



# EU Emissions Trading scheme in aviation: Policy analysis and suggestions

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## ABSTRACT

Effectively addressing the impact of aviation on climate change may prove a major challenge for policymakers. The European Union Emissions Trading Scheme (EU ETS) is one of the main instruments used to reach the statutory reduction of greenhouse gas emissions. This paper examines policy issues regarding the implementation of the EU ETS in aviation. A two-round Delphi study was undertaken based on a sample of 31 experts from Airlines and the International Air Transport Association; Air Navigation Service Providers; Civil Aviation Authorities; Government Institutions; and informed individuals (consultants and academics). The different allocation methods of allowances; the linking of EU ETS to similar schemes in other countries/continents; and the interconnection of the scheme with related environmental policies in Europe are found to significantly affect the efficiency of the EU ETS. Simpler monitoring, reporting and verification processes; streamlining and increased transparency of the auctions and penalties revenue policy; and achievement of balance in the allowance market are recommended to rectify caveats of the EU ETS from a policy perspective.

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## 1. Introduction

Despite its benefits for economic development and accessibility at different spatial levels, rapid air transport growth since the 1960s has created negative externalities and raised environmental concerns, such as climate change caused by the greenhouse effect (Burbidge, 2018). According to the Air Transport Action Group (ATAG, 2018) global aircraft operations produced 859 million tonnes of CO<sub>2</sub> in 2017. In fact, aviation currently accounts for over 2% of global greenhouse gas emissions; in the European Union (EU) the corresponding percentage is almost 3% (European Commission, 2018). While greenhouse gases (GHGs) in the EU increased by 5.5% from 1990 to 2003, emissions of carbon dioxide caused by international aviation in the Member States increased by 73% over the same period (CE, 2005). Moreover, international aviation emissions at a global level are expected to be around 70% higher in 2020 compared to 2005 (European Commission, 2018).

Barrett (2009: 59) argues that '... climate change may or may not be the most important problem the world has ever faced, but it

is certainly the greatest challenge for collective action'. Several innovations have been introduced to reduce aviation's environmental impact. In terms of technological innovations, liquid hydrocarbons from renewable sources (biofuels) may play a substantial role (Filimonau et al., 2018); nonetheless, their future is currently uncertain, due to high setup costs and operational challenges of large-scale production. From a policy perspective, the International Civil Aviation Organisation (ICAO) set the target to limit or reduce the impact of aviation GHG emissions on the global climate in 2004. Moreover, several Emissions Trading Schemes (ETs) has been developed around the world to tackle environmental pollution. The most important and comprehensive ETS was introduced by the EU and is based on the requirements of the Kyoto Protocol. In fact, the EU ETS is one of the main instruments used by the EU to reach the statutory reduction of GHG emissions. The original EU application of the Kyoto Protocol did not include emissions from aviation. In 2008, the European Parliament and the Council adopted a new law, namely Directive (2008)/101/EC, amending the EU ETS (Directive, 2003/87/EC) to include aviation activities. The EU ETS in aviation concerns only CO<sub>2</sub> aircraft emissions (Kantareva et al., 2016).

Xu et al. (2016) argue that it is essential to develop and implement environmental rules that consider economic and social

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development. When compared to technological advancements, ETS is (at least in theory) a lower cost solution to reduce carbon emissions from an emitter's perspective. Nevertheless, the various stakeholders express conflicting opinions about its effectiveness and implementation process. On the one hand, the airlines complain that the EU ETS introduces market distortions that may erode over 30% of the airline industry's profits (Tyler, 2012). On the other hand, Non-Government Organizations (NGOs) support that EU ETS is not effective and suffers from over-allocation of permits (Transport and Environment, 2017). This paper aims to undertake an in-depth look at what a selection of expert informants (representing different stakeholders) think about such an important policy instrument, in order to identify insights and lessons from implementation experience that might not be available from a general survey of stakeholders (Upham et al., 2004). Moreover, given the 2016 developments with ICAO's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) scheme (Scheelhaase et al., 2018), the paper may prove instrumental to policymakers considering reforms in the aviation EU ETS.

Section two of the paper examines the main principles of EU ETS. The empirical methodology based on a two-round Delphi study is subsequently discussed and related findings are presented in section four. Recommendations to policymakers are then drawn in section five, while section six concludes suggesting a way forward.

## 2. The EU Emissions Trading Scheme (EU ETS)

### 2.1. The workings of the scheme

The EU ETS is one of the main instruments used by the EU to achieve the statutory targets of GHGs emissions' reduction. As a cap-and-trade scheme, the EU ETS involves trading of emission allowances; these correspond to equivalents of carbon dioxide metric tonnes (MTCO<sub>2</sub> Eq.) (ICAO Doc 9885, 2008) assigned to aircraft operators (herein referred as 'entities') by the European Commission (EC). Aircraft operators have the option to use up to 15% of the auctioned allowances from a greater pool of allowances originating from other industries within EU ETS, i.e. the European Union Allowances (EUAs); from those traded by other aircraft operators, i.e. the European Union Aviation Allowances (EUAs); and from other eligible international projects (limited to a maximum of 1.5% of the annual verified emissions). The EU ETS does not include other GHGs apart from carbon dioxide. At the end of each year, the entities should surrender enough allowances to cover their actual emissions, or otherwise fines are imposed.

In 2012, the cap was set to 97% of the baseline, i.e. the average emissions of 2004, 2005 and 2006 also known as historic aviation emissions. As time passes by, the emission cap will be reduced and fewer allowances will be issued thus reducing CO<sub>2</sub> emissions further (Leggett et al., 2012; Meleo et al., 2016). The cap for the 2013 to 2020 period was reduced to 95% of the baseline (Directive, 2008/101/EC) and is set at 210,349,264 allowances per year (EC, 2016). Moreover 82% of aviation allowances are allocated for free to aircraft operators using benchmarking (EC, 2016). Freely allocated allowances amounted to about 32 million in 2017 (EC, 2017). The benchmark is calculated by dividing the total annual amount of free allowances available by the sum of tonne-kilometre data that aircraft operators send to the EC. So, every entity receives 0.6797 free allowances (baseline) for every 1000 tonne-kilometres of flight (EC, 2016). Benchmarking implicitly acknowledges the existence of grandfather rights since it is based on historical data and does not change on a yearly basis. Moreover, auctioning is used for 15% of the allowances while the remaining 3% (i.e. = 100% - 82% - 15%), i.e. 1.1 million in 2017 (EC, 2017), is reserved for new market entrants and/

or for fast-growing airlines (Anger and Kohler, 2010; EC, 2016). Aircraft operators can also bank their unused allowances or borrow allowances from future reserves. This intertemporal flexibility reduces the overall compliance costs for the entities (Kling and Rubin, 1997; Tietenberg, 2010).

