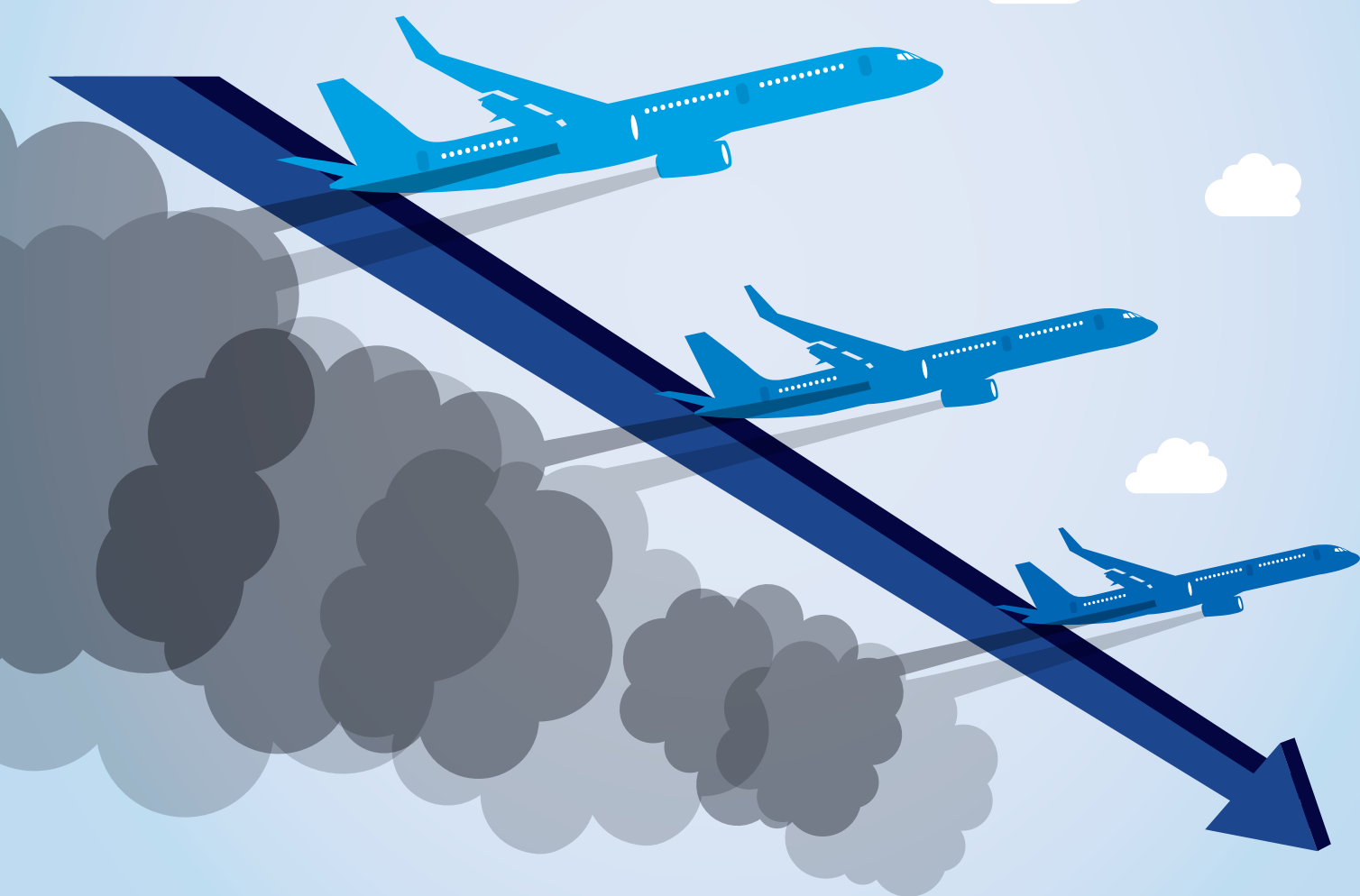


Aviation ETS – gaining altitude

An analysis of the aviation EU ETS 2013-2015

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Executive Summary

The inclusion of aviation in Europe's Emissions Trading Scheme (EU ETS) should be judged a success for several reasons;

1. The EU ETS has served as a model for other jurisdictions. Not only has the aviation ETS disproved sceptics both within and beyond Europe, but Europe's resolve has inspired and spurred moves to act at the global level and in other aviation markets;
2. On several counts the EU ETS provides greater certainty and environmental integrity than what is contained in the outline of a global deal to address aviation emissions that ICAO published early September;
3. The measure is fully functioning - it enjoys a very high degree of compliance, including aircraft operators from third countries who opposed even the inclusion of flights within Europe in the ETS.

Because of the low CO₂ permit prices resulting from oversupply of allowances, the aviation EU ETS has however not yet had the desired impact on aviation emissions.

This report analyses the performance of the EU ETS for aviation for the stop-the-clock years 2013-2015 and concludes that the measure shows the potential to achieve emissions reductions at lower cost through trading allowances with stationary ETS sectors, but only if Europe addresses the oversupply of allowances within the overall ETS.

While the emission reductions from aviation's inclusion in the ETS cannot be quantified at this stage, all CO₂ emitted by ETS sectors (aviation and stationary installations) remains under the overall ETS cap. Since this cap declines and measures have been taken to reduce the surplus, aviation's inclusion in the ETS will eventually lead to emission reductions in other sectors and at a lower cost than could have been achieved within the aviation sector .

Due to a combination of an overly generous allocation of free allowances granted to operators, and the low price of those allowances that operators were required to purchase at auction, the "cost" works out at between €0.26 and €0.76 on a short or medium haul flight ticket respectively. On top of this, earlier economic analyses¹ indicate that it is highly likely that airlines have enjoyed "windfall profits" from the scheme.

Expanding the scope of the aviation ETS could increase Europe's pre-2020 climate ambition by widening the emissions coverage and reductions required by the cap. Implementation of the scheme can also benefit from further improvements in transparency at both member state and European level. Post 2020, the aviation ETS needs to be better aligned with the EU's 2030 climate goals.

The aviation ETS fails to address the non-CO₂ effects of aviation emissions. The original European Commission proposal in December 2006 did provide for the NO_x impacts of aviation to be addressed in separate legislation but a subsequent NO_x study for the Commission was inconclusive. The European Parliament also proposed a non-CO₂ multiplier but this was rejected. The scientific evidence is compelling that aviation's non-CO₂ effects must be addressed.

The ETS has spurred global action

The aviation ETS as originally implemented on 1 January 2012 covered emissions from all flights arriving at and departing from airports in the European Economic Area (EEA). Following a highly charged and politicized campaign by industry, the International Civil Aviation Organisation (ICAO) and foreign governments, emergency "stop-the-clock" legislation was introduced in November 2012 to reduce the

¹ Transport & Environment, 2013. www.transportenvironment.org/publications/billion-euro-aviation-bonanza-aviations-participation-eu-ets

ETS scope to include only flights between EEA airports. This reduced, by three-quarters, the measure's environmental impact.

The EU *stopped-the-clock* on non-EU flights to provide ICAO time to produce an environmentally meaningful global measure. Four years later, even though ICAO has yet to deliver and is now discussing voluntary measures from 2020, industry is again calling for the aviation ETS to be dismantled and the US is calling on ICAO to outlaw regional measures.

EU legislation requires the Commission to review the outcome of ICAO's 2016 Assembly this September and for EU lawmakers to decide the future of aviation's inclusion in ETS. A thorough assessment of the merits of the ETS and of any measure agreed by ICAO will be necessary.

ETS compares favourably with the uncertain global deal

This report demonstrates that the aviation ETS, despite its shortcomings, is a legally sound measure, with a high degree of compliance and with the potential to deliver real emissions reductions through a declining cap. This contrasts with the published outline of the ICAO GMBM whose geographic coverage will fall well short of the ICAO's own goal of CNG in 2020 and which lacks both legal certainty and important environmental safeguards. EU lawmakers should be wary of replacing its hard fought ETS with a "global" approach whose environmental integrity and level of compliance remains subject to much uncertainty.

Recommendations

Strengthen overall ETS - *exhaust surplus to incentivise emission reductions*

1. Adopt measures beyond addressing surplus allowances through the Market Stability Reserve
2. Reduce the cap by 2.6 % annually
3. Broaden the scope of aviation in the ETS starting in 2017, for example to cover 50% of incoming and outgoing flights

Strengthen aviation ETS - *reflect true cost of aviation emissions and improve transparency*

- Reflect true cost of aviation emissions

4. Set declining cap on aviation allowances which will require operators to purchase more general ETS allowances
5. Phase out free allocation to aircraft operators
6. Apply a multiplier of two to aviation CO₂ emissions to account for non-CO₂ emissions and reflect its true climate impact

- Improve transparency

7. Disclose the amount of international credits used for compliance by aircraft operators
8. Put forward a clear deadline for when member states must publish complete lists of non-compliant airlines along with the status of the enforcement procedure and the fine to be paid

The report in numbers

✈ Aviation's climate impact

Aviation is responsible for **4.9%** of manmade climate change

Without action, aviation emissions could increase by up to **300%** by 2050

✈ Emissions mitigated

To cover their emissions for the years 2013 to 2015, operators purchased **68.3** million allowances

Between 2013 and 2015, aviation's inclusion in the ETS reduced the allowance surplus by **42.7** million

International and industry pressure cut the scope of the aviation EU ETS by **75%**

✈ Compliance

In 2013, 2014 and 2015 operators surrendered allowances for **99%** of emissions covered under the EU ETS

The compliance rate among Chinese operators is **100%** and **82%** of Russian operators complied

115 non-compliant aircraft operators are known to be penalised by member states

45% of fined operators came into compliance and **11%** remain non-compliant, the rest are now exempt

✈ ETS costs

ETS cost to carry each passenger is between **€0.26** and **€0.76**

A London to New York flight (currently excluded) would cost **€1.13** per passenger

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1. The inclusion of aviation in the EU ETS

The EU's Emissions Trading System (EU ETS) was introduced in 2005 and capped the emissions of heavy industrial, stationary, sectors within the European Economic Area (EEA)². The cap consists of tradeable allowances (EUAs) equal to the amount of tonnes CO₂-eq³ that can be emitted under that cap. The 'stationary' or 'general' ETS cap is slightly reduced every year, which is intended to drive emission reductions as polluters must either reduce their emissions or purchase additional allowances which progressively grow scarcer and more costly. Currently the EU ETS suffers from a large oversupply of allowances which needs to be addressed for the EU ETS to be effective (see Box 5).

In 2008, the EU agreed to include from 2012 aviation in its ETS, in order to address the forecast rapid growth of emissions from the sector. This decision followed the repeated failure of the UN's International Civil Aviation Organisation (ICAO) to adopt global measures as it was tasked with doing by the 1997 Kyoto Protocol.

Europe's decision to act was based in particular on the conclusions of the sixth meeting of the ICAO's environment committee (CAEP) in 2004, where it was agreed that a global aviation-specific emissions trading system based on a new legal instrument under ICAO auspices seemed sufficiently unattractive that it should not be pursued further. A subsequent Resolution of the 35th ICAO Assembly in October 2004 did not propose a new legal instrument but instead endorsed emissions trading and the possibility for States to incorporate emissions from international aviation into their emissions trading schemes.

