
SWEDAVIA'S CO2 EMISSION CHARGE 2022

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1**SUMMARY**

Swedavia is introducing a CO2 Emission Charge at Stockholm Arlanda and Göteborg Landvetter that is set to be revenue neutral for Swedavia. The charge is based on a bonus/malus differentiation for three separate segments of traffic.

1. Passenger traffic \leq 175 MTOW
2. Other traffic \leq 175 MTOW
3. All traffic $>$ 175 MTOW

The modulation is set for a financial turnover of 24.8 MSEK, of which 20 MSEK at Stockholm Arlanda and 4.8 MSEK at Göteborg Landvetter. This corresponds to approximately 10 % of the total invoicing of the take-off charge at the respective airports. A total of SEK 12.4 million is transferred from the flights deemed to have the greatest relative climate impact through fees to those flights that are deemed to have the least relative climate impact via bonuses. Each segment at each airport is modulated to have a neutral net effect and any deviations in outcomes, from the principle of cost neutrality, are regulated in subsequent years' charges similar to the management of the risk-sharing programs for traffic and investments.

The introduction of the CO2 Emission Charge is made to comply with § 6 of the Swedish regulation on airport charges.

The current Emission Charge will change name to 'NOx Emission Charge' 1 January 2022 for the avoidance of confusion.

2

INTRODUCTION

Following an amendment to the Swedish Act on Airport charges, *Lag (2011:886) om Flygplatsavgifter*, the Swedish government has introduced a requirement that airport charges should be differentiated for environmental purposes.

Pursuant to the new § 6 of the Swedish Regulation on Airport Charges, *Förordning (2011:867) om flygplatsavgifter*, airport charges relating to take-off or landing of aircrafts shall be differentiated in accordance with the aircrafts' climate impact and the differentiation shall reduce the climate impact of aviation.

6 § Flygplatsavgifter som avser start eller landning av luftfartyg ska differentieras i förhållande till luftfartygs klimatpåverkan. Differentieringen ska göras så att flygets klimatpåverkan minskar.

Amendment 2021:666 of 23 June 2021 to the regulation on airport charges (2011:867)

Swedavia initiated in spring 2021, with the aim to introduce an environmentally differentiated charge 1 January 2022, a dedicated working group together with airport users, aimed at finding the best way to differentiate charges for environmental purposes. The working group has had a technical focus with in-depth discussions resulting in proposals being featured in the regular consultation process.

Areas of division between different users have been made evident in the discussions in the working group as well as in the regular consultation process; some airport users would prefer a modulation that accounts for actual load factors, while others argue that such a model would only benefit certain business models and that it is the technology of aircraft's themselves that is to be focused upon.

Swedavia's CO2 Emission Charge focuses on the aircraft's emission of fossil CO2, which Swedavia considers best reflects the wording of the regulation cited above.

3 GENERAL DESCRIPTION OF THE CO2 EMISSION CHARGE

The charge is set up according to bonus/malus principles in order to incentivise the use of cleaner aircraft at Stockholm Arlanda and Göteborg Landvetter Airport, the two Swedavia airports directly regulated by the Act on Airport charges. The underlying mechanics of such a model is that aircraft which emit more CO₂ than average should pay a penalty which finances a bonus for aircraft emitting less than average. The modulation is set to have an increasing effect the further away from the relative average CO₂-emission value through a linear formula.

In Swedavia's price list, the charge is categorised as an aircraft related take-off charge and the financial turnover constitutes approximately 10 % of the take-off charges invoiced per airport, i.e., 20 MSEK at Stockholm Arlanda and 4.8 MSEK at Göteborg Landvetter. Overall, 12.4 MSEK is transferred through charges (malus) from flights assessed as having the largest relative climate impact to flights with the assessed lowest relative climate impact through discounts (bonus).

The climate impact of aviation can be monitored by measuring the average CO₂ emissions per airport over time.

Three segments are introduced to ensure relevant comparison, e.g. a smaller aircraft is compared to the average emission within its own segment rather than being compared against larger aircrafts. The evaluation of relative CO₂ emissions varies between the segments and is either based on CO₂ per MTOW or CO₂ per seat, further information in chapter 4.