The EU ETS excludes certain types of flights from the cap-and-trade system, such as military, circular and Public Service Obligation flights (EC, 2016). Furthermore, flights with airplanes with maximum certified take-off weight of less than 5700 kg; flights by airlines with fewer than 243 flights for three consecutive four-month periods; or those with annual emissions under 10,000 Mt per year are excluded (Kantareva et al., 2016).

One of the EU ETS targets is to minimize compliance costs for entities and to provide adaptive flexibility regarding the level of emissions. The EU ETS allows allowances to be banked, i.e. keep the spare allowances for future needs, and traded among the entities but also via the flexible mechanisms of Kyoto protocol, i.e. Joint Implementation (JI) and Clean Development Mechanism (CDM). The latter enables entities within the jurisdiction of EU ETS to reduce compliance costs through the acquisition of emission rights from developing countries (Chevallier, 2012).

An entity that has more allowances than needed can sell the excess allowances to another source that needs more, or to other entities. The price of allowances is determined at primary auctions based on relative demand and supply. Compared to free allocation of allowances, auctions offer the advantage of more efficient distribution, as entities that need additional allowances can obtain them (Cong and Wei, 2012). Moreover, the EC has set a minimum amount of about 500 EUAs (= 500 t CO<sub>2</sub>eq) (Minimum lot size) per transaction (EC, 2013). In 2012, 2.5 million EUAs were auctioned yielding 17.525 million Euro (DEHSt, 2012). In 2015, a total of 5.8 million EUAs were traded on the secondary market and a total of about 16.4 million EUAs were auctioned on the primary market as spot contracts (DEHSt, 2016). Around 15% of EUAs, worth of circa 30 million euros per year, will be auctioned from 2012 until 2020 according to EC (2012). When the price of allowances is high, aircraft operators have an economic incentive to reduce their emissions through operational and/or technological improvements and sell unused allowances to other polluters. Because of this commercial dimension, an economic incentive to be efficient and environmentally friendly is created (Preston et al., 2012). This is especially because the prices of offsets in mandatory markets, such as the EU ETS scheme, are higher than those in voluntary markets, e.g. as in the case of voluntary carbon offsetting schemes of specific airlines (Kollmuss et al., 2010).

Interestingly though and largely because of the global economic crisis that prevailed for a good part of the 2010s, EU/EUA prices are currently determined at much lower levels than originally anticipated; therefore, several policy measures have been introduced to stabilise allowance prices, such as delaying auctions or removing rights to create greater market tightness (IATA, 2013b). According to ICAO Doc 9951 (2011) most airlines provide a fair degree of transparency about the price of offsetting a flight. It should be noted that there is a substantial variation in CO<sub>2</sub> tonne prices charged to passengers by airlines to offset their emissions. For instance, United Airlines' offset programme offers a passenger the choice to pay \$12.83 or 1711 Award Miles for the Capricorn Ridge Wind Farm or \$15.40/2053 Award Miles for the Alto Mayo Conservation Initiative. Brussels Airlines (2017) argues that the price of carbon offset depends on the quality of the initiatives involved in the scheme; in the top-quality category (Gold Standard or Certified by the UN) the price is around €22 exclusive of VAT per tonne of CO<sub>2</sub>. According to IATA (2008), the main points to consider when selecting a project/initiative include: a) verification and auditing processes in place; b) price; c) relevance to the entity; d)

geographical location; and e) resonance with passengers. For instance, projects with social and economic benefits to local communities may increase the corporate social responsibility of the entity and consequently its brand image.

The term 'linking' describes the case where one system's allowances or commercial units can be used directly or indirectly by another one for compliance reasons (Grubb, 2009). The linking of systems creates larger emission reduction schemes with better financial liquidity and harmonized prices without distortions arising from competition among the trading units; thus, it is less vulnerable to price fluctuations (Tuerk et al., 2009). On the other hand, areas with rising carbon prices due to linking systems can experience increased carbon leakages. The converse occurs in areas with declining prices (Tuerk et al., 2009). Carbon leakage refers to the increase in CO<sub>2</sub> emissions outside of the countries with domestic mitigation policy (UNEP, 2015). For example, corporations may move factories to developing countries to escape restrictions on emissions. Linking environmental schemes can lead to caps reduction to benefit from additional possibilities (Tuerk et al., 2009). In fact, when linking ETSs, the following factors should be considered: a) allocation methods and relative stringency and intensity of targets, compliance and enforcement; b) banking provisions; c) registries and rules governing new entrants and closures; d) eligibility of offset credits; e) cost-containment measures and f) Monitoring, Reporting and Verification (MRV) rules for allowances. In fact, MRV of emissions determine the reliability of every emissions trading scheme. Without MRV, there would be no transparency in compliance and it would be much more difficult to enforce the schemes. This is the only way to ensure that aircraft operators comply with their obligation to surrender sufficient allowances (EC, 2012).

To reduce administrative costs, each aircraft operator in the EU is administered by a single Member State often referred to as Competent Authority. This is the issuer of a carrier's operating licence or the state with the greatest estimated attributed emissions from that aircraft operator in the base year (i.e. the average emissions of 2004–2006) (EC, 2016). If an airline does not comply with the EU ETS there is a fine for exceeding the permitted quantities. In the worst-case scenario, a carrier is banned from operating in the EU (Leggett et al., 2012).