The EU ETS is now in its third trading phase (2013-2020), following a pilot phase (2005-2007) and a second phase from 2008 to 2012. Negotiations on the provisions for phase IV (2021-2030) to align the ETS with the EU's 2030 emission reduction commitments are ongoing. Agreement between the Council of the EU and the European Parliament is expected late in 2017.

As was agreed in 2008, aviation emissions were provisionally capped just below their average level between 2004 and 2006. The cap on *aviation* allowances (EUAs) was separate to the overall EU ETS cap. This provisional cap on *aviation* allowances (EUAs) was set to apply for the periods 2012 and 2013-2020. From 01 January 2012, both commercial and non-commercial aircraft operators (AO) flying from or to an airport within the European Economic Area (EEA) were required to surrender an emission allowance for every tonne of CO₂ emitted.

Aviation emissions are expected to continue to grow over the years, due to continuing strong demand, subsidised pricing from fuel tax and VAT exemptions and unbridled state aid. Nevertheless the sector was accorded the privilege of being able to tap into the auctioned supply of allowances available to other sectors in order to accommodate its growth above the aviation cap. So the aviation EU ETS functions as a semi-open system under the general ETS cap. Airlines can purchase and surrender both EUAs and EUAs (general ETS allowances) to fulfil their ETS obligations beyond their allocation of free allowances but other sectors cannot purchase EUAs.

Moreover, unlike the stationary ETS sectors whose cap declines 1.74% each year, the sector was further privileged as the aviation cap does not decline on an annual basis. The cap was reduced from 97% of historical emissions (2004-2006) in 2012 to 95% during phase III (2013-2020) and is not set to decline further during the period until 2020. This was a concession made to industry pressure in 2008 and is without any basis in sound climate policy. For phase III (2013-2020) 82% of EUAs are allocated free of charge to aircraft operators and

² EU-28, Iceland, Liechtenstein and Norway

³ One allowance represents the right to emit one tonne of CO₂-equivalents (CO₂-eq). Aircraft operators only have to surrender allowances for CO₂ emissions (see 2.3) but since nitrous oxide (N₂O) and perfluorocarbon (PFC) emissions from certain industrial processes are included in the EU ETS, CO₂-eq is used as unit of measurement.

See EEA, 2016. Report No 6/2016, *Application of the EU Emissions Trading Directive*, www.eea.europa.eu/publications/ets-directive-2015

15% are auctioned. The remaining 3% is set aside in a Special Reserve (SR) for new airlines or for airlines whose emissions increased on average by at least 18% annually between 2010-2014.

1.1. International resistance

Well after the EU decided to include aviation into its ETS (2008), US carriers acting through Airlines for America (A4A), the powerful US industry lobby, sued in the UK courts in December 2009 that the ETS was illegal under international law. A4A was later able to convince the Obama Administration, specifically the US Federal Aviation Administration (FAA), to orchestrate foreign resistance to the law. United Airline's regulatory chief had led the industry legal challenge in 2009 and then taken up in June 2010 the post of Assistant Administrator for Policy, International Affairs and the Environment at the FAA.

At a meeting in Delhi, India in September 2011, orchestrated by the US, the "coalition of the unwilling" was formed and declared its opposition to aviation's inclusion in ETS. Aside from airlines in the US, Europe and in developing states, the unwilling coalition soon attracted support from states such as China, Russia, India, Saudi Arabia, Cuba, Algeria, Argentina and others. The US even passed a law - the Thune Bill - prohibiting US carriers from complying with the EU ETS when they operated in Europe. It still stands but has yet to be activated by the Federal Transport Secretary.

Since both intra-EEA and international flights departing and arriving at EEA airports were included in the ETS, the coalition of the unwilling claimed that the EU breached non-EU countries' sovereignty⁴. However the European Court of Justice, having had the challenge from US carriers referred to it, ruled in late 2011 that this was not the case and that the full scope of the EU ETS was fully consistent with international law.

Undeterred by such decisions, the sabre rattling continued and reached a crescendo in Airbus headquarters in Toulouse where company chiefs convinced themselves that Chinese threats not to purchase aircraft on order because of the ETS, despite having paid non-refundable deposits, were more important than European legislation to put the industry on a path towards sustainability. Calls from Airbus' Headquarters in Toulouse to heads of Government in Berlin, London and Paris, were followed by a tripartite Ministerial demarche to European Commission President Barroso. Within two weeks - the short timing was quite unprecedented - the European Commission waived its independent right to propose new laws and on 12 November 2012 issued a proposal to *stop the clock* on the aviation ETS.

This *stop-the-clock* law, formally agreed between Council and Parliament in April 2013 just before airlines were required to surrender allowances for 2012, reduced retroactively to 01 January 2012 the scope of the aviation ETS to only those flights operating between EEA airports (e.g. Prague to Warsaw but not London to New York). This reduced the emissions covered by some 75%. All carriers flying between EEA airports regardless of the carrier's country of registration would be required to comply with the reduced scope.

The European Commission justified its decision by claiming that stopping the clock for a year would add to the political momentum at the approaching 2013 ICAO Assembly to develop a Global Market Based Mechanism (GMBM)⁵. The 2013 ICAO Assembly did indeed agree to develop a GMBM for implementation in 2020 but all the difficult questions over the details of the measure were deferred for discussion over the next three years and decision at ICAO's 2016 Assembly.

Following the European Commission's review of the 2013 ICAO Assembly outcome, a further proposal was introduced by the European Commission on 16 October 2013 to extend the coverage of the aviation ETS by including in addition all flights between the EEA and third countries in proportion to the distance

⁴ The detailed story on international pressure can be found in Sandbag, 2013. *Aviation and the EU ETS*, www.sandbag.org.uk/site_media/pdfs/reports/Sandbag_Aviation_and_the_EU_ETS_2012_171213_1.pdf

⁵ European Commission, 2012. www.ec.europa.eu/clima/policies/transport/aviation/docs/com_2012_697_en.pdf

travelled within the European region. The “European Regional Airspace” approach would apply from 2014-2020. This proposal was not, however, supported by member states nor by a plenary majority of the European Parliament.

Instead a Regulation (421/2014) was decided in March 2014 to extend the *stop-the-clock* intra-EEA scope a second time until the end of 2016 with provision for a full snap back of the original scope of the EU ETS on 01 January 2017 unless further amended in light of the 2016 ICAO Assembly. Procedures were also simplified for small non-commercial operators by exempting those (some 2200 operators or an estimated 0.2% of emissions) with annual full scope emissions below 1000 tonnes⁶.

Despite these European moves, some countries even objected to the inclusion of their intra-EEA flights in the ETS. States such as China, India, Saudi Arabia and Russia went so far as to prohibit their airlines to comply with the reduced scope ETS.

Box 1: The reduced ETS scope in practice

Under the second *stop-the-clock* legislation (2013-2016) the amount of free and auctioned EUAAs was reduced proportionately to cover flights departing from and arriving at EEA airports only. All unallocated allowances were cancelled. In order for operators to adjust to the reduced scope of the scheme, they were granted an extra year to fulfil their 2013 compliance obligations. Therefore, reporting and surrendering obligations for both 2013 and 2014 were due in 2015.

⁶ European Commission, 2013. http://europa.eu/rapid/press-release_MEMO-13-905_en.htm

2. Emissions mitigated

While crucial reforms to strengthen the system are indispensable, the EU ETS proves effective in mitigating aviation emissions.

2.1. The aviation cap

Under the aviation EU ETS, emissions from aviation are capped. This means an emission allowance has to be surrendered for every tonne of CO₂ an aircraft operator emits.

In the midst of the legislative uncertainty following the original *stop-the-clock* proposal, a number of exceptional changes affected the aviation cap. Operators were granted an extra year to surrender allowances for their 2013 emissions and the auctioning of 9.5 million allowances was postponed from 2012 to 2014.⁷ These technical changes affect the assessment of the scheme's environmental impact for the 2013-2015 period covered by this report. The 9.5 million extra aviation allowances that came onto the market in 2014 and 2015 led to fewer reductions in the overall ETS (see 2.2). This one-off postponement is unlikely to occur again during the remaining years of phase III (2016 - 2020).

To capture the environmental impact of the scheme during the period 2013 - 2015, we differentiate between an annual 'legal' cap – the reduced cap as foreseen in the ETS legislation - and an annual 'de facto' cap that consists of all aviation allowances actually *available* to operators by taking the effect of the technical changes into account (see Box 2).

In the current third ETS phase (2013-2020) the aviation cap corresponds to 95% of the average historical aviation emissions between 2004 and 2006.⁸ Under the original full scope of the aviation ETS - covering all flights from and to EEA airports - the legal annual cap was set at 210.5 million EU Aviation Allowances (EUAs). This cap includes the allowances that were added when Croatia joined the scheme (see Figure 1). In addition, aircraft operators are entitled to use credits bought on the international carbon market - above the legal cap - to account for up to 1.5%⁹ of their total verified emissions in phase III (see Box 3).

Box 2: Legal versus *de facto* aviation cap

In this report we refer to the annual 'legal' aviation cap to indicate all phase III EU Aviation Allowances (EUAs) that enter the market every year, as foreseen in the ETS legislation. This includes all EUAs allocated for free (82%), all auctioned EUAs (15%) and the allowances issued from the special reserve (3%).

However, in phase III extra EUAs came available to operators in addition to those envisaged by the ETS legislation. These extra EUAs were postponed from phase II (2012) to phase III following the first *stop-the-clock* decision. Therefore, when calculating the *de facto* cap for the 2013-2015 period in question, we must combine the legal annual EUAs and those EUAs postponed from 2012. While the ETS is usually evaluated at the end of the trading period, the *de facto* cap enables us to calculate the *annual* emissions mitigated by the inclusion of aviation in the ETS (see 2.3).

⁷ A small amount was auctioned in 2015. See Annex I

⁸ Average EU aviation emissions for 2004-2006 stood at 219,476,343 tonnes. However, since the ETS covers the entire EEA, total historical emissions were calculated at 221,420,279 tonnes. See European Commission, 2011. *Decision No 87/2011 of the EEA Joint Committee*, http://ec.europa.eu/clima/policies/ets/allowances/aviation/docs/eea_01072011_en.pdf

⁹ In addition to this, operators had the opportunity to bank and transfer all unused international credit entitlements from phase II (2012) to phase III (see Box 3)

Box 3: International credits

The EU ETS was developed in the context of the Kyoto Protocol requiring emission reductions in industrialised - Annex I - countries. By means of two flexibility mechanisms, Joint Implementation (JI) and the Clean Development Mechanism (CDM), the Kyoto Protocol allows Annex I countries to achieve their reduction targets cost-effectively by purchasing emission reductions in other countries. In Annex I countries, these so-called offsets are captured in Emission Reduction Units (ERUs) under JI. Reductions in developing countries, on the other hand, generate Certified Emission Reduction (CER) credits under the CDM. While subject to qualitative¹⁰ and quantitative restrictions, both types of international credits can be used for compliance with the EU ETS. In phase III, aircraft operators are allowed to use international credits to account for up to 1.5% of their total verified emissions. This constitutes an operator's 'international credit entitlement'. In addition to this, operators had the opportunity to bank and transfer all unused international credit entitlements from phase II (2012) to phase III.

