Portugal, and The Netherlands). Although Germany is the highest-emitting country, most German companies failed to offer enough information on their accounting treatment compared to firms from other countries. On the one hand, German companies are the least transparent as more than 40% lack information on how they accounted for EUAs in 2016. On the other hand, although most of them favoured the net method, they did not seem to follow a clear pattern. This result can be attributed to the choice allowed by the German standard between net and gross methods. A similar situation occurs in the Netherlands, where the local standard aligns with both methods. Additionally, Table 9 reports that firms from countries where the local standards were issued between 2011 and 2016 were more aligned with the overall method that the standard prescribes (France, Italy, and Poland). The standards from those countries suggest a net method, which was the most common among firms in 2011. For instance, in Italy and Poland, the percentage of companies applying a net method increased, from 40% and 57% to 63% and 78%, respectively. The French standard also follows a net method; 88% of companies from France applied it in 2011 and 2016. The Portuguese standard was issued in 2010, and fewer companies were aligned with the net method (67% in 2011 and 50% in 2016). The Spanish

and Austrian standards suggest a gross method. However, both countries follow different patterns. The Spanish standard aligns with a gross method in both the 2016 and the 2006 versions. This fact explains the limited increase in the percentage of firms applying this method. Regarding Austria, companies moved from following either a gross or a net method in 2011 to non-disclosing information, which was the most widespread option in 2016.

*[Table 9 near here]*

We also compared methods within industries due to differences in the extent to which they have been affected by the auctioning allocation system (Table 10). We observe that the ratio of granted allocated EUAs (A) to total verified emissions (V) decreased for all sectors. However, the pattern of accounting practices is similar in both years, with the net method or the lack of information being the most widespread options in all industries. The allocation of granted EUAs was more dramatically reduced for power generators, which went from receiving 94% of their EUAs for free in 2011 to almost zero in 2016. A small increase in the number of companies that applied a gross method was found in their case. The EU allowed some countries (Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Lithuania, Poland, and Romania) to transitionally derogate the 100% auctioning allocation systems of power generators until 2019 (Haupt and Ismer 2013). To examine the effect of auctioning more in-depth, Table 11 analyses the accounting method of power generators, considering whether they are from countries with a transitional derogation. Before the introduction of the auctioning system, the options were equally distributed among power generators across countries. However, in 2016, the divergence increased. Power generators from countries allowed to derogate the auctioning system moved to the net method. This trend is mainly driven by Polish firms, as their standard recommends this method. In contrast, the proportion of firms that applied the gross method increased in countries implementing the full auctioning system. This finding could prefigure a future trend when full auctioning is the rule. However,

the net method remained the most widespread option. Overall, these findings suggest that domestic standards seemed to play a more important role in determining accounting practices than auctioning.

*[Table 10 near here]*

*[Table 11 near here]*

## **5. Conclusions**

This study explores the carbon accounting practices of the EU ETS highest emitters in 2011 and 2016 to investigate the influence of the auctioning EUA allocation system and domestic accounting standards on the treatment that companies followed to record EUAs in their financial statements. Our findings allow us to draw three conclusions that contribute to understanding the role of accounting in the functioning of carbon markets, the governance of climate change, and the fight against global warming.

First, by increasing the financial burden on firms, auctioning should increase transparency by encouraging companies to provide more information on EUAs to the users of financial statements. However, we document no relevant shifts in accounting patterns after the transition to the auctioning system in the EU ETS Phase 3. Although a limited number of firms moved from the net to the gross method or vice versa, our findings reveal a similar distribution of accounting treatments before (2011) and after (2016) the enactment of the auctioning regime. This finding indicates that companies responded to the uncertainty about the accounting implications of the auctioning system that existed before its implementation (Lovell et al., 2010) by maintaining their accounting treatment for EUAs. Nonetheless, although auctioning did not drive changes in accounting practices, it increased the financial burden on companies. Thus, while reducing the free allocation of EUAs may not have directly affected accounting practices, it boosted their importance within financial statements.

Second, we found that carbon accounting in financial statements is characterised by its ‘messiness’. There is limited convergence among firms’ practices because they seem to adapt and apply the accounting treatment that best suits their case. This messiness is determined by the little homogenisation in accounting treatments and the silence of many companies regarding their accounting treatment to register EUAs in their financial statements. In line with Lovell et al. (2013), we caution that this ‘messiness’, along with the net method being the most common approach for registering EUAs, are likely to have relevant consequences for the functioning of carbon markets. Both issues impede the provision of a complete and comprehensive representation of the impact of EUAs in firms’ financial statements, thereby limiting the quality of climate change information available in the market. This observation calls the attention of SEA scholars to an absence that, beyond corporate silence of EUAs in their financial reports, is the silence of accounting research about an aspect that pertains to the core of the accounting craft and is harming the relevance of corporate information for financial markets and carbon markets.