## 2.2. Reactions against EU ETS and the role of CORSIA

Despite the lower abatement costs (i.e. the cost of reducing negative environmental externalities) for aircraft operators in comparison to other possible environmental regulations, the inclusion of aviation to EU ETS was not widely accepted by all airlines and states outside Europe. The USA, China and some other countries have requested their airlines to be exempted from the EU ETS (Malina et al., 2012). They claimed that the unilateral implementation of EU ETS to non-European carriers violates the 1944 Chicago Convention and that the issue should be resolved by ICAO (Havel and Sanchez, 2012). Europe's representatives responded by saying that the regulation is not contradictory to the Chicago Convention and that the consent of the other countries is not required (American Society of International Law, 2008). As a result, Airlines for America (A4A) appealed to the Court of Justice of the European Union. The Court ruled that application of the EU ETS to aircraft operators does not infringe either the principle of territoriality or the sovereignty of third-party State and does not contravene the Chicago Convention, the Kyoto Protocol or the US-EU Open Skies Agreement (Court of Justice of the European Union, 2011). In any case, and because of growing international reaction against the scheme, the EC issued Decision No. 377/2013/EU, known as 'Stop-the-Clock' according to which entities operating flights to and from

airports in countries that are not members of the EU or the European Economic Area (EEA) are not obliged to surrender any allowances back and are exempted from the EU ETS. For example, a flight from Florida to Frankfurt is not subject to EU ETS. Only carriers that depart and land at an airport within EU and the EEA are obliged to surrender back to the EC the same amount of allowances they were initially given. Flights from and to outermost regions are excluded (EC, 2013).

Nevertheless, some international airlines (e.g. Korean Air, Fed Ex and Nippon Air) complied with the full, original scope of EU ETS (Sandbag, 2013). The reason for such a decision was that they considered it financially advantageous to receive the generous number of free allowances. The political process has selected a cap-and-trade system with generous grandfather rights and low permit prices to the benefit of the industry (Helm, 2006). According to Sandbag (2013) Delta Airlines publicly announced an ETS charge of \$3 per passenger per flight. Ryanair announced an ETS charge of €0.25 per passenger per flight, and had €8 million windfall profits since their actual ETS cost was €0.13 in 2012 per passenger per flight (Sandbag, 2013).

In any case, the introduction of the EU ETS, the subsequent reactions and the eventual compromising decision of the EU to 'Stop-the-Clock' are supportive of the view that climate change needs to be addressed at an international level. On these grounds, and despite its lengthy bureaucratic procedures, ICAO may prove a natural forum to undertake such discussions and seek consensus. In fact, since the 1997 Kyoto Protocol, ICAO has published technical information, recommendations and a range of different volunteering options about the limitation of GHG emissions from aviation. ICAO emphasized that environmental regulation needs to be based on the agreement of all involved member states and be non-discriminatory (Leggett et al., 2012).

The 2013 ICAO Assembly (comprising 191 members) meeting agreed to develop a global scheme based on Market-Based Measures (MBM) to limit CO<sub>2</sub> emissions from international aviation. The proposed basket of measures included the following: a) Global Mandatory Offsetting; b) Global Mandatory Offsetting with Revenue; and c) Global Emissions Trading. These MBMs offered participants the flexibility to choose between the implementation of emission reduction measures within their own sector, or the offsetting their CO<sub>2</sub> emissions in other sectors. This was particularly important for the aviation industry, where in-sector emissions' reductions are expensive and limited (ICAO, 2013). Having the above in mind, during the 39th ICAO Assembly in October 2016, 65 states including the USA, China and all EU countries agreed that environmental protection is of critical importance and signed up for voluntarily participation between 2021 and 2026 in the Carbon Offset and Reduction Scheme for International Aviation (CORSIA). CORSIA is a carbon-offsetting scheme and is the first global measure covering an entire industrial sector (Scheelhaase et al., 2018).

According to CORSIA, an aircraft operator acquires emissions units equivalent to its obligation in the carbon market; each emissions unit corresponds to one tonne of CO<sub>2</sub> that is offset by another project/initiative (ICAO, 2016). The quantity to be offset by each operator is calculated using a formula that considers the average percentage increase in the sector's emissions, the operator's individual percentage increase in emissions, as well as adjustments for fast growers and early movers. The first compliance cycle of CORSIA will be in 2021–2023; the second cycle concerns the period 2024–2026; and finally, the third period will be in 2027–2029 (ICAO, 2016). CORSIA 'is expected to offset around 80% of global airline CO<sub>2</sub> emissions above 2020 levels between 2021 and 2035' according to de Juniac, Director General of IATA (ATWonline.com, 2016).

Although, the EU-ETS and CORSIA have different objectives, i.e.



the former is a cap-and-trade scheme while the latter is an offset system (Scheelhaase et al., 2018), the introduction of CORSIA will most probably affect the future dynamics of the EU-ETS. Before introducing, however, any changes into the EU-ETS, policymakers should have a very clear understanding of the issues that have emerged as a result of the implementation of the scheme since 2012. In this context, the following sections of the paper may prove topical and of added value as they show, discuss and subsequently synthesise the results of a Delphi study complemented by unstructured interviews with experts on this very topic.

### 3. Methodology

The Delphi method is used in a variety of fields and is regarded as one of the best tools to collect in-depth information from a panel of (aviation) experts who are geographically dispersed. Peeters et al. (2016) used Delphi method to evaluate technology's contribution to climate change mitigation. Anonymity, iteration, controlled feedback and statistical aggregation of group responses define the success of Delphi method (Skulmoski et al., 2007). By protecting the identity of participants, the potential risk of self-censorship is reduced (Ballantyne et al., 2016).

The questions/statements for the present research were set based on literature and exploratory interviews with four academics specializing in the area of sustainable transportation. The first step in building the questionnaire concerned the framework of the EU ETS in aviation per se. The next step related to the selection of critical areas affecting the efficiency and effectiveness of EU ETS, i.e. the allocation of allowances, the linking of EU ETS with different ETSs and the effectiveness of other schemes such as the voluntary carbon offsetting scheme. A pilot survey was conducted to a panel of six experts (consisting of Civil Aviation Authorities, EUROCONTROL, European Commission and airline representatives) to ensure the conceptual validity of the questions. Feedback from the experts was used to review the questionnaire and develop its final version based on three main sets of questions/statements. In the first and third sets the participants were asked to rate statements using a Likert scale from 1 to 5, where 1 stood for strong disagreement and 5 for strong agreement; they were also given the opportunity to make comments. In the second question set, the participants were asked to allocate 100 points among the various allocation methods. In addition to replying to the questionnaire, some of the Delphi method participants discussed the future of EU ETS with the authors and offered valuable professional opinions and recommendations for policymakers.

The implementation of a Delphi method is time-consuming and requires considerable interaction between researchers and participants. In the present case, the Delphi study was conducted in two rounds as there were no major changes in the experts' opinions between the first and the second round. The first completed questionnaire of the first round was returned to the authors on the 11th June 2014 and the last one on the 11th May 2015. Likewise, the first questionnaire of the second round was received on the 1st July 2015 and the last on the 29th April 2016. Finally, most of the participants engaged in further discussions about environmental policies.