International credits come on top of the overall EU ETS cap, which is also one of several reasons why the 'legal cap' differs from the 'de facto' cap in a given year (see Box 2). However, due to a lack of transparency (see Box 4) the actual number of international credits available and used by operators can no longer be quantified. Therefore, international credits have been excluded from our calculation of the de facto cap.

The Regulation prolonging the *stop-the-clock* Decision at the beginning of phase III reduced the scope of the aviation EU ETS by 75% (see Annex I). This created a reduced cap to reflect the new situation. The phase III (82%-15%) split between free and auctioned EUAAs was retained but the actual amount of both free and auctioned EUAAs was reduced proportionately to cover only flights departing from and arriving at EEA airports.¹¹

Due to the hasty changes to the legislation following the *stop-the-clock* Decision, a number of exceptional deviations such as the delayed auctioning of some 9.5 million allowances, affected the number of allowances actually available to operators (see Box 2). Table 1 therefore presents the annual *de facto* cap for the year 2013 to 2015. Further methodological details can be found in Annex I.

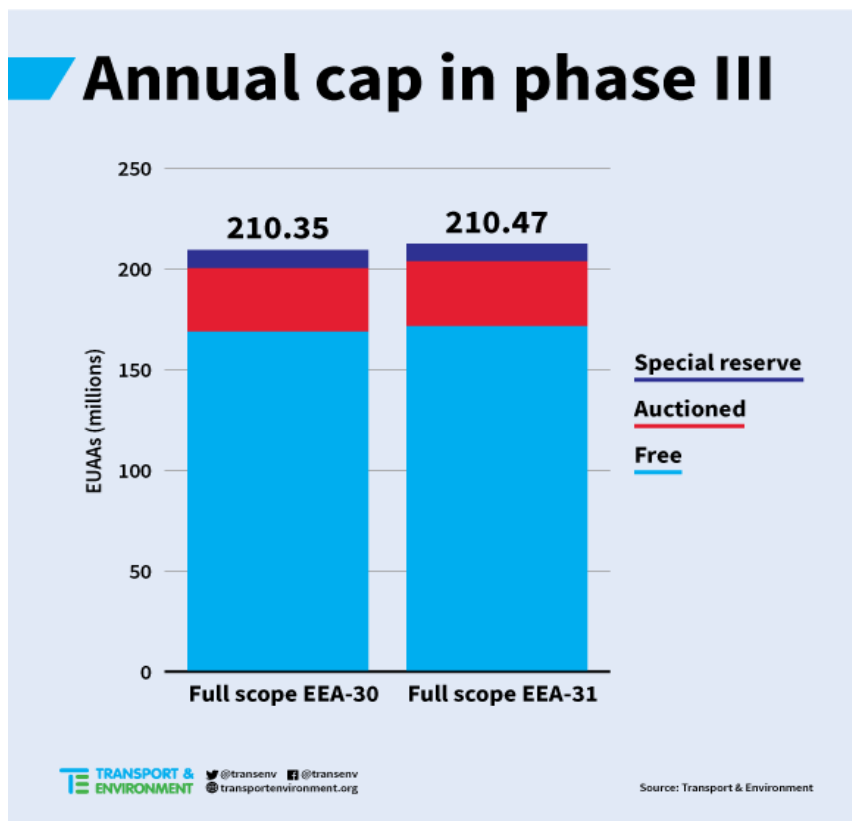
	Free EUAAs	Auctioned EUAAs	Postponed phase II EUAAs	De facto cap
2013	32,352,975	5,427,375	0	37,780,350
2014	32,300,688	5,427,375	9,278,000	47,006,063
2015	32,300,680	5,427,375	108,375	37,836,430

Table 1: 2013-2015 *de facto* annual cap

¹⁰ All existing (pre-2012) ERUs and CERs from the first commitment period of the Kyoto Protocol (2008-2012) remain valid. However, in addition to qualitative criteria the use of international credits is increasingly restricted. Newly generated (post-2012) ERUs have to be generated by projects in countries that have ratified the second commitment period of the Kyoto Protocol (2013-2020). Post-2020 CERs have to be generated in Least Developed Countries (LDCs). See European Commission, 2016. http://ec.europa.eu/clima/policies/ets/credits/index_en.htm

¹¹ Unlike the free and auctioning EUAAs, the amount of Special Reserve (SR) allowances destined for new and growing AOs was not reduced proportionately to reflect the reduced scope. The SR thus remains at 3% of the original scope. Importantly, the amount actually given out to new and growing operators is based on their intra-EEA activity and therefore still corresponds to the reduced scope. All remaining unallocated allowances from the SR will be cancelled at the end of the third trading phase. See European Commission, 2015.

http://ec.europa.eu/clima/policies/transport/aviation/docs/faq_special_reserve_en.pdf



Neither the legal nor the de facto aviation cap provides an absolute ceiling for aviation emissions. The aviation ETS is semi-open: airline operators are permitted to buy and surrender general EUAs from the stationary ETS in order to account for their above-the-cap emissions (see 2.2).

Figure 1: Full scope aviation allowances - before and after the inclusion of Croatia

Box 4: Exchange of international credits and reduced transparency

In the third trading phase (2013-2020) international credits cannot be surrendered for compliance directly and need to be first converted into EUAAs. Since international credits can no longer be tracked publically, their inclusion in the analysis of surrendered units is not possible.

Publically accessible information on the EU Transaction Log (EUTL) provides only the total amount of remaining entitlements covering the combined phases II and III, i.e. 2008-2020, without specifying the number of credits each operator surrenders annually in the form of EUAAs.

The lack of transparency impedes any assessment of the environmental integrity of the international credits, as well as the true costs to the operators. After 2012 it is no longer possible to publically trace either the amount or the origins of the international credits surrendered for compliance.¹² Arguably, the current system provides for a sustainability check by the Commission, which only converts international credits into EUAs when all sustainability criteria laid down in the EU legislation are fulfilled. Nonetheless, until such times as the use of international credits is discontinued, the functioning of the aviation EU ETS would benefit from the Commission providing increased transparency in this regard.¹³

¹² This stands in stark contrast with the phase II (2008-2012) rules on surrendering international credits, where AOs were allowed to surrender CERs and ERUs directly, making it possible to publically track the amount of international credits. Due to this transparency, the Sandbag report on "stop the clock" in 2012 estimated the windfall profits acquired by operators. See Sandbag, 2013. *Aviation and the EU ETS*

¹³ The Commission publishes annual international credit exchange statistics, including exchanges both to EUAAs and EUAs, but only in aggregate format per operator. This impedes the analysis of the exchange performed by AOs as no split data is provided

2.2. Emissions mitigated

If left unchecked, international aviation emissions are projected to increase by up to 300% by 2050¹⁴. The sector's rapid and unregulated growth poses an immense challenge to any realistic prospect of limiting temperature increase to 2°C, let alone 1.5°C. This growth has been fuelled by subsidies, including VAT and fuel taxation exemptions, which are unavailable to other modes of transport. EU aviation emissions are growing continuously beyond the aviation ETS cap. Intra-EEA emissions saw a 6.5% increase from 53.5 million tonnes in 2013 to 57 million tonnes in 2015.

	Verified emissions (tonnes CO ₂)	De facto aviation cap	Purchased EUAs
2013	53,488,202	37,780,350	15,707,852
2014	54,807,478	47,006,063	7,801,415
2015	56,998,815	37,836,430	19,162,385
Total	165,294,495	122,622,843	42,671,652

Table 2: Purchase of general ETS allowances in 2013-2015

However, the intention behind the inclusion of aviation in the EU ETS was to enable mitigation at the lowest cost – whether that be within the aviation sector itself or through purchasing allowances from other sectors. To this end, airlines are allowed to purchase general ETS allowances (EUAs) in order to make up for the gap between their total annual emissions and the sector's own cap. By reducing the amount of allowances available for stationary ETS sectors, aviation's inclusion in the ETS drives emission reductions in these sectors.

To cover their emissions for the years 2013 to 2015, operators purchased 42.7 million EUAs (Table 2). This amount reflects the tonnes of CO₂ mitigated at the EU level by reducing the availability of emission allowances for other sectors in the EU ETS.

By means of the *de facto* cap – the amount of aviation allowances available to operators – we can estimate the amount of general ETS allowances purchased. The lower the *de facto* cap, the more EUAs operators have to purchase from the general ETS. Table 2 indicates that while aviation emissions were capped just below 38 million tonnes in 2013, the total amount of aviation emissions stood at 53.5 million tonnes. Operators thus purchased an estimated 15.7 million EUAs to cover their 2013 emissions. In 2014, due to the auctioning of 9.5 million postponed 2012 allowances on top of the legal cap, the *de facto* cap increased to 47 million allowances and operators purchased 7.8 million EUAs. In 2015, the amount of aviation allowances entering the market normalised again to 38 million, spurring operators to purchase 19.2 million EUAs. Between 2013 and 2015, operators had to purchase 42.7 million EUAs to cover their emissions above the aviation cap. If it were not for the surplus in the general ETS, this number would represent the tonnes of CO₂ reduced in non-aviation sectors. Currently, aviation contributes to the depletion of the surplus. Since the general ETS cap declines and measures have been taken to reduce the surplus, aviation's inclusion will eventually lead to an overall reduction in emissions from these covered sectors (see Box 5).

Box 5: aviation's emission reductions will occur when the ETS surplus is eliminated

Due to the 2008 recession and the overly generous allocation of free allowances, the stationary ETS suffers from an oversupply of two billion allowances. As such, the carbon price remains too low to effectively drive emission reductions. Stationary installations will be able to cover their emissions with allocated and banked allowances until far into the fourth trading period – possibly until 2028 - depending on the ambition of the ongoing legislative review of the EU ETS.

Importantly, the exhaustion of the surplus is accelerated by the inclusion of aviation in the ETS. The increasing demand for allowances from the aviation sector will bring forward the date by

¹⁴ ICAO, 2009. www.icao.int/environmental-protection/GIACC/Giacc-4/CENV_GIACC4_IP1_IP2%20IP3.pdf

which banked allowances for use by stationary installations will be exhausted. The larger the geographic scope of the aviation ETS and thus demand for EUAs, the earlier the surplus will be exhausted. While the exact emission reductions from aviation's inclusion in the ETS cannot be quantified at this stage¹⁵, the total emissions under the ETS in the period 2012-2030 will be lower than they would have been without the inclusion of aviation in the scheme.

While aviation emissions grow above the *aviation cap*, all CO₂ emitted by ETS sectors (aviation and stationary installations) remains under the overall ETS cap. As this cap declines and important initial measures have been taken to reduce the surplus, aviation's inclusion will eventually lead to an overall reduction in emissions from these covered sectors. Further measures to reduce the oversupply of allowances need to be addressed by decision makers as they legislate for the fourth phase of the ETS (2021 - 2030) to effectively implement the EU's 2030 climate package. As scarcity of allowances increases, resulting in an increase in the average price of allowances, emission reductions within both the stationary and aviation sectors will be incentivised.