Finally, despite the voluntary nature of domestic standards for most EU ETS firms, they seem to play a relevant role in shaping how companies record EUAs, particularly if their prescriptions suggest the net method. This role is mainly observable in power generator industries. We document that domestic standards, rather than the auctioning system (or the lack of it), are more relevant in explaining carbon accounting practices. Notions from normativity (Bebbington et al. 2012; Chauvey et al. 2015) justify this finding and why it differs from Allini et al. (2018), who concluded that firms’ EUA recording was not aligned with their local standards. The normativity perspective contributes to understanding why soft-law or voluntary mechanisms may acquire normativity (i.e., be regarded as ‘norms’ by actors). One of the important conditions that foster actors’ application of a standard is its congruence with prior corporate practices. As Table 1 shows, some of the standards issued

between 2011 and 2016 suggest a net method (France, Italy, and Poland). Consistent with this premise, carbon accounting practices are highly aligned with the standards from these countries because this method was already the most common approach in 2011. France and Poland are the two countries in which the recording of EUAs was more consistent with domestic standards. These cases explain the divergence of our finding with that of Allini et al. (2018) because these are two of the three additional standards considered in our study compared to their investigation (see footnote 4). Finally, we highlight that in Germany, the highest emitting country within the EU ETS, accounting practices became messier as time passed, and firms opted to be more silent about their carbon accounting treatment.

The three conclusions point to the relevance of accounting research in informing policymaking and fostering the engagement of the IPCC with social science disciplines to fight climate change (Charnock and Thomson 2018). Particularly, our findings provide evidence on how carbon accounting interacts with elements of the regulatory framework of carbon markets (i.e., auctioning) to facilitate or impede their functioning. Additionally, the results emphasise the role of carbon accounting enabling companies to integrate the financial risks of GHG emissions in their financial statements, something that is critical to enabling the consideration of the environment in financing decisions.

We note some limitations of this research and provide ideas for future research. We were unable to categorise the accounting treatment of some companies as they lacked information on that matter. If the presence of carbon accounting indicates companies' willingness to be accountable for their GHG emissions, the accounting silence can result either from a deliberate choice or a lapse by management. A more in-depth exploration of carbon accounting silences could contribute to understanding the implications of non-disclosure and provide explanations of such accounting choices. Additionally, we found that EU ETS market participants deliver highly heterogeneous information to users. Future

research could investigate the extent to which the standard-setting process, either locally or at an international level, may contribute to improving comparability among firms. Finally, large European companies must comply with the same European Directive 2014/95/UE that mandates the provision of non-financial information on corporate environmental and social impacts in the management report included in financial statements. This requirement points to the need to investigate the interplay between financial and non-financial reporting.

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## TABLES

**Table 1. Summary of local accounting standards for EUAs**

<b>Country</b>	<b>Standard</b>	<b>Year</b>	<b>Method</b>	<b>Type of accounting element</b>	<b>Initial measurement/ Income recognition</b>	<b>Recognition and measurement of the liability</b>
<b>IASB</b>	IFRIC 3	2004	<b>Gross</b>	Intangible assets	Granted at fair value and acquired at cost.	For the whole amount of emissions, valued at fair value at the reporting date. Liability recognized against expenses when the entity emits pollutants.
<b>The Netherlands</b>	DAS 274	2005	<b>Gross/ Net</b>	Intangible assets	Granted at fair value or cost (optional), and acquired at cost. Consumption expense in the income statement.	For the whole amount of emissions, valued at cost of already held with balance at fair value at the reporting date.
<b>Germany</b>	IDW RS HFA 15	2006	<b>Gross/ Net</b>	Inventory (production) /Intangible-other current assets	Granted at fair value or cost (optional), and acquired at cost. Consumption expense in the income statement.	For the whole amount of emissions, valued at cost of already held with balance at fair value at the reporting date.
<b>Portugal</b>	NCRF 26	2010	<b>Net</b>	Intangible assets	Granted at fair value. Emissions as an expense at cost.	If shortfall.
<b>France</b>	Règlement ANC N° 2012-03	2012	<b>Net</b>	Inventory	Only recognized if at reporting date EUAs exceed emissions, valued at cost. Production expense in the income statement.	Only if shortfall, valued at the best estimate of the outflow of resources.
<b>Italy</b>	OIC 8	2013	<b>Net</b>	NA	Allowances expenses in income statement. Only recognized as assets if at reporting date EUAs exceed emissions, valued at cost.	Only if shortfall, valued at market value at the reporting date.
<b>Poland</b>	Article 28§2 Accounting Law	2015	<b>Net</b>	Intangible assets	Granted and acquired at cost. Amortization is a production expense.	Only if shortfall, valued at market value at the reporting date.