There are three parametric statistical methods to check the consensus and reliability of a Delphi study (Shah and Kalaian, 2009), i.e.: a) the Coefficient of Variation (CV); b) the Pearson correlation coefficient; and c) the F-test. Shah and Kalaian (2009) regard the CV as the best statistic to test reliability and determine the stopping rule of rounds in a Delphi study. The Coefficient of Variation (CV) takes values between 0 and  $\sqrt{N-1}$ , where N refers to the sample size. The maximum value of CV is reached when all

observations but one are equal to zero (Abdi, 2010). Therefore, the CV in the EU ETS survey may take values ranging from 0 (lowest possible value) to  $5.48 (= \sqrt{31-1})$ , i.e. highest possible value. The absolute difference in CV ( $\Delta CV$ ) is used to study if the participants changed their position in the second round. For each of the questions,  $\Delta CV$  is calculated by deducting the corresponding CV in round one from the CV in round two. Exploratory Factor Analysis (EFA) was also conducted. Varimax rotation was used, but the correlation matrix determinant was zero. Consequently, EFA results do not offer added value and are not further discussed.

According to the literature (Okoli and Pawlowski, 2004; Balasubramanian and Agarwal, 2013; Schmiedel et al., 2013), 10–18 experts should be sufficient in a Delphi panel. Nonetheless, due to the complexity of the EU ETS and the number of stakeholders involved, participation of approximately thirty experts was deemed necessary. In fact, the sample consists of 31 experts in the first round and thirty in the second round. Six experts are from airlines, two from Air Navigation Service Providers (ANSPs), five from Governmental institutions (such as Ministries of Transport), four from Civil Aviation Authorities (CAAs), six from the International Air Transport Association (IATA) and seven are individual experts/consultant/academics. The selected categories cover the aviation groups concerned with the EU ETS except for aircraft/engine manufacturers. Chain-referral sampling was used to identify experts. Since the participants were not anonymous, the researchers could eliminate non-suitable experts. Quota sampling was used to achieve balance in the participants background. According to Sandbag (2013) 1169 airlines and operators participated in the EU ETS, 788 (67%) of which were non-EU, with the remaining 381 (33%) being EU registered. Under the stop-the clock principle all airlines operating flights within EEA are obliged to comply with the EU ETS with only few of them having a full-time employee working on EU ETS. Passengers are not familiar with the implemented scheme; hence, they are not qualified to participate in the Delphi study. Moreover, unstructured interviews with two senior experts from the European Commission and Transport and Environment (NGO) were conducted. Those two experts did not participate in the Delphi study, but gave valuable insights into the workings of EU ETS in aviation, as also discussed in the recommendations section of the paper.

### 4. Findings and discussion

Based on the literature review and confirmed by the questionnaire consultation, the main elements that affect the efficiency and the design of the EU ETS are the allocation of emissions, the policy influences on the market and the linking of EU ETS with other schemes.

#### 4.1. Position of participants on EU ETS in aviation

Table 1 gives information about the sample size (N), the minimum (Min) and maximum (Max) values, the mean, the Standard Deviation (SD) and the absolute difference in the Coefficient of Variation ( $\Delta CV$ ) regarding the first set of statements, which reflects the position of participants on EU ETS in aviation. Surprisingly, the mean for the statement 'the cap of EU ETS is too generous' is 2.71 which suggest a modest disagreement. Participants tend to agree with the statement that the economic dimension of the EU ETS is characterised by heavy lobbying regarding the allocation of EU ETS allowances (mean = 3.93 and SD = 0.8). Moreover, participants agreed with the statement that it is possible to link the EU ETS with other Emissions Trading Schemes and have a global ETS (mean = 4.03 and SD = 0.94).

**Table 1**

Position of participants on EU ETS (1: strongly disagree and 5: strongly agree).

	N	Min	Max	Mean	SD	CV	ΔCV
It is possible to link the EU ETS and the other Emissions Trading schemes and have a global ETS.	29	1	5	4.03	0.94	0.23	0.04
The economic dimension of the EU ETS drives heavy lobbying around allocation of EU ETS allowances.	29	2	5	3.93	0.80	0.20	0.01
The carbon market's stability is vulnerable because of the continuous changes in legislation.	30	2	5	3.70	0.88	0.24	0.02
The EU ETS is causing competition issues to airlines.	30	1	5	3.47	1.20	0.34	0.06
Using biofuels is a promising solution for carbon offsetting.	28	1	5	3.39	1.23	0.36	0.01
Postponing the auctions can force the prices of allowances to increase.	28	2	5	3.36	0.78	0.23	0.13
The monitoring, reporting and verification of emissions in the EU ETS is effective.	30	1	5	3.27	0.91	0.28	0.07
The multi-period nature of allocations (i.e. banking and borrowing flexibility) drives dependence both upon post-2012 decisions and creates risk of perverse incentives.	28	1	4	3.25	0.84	0.26	0.01
The EU ETS can result in carbon leakage.	29	2	5	3.24	0.91	0.28	0.03
The EU ETS is vulnerable to frauds, for instance VAT fraud and 'phishing' scams.	29	1	5	3.17	1.10	0.35	0.07
The carbon market stability is vulnerable because of the low prices of the allowances.	28	1	5	3.11	0.96	0.31	0.05
The creation of carbon as a "financial instrument" can lead to sufficient carbon reduction.	29	1	5	3.00	0.93	0.31	0.05
The corresponding large proportion of free allocation underlies legal stresses and a scope for distortions.	28	1	4	2.86	0.76	0.26	0.07
The EU ETS is source of profit-making incentives unprecedented in the history of environmental policy.	30	1	5	2.83	0.99	0.35	0.11
There are small emissions reductions relative to 'business-as-usual' and this leads to instabilities related to economics, policies and time frames) in the EU ETS.	29	1	4	2.76	0.58	0.21	0.11
The inclusion of aviation in the EU ETS will influence negatively the development of non-European airlines if they are included in EU ETS.	30	1	5	2.73	1.17	0.43	0.08

Differences in the replies of the different stakeholders are noteworthy. Five out of six EU airlines' experts that participated in the Delphi method believe that if EU ETS would extend the scope and include all the airlines, i.e. if the stop-the-clock decision is not renewed, those airlines will not be influenced negatively. On the other hand, 5/6 IATA experts believe that those non-EU airlines will be negatively affected. Moreover, almost all participants believe that airlines will not be 'forced' to merge to receive more allowances. Despite that, many of the participants believe that EU ETS raises competition issues to airlines.