2.3. Aviation's non-CO₂ effects

When the European Commission proposed in December 2006 that aviation be brought into the EU ETS, it noted that

Aviation has an impact on the global climate through releases of carbon dioxide, nitrogen oxides, water vapour and sulphate and soot particles. The IPCC has estimated that the total impact of aviation currently is two to four times higher than the effect of its past carbon dioxide emissions alone. [...] In accordance with Article 174(2) of the Treaty, Community environment policy must be based on the precautionary principle and therefore all impacts of aviation should be addressed to the extent possible. Pending scientific progress to identify suitable metrics for comparing the different impacts, a pragmatic and precautionary approach is required. Emissions of nitrogen oxides will be addressed in other legislation to be presented by the Commission¹⁶.

The European Parliament subsequently proposed in 2008 that, pending the other legislation on NO_x emissions envisaged by the Commission, a multiplier of two be applied to aviation CO₂ emissions under the ETS. This proposal was rejected by member states. In October 2008, after the incorporation of aviation into the EU ETS had been agreed, CE Delft published a report "Lower NO_x at Higher Altitudes"¹⁷ for the European Commission which concluded that two cost-effective policy instruments - a NO_x charge or the inclusion of NO_x in the aviation EU ETS - have the potential to reduce the climate impact of aviation NO_x emissions. Further research is needed before these instruments can be implemented¹⁸.

The report estimates that this can be done within three to five years, given sufficient study. Based on the CE Delft conclusion the Commission decided not to take any further action. We are not aware of any further work by the Commission to follow up on the research needs identified by CE Delft.

Barely months after the CE Delft study was published, in April 2009, eight international scientists put aviation's total contribution to climate change – measured by its radiative forcing - in 2005 at an estimated

¹⁵ The 42.7 tonnes of CO₂ represent a proxy for the aviation emissions mitigated at EU level

¹⁶ European Commission, 2006. *COM(2006) 818 final*, <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52006PC0818>

¹⁷ CE Delft, 2008. *Lower NO_x at Higher Altitudes*, http://ec.europa.eu/transport/modes/air/studies/doc/environment/oct_2008_nox_final_report.pdf

¹⁸ A global warming potential (GWP) for aviation NO_x has to be established and the relationship between Landing and Take Off (LTO) and cruise emissions has to be established in a sufficiently robust way

4.9%.¹⁹ This figure was well over the 3% these same authors came up with two years previously in the IPCC's Fourth Assessment Report on the state of global warming.

2.4. Aviation biofuels

Under the EU ETS, aviation operators are requested to report the use of alternative fuels. If these fuels comply with the sustainability criteria under the Renewable Energy Directive (RED), they are not counted as emissions. However, those sustainability criteria do not account for Indirect Land Use Change (ILUC). This occurs when agricultural land is used to grow biofuel feedstocks, which indirectly leads to more deforestation to make up for the loss of land to produce food. As was demonstrated by a recent study²⁰ for the European Commission that included ILUC into its analysis, the majority of biofuels currently on the market for road transport do not reduce, and in some cases even produce considerably more, emissions compared to the fossil fuel they replace.

By allowing the zero-rating of the biofuel emissions, operators do not need to surrender emission allowances for the use of a fuel that still contributes to climate change. So far, no operator has made use of this possibility. Due to the low allowance price operators prefer to pay for the emissions instead of proving that the alternative fuel complies with RED criteria.

Despite operator's limited interest, zero-rating needs to be abolished. Measured proposed by IATA²¹ and ICAO²² to address the steep growth of aviation emissions rely heavily on biofuels. However, the mistakes of road transport policies incentivising unsustainable biofuels, leading to massive deforestation should be avoided when governments and industry are looking for ways to increase the uptake of biofuels. Only truly sustainable advanced biofuels from non-land based feedstocks such as organic waste should be promoted as an alternative to fossil fuels. Aviation has to compete with other sectors for the already limited amount of advance biofuels and the development of new alternatives is facing difficulties. The small supply of truly sustainable biofuels suitable for aviation will not satisfy the sector's exponential demand. Consequently, waiting for biofuels to bring about a future of sustainable aviation is not an option.

2.5. Conclusions and recommendations

Despite the changes following the reduction of the scope, the inclusion of aviation in EU ETS can be judged a success. The aviation EU ETS proves an important functional scheme that has been effective in capping aviation emissions. In the years 2013-2015, for every tonne of aviation CO₂ emitted by intra-EEA flights, an emission allowance has been surrendered by operators. While EU aviation emissions continue to rise, this growth above the cap - set at the average of 2004-2006 aviation emissions levels - eventually results in emission reductions in other (stationary) ETS sectors and at a lower cost than could have been achieved within the aviation sector.

Nonetheless, the overall EU ETS needs to be strengthened. Legislators have to seize the opportunity presented by the ongoing legislative review of the fourth trading period (2021-2030) to address the surplus of allowances in the general ETS. Structural reforms beyond the establishment of a Market Stability Reserve (MSR) are needed for the carbon price to incentivise structural emission reductions and to address the surplus allowances in a sensible timeframe. One way of addressing this issue is to increase the linear reduction factor (LRF) in the general EU ETS and introduce a similar LRF for the aviation ETS. Furthermore, the environmental impact of the aviation ETS will be significantly improved by adding a multiplier to account for non-CO₂ emissions.

¹⁹ Lee et al., 2009. *Aviation and global climate change in the 21st century*, <http://tinyurl.com/opk8nc>

²⁰ Ecofys, IIASA and E4tech, 2015. *The land use change impact of biofuels consumed in the EU*, https://ec.europa.eu/energy/sites/ener/files/documents/Final%20Report_GLOBIOM_publication.pdf

²¹ Global Aviation Industry, 2010. *The right flightpath to reduce aviation emissions* (A position paper), www.atag.org/component/downloads/downloads/72.html

²² ICAO, 2013. *Present and future trends in aircraft noise and emissions* (Assembly 28th Session No. Working paper), www.icao.int/Meetings/a38/Documents/WP/wp026_en.pdf

3. Compliance

Third country operators increasingly come into compliance with the aviation EU ETS. Three years into the third trading phase, there has been a high degree of compliance even by operators from third countries whose governments vowed to oppose the measure. While some issues particularly relating to transparency of enforcement remain, our analysis shows that the aviation EU ETS proves to be a functional system.

3.1. The annual compliance cycle

Under the second *stop-the-clock* legislation 2013-2016, all airlines that operated flights between airports located in the EEA in a given year had to report their emissions to their administering member state²³ by March 31 of the following year. Allowances covering these emissions had to be surrendered by April 30. Due to the late changes to operator's obligations when the aviation EU ETS was scaled down to its current intra-EAA scope, operators were granted an extra year to fulfil their 2013 obligations. Therefore, reporting and surrendering obligations for both 2013 and 2014 were due in March and April 2015. Apart from operators that are exempt from the scheme due to their small size or public function²⁴, all operators that fail to report emissions or surrender allowances are non-compliant. For the sake of simplicity we identify two types of non-compliance: (1) operators who opened an Aircraft Operator Holding Account (AOHA) in the European Union Transaction Log (EUTL)²⁵ but failed to surrender sufficient allowances to cover their emissions and (2) operators who operated flights within the EEA but did not open an AOHA (see Figure 2).

3.2. Enforcement

The responsibility for the implementation of the aviation EU ETS lies with the member states that transpose the Directive into their national legislation. Member states confirm which operators have surrendering obligations and whether sufficient allowances have been issued. The Directive stipulates a fine of €100 per allowance that an operator fails to surrender, as well as the operator's obligation to surrender allowances to cover its emissions.²⁶ In addition, many member states have additional 'local' penalty enforcement measures which differ from state to state. As a last resort, when an airline persistently refuses to comply or settle the non-compliance penalty, the Directive provides that the member state can request the Commission to impose an operating ban on the respective airline. So far, no member state has requested that such a ban be applied.

3.2.1. Disclosure of non-compliance

The Directive requires member states to publish the names of non-compliant operators.²⁷ However, so far member states appear reluctant to call out publicly or openly penalise airlines, partly due to the political sensitivities surrounding the scheme. Member states argue that the names of these airlines should not be published until legal disputes have been resolved. Since airlines can appeal against the estimate of their verified emissions²⁸, delay can be substantial. Due to this lack of transparency, an exhaustive list of operators

²³ An airline's ETS obligations are administered by the Competent Authority of the member state that represents the largest share of its estimated emissions, or, in case of EEA-based airlines, by the member state that provided their operating license. See EU ETS Directive, Article 18a, http://ec.europa.eu/clima/policies/ets/monitoring/operators/index_en.htm

²⁴ Laid down in Annex I of the ETS Directive

²⁵ The European Union Transaction Log (EUTL) is a publicly accessible database, which mirrors parts of the Union Registry. The Registry is the general accounting system managed by the Commission containing all data on the accounts in which allowances are held. In terms of data on verified emissions, surrendering obligations and compliance status, the EUTL only shows annual snapshots of the Registry

²⁶ EU ETS Directive, Art. 16(3)

²⁷ EU ETS Directive, Art. 16(2)

²⁸ Member states obtain conservative emission estimates from Eurocontrol when an airline does not report its emissions. See EEA, 2016. *Application of the EU Emissions Trading Directive*

that received penalties is not available (see Box 6). Out of all airlines that have received payment notices, only the names of the airlines that do not contest the penalty are disclosed at a time that the member state sees fit. Figure 2 outlines member states enforcement procedures and illustrates where a lack of transparency hampers public assessment of compliance.

Box 6: Non-transparency of enforcement procedures

Although its domestic legislation requires the publication of an annual non-compliance list, the UK publishes the 2012 non-compliance list of 25 operators in March 2016. In August 2016, four cases of 2013-2014 non-compliance were added. In 2015 Germany published a list of 44 definitive cases out of a total of 60 airlines which had received payment notices related to the 2012 compliance cycle. To date the list has not been updated, leaving unknown the status of the remaining 16 airlines.²⁹

Delaying publication of non-compliance lists until lengthy legal proceedings have been resolved, undermines the ETS' transparency. This practice protects non-compliant airlines that opt to appeal against a fine. The payment notice in itself - before the official fine is issued - indicates irregularities and thus a form of prima facie non-compliance. Its non-publication creates speculation as to which airlines are non-compliant and for what reasons.

In quite a few cases the airlines have gone bankrupt and conclusion or recovery of fines is proving difficult. In other cases, non-compliance was the result of an explicit prohibition to comply, imposed by the carrier's home government. The example of China Southern, which was not issued a fine by the Dutch Government on the apparent condition it would come into compliance, suggests that in some cases enforcement is subject to political, diplomatic or commercial considerations which undermine the measure's integrity. By waiving penalties, member states are not only in breach of the Directive, but also grant airlines from larger, more politically powerful, states an advantage in avoiding compliance.