<b>Country</b>	<b>Standard</b>	<b>Year</b>	<b>Method</b>	<b>Type of accounting element</b>	<b>Initial measurement/ Income recognition</b>	<b>Recognition and measurement of the liability</b>
<b>Austria</b>	AFRAC- Stellungnahme 1	2015	<b>Gross</b>	Intangible -other current assets	Granted at fair value and acquired at cost. Consumption expense in the income statement.	For the whole amount of emissions, valued at cost of already held with balance at fair value at the reporting date.
<b>Spain</b>	Real Decreto 602/2016	2016	<b>Gross</b>	Inventory	Granted at fair value and acquired at cost.	For the whole amount of emissions, valued at cost of already held with balance at fair value at the reporting date. Liability recognized against expenses when the entity emits pollutants.

**Table 2. Volume of auctioned EUAs and EUA year-end market price 2012-2018**

Year	EUAs <sup>1</sup>	Price (€/EUA) <sup>2</sup>
2012	89,701,500	6.48
2013	808,146,500	4.86
2014	528,399,500	7.27
2015	632,725,500	8.25
2016	715,289,500	6.55
2017	951,195,500	8.15
2018	915,750,000	24.73

Sources:

<sup>1</sup>European Commission (2020, p. 21).

<sup>2</sup>Ember Climate – Carbon price viewer. Available at: <https://ember-climate.org/data/carbon-price-viewer/>

**Table 3. Sampling procedure**

<b>Level 1. Installations</b>		
Installations registered in the EU ETS registry as of March, 2018		13,668
Of which had to verify their emissions in 2011 and/or 2016		10,301
<b>Level 2. Legal entities</b>		
Legal entities owning installations		6,286
Of which emitted >1M tons of CO <sub>2</sub> in 2016 <sup>1</sup>		317
	<b>2011</b>	<b>2016</b>
	(69%, 65%)	(74%, 55%)
<b>Level 3. Corporate groups</b>		
	<b>2011</b>	<b>2016</b>
Legal entities belonging to corporate groups	158	156
<b>Level 4. Financial statements included in the survey<sup>1</sup></b>		
	<b>2011</b>	<b>2016</b>
Corporate groups with financial statements or annual report available in English, French, or Spanish	107 (62%, 59%)	122 (68%, 49%)

<sup>1</sup> Figures between brackets represent the percentage of total verified emissions and the percentage of total allocated EUAs respect to the whole EU ETS system in each year.