Airlines, ANSPs, IATA and some experts believe that the level of allowances provided is fair. 4/5 of the Government Bodies, 2/4 of CAA and 2/7 of individual experts believe that the cap of EU ETS is too generous. The divergence of views between the regulators and the airlines is quite evident in this statement. When the participants were asked about making the free allocation of allowances stricter, most airline representatives and IATA argued against, whereas all the ANSPs, 3/5 of CAA, 2/7 of individual experts and surprisingly 1/6 of IATA experts suggested stricter allocations. The government bodies' representatives kept a neutral position.

Most participants agreed with the statement that the economic dimension of EU ETS drives heavy lobbying around allowances allocation, with only one expert working in an airline disagreeing. Only three airline representatives argued that linking the EU ETS with other ETs around the world and creating a global scheme is not possible. The remaining experts participating in the survey argued in favour. It should be noted that the EU ETS is incorporated in the ICAO Basket of Measures but is not mandatorily taken into consideration by ICAO CORSIA.

Most participants indicated that the continuous changes in the legislation (for instance the stop-the-clock in the first year of EU ETS and the CORSIA in less than 5 years from the enforcement of EU ETS) make the carbon market less stable. Two out of five experts working for government bodies disagreed with the above statement, but surprisingly one of them agreed.

Regardless of their group, the Delphi participants had diverse opinions about the vulnerability of EU ETS to frauds. The minimum value they gave was 2 and the maximum was 5. One out of five experts from governmental bodies disagreed with the statement and two agreed with the statement. Moreover, two out of four experts from governmental bodies, three out of six IATA experts, two out of six airlines representatives and two out of three experts working at CAAs agreed that carbon market stability is vulnerable

due to low prices of the allowances. Most participants agreed that postponing the auctions can force the prices of allowances to increase.

Several concerns are expressed in the literature about carbon leakage (Bernard and Vielle, 2009; Dröge et al., 2009; Clò, 2010; Kuik and Hofkes, 2010; Monjon and Quirion, 2011). Two experts working for governmental bodies, two individual experts and one airline do not believe that EU ETS can result in carbon leakage. Nonetheless, the opposite opinion is supported by two airlines, four CAAs, one IATA expert and three individual experts. None of the representatives of government bodies believes that EU ETS can result in carbon leakage. It should be noted that there are quotas for receiving emissions from the flexible mechanism of Kyoto Protocol.

Various approaches to environmental problems were investigated via the first set of questions. The participants were given statements about operational changes that may lead to carbon neutral growth, i.e. no increase to the level of net CO<sub>2</sub> emissions from 2012 onwards. The use of biofuels is an issue that is more familiar to airlines, IATA experts, individual experts and government bodies. All stakeholders though expressed different opinions on this matter. Half of the experts working in airlines believe that the use of biofuels is a promising solution for carbon offsetting and the other half do not. This is related to the culture of the airline and the strategy of using biofuels or not is related to the availability of supplied biofuels. The northern European airlines like SAS and central Europe airlines with extended network like Lufthansa have invested in biofuels and have access to them. Therefore, it is deduced that those airlines are more familiar with their use and are strong supporters of biofuels while others are not. One expert working for IATA, one for ANSP and one expert working for a government body do not believe that biofuels are a promising solution for carbon offsetting. The diverse opinions about biofuels and offsetting is a very important finding when considering the emphasis policy makers put on biofuels research and development.

Additional fuel savings may also be achieved thanks to better fuel use predictability. Nonetheless, three out of five experts in government bodies disagreed with this claim. The airlines and the ANSPs are more familiar with route structures and the weight due to excessive fuel carrying and its contribution to fuel consumption. Therefore, their supportive opinion is much more important in this statement.

An important finding is that participants have diverse opinions on whether the carbon markets can lead to major carbon

reductions. In addition, the participants do not believe that route optimisation is enough for carbon neutral growth as horizontal en-route flight efficiency and other airspace operational improvements are not enough to stabilise emissions as also discussed in Efthymiou and Papatheodorou (2018).

As far as the absolute difference of Coefficient of Variation ( $\Delta CV$ ) is concerned, the first set of questions/statements about EU ETS had a mean  $\Delta CV$  of 0.056, with values ranging between 0.00 and 0.13. The participants gave the same answer in the two rounds on additional fuel savings. The statements where the participants slightly revised their opinions in the second round were 'The cap of EU ETS is too generous'; 'The EU ETS is source of profit-making incentives unprecedented in the history of environmental policy'; 'There are small emissions reductions relative to 'business-as-usual' and this leads to instabilities related to economics, policies and time frames) in the EU ETS'; 'Route optimisation is sufficient enough for carbon neutral growth' and 'Postponing the auctions can force the prices of allowances to increase'.

#### 4.2. Allocation methods in EU – ETS in aviation

24 experts replied in the second set of statements, which requires a solid understanding of allowances allocation methods. The airlines and ANSPs were never exposed to the different ways of allocating permits. Therefore, some of them did not reply to this set. Most of the 24 participants believe that benchmarking is the ideal method of allowances allocation (Table 2). The auctioning method had a mean of around 36% and the grandfathering method gathered 23 points. It should be noted that most of the participants who selected more than two methods of allocations had quite different opinions. The participants in the second round gave almost the same points as in the first round for the auctioning method. The  $\Delta CV$  was 0.05. Moreover, the participants gave fewer points to the grandfathering method and more points to the benchmarking method in the second round.

The least preferred method for the airlines is auctioning (max points = 25%) and the most favourite is benchmarking (max points = 80%). The CAA showed almost equal preference for auctioning and benchmarking. The individual experts allocated the least points to the grandfathering method and showed a preference for auctioning (max points = 90%) and benchmarking (max points = 60%).