By withholding information on ongoing enforcement procedures, member states obscure the strength of their own enforcement powers and arguably undermine their sovereignty. Furthermore, the impression may arise that non-compliance is much higher than it is in reality. Member states should thus disclose all information on enforcement procedures, both to increase compliance as well as to fulfil their duty of transparency.

Germany, France, Italy and the UK are the few member states that facilitate public scrutiny by publishing the names of penalised airlines on the websites of their respective Competent Authorities (CAs) – although after considerable delay. Other member states either report airlines that have received penalties through the Article 21 report - in which they document the domestic application of the ETS Directive - or remain silent on the matter altogether. Since member state reports are rather inaccessible and thus rarely consulted by media or relevant stakeholders, the public nature of this information can be questioned. While these member states are not in breach of their reporting requirements, the publication of non-compliance lists on competent authority websites should be encouraged.

²⁹ Green Air, 2015. www.greenaironline.com/news.php?viewStory=2054

Enforcement of aviation ETS

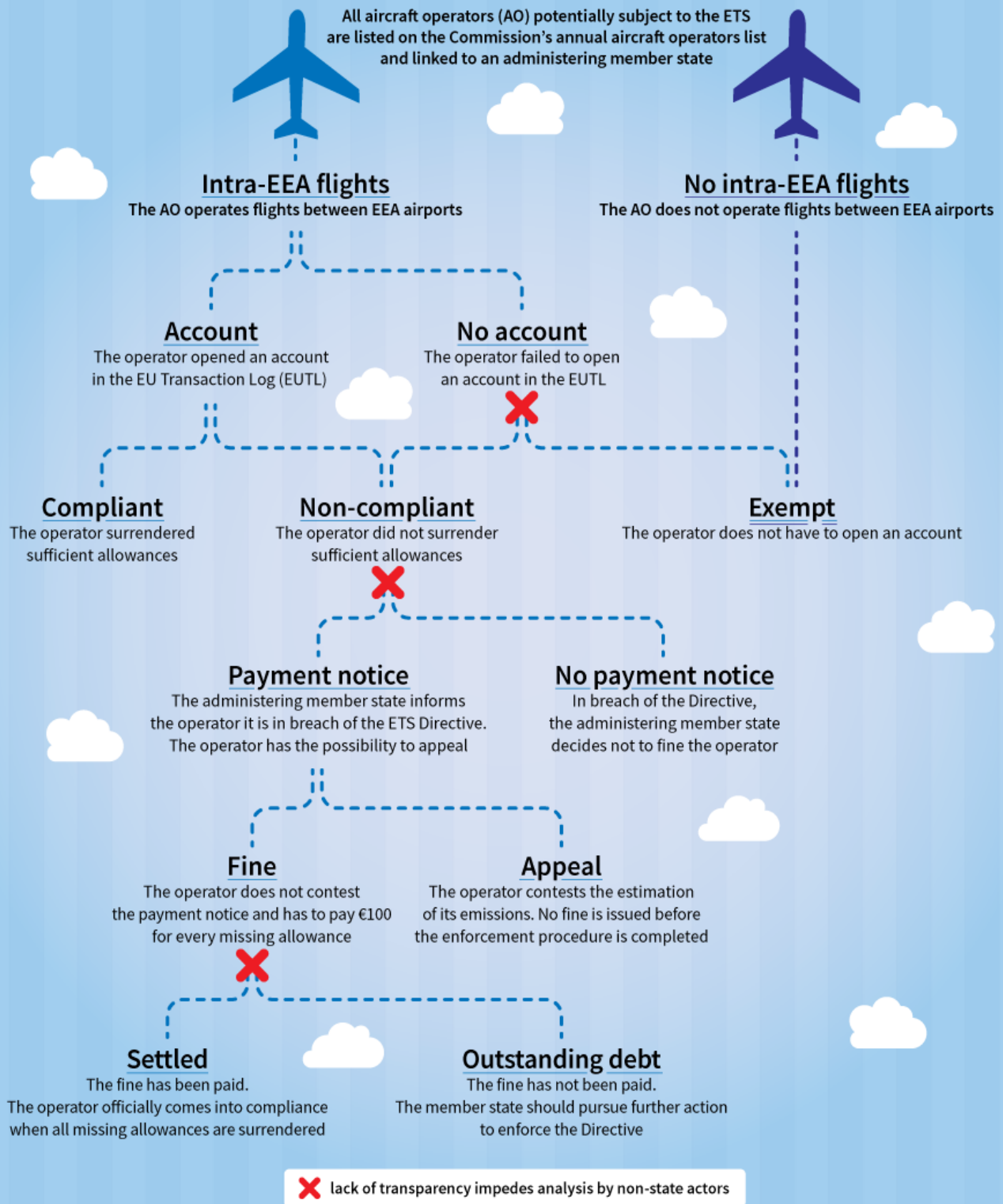


Figure 2: Member states' enforcement procedures

3.3. Non-compliance

Figures from the European Commission indicate that both for 2013-14 and 2015 “[t]he level of compliance with the EU ETS rules is higher: aircraft operators responsible for 99% of aviation emissions covered under the EU ETS comply”³⁰. The remaining one percent were emissions of operators with an AOHA who failed to surrender sufficient allowances³¹ and from operators who never opened an account. The compliance rate in terms of number of aircraft operators is lower due to the unknown but substantial number of non-compliant small operators. These account for a very minor share of EU aviation emissions.

3.3.1. Missing AOHA and small operators

Since the EUTL only contains information on operators that have an account, it is impossible to know whether a missing AOHA indicates non-compliance. The operator could be exempt from the ETS. In addition to existing exemptions for small operators, the second *stop-the-clock* legislation exempted around 2200 non-commercial small operators – responsible for 0.2% of emissions. Other operators may have either ceased intra-EEA operations or ceased operations altogether over the course of the years. Since small emitters are defined by a flight and emissions based threshold, operators can be exempt in one year and have surrendering obligations again in the next. Following the reduction of the scope, this was especially the case for some larger third country airlines that had become small emitters in terms of intra-EEA emissions.

In addition to this uncertainty surrounding exempt operators, the amount of missing AOHA has not been made public (a transparency issue). Consequently, it remains impossible for non-state actors to quantify whether compliance increased or decreased among all operators. However, since all non-compliant operators combined, both with and without AOHA, account for only one percent of emissions covered by the scheme, we assume that mainly small emitters are missing an account. Furthermore, as the second *stop-the-clock* legislation (2013-2016) broadened the exemptions for non-commercial small operators, many operators that did not open an account in 2013 or thereafter should no longer be included in the assessment of compliance. We understand that the amount of non-compliant aircraft operators without an account is very limited. In this report we thus limit our analysis to those airlines that appear in the EUTL. Methodological caveats can be found in Annex III.

3.3.2. General compliance rate

Annual data published by the Commission³² shows compliance is high. For the 2013-14 compliance cycle, 93% (522 out of 561) of operators with surrendering obligations complied. 763 operators with an account were exempt. For 2015, 94% (564 out of 602) were compliant and 723 were exempt.

3.4. Third country compliance

Even after the scope of the aviation ETS was reduced to intra-EEA flights, countries such as India, China, Saudi Arabia and Russia continued to maintain their opposition to the reduced scope and obliged their airlines not to comply with the EU ETS. While the 2012 compliance rate among operators from these countries was still higher than expected,³³ third country airlines such as Air India, Jet Airways, Air China, Aeroflot, Ethiopian Airlines, Kenyan Airlines and Saudi Arabian Airlines did not comply.

Due to the incompleteness of the EUTL (see Annex III) and the unknown amount of missing operator accounts, it is not possible to get an exhaustive overview of the current compliance rate among third country operators. We therefore analysed compliance among (1) Chinese and (2) Russian carriers as well as (3) large

³⁰ European Commission, 2015. http://europa.eu/rapid/press-release_IP-15-4987_en.htm;

European Commission, 2016. http://ec.europa.eu/clima/news/articles/news_2016052001_en.htm

³¹ This is indicated in the EUTL as compliance code B or C

³² European Commission, 2016. http://ec.europa.eu/clima/policies/ets/registry/documentation_en.htm (Compliance data in annual Commission reports)

³³ Sandbag, 2013. *Aviation and the EU ETS*

third country airlines and (4) a sample of aircraft operators that refused to comply in 2012. Despite a few exceptions, political resistance has declined dramatically and the aviation ETS is almost universally accepted.

3.4.1. China

Despite initial resistance³⁴, all Chinese operators have come into compliance³⁵. In 2012 only two operators - Hong Kong based Cathay Pacific and Metrojet - were compliant. Most Chinese carriers came into compliance in 2014, including large operators such as flag carrier Air China and China Southern. China Southern complied following negotiations with the Dutch Competent Authority which waived its 2012 fine (see Box 6). China Eastern and Hainan Airlines were exempt in 2015 but have - since 2014 - complied with all previous compliance cycles³⁶. A large number of small Chinese operators (33) did not open an account. According to information from ETS administrators, these airlines are either exempt or ceased operations covered by the EU ETS. These operators might still be non-compliant for the 2012 compliance cycle, because member states do not publish information on the settlement of ETS penalties (see below). However, among Chinese operators that have surrendering obligations, the compliance rate is 100%. The analysis can be consulted in Annex IV.

3.4.2. Russia

14 out of 17 (82%) Russian operators covered by the ETS are currently compliant, of which 11 have been compliant since the start of the scheme in 2012. Three operators are non-compliant. Transaero Airlines went bankrupt in late 2015, but had always complied up until 2015. Aeroflot and Rossiya Airlines - two affiliated state owned carriers administered by Germany - never surrendered allowances. They are part of the few third country operators that still refuse to comply with the ETS. As with the many small Chinese carriers, all 113 Russian operators without account are presumably exempt, among which also Mikoyan³⁷ that was recently fined by the UK for 2012 compliance. An overview can be consulted in Annex IV.

3.4.3. Other third country airlines

Compliance is high among large airlines. 27 out of the 30 largest commercial third country operators - in terms of 2012 intra-EEA emissions³⁸ - are currently compliant. Those that are not either ceased operations - two US airlines - or entered negotiations with its administrative EU member state. Despite successful negotiations with the Flemish Competent Authority³⁹, Saudi Arabian Airlines remains non-compliant according to the EUTL, but this could be due to the time lag between annual EUTL updates (see Annex III).

Table 3 presents a non-exhaustive list of third country operators that did not comply in 2012. Most of them have come into compliance throughout the years, which demonstrates the scheme is increasingly effective.

