Annex A: Estimating Carbon Dioxide (CO$_2$) Emissions Related to Air Transport
Area C Report to 15th UNCEEA

Background and Rationale

Emissions of greenhouse gases (GHGs), among which carbon dioxide (CO$_2$), play a key role in the global warming process that is currently at work (IPCC, 2014). Its relevance for policymaking has grown significantly since the signature of the 2015 Paris Agreement aiming at a sustainable low-carbon future.

"Emissions of greenhouse gases from human activities disturb the radiative energy balance of the Earth-atmosphere system, leading to temperature changes and other disruptions of the earth's climate. Climate change affects ecosystems, water resources, food production, human settlements and the frequency and scale of extreme weather events with significant consequences for human well-being and economic output."[1]

The OECD have developed a methodology (Working paper forthcoming) to estimate CO2 emissions related to air transport that applies globally. According to IPCC (2006), aircraft engine emissions are composed of about 70% CO$_2$, and these CO$_2$ emissions constitute practically the entirety or contributions to climate change from air transport.

Furthermore, air transport accounts for 30% of all transport-related CO$_2$ emissions, and 6% of all CO$_2$ emissions generated by economic industries in the European Union (EU) in 2018.[2] Moreover, the International Air Transport Association (IATA) anticipated a doubling of air passenger traffic in the next 20 years,[3] thus reinforcing the relevance of closely monitoring CO$_2$ emissions related to air transport.[4]

The methodology applied for the estimation of CO$_2$ emissions from air transport was developed in the context of a broader project at the OECD to develop air emissions accounts (AEAs) following the System of Environmental-Economic Accounting (SEEA), endorsed as an international statistical standard by the UN Statistical Commission (UNSC) in 2012. The OECD is the lead agency, under the UN Committee of Experts on Environmental-Economic Accounting (UNCEEA), for developing global air emissions accounts databases.

Air Emissions Accounting

Air Emissions Accounts (AEAs) record and present data on air emissions, by economic unit and by type of substance emitted, in a way that is compatible with the System of National Accounts (SNA). AEAs provide a way to relate GHG and other emissions to economic activities, using the same industrial classification (ISIC rev. 4 / NACE rev. 2) as in the SNA. The accounts allows for analysing which industries contribute most to air emissions, and decomposing the evolutions over time. These analyses are directly relevant for monitoring progress towards the UN Sustainable Development

---

[1] OECD (2020), *Environment at a Glance 2020*, OECD Publishing, Paris,https://doi.org/10.1787/4ea7d35f-en.

[2] In 2018, economic industries (i.e. excluding households) in the EU-28 emitted 2.84Gt of CO$_2$, of which 0.53Gt were due to transportation and storage as a whole, and 0.16Gt to air transport. 'Transportation and storage' corresponds to industry H in the ISIC rev. 4 and NACE rev. 2 classifications, and air transport to industry H51.

[3] IATA (2018): "IATA Forecast Predicts 8.2 Billion Air travellers in 2037". IATA Press Release, 24 October 2018 https://www.iata.org/en/pressroom/pr/2018-10-24-02/

[4] While the coronavirus pandemic has created an outlier situation for the trend in 2020, significant growth in air travel remains the expectation in the longer term

Goals (SDGs), especially under Goal 13 "Take urgent action to combat climate change and its impacts" and under Goal 12 "Ensure sustainable consumption and production patterns". Furthermore, the OECD makes use of the estimated air emission accounts in deriving CO2 emissions embodied in international trade[5], the OECD Environmental Performance Reviews and integrated policy analyses.

In collaboration with Eurostat, the OECD makes available officially reported national air emission accounts for European Union countries, Australia, Canada, Korea, New Zealand, Norway, Switzerland, Turkey and Serbia. The strategy is to use nationally available SEEA accounts whenever possible and to complement these with estimates for those countries that do not yet compile them by using internationally available sources.

In respect to the latter, the OECD developed a methodology to estimate SEEA AEAs based on the detailed national inventories submitted to the UN Framework Convention on Climate Change (UNFCCC) by Annex-I countries (Flachenecker *et al.* 2018). This OECD methodology has been endorsed by the SEEA Technical Committee and the UNCEEA.

Based on the OECD methodology, the OECD has now published estimated SEEA air emission accounts for Japan, Kazakhstan, the Russian Federation, Ukraine and the United States in a dedicated database, after communicating with the countries and explicitly flagging the results as OECD estimates. The OECD estimates can be accessed here, and can be used as a starting point for countries that do not yet compile AEAs to increase the coverage of countries.

So far, AEAs, are only available on a territory basis, meaning that the recorded air emissions are those occurring on the geographic territory of a country. Consistent with the System of National Accounts (SNA), the SEEA recommends recording air emissions on a residence basis, so that air emissions are consistent with the recording of output and value added, and thus GDP, of a country.

Naturally, the difference between allocating emissions according to residence or territory principle will be particularly significant for air transport. Therefore, in addition to producing important statistics on CO_2 emission from air transport, this methodology also provides a major advancement towards residence-territory adjustment in AEAs.

Estimation of CO_2 Emissions Related to Air Transport

The main source of information used in the annexed paper for the estimation of CO_2 emissions related to air transport is a database compiled at annual frequency by the International Civil Aviation Organisation (ICAO). This database contains information on all commercial passenger and freight flights scheduled around the world. For each flight, information is included on the departure and arrival airports, the operating airline, and the type of aircraft used. For each airline, we also know which country has delivered its Air Operator's Certificate (AOC).[6]

This information from the ICAO database is combined with a CO_2 emission calculator provided by Eurocontrol.[7] Given an aircraft type equipped with specific engines and a (great-circle) distance to travel, this tool calculates a flight trajectory, a quantity of fuel burnt and the quantity of CO_2 emitted.

---

[5] http://www.oecd.org/sti/ind/carbondioxideemissionsembodiedininternationaltrade.htm

[6] An Air Operator's Certificate is the approval granted by a national aviation authority to an aircraft operator allowing it to use aircrafts for commercial purposes. The exact name may vary from one country to the other. For example, it is referred to as an Air Carrier Operating Certificate in the United States, and as an Air Operator Certification in New Zealand.

[7] https://www.eurocontrol.int/publication/eurocontrol-method-estimating-aviation-fuel-burnt-and-emissions

If we then assume, for simplicity, that the residence[8] for each operating airline is the country that delivered the AOC, the information from ICAO is sufficient for estimating CO_2 emissions on a residence basis for domestic and international passenger air transport in all countries.

The assumption of using AOC to establish residence for the airline companies could be relaxed, e.g. for multi-territory enterprises, by introducing more specific criteria, on a case-by-case basis, or based on further analysis of the significance that such adjustments of the criteria would make on the estimated emissions by country. Detailed testing of the impact of this assumption for establishing residence of airline companies were examined previously (results to be published in the forthcoming Working Paper).

Conclusion

The methodology provides accurate estimates of CO_2 emissions related to air transport, on both a territory and a residence basis. These estimates shed light on a significant and growing source of CO_2 emissions in a number of countries. In the future, they could be used to assess the efficiency of economic instruments to curb aviation-related CO_2 emissions. From an accounting point of view, these estimates will also facilitate the compilation of global air emission accounts according to the SEEA.

---

[8] According to use of this term in the System of National Accounts (SNA), i.e. the country, in which an economic agent has a centre of predominant economic interest.