**Table 4. Sample description**

<b>Panel A. Country distribution</b>					
	<b>2011</b>	<b>2016</b>		<b>2011</b>	<b>2016</b>
Austria	5 (5%)	6 (5%)	Luxembourg	1 (1%)	1 (1%)
Belgium	1 (1%)	1 (1%)	Mexico	1 (1%)	1 (1%)
Croatia		3 (2%)	Norway	2 (2%)	4 (3%)
Bulgaria	1 (1%)		Poland	7 (7%)	9 (7%)
Cyprus	1 (1%)	1 (1%)	Portugal	3 (3%)	4 (3%)
Czech Republic	3 (3%)	3 (2%)	Romania	1 (1%)	1 (1%)
Denmark	3 (3%)	3 (2%)	Russia	1 (1%)	2 (2%)
Estonia	1 (1%)	1 (1%)	Saudi Arabia	1 (1%)	1 (1%)
Finland	3 (3%)	3 (2%)	Slovakia	2 (2%)	2 (2%)
France	8 (7%)	8 (7%)	Slovenia	1 (1%)	1 (1%)
Germany	13 (12%)	17 (14%)	Spain	8 (7%)	7 (6%)
Greece	5 (5%)	5 (4%)	Sweden	4 (4%)	5 (4%)
Hungary	1 (1%)	2 (2%)	Switzerland	2 (2%)	3 (2%)
India	2 (2%)	2 (2%)	The Netherlands	3 (3%)	3 (2%)
Ireland	2 (2%)	3 (2%)	UK	3 (3%)	4 (3%)
Italy	10 (9%)	8 (7%)	USA	6 (6%)	6 (5%)
Jersey	1 (1%)	1 (1%)			
Lithuania	1 (1%)	1 (1%)	<b>Total</b>	<b>107 100%</b>	<b>122 (100%)</b>
<b>Panel B: Industry</b>			<b>Panel C. Accounting standards applied</b>		
	<b>2011</b>	<b>2016</b>		<b>2011</b>	<b>2016</b>
Automotive	2 (2%)	2 (2%)	IFRS	75 (70%)	83 (68%)
Construction materials	13 (12%)	10 (8%)	IFRS + domestic standard	14 (13%)	23 (19%)
Chemical	15 (14%)	16 (13%)	Domestic standard	16 (15%)	15 (12%)
Commercial airlines		9 (7%)	N/A	2 (2%)	1 (1%)
Metal	12 (11%)	11 (9%)			
Oil	22 (21%)	26 (21%)			
Power generation	42 (39%)	47 (39%)			
Shipping	1 (1%)	1 (1%)			
	<b>(100%)</b>				
<b>Total</b>	<b>107 )</b>	<b>122 100%</b>	<b>Total</b>	<b>107 100%</b>	<b>122 (100%)</b>

**Table 5. Classification of accounting treatment and examples**

<b>Method classification</b>	<b>Key features</b>	<b>Examples</b>
<b>Gross Method<sup>1</sup></b>	<ul style="list-style-type: none"> <li>- EUAs recognized as assets when granted or purchased</li> <li>- Granted EUAs at fair value</li> <li>- Liability for the whole amount of emissions</li> </ul>	<b>REPSOL 2016 (Spain)</b> <ul style="list-style-type: none"> <li>- Granted and purchased EUAs as intangible assets</li> <li>- Granted EUAs at fair value against deferred income</li> <li>- Liability at cost (carrying value) with balance at market value</li> </ul>
<b>Net Method</b>	<ul style="list-style-type: none"> <li>- Granted EUAs at nil value or not recognized</li> <li>- EUAs recognized as assets only if there is a surplus to cover emissions</li> <li>- Liability only for shortfalls to cover emissions</li> </ul>	<b>EDISON SPA 2016 (Italy)</b> <ul style="list-style-type: none"> <li>- Granted EUAs at nil value</li> <li>- Intangible assets, only recognized if there is a surplus to cover emissions</li> <li>- No obligation recognized unless there is a shortfall compared to granted allowances</li> </ul>
<b>Hybrid Method</b>	<ul style="list-style-type: none"> <li>- Other methods that having all information, the accounting treatment did not fall in any of the previous methods</li> </ul>	<b>ČEZ 2011 (Poland)</b> <ul style="list-style-type: none"> <li>- Granted EUAs are measured at the amount of the gift tax consequent to their free reception</li> <li>- Liability at carrying value of already held with balance at market value</li> </ul>
<b>No information</b>	<ul style="list-style-type: none"> <li>- Not enough information to classify the method</li> </ul>	<b>Lyondelbasel N.V. 2016 (The Netherlands)</b> <ul style="list-style-type: none"> <li>- Granted and purchased EUAs recorded as intangible assets</li> <li>- Initial valuation of EUAs is not specified</li> <li>-No information provided regarding the liability</li> </ul>

<sup>1</sup> We also classified as gross method those firms that did not explain the treatment of granted EUAs when they did not receive any.