	Airline	State of operator	Administering EU member state	Non-compliance	Enforcement status	(Potential) fine
Curr entlv	Tam Linhas Aereas	Brazil	UK	2012	Unknown	€23,500

³⁴ In 2012, Chinese airlines were prohibited to comply with the EU ETS without government approval. See The Telegraph, 2012. www.telegraph.co.uk/travel/news/China-bans-airlines-from-EUs-Emissions-Trading-Scheme

³⁵ Eight Chinese operators with ETS obligations have surrendered allowances for all compliance cycles

³⁶ The compliance code indicates whether the operator was compliant in all previous compliance cycles

³⁷ Listed by the Commission as MIG Russian Aircraft

³⁸ Council of the European Union, 2013. *Interinstitutional file 2013/0344(COD)*, <http://data.consilium.europa.eu/doc/document/ST-16247-2013-INIT/en/pdf>

³⁹ The Flemish Competent Authority confirmed that negotiations were completed and Saudi Arabian Airlines surrendered sufficient allowances for all compliance cycles (email correspondence May 2016)

Non-compliant	Air India	India	UK	2012-14	2012 penalty	€14,761
	Jet Airways	India	UK	2012	2012 penalty	€15,175
	Kenya Airways*	Kenya	UK	2012-14	2013-14 penalty**	€17,600
	Ethiopian Airlines	Ethiopia	IT	2012	2012 penalty	€1,962,000
	Iraqi Airways	Iraq	DE	2014-15	Unknown	€311,700
	Saudi Arabian Airlines***	Saudi Arabia	BE (FL)	2012-15	2012 penalty	€1,433,700

* Excluded

** Insufficient fine

*** Successful diplomatic effort but still non-compliant in EUTL

Table 3: third country operators

3.5. Fines

Between 2013 and 2016, 113 aircraft operators have been reported by member states as non-compliant. Currently, only the German⁴⁰ (44), Italian⁴¹ (15), French⁴² (16) and British⁴³ (29) Competent Authorities published the names of these airlines on their websites. Four other member states (Cyprus, Luxembourg, Spain and Sweden) and Iceland reported penalising aircraft operators by means of the Article 21 report on the application of the ETS Directive. While there is a large overlap between both reporting tools, France, for instance, published a non-compliance list on its website but did not mention these penalties in the Article 21 report. Many other countries only used the report to disclose non-compliance (see Box 7).

In 2015, Belgium fined Saudi Arabian Airlines €1.4 million but never reported the airline, neither through the Article 21 report nor on its website. In

Box 7: Article 21

Article 21 of the EU ETS Directive requires member states to report on all aspects related to the implementation of the Directive, including member states' specific enforcement measures. The Commission provided a template for these reports by means of an Article 21 questionnaire. Penalties should be reported through question 11.8: *"In the table below, please provide the names of aircraft operators for which excess emission penalties were imposed during the reporting period pursuant to Article 16(3) of Directive 2003/87/EC."*⁴⁶

89 operators have been reported in the Article 21 questionnaire⁴⁷. These include the AOs published on the German, Italian and British Competent Authority websites. 24 operators (Germany (4), UK (4) and France (16)) are mentioned on non-

⁴⁰ German Emissions Trading Authority (DEHSt), 2015.

www.dehst.de/Archiv/Emissionshandel/Sanktionierung/sanktionierung_node.html

⁴¹Italian Ministry of the Environment, 2014.

www.minambiente.it/sites/default/files/archivio/allegati/emission_trading/comunicato_operatori_aerei_sanzione_rev_2.pdf

⁴² French Directorate General for Civil Aviation (DGAC), 2016. www.developpement-durable.gouv.fr/Account-in-the-European-registry.html

⁴³Oddly, when the UK updated the list in August 2016 to include 2013-2014 non-compliance, five operators - Air India, Primevalue Trading, Media Consulting Services, Oranto Petroleum and Loid Global - disappeared. This study incorporates all information, before and after this update. See UK Environment Agency, 2016. www.gov.uk/government/publications/climate-change-regimes-civil-penalties-imposed/eu-ets-civil-penalties-aviation

⁴⁶ European Commission, 2014. <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014D0166>

⁴⁷ Article 21 reports on the EEA Central Data Repository, <http://cdr.eionet.europa.eu/ReportekEngine/searchdataflow>

the 2014 report, the Flemish Competent Authority responsible for administering the airline mentioned negotiations were ongoing but even after the fine was settled⁴⁴, Belgium did not report the case of non-compliance as required under the ETS Directive⁴⁵. Only after rumours arose was the penalty confirmed through a Flemish Parliamentary Question, which moreover revealed that Flanders had also fined a second operator, a US company Green Diesel, €6,600. Green Diesel ceased operations in 2013 and the Flemish authorities have been unable to recover the fine.

compliance lists but do not appear in the questionnaire, bringing the total to 113.

Apart from the British list, so far the official non-compliance lists only concern the 2012 compliance cycle as member states delay publication until all enforcement procedures are completed. The Article 21 questionnaire assesses penalties imposed during the reported period. However, due to the long enforcement process and political nature of certain penalties, the fine could concern non-compliance in any previous compliance cycle.

Including both Flemish penalties, the number of uncontested fines imposed for both types of non-compliance amounts to 115, mostly concerning the 2012 compliance cycle (see Box 7). The number of airlines receiving payment notices is higher, but as member states generally do not disclose information on these 'non-definitive cases', no complete figures on airlines receiving payment notices are available. Furthermore, information on the exact value of the uncontested penalties, as well as whether these have been settled, often remains an open question as this information is not systematically published⁴⁸. So far, only the UK and France included the value of the penalties in their non-compliance lists. Fines ranged from €1,728 to €188,979 in the UK and €1,200 to €69,400 in France. According to GreenAir, the German fines ranged from €100 to €203,600 and amount to a total of €597,000. The contested cases total €4,766,400.⁴⁹

In order to improve the essential transparency of the aviation EU ETS, member states should publish the names of all airlines receiving payment notices – including contested cases. Additionally the amount of the penalty as well as the status of the enforcement procedure - contested, uncontested, settled – should be disclosed.

3.5.1. Compliance among fined operators

Based on the information available in the EUTL, 45% of fined operators came into compliance, 41% did not open an account and 11% remain non-compliant⁵⁰. Most of the latter are currently exempt due to their small size but remain non-compliant as they did not surrender the missing 2012 allowances. According to information from ETS administrators, those without an account are either exempt or ceased (intra-EEA) operations. Among operators that have an account (including those that were exempt in 2015), 76% are compliant. Among fined operators that currently have surrendering obligations - thus leaving out all exempt operators - 92% are compliant (see Annex V).

In terms of the effectiveness of the penalties, certain member states appear more successful than others. The UK stands out with 86% of fined airlines that are currently compliant. Many of these are larger airlines coming into compliance during the 2013-14 compliance cycle. France, Germany and Italy predominantly fined smaller operators that either ceased intra-EEA operations or were exempt from 2013 onwards. When leaving exempt operators out of the analysis, compliance rates among operators fined by the UK, France, Germany and Italy rise to above 60%. In the case of the UK, all but one fined operator currently comply with the ETS (see Annex V).

⁴⁴ Email correspondence May 2016

⁴⁵ Belgian Article 21 report, http://cdr.eionet.europa.eu/Converters/run_conversion?file=be/eu/emt/envvvyi3a/be-eu-emt-envu6gexg.xml&conv=527&source=remote

⁴⁸ To obtain this information each individual Competent Authority should be approached. However, certain member states such as Italy fail to respond to formal requests for environmental information

⁴⁹ Green Air, 2015. www.greenaironline.com/news.php?viewStory=2054

⁵⁰ The remaining 3% have an account but no assigned compliance code. See Annex III

As highlighted by the Commission in 2013, member states' diplomatic outreach to third countries combined with "a firm approach to enforcement against non-compliance under the 2012 *stop-the-clock* Decision will set a strong precedent and increase the credibility of the EU ETS with all operators."⁵¹ While member states should disclose complete information on enforcement procedures and refrain from penalty waivers, the EU's commitment to firm enforcement has proven to be effective.

The scheme's high compliance rate and especially the fact that nearly all large third country airlines, as well as airlines from India and China comply, demonstrates that the EU's right to regulate EEA flights has been accepted.

3.6. Conclusions and recommendations

The compliance rate of the aviation EU ETS is high and in terms of the share of total *aviation emissions* is as high as 99%. Based on the available information in the EUTL between 93% and 94% of *operators* comply. Furthermore, a considerable number of penalised airlines that are still covered by the ETS have now come into compliance. Nearly all airlines that failed to comply in 2012 have come into compliance. Some of these have been fined but others should still face penalties for the years they did not surrender (sufficient) allowances.

While a complete picture is not available due to a lack of data on non-compliance, individual cases as well as targeted country analyses indicate that political resistance - by refusing to comply - has declined dramatically. Apart from Aeroflot, Rossiya Airlines and Iraqi Airlines, the vast majority of airlines from countries resisting the scheme on political grounds came into compliance during the first years of the third trading period. Due to effective enforcement and especially diplomatic outreach by administering member states, the Europe's right to regulate EEA flights is now accepted international practice.

⁵¹ Council of the European Union, 2013. *Interinstitutional file 2013/0344(COD)*

4. Costs and revenues

The costs ETS would impose on the industry and passengers, as well as the “dishonest” use of auction revenues by the member states, were at the forefront of the industry attacks on the inclusion of aviation in the EU ETS. In 2008, IATA claimed that *“In its first year of operation, the ETS will add €3.5 billion to industry costs and this will rise year-on-year. [...] The plain fact is that the only sure beneficiaries of the €3.5 billion cost will be national government coffers. There is no assurance that any of the money will go to environmental programmes”*.⁵² The following analysis shows that, not only were the costs to the industry four times smaller than what IATA claimed between 2013-2015, but that even though the ETS costs are generally passed on to passengers, they have negligible impact on ticket prices. In addition, data on the use of auction revenues indicate that on average more than two thirds of all the EU ETS revenues have been spent for climate and energy purposes by EU member states – more than the recommended 50% under the ETS directive.

The move to auctioning as the only method of distributing aviation allowances has yet to occur. This is especially counterproductive given that the average price of a tonne of CO₂ stood at around €6 in recent years, which is itself too low to incentivise investment into CO₂ abatement measures. Currently, only 15% of aviation allowances (and all the additional EUAs that operators have to purchase) are auctioned, which represents a small share of total auctioning revenues. In this section we look into the revenue that member states obtained from auctioning EUAAs, as well as the related cost for the aviation industry.

As the verified emissions (in tonnes of CO₂) of airlines exceed the number of free aviation allowances allocated to them, airlines have to purchase EUAAs through auctions. Since aviation remains a growth industry, operators are also allowed to purchase and surrender EUAs in order to make up for the gap between their total annual verified emissions and the aviation ETS cap. Total ETS costs to the aviation industry thus consist of the auctioned EUAAs and the EUAs operators purchase (as well as the international credits, although they can no longer be tracked publically in phase III).

The number of allowances to be auctioned each year by a specific member state⁵³ is based on the share of aviation emissions attributed to each member state.⁵⁴ However, the number of EUAAs actually auctioned is less straightforward due to the technical changes following the reduction of the scope to intra-EEA flights only (see 2.1).

The auctioning of aviation allowances was suspended in 2012, following the first *stop-the-clock* Decision (377/2013/EU) and resumed in 2014 after the second *stop-the-clock* Regulation (421/2014). Germany had already auctioned 2.5 million EUAAs. As a result, the remaining 9.5 million phase II EUAAs were postponed to 2014.⁵⁵ In addition, due to the ongoing negotiations on the second *stop-the-clock*, the aviation auctions for 2013, 2014 and 2015 were held in early 2015.⁵⁶ Hence, when calculating the amount of purchased EUAAs, one also needs to account for the postponed allowances from the phase II (see Table 4).