The government bodies' representatives deemed auctioning as a better method for allowances allocation. Four government representatives gave 0–10% to grandfathering and 4/5 gave fewer than 30 points (out of 100 points) to benchmarking, whereas two government representatives gave 80–90 points to auctioning. The remaining three government representatives gave fewer than 30 points to auctioning. Despite that the policymakers believe that auctioning is a more appropriate method for allocation of emissions, the EU ETS for aviation is based on grandfathering. Both under grandfathering and benchmarking, allowances are allocated free of charge. The auctioning of allowances in aviation is quite limited. Interestingly, most government representatives who supported that the economic dimension of EU ETS drives heavy lobbying around allocation of EU ETS allowances also claim that

auctioning is a better method for allocating allowances. EC used the grandfathering and benchmarking to a larger extent than auctioning (only 15% of allowances are subject to auctioning) in practice. A logical speculation would be that the heavy lobbying affected the regulation.

#### 4.3. Linking different ETSs

In the first set of statements, the 29 participants agreed on average (with a mean score of 4.03) that it is feasible to link the EU ETS with other schemes (Table 1). The third set of statements (Table 3) explored the commonality of specific factors to be considered when linking such schemes. The 26–27 participants agreed that the main factor that needs to be the same are Monitoring, Reporting and Verification (MRV) allowance rules (mean = 4.26). They expressed a rather neutral opinion on the banking provisions, the compliance periods and the stringency of the targets. Overall, the participants agreed with all the statements and showed consensus except for the stringency of targets, compliance period and banking provisions. 1/6 of airlines, 1/2 of ANSPs and 1/4 of CAAs disagreed with the statement that in order to link the different ETS around the world with the EU ETS the same stringency of targets should be granted. The ANSPs opinion is not that relevant in this question and the airlines most probably had benchmarking in mind and mainly the differences among the airlines in terms of readiness. None of the participants added an additional factor to the provided list. Finally, the  $\Delta CV$  ranged from 0.06 to 0.26. The lowest  $\Delta CV$  value was noted in the banking provisions factor, whereas the highest value was in the allocation methods and the compliance periods. The average  $\Delta CV$  of all the factors in this question was 0.20.

The Delphi study included the main stakeholders of the EU ETS. As expected, the opinions expressed by IATA were very similar with those of airlines. The airline industry pushes for the relaxation of the environmental regulations and policies, whereas academics and governmental institutions believe the EU ETS allowance allocation should have been stricter to press airlines to reduce their CO<sub>2</sub> emissions. Nevertheless, all stakeholders agree that lobbying influences the EU ETS and most probably the shaping of all environmental policies. In the area of EU ETS in aviation, the most influential players are the airlines and the governmental institutions with conflicting interests regarding environment. Academics are strong advocates of sustainable aviation with some influence on policy decisions. Therefore, there seems to be an overall positive stance vis-à-vis environmental considerations, although changes may prove slow due to resistance from the affected parties, i.e. the airlines. To counter such reactions and propose a meaningful way forward various policy recommendations can be made as discussed in the next section of the paper.

### 5. Policy recommendations

Helm (2009) argued that the Kyoto Protocol did not have a sufficient impact on climate change mitigation because it did not include aviation and shipping. These two sectors are not directly considered in the 2015 Paris Agreement either (UNFCCC, 2016). The allocation of responsibility for the existing stock of carbon; the fact that some countries may benefit from climate change; the free-rider incentives; and the difficult measurement of emissions make climate change management intractable (Helm, 2009). The EU ETS has also been criticized as having failed to provide the necessary incentives to reduce emissions due to undesirable distributional effects and competition distortions emerging from divergent rules between the different sectors (Clò, 2010). In fact, and from a pure welfare economic approach under uncertainty an

**Table 2**  
Ideal allocation method for aviation (2nd round of Questionnaire).

	N	Min	Max	Mean	Std. Deviation	CV	$\Delta CV$
Benchmarking	24	0	80	41.04	24.27	0.59	0.08
Auctioning	24	0	90	36.25	24.10	0.66	0.05
Grandfathering	24	0	75	22.71	22.02	0.97	0.15

**Table 3**

Factors to be considered for linking different ETSs (2nd round of Questionnaire).

	N	Min	Max	Mean	SD	CV	ΔCV
There are the same Monitoring, Reporting and Verification (MRV) rules for allowances	27	1	5	4.26	0.90	0.21	0.19
There is the same stringency of enforcement	26	2	5	4.19	0.85	0.20	0.21
There is the same eligibility of offset credits	26	2	5	4.19	0.80	0.19	0.21
There are the same rules governing new entrants and closures	26	3	5	4.15	0.73	0.18	0.22
The same allocation methods are applied	26	2	5	4.12	0.82	0.20	0.24
There are the same registries' rules	27	2	5	4.04	0.81	0.20	0.20
There are the same banking provisions	26	2	5	3.65	0.80	0.22	0.06
There are the same compliance periods	26	2	5	3.65	0.94	0.26	0.26
There is the same stringency of targets	26	2	5	3.88	0.95	0.25	0.20

emission tax could prove a better option (Nordhaus, 2008; Helm, 2008; Pizer, 2002). In any case, the EU ETS is the most important ETS in scale and size worldwide. The impact of emissions trading in aviation affects companies of all sizes and from various industrial sectors. When it comes to compliance with the EU ETS, there are different options. These options may be of short- (e.g. optimized use of existing technologies) or long-term nature (e.g. investment in technical progress and new technologies). The research conducted in this paper shows that there is room for improvement in the EU ETS for aviation. Therefore, the following recommendations are proposed.

### 5.1. Simpler monitoring, reporting and verification processes

Aircraft operators are requested to surrender several allowances to the Competent Authority (CA). A major difficulty in the Monitoring, Reporting and Verification of emissions is the verification of biofuels used. Many airlines, verifiers and fuel suppliers expressed concerns during the Delphi study about the process of MRV and discussed extensively the role of alternative fuels on the emissions reduction.

The EU has set sustainability criteria (Directive, 2009/28/EC) to ensure that the carbon savings from biofuels are real and that biodiversity is protected. Biofuels cannot be produced either in areas converted from land with previously high carbon stock (such as wetlands or forests) or from raw materials obtained from land with high biodiversity (such as primary forests or highly biodiverse grasslands). Biofuels not produced according to the sustainability criteria do not count towards the achievement of environmental targets.

To encourage the diversification of feedstocks used to produce biofuels, i.e. biofuels produced from wastes, residues and lignocellulosic, the EU double-counts their real energy value contribution to the national EU mandates in the Renewable Energy Directive (2009/28/EC). This double-counting gives an economic value to some biofuel pathways (advanced biofuels) and it can increase their chances of being selected by airlines.