**Table 6. Key aspects of the accounting treatment of EUAs<sup>1</sup>**

<b>Panel A. Granted EUAs - Initial recognition</b>	<b>2011</b>	<b>2016</b>	<b>2016both</b>
Intangible assets	40% (43)	32% (39)	33% (32)
Inventory	7% (7)	11% (13)	10% (10)
Financial assets	1% (1)	0% (0)	0% (0)
Other	7% (7)	5% (6)	6% (6)
Off-balance item	0% (0)	2% (2)	1% (1)
Not recorded <sup>2</sup>	7% (8)	7% (9)	6% (6)
Non-disclosure <sup>3</sup>	38% (41)	43% (53)	43% (42)
<b>Total</b>	<b>100% (107)</b>	<b>100% (122)</b>	<b>100% (97)</b>
<b>Panel B. Purchased EUAs - Initial recognition</b>	<b>2011</b>	<b>2016</b>	<b>2016both</b>
Intangible assets	47% (50)	44% (54)	44% (43)
Inventory	7% (8)	16% (20)	16% (16)
Financial assets	1% (1)	0% (0)	0% (0)
Other	7% (8)	6% (7)	6% (6)
Non-disclosure <sup>3</sup>	37% (40)	34% (41)	33% (32)
<b>Total</b>	<b>100% (107)</b>	<b>100% (122)</b>	<b>100% (97)</b>
<b>Panel C. Granted EUAs – Initial valuation</b>	<b>2011</b>	<b>2016</b>	<b>2016both</b>
Nil value	35% (37)	34% (41)	32% (31)
Fair value	14% (15)	8% (10)	9% (9)
Other value	3% (3)	1% (1)	1% (1)
Reduction of financial obligations related to CO2	1% (1)	1% (1)	1% (1)
Non-disclosure <sup>3</sup>	48% (51)	57% (69)	57% (55)
<b>Total</b>	<b>100% (107)</b>	<b>100% (122)</b>	<b>100% (97)</b>
<b>Panel D. Amortisation of EUAs recognised as intangible assets<sup>4</sup></b>	<b>2011</b>	<b>2016</b>	<b>2016both</b>
Yes	32% (16)	35% (19)	33% (14)
No	12% (6)	13% (7)	16% (7)
Non-disclosure <sup>3</sup>	56% (28)	52% (28)	51% (22)
<b>Total</b>	<b>100% (50)</b>	<b>100% (54)</b>	<b>100% (43)</b>
<b>Panel E. Subsequent valuation</b>	<b>2011</b>	<b>2016</b>	<b>2016both</b>
Cost	13% (14)	19% (23)	20% (19)
Lower cost or fair value	29% (31)	31% (38)	33% (32)
Fair value	2% (2)	1% (1)	1% (1)
Other	3% (3)	3% (3)	3% (3)
Non-disclosure <sup>3</sup>	53% (57)	47% (57)	43% (42)
<b>Total</b>	<b>100% (107)</b>	<b>100% (122)</b>	<b>100% (97)</b>
<b>Panel F. Liability - Recognition and valuation</b>	<b>2011</b>	<b>2016</b>	<b>2016both</b>
Entire obligation	20% (21)	23% (28)	24% (23)
Only if shortfall	38% (41)	39% (48)	39% (38)
Measurement not specified	2% (2)	1% (1)	1% (1)
Non-disclosure <sup>3</sup>	40% (43)	37% (45)	36% (35)
<b>Total</b>	<b>100% (107)</b>	<b>100% (122)</b>	<b>100% (97)</b>

<sup>1</sup> Figures between brackets indicate the number of firms following each option

<sup>2</sup> Firms receiving granted EUAs that explicitly state that they do not account for them in their financial statements (not even at nil value).

<sup>3</sup> Firms do not offer any information on the particular aspect.

<sup>4</sup> Percentages are calculated respect to the number of companies classifying EUAs as intangible (50 firms in 2011, 54 firms in 2016, 43 2016both).

**Table 7. Overall carbon accounting method<sup>1</sup>**

Accounting method	% Firms		
	2011	2016	2016both
Gross method	12% (13)	14% (17)	16% (16)
Net method	47% (50)	47% (57)	46% (45)
Hybrid method	5% (5)	2% (2)	2% (2)
No enough info	10% (11)	11% (14)	9% (9)
No info at all	26% (28)	26% (32)	26% (25)
<b>Total</b>	<b>100% (107)</b>	<b>100% (122)</b>	<b>100.00% (97)</b>

<sup>1</sup> Figures between brackets indicate the number of firms following each option

**Table 8. Change in carbon accounting method 2011 vs 2016**

Method change	n	%	A/V <sup>1</sup> 2011	A/V <sup>1</sup> 2016
<b>No change</b>	<b>74</b>	<b>76%</b>	<b>1.24</b>	<b>0.56</b>
<b>To Gross</b>	<b>6</b>	<b>6%</b>		
<i>From net</i>	4	4%	0.68	0.00
<i>From N.D.</i>	2	2%	0.92	0.02
<b>To Net</b>	<b>10</b>	<b>10%</b>		
<i>From gross</i>	2	2%	1.02	0.49
<i>From hybrid</i>	1	1%	1.12	0.03
<i>From N. D.</i>	7	7%	1.07	0.41
<b>To N.D.</b>	<b>7</b>	<b>7%</b>	<b>1.61</b>	<b>0.62</b>
<b>TOTAL</b>	<b>97</b>	<b>100%</b>		

<sup>1</sup> Ratio of allocated EUAs respect to the total verified emissions.