Airlines can also invest in sustainable aviation fuels in order to lower their fossil carbon footprint, which is reflected in the modulation through the possibility to deduct emissions from all non-fossil fuels which meet Swedavia's requirements for sustainable aviation fuel. This option is voluntary for airlines and is also extended to volumes refuelled at other airports so long as the airline in question has a route to Stockholm Arlanda or Göteborg Landvetter to which they can dedicate the fuel in question.

$$\text{Bonus/Reward} = \frac{\text{max reward}}{(\text{min CO}_2 - \text{avg CO}_2)} \times (\text{adjusted CO}_2 - \text{avg CO}_2)$$

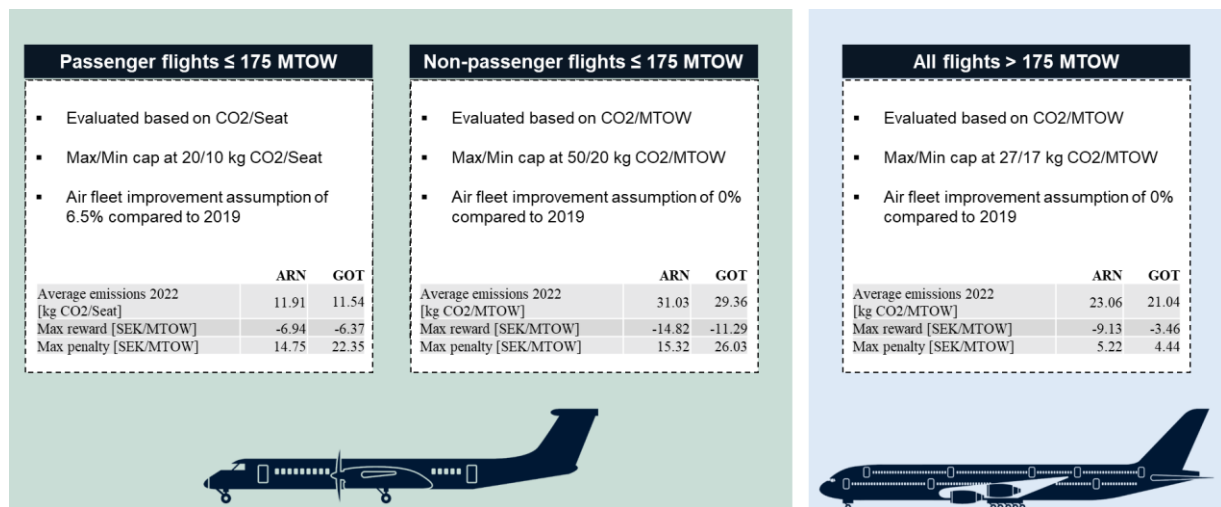
$$\text{Malus/Penalty} = \frac{\text{max penalty}}{(\text{max CO}_2 - \text{avg CO}_2)} \times (\text{adjusted CO}_2 - \text{avg CO}_2)$$

where, *adjusted CO₂* = Total CO₂ – CO₂ from SAF proportion

The above formulas determine the size of the reward, if the aircraft emits less than average, or the penalty if the aircraft emits more than average for the airport and segment in question. Emission values for each engine set are gathered from the ICAO engine emission databank for an average landing and take-off cycle and is related to the number of seats on the aircraft or, depending on the segment, the

aircraft's maximum take-off weight in order to receive a relative emission value to apply in the formula.

This gives each aircraft and engine-set combination the same value, making it relatively easy for airlines to calculate their bonus or penalty before their route planning. The relative CO2 values are also capped for a maximum and minimum value in order to assure a meaningful effect for the majority of aircrafts.



Swedavia's three segments, max/min CO2 cap in the modulation, assumed average emissions 2022, and max reward/penalty per segment

4 INDIVIDUAL COMPONENTS EXPLAINED

4.1 Bonus Malus and implementation

To ensure revenue neutrality for Swedavia a bonus malus system is used. Flights assessed as having the largest climate impact pays a penalty (malus) which is used to finance the discounts (bonus) for flights assessed as having the lowest climate impact. The bonus malus is based on assumptions for 2022's traffic volume, pattern, and emissions. Any deviation, i.e. if the balance of the charge deviates from 0, at the year end is transferred to next years charges, with similar principles as Swedavia's other risk sharing programs.