Biofuels are difficult to track when they are blended with standard aviation fuel. In certain airports, some airlines have dedicated fuel tank farms. In case airlines do not have one, the purchased blend of biofuel ends up in the common tank that supplies all carriers. Fig. 1 depicts the biofuel journey. For instance, if Airline A buys 50% blend of bio-kerosene and this ends up in the common tank farm, it blends with the Fossil Jet A1 fuel that is paid by other airlines. Consequently, everyone ends up with a blend of the blend and Airline A does not use what they paid for. In this case, the physical tracing of bio-kerosene is almost impossible. A fuel balance algorithm is used to estimate the use of bio-kerosene. However, the verifier of biofuel has no knowledge about whether other airlines purchased bio-kerosene, which imposes the risk of double-counting biofuel and credits. Furthermore, it cannot be

verified whether the bio-kerosene is used for flights within the EU or for international flights.

The above described practical problem could be resolved in different ways. For instance, every airline could have its designated tank farm in every airport where it buys fuel. This might solve the problem with the use of the biofuel blend but, on the other hand, it would increase the cost of infrastructure and create land use problems. Building biofuel tank farms could be a solution, which could become a reality as soon as more airlines purchase biofuels.

Another solution would be to virtually assign the credits of biofuels to airlines and to take for granted that the biofuel is used for EU flights. One could then count the total use of biofuels vs fossil fuel; this would make the process much easier and faster and encourage airlines to start reporting their use of biofuels. At present, this is not the case because the process is too complex, and the use of biofuels is limited to a small number of flights. All interviewees in the present study agreed that the process is too complicated.

Aircraft operators, the MRV authorities as well as everyone involved in the documentation and administration of the EU ETS should first undergo training by the same organisation or training agency to have the same level of information as well as reference point for questions and answers. This training will first help raise the environmental awareness of the involved members and, second, it can ensure a better administration and handling of the EU ETS. The implementation of simpler MRV processes and environmental training is an easy and inexpensive procedure.

### 5.2. Streamlining and increased transparency of the auctions and penalties' revenue policy

The EU ETS involves revenue generating transactions for Member States (MS). These receive revenues by selling allowances through the primary auctions and from penalties imposed to aircraft operators. Moreover, according to article 10(3) of the EU ETS Directive, MS are required to use at least 50% of auction revenues to combat climate change in the EU and third countries. However, since the MS do not have any obligation to publish relevant information, it is often unknown how much revenue is generated.

The MS and the CAs in particular are responsible for imposing penalties. According to EC Carbon Market Report 2017, the application of the 'excess emissions penalty' in 2016 was reported for 48 aircraft operators in four Member States (BE, DE, ES, UK). As provided for by the Directive, the MS should increase the penalty in accordance with the EU Consumer Price Index. The range of different penalties varies substantially across MS; in certain cases, the minimum can be a few hundred euros and the maximum €75,000, whereas in other cases the imposed penalties might range from €5000 to €15 million. No penalties in the form of imprisonment were reported in 2016 but fines for involved installations and aircraft operators exceeded €1.5 million (EC, 2017).



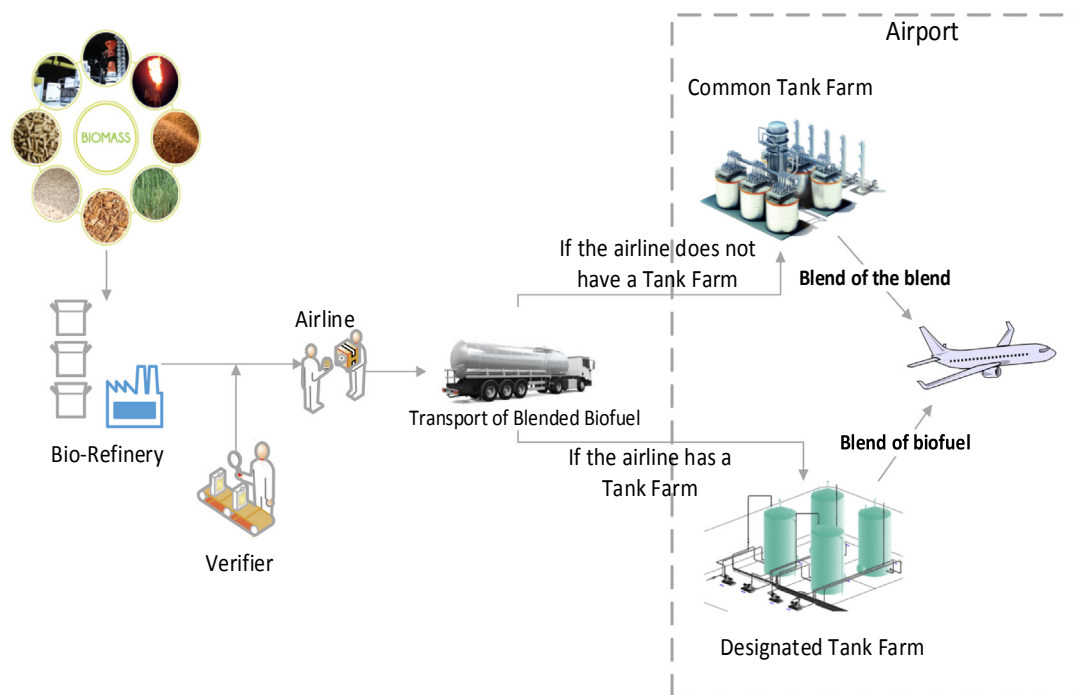


Fig. 1. The biofuel journey from production to consumption (Source: own elaboration).

Another important issue is the transaction cost of the EU ETS due to apparent inconsistencies, as some MS charge the airlines administrative fees, whereas others do not. According to the Carbon Market Report 2017 there are fifteen countries that do not charge fees to aircraft operators. Most Member States reported that they collect fees for various services, such as the approval or update of monitoring plans or permits. Those fees vary significantly in aviation, ranging between €5 and €2400 for a new monitoring plan approval. Nonetheless, it seems that some member states recover their transaction cost, whereas others do not. This inconsistency, however, is unfair to both the member states administration offices and the aircraft operators.

This situation calls for a standardisation of the processes; penalties should be imposed by a central agency following the same criteria and methods for all the operators in all countries. The CAs should be responsible for MRV and not for imposing penalties in questionable ways. It is also proposed that the MS should publish information about the funneling of collected revenues. Moreover, the MS should monitor the progress of the carbon offsetting schemes and/or the environmental improvement projects.