⁵² IATA, 2008. *European ETS Vote: The Wrong Answer*, <http://www.iata.org/pressroom/pr/Pages/2008-07-08-01.aspx>

⁵³ 25 member states auction allowances through a common auction platform set up at European Energy Exchange (EEX). Germany and Poland chose to opt-out from the common platform and auction their shares of allowances separately at EEX. The UK chose ICE Futures Europe as their opt-out auction platform. See http://ec.europa.eu/clima/policies/ets/auctioning/index_en.htm

⁵⁴ The total of an operator’s emissions are attributed to its administering member state, where most emissions took place during the reference year (i.e. 2010). See European Commission, 2010. http://europa.eu/rapid/press-release_MEMO-11-139_en.htm

⁵⁵ European Commission, 2014. http://ec.europa.eu/clima/news/articles/news_2014072901_en.htm

⁵⁶ Auctions were held before 30th of April 2015 - the deadline to surrender allowances for 2013 and 2014 emissions

4.1. Total costs of aviation ETS

The purchase of emission allowances constitutes the main cost for operators as a result of being included into the aviation EU ETS.⁵⁷ The other costs are mainly administrative, which will not be analysed in this report. The non-administrative cost is calculated based on the total amount of EUAAs and EUAs airline operators purchase at auction.⁵⁸

Table 4 presents the total purchased allowances and the associated costs to operators. It illustrates that as operators' emissions grew between 2013 and 2015, total costs also increased as a result of a need to purchase more allowances. These costs were approximately €152 million in 2013, €148 million in 2014 and €178 million in 2015. As the price of allowances fluctuates, while aviation emissions increased in 2014, the lower price of allowances in that year resulted in a lower financial cost for operators.

However, the absolute increase in costs between 2013 and 2015 (also) reflects the fact that operators pay increasing amounts to cover their growing requirement for additional EUAs.

	Verified emissions (tonnes CO ₂)	Free EUAAs	Purchased allowances		Total	
			Estimated EUAAs	Estimated EUAs	Purchased allowances	Costs
2013	53,488,202	32,352,975	5,427,375	15,707,852	21,135,227	€152,718,429
2014	54,807,478	32,300,688	14,705,375	7,801,415	22,506,790	€148,930,270
2015	56,998,815	32,300,680	5,535,750	19,162,385	24,698,135	€178,509,413
Total	165,294,49	96,954,343	25,668,500	42,671,652	68,340,152	€480,158,112

Table 4: ETS costs for aircraft operators

⁵⁷ The cost of international credits used for compliance is not taken into account as the purchase and surrender of international credits can no longer be tracked (see Box 5)

⁵⁸ The total cost for the purchased EUAAs is available on the auction platforms. However, since neither auction platform discloses the identity of the buyers of EUAs, it is not possible to differentiate between the EUAs purchased by airline operators and the operators of stationary installations. Hence, an average price for all EUAs can be used for calculating the costs to the AOs purchasing EUAs in addition to the EUAAs. Furthermore, it is also assumed that airline operators purchased all of their EUAs in 2015 to cover the years 2013-2015

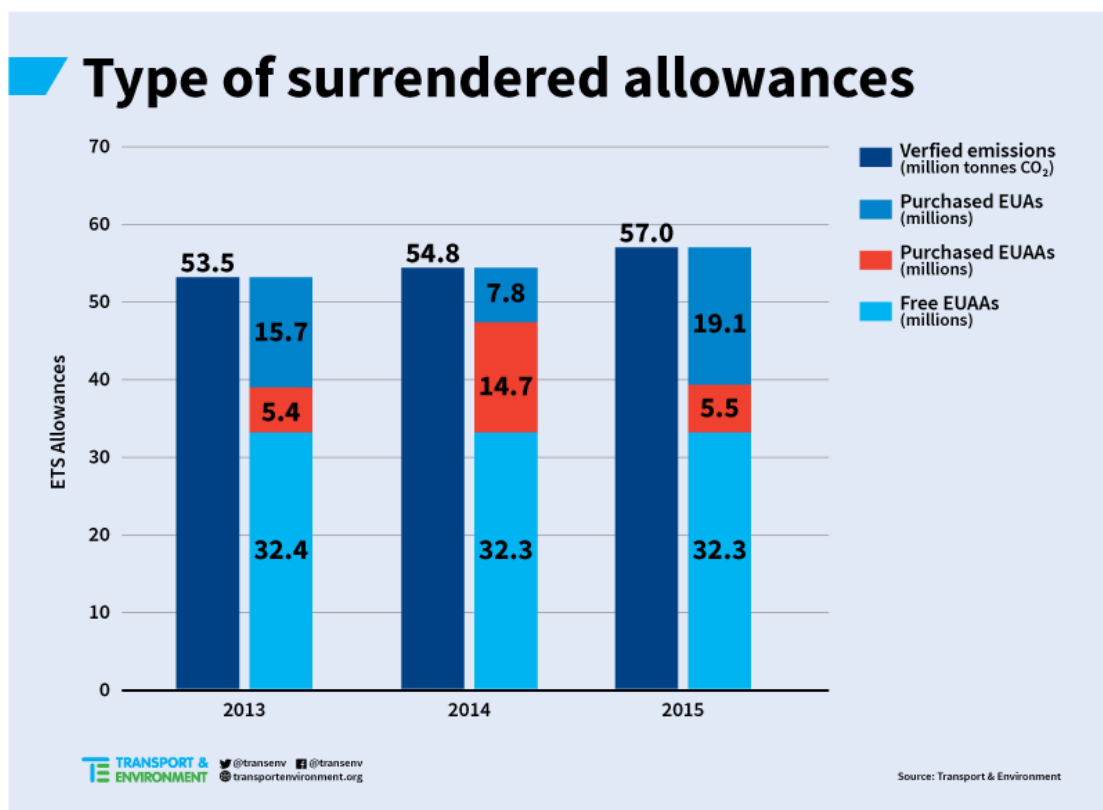


Figure 3: growth in 2013-2015 verified emissions

These figures indicate that the costs to industry have been much lower than those presented by industry at the onset of the aviation ETS - €3.5 billion per annum. Even when the reduction of scope (-75%) is taken into account - approximately €875 million per annum - the industry figure is more than four times higher than the average annual cost of €150 and €180 million between 2013-2015.

Table 4 and Figure 3 present an interesting conclusion: under the current ETS rules the per tonne unit cost of total emitted CO₂ (i.e. total cost/verified emissions) was about 3€/t between 2013-2015⁵⁹ - approximately half as much as the average CO₂/t price in the EU ETS.⁶⁰ This is because 82% of EUAs are allocated to operators free of charge, which reduces the total ETS costs for aircraft operators by about 50%.⁶¹ One implication of this is that, unless the current split of free and auctioned allowances changes, any increase in the price of CO₂/t will only be reflected marginally in the total costs to operators. To put it simply, if the CO₂/t price rose by 100% under the current emissions level and free/auctioned EUAA split, this would only increase the total cost to industry by roughly 50%.

Under current carbon prices the additional cost to operators of carrying each passenger per flight is also insignificant compared to the broader environmental impact of aviation emissions. ICAO's emissions calculator allows to estimate CO₂ emissions per passenger per distance/journey travelled⁶², which can then be used to measure the additional costs of aviation ETS per passenger if these costs are added to ticket prices (see Figure 4 and Annex VI).

⁵⁹ €2.86/t in 2013, €2.72/t in 2014 and €3.13/t in 2015

⁶⁰ On average €6.75/t between 2013-2015

⁶¹ The total cost of purchased and auctioned EUAs and EAs divided by total verified emissions

⁶² ICAO Carbon Calculator, <http://applications.icao.int/icec>

Per ticket additional costs of EU aviation ETS (€)

✈ Climate ambition arrival status

RANGE	DEPARTING AIRPORT	ARRIVAL AIRPORT	CO ₂ BURNED PER PASSENGER (KG)	CURRENT ETS COST (€)	STATUS
SHORT-HAUL	LONDON	FRANKFURT	84.2	0.26	TOO LOW
MEDIUM-HAUL	LONDON	LARNACA	242.6	0.76	TOO LOW
LONG-HAUL	LONDON	NEW YORK	361.9	1.13	TOO LOW

Figure 4: per ticket additional costs of aviation EU ETS (€)

Taking into account the real per tonne unit cost of total emitted CO₂ in 2015 - €3.13/t – the aviation EU ETS adds approximately €0.26 to a single economy class passenger ticket between London and Frankfurt, €0.76 to a ticket between London and Larnaca, and €1.13 to a ticket between London and New York (currently exempt, thus, hypothetical comparison). If operators were to purchase all of their allowances without any free allocation, under the average 2015 carbon prices (€7.33/t) this would add €0.62 to a London-Frankfurt ticket, €1.78 to a London-Larnaca ticket and €2.65 to a London-New York ticket. Under a hypothetical €25/t (and no free allocation) scenario, the same additional cost per ticket would be €2.11 for a London-Frankfurt flight, €6.07 for a London-Larnaca flight and €9.05 for a London-New York flight assuming ETS costs were to be passed on to passengers.

Furthermore, airlines that have received free EUAAs are likely to have passed on the opportunity costs of these free allowances through higher fares or surcharges because, in principle, they could sell these EUAAs on the market. Doing so would generate windfall profits ('Opportunity cost windfall').⁶³

4.2. Auction revenue for governments

The total revenues derived from the auctioning of EUAAs by the administering governments are publically accessible under two tracks: 1) ICE and EEX auction platform reports, and 2) member state Article 17 reports to the European Commission on their auction revenues and spending from these revenues on green projects.

Regarding the auction platforms, split revenues can be calculated for the UK, Germany and Poland, as these countries have chosen to auction their shares separately (see Table 5). However, split EUAA related revenues for the remaining EU25 are not provided by the auction platforms.

As far as the member states Article 17 reports are concerned, the quality of data is at best insufficient, as there are delays and inconsistencies in member state reporting. Therefore, data from auction platforms offer a better route to calculate auction revenues.

⁶³ CE Delft, 2012. *Costs and Benefits of Stopping the Clock: How Airlines Profit from Changes in the EU ETS*, www.transportenvironment.org/sites/te/files/publications/CE_Delft_7931_Costs_and_Benefits_Stopping_Clock_Final.pdf

	2013		2014		2015	
	EUAAs	Revenues (€)	EUAAs	Revenues (€)	EUAAs	Revenues (€)
EU25⁶⁴	0	0	6,570,500	39,454,510	11,207,500	78,864,225
Germany	0	0	0	0	2,229,000	16,867,680
Poland	0	0	0	0	433,500	2,982,480
UK	0	0	2,707,500	14,079,000	2,520,500	18,540,740
Total	0	0	9,278,000	53,533,510	16,390,500	117,255,125

Table 5: Revenues from EUAAs by the EU member states⁶⁵

As table 5 indicates, the total revenues from auctioning of EUAAs stood at approximately €54 million for 2014, while the figure rises to €117 million in 2015. Revenues for 2013 total zero - this is explained by the fact that the second stop-the-clock legislation provided the operator with the option to surrender 2013 allowances in 2015 instead of 2014. Therefore, ECAA auctions for 2013 and 2014 took place in 2015, so revenues were allocated to that year. The revenues generated in 2014, on the other hand, came from the auctioning of the postponed 2012 revenues. Given the fact that from 2016 there are no more carried-over (from 2012) EUAAs, under the current scope of the aviation EU ETS, the revenues of the member states will likely be lower for the year 2016.