Bonuses and revenues will be continuously invoiced along with other airport charges.

4.2 Three segments and their metrics

Large aircrafts >175 MTOW – Metric CO2 per MTOW

As the aim of the modulation is to incentivize the use of the most efficient aircraft available for the type of operation that is being performed, Swedavia created a segmented modulation where larger aircraft (>175 MTOW) are measured against

their own average. This definition for separating between smaller and larger aircrafts already exists in Swedavia's price list. All larger aircrafts' relative emission is measured by CO2 per MTOW.

Passenger flights ≤ 175 MTOW - Metric CO2 per seat

The modulation is further segmented between passenger flights and non-passenger flights for aircraft ≤ 175 MTOW, where passenger flights are measured according to CO2 per seat, as applying CO2 per MTOW for this segment could lead to adverse effects¹. Since passenger traffic ≤ 175 MTOW rarely operates with a mix of passengers and freight on the same aircraft, CO2 per seat is found more suitable. A passenger flight is registered with the ICAO subclass "P" (for "Passenger").

Non-passenger flights ≤ 175 MTOW - Metric CO2 per MTOW

Non-passenger flights for aircraft ≤ 175 MTOW flights are measured according to CO2 per MTOW.

The modulation could in theory be divided into more segments, however this significantly raises the complexity of the modulation as each segment at each airport is to be financially balanced towards revenue neutrality for Swedavia.

4.3 Use of data for the modulation

Swedavia has decided to base the modulation on certified engine data from the ICAO Engine Emission Databank to assess the emissions during a landing and take-off cycle (LTO) at the respective airport. Each mode in the LTO has a registered fuel flow which is multiplied by the average mode time. The following standard ICAO LTO cycle times are applied without adjustments at all airports: Approach 4 min, Take-Off 0.7 min and Climb 2.2 min. The mode time for Idle is the measured average for the respective airport, ARN: 17.5 min and GOT: 13 min.

4.4 Assumptions made of traffic 2022

As a result of the pandemic, future traffic predictions are challenging to make and the only simulation data relevant for use is from 2019. It is therefore necessary to, where possible, make assumptions for the overall improvement of CO2 efficiency between 2019 and 2022 in order to best set the modulation to achieve revenue neutrality. For the CO2 Emission Charge, estimated average emissions per segment have been made by combining:

1. Known fleet improvements between 2019 and 2022,
2. Historic improvement rates,
3. Assumptions of the effects of SAF-reporting

¹ MTOW is Swedavia's main metric but for the passenger flights ≤ 175 MTOW segment, a re-classification of MTOW due to a reduction of the aircraft's original weight, leads to adverse effects when dividing the CO2 emissions by a lower number of tons in MTOW

Balancing each segment and airport towards revenue neutrality and intended turnover first means adjusting for changes in traffic volume between 2019 and 2022 and second to lower the average CO2 per MTOW in accordance with the estimated improvement in the overall fleets average CO2 between 2019 and 2022.

Estimations on the average fleet improvements have partly been made through analysing the known changes in fleet composition and partly through using a normalized annual improvement (for airlines where no information is known). The effects of SAF reported is then also added.

A clear conclusion could be drawn from the annual fleet improvement on passenger aircraft lighter than 175 MTOW with 1% emission improvement per year of normal operations. As Swedavia has good insight in the fleet renewals of certain airlines, these specific renewals are adjusted for separately while the proportion of unknown traffic is assumed to have had the same rate of improvement between 2016-2019 as 2019-2022. Reporting of SAF has been estimated to reduce the average emission in 2022 by an additional 0.5 percentage units.