### 5.3. Achieving balance in the allowances market

The allocation of allowances affects the abatement cost of the carriers; therefore, it is of critical importance for the efficiency of the scheme. The EU ETS is a virtual market based on shadow prices and requires that wisely set constraints are applied to all aircraft operators in all EU countries to reduce negative environmental externalities. As in most markets, the laws of demand and supply apply to the EU ETS. As discussed in the literature review, it is evident that there is an imbalance between the supply and the demand for allowances, which raises concerns over carbon price stability as also observed by two interviewees. A mechanism is thus required to accommodate this need for balance in the market.

There are numerous trials to project CO<sub>2</sub> emissions. Different scenarios are applied to capture the interaction of different policies, reforms, changes. Nonetheless, the problem arises when the

different scenarios do not develop according to plan and, in that case, amendment or corrective measures should be taken by the regulator to adapt to the new standards and situations.

According to the EC, there is a surplus of allowances leading to lower carbon prices and weaker incentives to reduce emissions. The surplus amounted to around 2 billion allowances at the start of phase 3 (2013–2020) and it increased further to more than 2.1 billion in 2013. In 2015, it was reduced to around 1.78 billion because of back-loading (i.e. delaying the auctions). Without this, the surplus would have been almost 40% higher at the end of 2015 (EC, 2016). This massive oversupply of allowances has greatly reduced the carbon price.

The surplus is a major issue for the position of aviation in the EU ETS and the existence of a surplus is proven by the allowances price in European Energy Exchange (EEX). The surplus can be either due to a generous cap or excess supply. As discussed in the Delphi analysis, the CAAs (40%), some individual experts (29%) and other governmental bodies (60%) believe that the cap of the EU ETS is too generous. On the other hand, IATA (66%), the airlines (57%) and the ANSPs (100%) argue the opposite. According to SSE (n.d.) the fundamental issue faced by the ETS is the fixed nature of the cap based on a stable baseline; nonetheless, if the cap were flexible the airlines would not be able to conduct emissions planning and strategy and therefore the concept of EU ETS would be jeopardised.

Companies that have been given enough free allowances to cover their emissions have an economic incentive to sell any offsets they do not actually need, giving them the option to make a profit. According to SSE (n.d.), the linear reduction factor does not align with expected targets. This phenomenon is mostly observed in energy industries, but it affects the supply of allowances in the aviation industry, too. This difference in the supply and demand of allowances makes the EU ETS vulnerable and increases the risks for stakeholders and especially investors.

The supply of allowances needs to be controlled for the market to operate in a more stable setting. A Supply Adjustment Mechanism (SAM) would allow the supply of allowances to respond to demand. To control the market, allowances considered as surplus



could be placed into a strategic reserve which could be used only when the demand is much higher than the supply. To control supply and demand, the EC postponed auctions in the aviation sector and created some kind of scarcity in the market. This was an ad hoc measure with limited and insufficient results for market stability. A more organised strategy like a SAM would be more beneficial for the virtual market of the EU ETS. The SAM can be used when additional schemes affect the availability of the allowances. For instance, airspace structural improvements provide aircraft users with shorter routes through the optimisation of the airspace and, consequently, lead to lower emissions, saving in allowance usage. Technological improvements in the aircraft fuselage and the engines have the same effect. Therefore, the supply of allowances becomes higher than demand and the emissions market becomes vulnerable. The target of those changes is to achieve the minimum cost of fuel consumption, but not necessarily to achieve carbon neutrality that might have a high cost for carriers. Therefore, environmental policies, like the EU ETS are vital to achieve environmental targets that go beyond the abatement cost of airlines.

The surplus of allowances can be identified in the auction markets or the banking reserves of the airlines. Airlines can bank the allowances they have not used. [Schleich et al. \(2016:117\)](#) claim that 'banning the transfer of allowances increases the overall compliance costs because cost savings cannot be traded over time'. Based on simulations, they also concluded that a generous allocation of allowances in the first phase results in the collapse of market prices towards the end of the first commitment period and a sharp increase afterwards when targets become stricter. Nonetheless, reality proved that EU ETS does not perform to its maximum potential and needs to change. If the supply of allowances needs to be controlled, the banking of allowances rule should change, or the free allowances given for the following year need to be reduced. Simply said, if supply is much higher than demand, prices fall. Consequently, aircraft operators will no longer have an incentive to cut emissions or even auction excess allowances.

The Market Stability Reserve (MSR) is a rule-based mechanism that allows the supply of allowances to respond to the changes in demand, maintaining the balance in the EU ETS carbon market. In other words, the MSR adjusts the auction volumes. By using the total number of allowances in the market as an indicator, market imbalances due to unexpected shocks that impact demand, such as an economic crisis, can be addressed. This allows the EU ETS to maintain its objective for emission reduction in a cost-effective and economically efficient manner, even under unexpected circumstances.

Another way to achieve stability and credibility in the market can be the introduction of a price floor for auctioned allowances. Still, this may not serve the target as effectively as the control of the allowances supply. The minimum price for purchase of allowances will increase, ensuring minimum revenues from the auctions, but this does not mean that the oversupply is under control or that the market operates efficiently. Undoubtedly, it is a measure that can be implemented more easily than the ban of banking or further reduction of free allocated allowances and its implementation is recommended, but only as a complement to SAM.

## 6. Conclusions and the way forward

This paper highlighted strategic and operational issues regarding the design, implementation and monitoring of the EU ETS. Theory was complemented by a thorough discussion of the undertaken Delphi survey of key experts in the field; recommendations were also made to deal with the emerging problems. The inclusion of aviation in EU ETS affects companies of all sizes and from various industrial sectors. Since climate change is gradually

becoming noticeable and may have dramatic impacts on human well-being, aviation emissions as well as all other factors affecting climate change need to be regulated. The EC does not have the regulatory power to impose rules to non-EU countries and carriers. Therefore, ICAO is more appropriate to regulate the contribution of aviation into climate change. As soon as ICAO fully implements CORSIA in the early 2030s, there will be no need for the EU ETS to include international aviation; the scheme can then focus on other industries where no administrative overlaps exist. The policy-makers should approach this option by taking into consideration all industries and addressing climate change holistically. The results of the present study and the lessons to be learnt from the EU ETS caveats will hopefully contribute in this direction.

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