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# Civil aviation emissions in Argentina

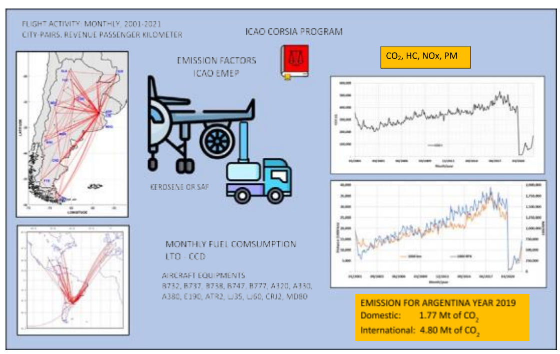
S. Enrique Puliafito

*Argentine National Technological University (GEAA UTN / CONICET), Argentina*

## HIGHLIGHTS

- Aeronautical activity is growing in passengers and number of flights.
- Efficiency for the period 2001–2021 improved twice in gCO2eq/RPK.
- Jet fuel can be replaced by SAF to reduce emissions.
- Argentina has the potential capacity to produce SAF.
- Cost and availability of biomass are critical to SAF production.

## GRAPHICAL ABSTRACT

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## ABSTRACT

The impact of aviation on climate change is reflected in increasing emissions of CO2 and other pollutants from fuel burning emitted at high altitudes, representing 2.9 % of total Greenhouse gases (GHG) emissions in 2019. However, mitigations options for decarbonization of aviation are difficult to implement given operational safety, technology maturity, energy density and other constraints. One alternative for mitigation is the use of certified sustainable aviation fuel (SAF) with lower carbon intensity than conventional jet fuel (CJF). This research presents an inventory of Argentine civil aviation emissions for its domestic and international flights, and analyzes the possibility of supplying SAF as a mitigation strategy given its abundant biomass production. Argentine aviation activity is presented as a monthly 4D (latitude, longitude, altitude and time) spatial inventory for the interval 2001–2021, based on origin and destination city pairs, aircraft types and airlines. Fuel consumption and pollutant emissions were calculated for landing-and-take-off and cruise phases. Monthly domestic ranged from 67 to 179 kt $CO_{2eq}$ (2001–2019). Annual peak values occurred in 2019 consuming 560 kt CJF and direct emitting of 1.77 Mt $CO_{2eq}$. While Revenue-Passenger-Kilometer (RPK) grew almost 4 times ($4.18 \times 10^9$ in 2001 to $16.42 \times 10^9$ in 2019), the number of flights changed only 1.5 times (from 98,000 in 2002 to 152,000 in 2019). The main efficiency indexes varied from 97 t CJF/RPK, 308 $gCO_{2eq}$/RPK to 34 t CJF/RPK, 107 $gCO_{2eq}$/RPK between 2001 and 2019, respectively, showing an average annual improvement of 3.5 % due to partial fleet renewal, especially from 2015 onwards. Emissions of other pollutants for 2019 reached total values of CO 14.14 kt; NOx 6.77 kt; PM tot 55.12 kt. For the period 2001–2019, international aviation consumed between 1 Mt - 1.5 Mt CJF, directly emitting between 3.30 and 4.80 Mt of $CO_{2eq}$; RPKs went from $6.234 \times 10^9$ to $20.524 \times 10^9$; the efficiency indices ranged from 529 to 240 $gCO_{2eq}$/RPK. The most important changes occurred with an optimization of routes and number of flights and the replacement of the four-engines (B747, A380) by more efficient twin-engines (B777, A330) aircraft. Argentina is not required to any offsetting regulatory program due to its small aviation market (approx. 0.22 % global market in 2019), nor has to date certified SAF production pathways, nevertheless it has potential for SAF availability based on actual biofuels production (ethanol, biodiesel and soybean oil) and biomass feedstock's existences. In this sense this studies proposes that 2019 domestic fuel consumption could be supplied using 79 % exportable amounts of sugarcane ethanol (257 ± 53 kt) (by Ethanol to Jet ETJ) and 34 % of exportable soybean oil (1079 ± 160 kt) (by hydroprocessed esters and fatty acids- HEFA) pathways. For this scenario average

*E-mail address:* epuliafito@frm.utn.edu.ar.

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GHG emissions reached 1.321 ± 0.115 Mt CO2eq; which would imply a 62 % of the current emission value using CJF (2.17Mt CO2eq), or savings of about 838 kt CO2eq (38 %). At the 2019 level of harvest and biofuel production, up to 1.4 Mt of SAF could be produced from sugarcane ethanol/ETJ and soybean oil/HEFA mitigating up to 1.8 MtCO2eq. A 35 kt $CO_{2eq}$ annual sectoral national mitigation strategy could be reached by using 14 kt of SAF.

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