It is important to note that the calculations in table 5 only cover the reduced scope of the aviation EU ETS. Potential revenues from flights from and to third country airports have been foregone. Assuming 15% auctioning split, under the average ECAA €7.40/t price for 2015 the full scope ETS (210 million tonnes cap) would have generated approximately €234 million of revenues for member states. If all allowances under the full scope were to be allocated via auction only, revenues would rise to about €1.55 billion in 2015. Under a €25/t price scenario, the full scope aviation ETS would generate more than €5 billion in revenue.

4.3. Use of Auction revenues

Under the ETS rules, member states are recommended to use at least 50% of their auction revenues on projects to tackle climate change in the EU and third countries. In reality, this proportion has proven to be much higher. Member states report to the Commission their revenues from the total EU ETS and their corresponding spending on environmental projects.⁶⁶ Unfortunately, most member states do not differentiate between ECAA and ECAA revenue. Despite the lack of split data, as well as missing information on several member states (such as unreported revenues and spending), our analysis of member states' reporting demonstrates that more than two-thirds of the revenues generated by the EU ETS (both general and aviation) are spent on environmental projects.

In specific terms, in 2013 out of €3.6 million total ETS revenue, €2.8 million was spent on climate and energy projects (78.4%). In 2014 this amounted to €2.6 million out of a total of €3.2 million (83.4%), while in 2015 out of €4.2 million revenue, €3.5 million was spent on green projects (84.6%). Member states thus spend significantly more than half of the ETS revenue for climate and energy purposes.

However, it is not possible to calculate the split share of ECAA auction revenues spent on climate and energy projects as the majority of the member states report their spending from the EUAs and ECAAAs in a single pot.

⁶⁴ In fact, this figure includes Norway, Iceland and Liechtenstein in addition to the remaining EU 25

⁶⁵ Unlike costs for the industry, it is very difficult and potentially impractical to apportion auctioning revenues to the years 2013 to 2015. Therefore, in this report the ECAA auction revenues are allocated to the years they were sold

⁶⁶ Article 17 reports on the EEA Central Data Repository, <http://cdr.eionet.europa.eu/ReportekEngine/searchdataflow>

4.1. Conclusions and recommendations

The analysis of the aviation ETS has indicated that the cost to industry has been much lower than what industry claimed. On the one hand, even the “costs to industry” itself is misleading as the ETS costs will have largely or entirely been passed onto passengers, and in some cases leading to windfall profits to the airlines.⁶⁷ At the individual passenger level the ETS costs are negligible, ranging from €0.26 for a short-haul flight to €1.78 for a (hypothetical) long-haul flight. On the other hand, member states of the EU have been consistent in earmarking the majority of ETS revenue for financing environmental projects.

Nevertheless, the aviation ETS would benefit from further structural reforms, such as elimination of free allocation and surplus in general EU ETS, in order to ensure that the cost of the ETS truly reflects aviation’s external costs.

⁶⁷ Sandbag, 2013. *Aviation and the EU ETS*

5. Policy recommendations

The current revision of the EU ETS for the period 2021-2030 is a crucial opportunity for legislators to enhance the scheme's environmental performance. The following reforms are indispensable to strengthen EU ETS:

Strengthen overall ETS - *exhaust surplus to incentivise emission reductions*

1. Adopt measures beyond addressing surplus allowances through the Market Stability Reserve
2. Reduce the cap by 2.6 % annually
3. Broaden the scope of aviation in the ETS starting in 2017, for example to cover 50% of incoming and outgoing flights

Strengthen aviation ETS - *reflect true cost of aviation emissions and improve transparency*

- Reflect true cost of aviation emissions

4. Set declining cap on aviation allowances which will require operators to purchase more general ETS allowances
5. Phase out free allocation to aircraft operators
6. Apply a multiplier of two to aviation CO₂ emissions to account for non-CO₂ emissions and reflect its true climate impact

- Improve transparency

7. Disclose the amount of international credits used for compliance by aircraft operators
8. Put forward a clear deadline for when member states must publish *complete* lists of non-compliant airlines along with the status of the enforcement procedure and the fine to be payed

ANNEX I: Methodology of the *stop-the-clock de facto* cap

After the first *stop-the-clock* decision, auctions of EUAAs were suspended. Germany had already conducted its EUAA auction for 2012 by that time, becoming the only country to auction 2.5 million EUAAs. All other countries postponed their 2012 EUAA auctions and resumed them only in 2014. For phase III, the 2013 to 2015 EUAAs were auctioned in 2015. Poland was an exception as it auctioned all 2012 to 2015 EUAA volumes in 2015 and did not auction any EUAAs in 2014.⁶⁸

The following approach⁶⁹ was taken to distribute auctioned EUAAs between 2013, 2014 and 2015:

- i. The number of phase III EUAAs auctioned in 2015 (EU25, UK and Germany) were divided by 3 and distributed equally among the years 2013 to 2015;
- ii. The number of EUAAs auctioned in 2015 by Poland were divided by 4. The 3 portions were distributed equally between 2013-2015, while the 4th portion (Poland's share of the postponed 2012 EUAAs) added to the share of 2015;
- iii. Approximately 9.3 million of postponed 2012 EUAAs (EU25 and UK), which were auctioned in 2014, were added to the reduced cap of 2014.

Technically, Special Reserve allowances belong to the “de-facto cap”. However, since they have yet to be allocated for the years 2013-2015 (retroactive allocation starts in 2017), they do not carry practical relevance for the estimation of mitigated emissions. Consequently, SR allowances were left out of the quantification of the *de facto* cap.

⁶⁸ European Commission, 2014. www.ec.europa.eu/clima/news/articles/news_2014100901_en.htm

⁶⁹ Partly based on the methodology used by the European Environmental Agency, 2015. *Trends and projections in the EU ETS in 2015*, www.eea.europa.eu/publications/trends-and-projections-eu-ets-2015

ANNEX II: Methodology of the *stop-the-clock* scope

When the aviation ETS was scaled down to cover intra-EEA flights only, the scope – in terms of emissions covered - was reduced by 75%.

When quantifying this reduction, we define the scope as the total amount of aviation *emissions* under the ETS. All emissions from flights departing and arriving at intra-EEA airports – the full scope – amounted to 221,420,279 tonnes.⁷⁰ The average verified emissions during *stop-the-clock* years 2013-2015 (55,098,165 tonnes) represent 25% of the original full scope.

We chose to calculate the reduction of the scope based on the actual annual *emissions* instead of using the annual aviation *cap* as a proxy. The eventual number of allowances that determine the level of the cap is a political decision on a policy tool designed to bring down emissions. It does not correspond to the actual amount of emissions brought under EU climate policy. This is especially relevant because operators need to account not only for the emissions under, but also above, the aviation cap. Therefore, emissions both under and above the cap (i.e. verified emissions) are part of the scope.

⁷⁰ Reference year 2012 is used to calculate the aviation cap. The accession of Croatia is accounted for

ANNEX III: Incomplete EUTL data

Calculations and qualitative assessments based on the EUTL should be treated with caution. Member States, who are responsible for monitoring operators, continuously update this information. The Commission only updates the EUTL once a year, on 1st May. This suggests that there may well be a time lag before operators coming into compliance throughout the year appear in the EUTL. When the airline operates intra-EEA without opening an account, the member state is authorised to enter verified emissions and/or a compliance code retroactively. It is unclear whether this is done by all member states. To further complicate the issue, certain operators are confronted with (administrative) difficulties when attempting to open an account. For instance, to avoid money laundering, France screens all operators before they can open an account. As such, operators without verified emissions and/or compliance codes in certain years, can either be non-compliant, exempt or in the process of opening an account. Lastly, member states can correct earlier mistakes that are only updated the following year. Consequently, the Commission reports and the EUTL do not contain full and accurate data, which is exemplified by the empty compliance codes and verified emission fields of certain EUTL entries.

Since many third country operators came into compliance during the 2013-2014 compliance cycle, we assume that most significant updates of the EUTL have been carried out. While far from completely accurate, quantitative assessments based on the EUTL – last updated on May 1st 2016 – can give an indication of the compliance rate.

ANNEX IV: Analysis third country airlines

	Airline	Administering EU member state	Non-compliance	Enforcement status	Potential fine
Previously non-compliant	Premier Aviation	FR	2012-2014	Unknown	€95,100
	Atran-Aviatrans	SE	2014	Unknown	€454,700
	Petroff Air*	IT	2012	verified emissions: 0	not applicable
Non-compliant	Transaero Airlines	ES	2015	Unknown	€13,100
	Aeroflot	DE	2012-2015	Unknown	€215,000
	Rossiya Airlines	DE	2012-2015	Unknown	€52,800

* excluded

Table 6: Russian operators that refused to comply in 2012

Airline	Administering EU member state	Non-compliance	Enforcement status	Potential fine
Air China	DE	2012	Unknown	€825,700
Air China Cargo	DE	2012	Unknown	€93,100
China Southern	NL	2012	Unknown	€551,700
China Eastern*	FR	2012	not fined	€272,300
China Cargo Airlines	FR	2012	not fined	€199,400
Yangtze River Express	LU	2012-2014	2012 penalty	€480,100 (2012) €1,558,200 (2013-14)
Hainan Airlines*	BE	2012	Unknown	€3,700
Baa Jet Management	UK	2012	Unknown	€9,100
Cathay Pacific	UK	compliant	compliant	compliant
MetroJet	UK	compliant	compliant	compliant

Table 7: Previous non-compliance Chinese operators

ANNEX V: Analysis fined operators

	Total	Compliant	Non-compliant	No account	Compliance rate
UK	29	25	1	3	86%
FR	16	2	1	11	13%
DE	44	13	8	22	30%
IT	15	6	1	7	40%

Table 8: Compliance rate among all fined operators (including operators without account)

	Compliant	Total	Compliance rate
UK	25	26	96%
FR	2	3	67%
DE	13	21	62%
IT	6	7	86%

Table 9: Compliance rate among fined operators in EUTL (excluding operators without account)

Annex VI: Additional costs of aviation ETS

Range	Departing Airport	Arriving Airport	Distance (km)	Aircraft Fuel Burn (kg)	CO ₂ burned per passenger (kg)	Per ticket additional costs (€)		
						Actual ETS cost (€3.13/t)	Hypothetical full auctioning cost (€7.33/t)	Hypothetical 25€ ETS cost (€25/t)
Short-Haul	London	Frankfurt	653	4247.9	84.2	€0.26	€0.62	€2.11
Medium-Haul	London	Larnaca	3275	17161.8	242.6	€0.76	€1.78	€6.07
Long-Haul*	London	New York	5536	56781.9	361.9	€1.13	€2.65	€9.05

*Full scope ETS

Table 10: Per ticket additional costs of EU aviation ETS (€)