**Table 9. Analysis of carbon accounting methods per country.**

Country	Local standard year	Local standard method	2011								2016							
			n	% V.E. <sup>1</sup>	A/V <sup>2</sup>	Gross method	Net method	Hybrid method	Not enough info	No info at all	n	% V.E. <sup>1</sup>	A/V <sup>2</sup>	Gross method	Net method	Hybrid method	No enough info	No info at all
Austria	2016	Gross	5	0.80%	1.25	40%	40%	20%	0%	0%	6	1.46%	0.60	17%	17%	17%	50%	0%
France	2012	Net	8	7.09%	1.05	0%	88%	0%	0%	13%	8	5.74%	0.22	0%	88%	0%	0%	13%
Germany	2006	Gross/Net	13	15.55%	0.82	8%	46%	8%	8%	31%	17	16.99%	0.21	18%	35%	0%	6%	41%
Italy	2013	Net	10	5.35%	1.12	10%	40%	0%	30%	20%	8	4.99%	0.20	13%	63%	0%	0%	25%
The Netherlands	2005	Gross/Net	3	0.97%	1.14	0%	33%	0%	33%	33%	3	1.24%	0.69	0%	33%	0%	33%	33%
Poland	2015	Net	7	5.55%	0.94	29%	57%	0%	14%	0%	9	6.93%	0.14	11%	78%	0%	11%	0%
Portugal	2010	Net	3	1.05%	1.05	0%	67%	0%	0%	33%	4	1.30%	0.24	25%	50%	0%	0%	25%
Spain	2016	Gross	8	4.16%	0.93	63%	13%	0%	0%	25%	7	3.97%	0.21	71%	0%	0%	0%	29%

<sup>1</sup> Percentage of verified emissions of the country respect to the whole EU ETS.

<sup>2</sup> Ratio of allocated EUAs respect to the total verified emissions.

**Table 10. Analysis of carbon accounting methods per industry.**

Industry	2011							2016						
	n	A/V <sup>1</sup>	Gross method	Net method	Hybrid method	No enough info	No info at all	n	A/V <sup>1</sup>	Gross method	Net method	Hybrid method	No enough info	No info at all
Automotive	2	1.03	0%	0%	0%	0%	100%	2	0.25	0%	0%	0%	0%	100%
Construction materials	13	1.66	15%	77%	0%	0%	8%	10	1.13	10%	80%	0%	10%	0%
Chemical	15	1.51	13%	20%	7%	20%	40%	16	0.74	0%	25%	0%	25%	50%
Commercial airlines								9	0.54	0%	56%	0%	11%	33%
Metal	12	1.40	8%	42%	8%	0%	42%	11	0.90	9%	45%	9%	0%	36%
Oil	22	1.05	9%	36%	5%	14%	36%	26	0.61	8%	46%	4%	4%	38%
Power generation	42	0.94	14%	57%	5%	12%	12%	47	0.09	28%	49%	0%	15%	9%
Shipping	1	1.27	0%	0%	0%	0%	100%	1	1.03	0%	0%	0%	0%	100%
<b>Total</b>	<b>107</b>	<b>1.19</b>	<b>12%</b>	<b>47%</b>	<b>5%</b>	<b>10%</b>	<b>26%</b>	<b>122</b>	<b>0.49</b>	<b>14%</b>	<b>47%</b>	<b>2%</b>	<b>11%</b>	<b>26%</b>

<sup>1</sup> Ratio of allocated EUAs respect to the total verified emissions.

**Table 11. Analysis of carbon accounting method of power generators per country type in 2016**

<b>Panel A: 2011</b>						
	Gross method	Net method	Hybrid method	No enough info	No info at all	n
Countries with derogation	13%	63%	13%	0%	13%	8
Countries without derogation	15%	56%	3%	15%	12%	34
Total	14%	57%	5%	12%	12%	42

  

<b>Panel A: 2016</b>						
	Gross method	Net method	Hybrid method	No enough info	No info at all	n
Countries with derogation	11%	89%	0%	0%	0%	9
Countries without derogation	32%	39%	0%	18%	11%	38
Total	28%	49%	0%	15%	9%	47