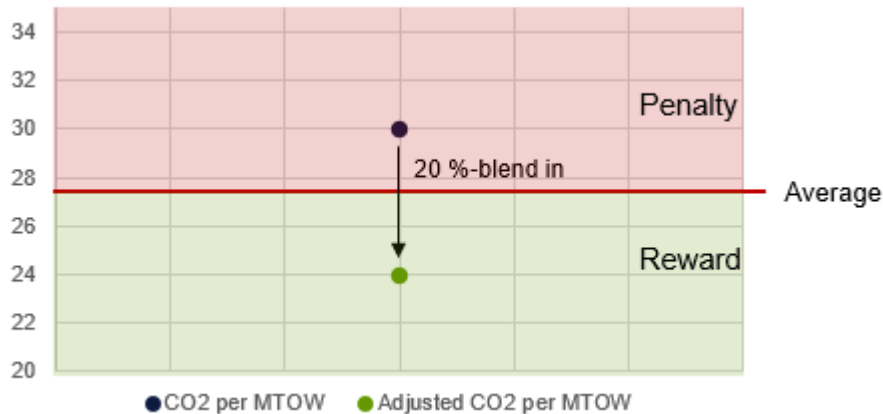
Combining the known changes of fleet, historic improvement rate and SAF-reporting, the estimated efficiency between 2019 and 2022 is 6.5 % for both Stockholm Arlanda and Göteborg Landvetter individually.

No information on fleet improvements is known for the other segments, Large aircrafts >175 MTOW and non-passenger flights \leq 175 MTOW, and no clear improvement trend has been found in the years studied, why the assumption is that the improvement between 2019 and 2022 will be 0% for these segments.

4.5 Inclusion of SAF

Swedavia has decided to offer the possibility of accounting for Sustainable Aviation Fuel (SAF) that has been used and thereby deduct the non-fossil proportion of emissions from the modulation. This decision applies regardless of where the SAF has been refuelled so long as airlines can verify their purchase and subsequent injection of the SAF into the fuelling system and attest to only attributing the volumes to routes to or from ARN or GOT.

Since tracking each fuel-molecule is impossible, the SAF must be allocated to specific flights to/from ARN or GOT. Airlines must also provide Swedavia with the total amount refuelled for these flights (round trip) in order for Swedavia to calculate a percentage of the total blend during the round trip that constitutes of SAF. The SAF volumes must also meet the same sustainability criteria as demanded in the SAF-Incentive program. Applications of purchased SAF may only be made at two occasions per year and airline on a consolidated basis in order to reduce administration for Swedavia and adjustments to the CO2 Emission Charge will only be credited on a retroactive basis.



Illustrative and fictional example of the effects of reporting SAF in the modulation

Airlines will also be able to account for SAF from national blend in requirements, but these volumes are capped to the specific requirement (not possible to aggregate total SAF volumes to ARN/GOT as destination if the requirement is 2% of overall fuel). SAF pertaining to a blend in-requirement and refuelled at ARN or GOT is excluded from the modulation as an inclusion would affect all airlines equally and ultimately serve no differentiation purpose for the modulation. SAF volumes relating to blend in requirements/reduction schemes may only be reported after the calendar year is concluded and an application must be made before 1 April the following year. Such applications must also contain a verification from the airlines' fuel supplier of the rate of compliance as Swedavia will only credit actual SAF and not accept volumes substituted by penalties.

4.6 Delimitations

Swedavia does not have emission data for aircraft smaller than 5.7 tons and it is not likely that Swedavia will be able to receive such data. These aircraft are primarily propeller planes owned and operated by private individuals as a hobby.

Swedavia also abstains from invoicing charges to foreign military aircraft and pricing proposes that this exception is also extended to the environmental modulation.

The modulation is also not suitable and will therefore not be applied to helicopters.

5 **IMPLEMENTATION**

The CO2 Emission Charge will be introduced 1 January 2022 and will appear on the regular invoices for airport charges that airlines receive on a per-departure level basis.

The possibility to account for SAF-usage will be limited to two applications per year and airline (not including the possibility to account for SAF connected to a blend in requirement which can only be submitted after the charges period and before 1 April during the following year). It is only possible to retroactively allocate SAF-volumes and a blend in will be calculated for the entire round trip.

Swedavia has, for the avoidance of confusion, also decided to change the name of Swedavia's current charge relating to NOx emissions to "NOx Emission Charge". This alteration will also be performed 1 January 2022.