Flight emissions calculation methodology: Summary

Flight emissions are very complex to calculate and various methodologies are available. South Pole does its best to reach a realistic estimate based on the most reliable data sources available, in this case supplied by the UK Government.

Passenger flights

South Pole's calculation procedure for GHG emissions from flights is based on the Greenhouse Gas Protocol (GHG Protocol)[1], the most widely used international accounting tool for government and business leaders to understand, quantify and manage greenhouse gas emissions. The GHG Protocol was developed by the World Resources Institute and the World Business Council for Sustainable Development.

South Pole also follows the UK Department for Business, Energy & Industrial Strategy (UK BEIS) methodology (previously published by DEFRA and DECC) for determining flight emission factors and uses UK BEIS data to calculate flight emissions. The UK BEIS guidelines on the calculation of GHG emissions from flights are one of the de-facto standards of our industry, since they are one of the few reliable and up to date sources for data on flight emissions. The latest UK BEIS emission factors for flights can be found in the UK Government web page.

UK BEIS divides flight emissions into three different distance brackets: domestic, short-haul and long-haul. UK BEIS current preferred definition is that domestic flights are those that start and end in the United Kingdom (assumed to be below 463 km [2]), and considers all fights to "Europe" (or those of similar distance, up to a 3,700km maximum) as short-haul, and those to non-European destinations (or for flights over 3,700km) as long-haul. Nonetheless, it leaves it up to the user to use their best judgement in deciding on the appropriate category for each flight.

South Pole follows the guidance from UK BEIS, although it has re-named the distance brackets to make them applicable to other countries outside the UK and the Europe, as shown in Table 1:

Table 1. Flight classification based on distance

South Pole classification	UK BEIS classification	Distance (km)
Short-haul	Domestic	<463 km
Medium-haul	Short-haul	463 – 3,700 km
Long-haul	Long-haul	>3,700 km

[1] WRI and WBCSD, GHG Protocol, available at: http://www.ghgprotocol.org
[2] The 463 km value is the maximum distance within the sample of "domestic flights" presented in the 2018 UK BEIS methodology paper for emission factors (table 29), available at: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2018

Using the relevant emission factor for short-haul, medium-haul or long-haul travel, South Pole then calculates emissions for a given distance (in passenger-km or pkm). The UK BEIS emission factors, which South Pole uses, include an 8% uplift factor to scale up Great Circle Distances (GCD) between airports to account for indirect flight paths, delays and circling (for more details see South Pole's "Flight Emissions calculation methodology: detailed", Section 6: Great Circle Flight Distances).

To the emission factors based on distance, multipliers for different seating classes are also applied. Premium priced seating, such as in First and Business class, takes up considerably more room in the aircraft than economy seating and therefore reduces the total number of passengers that can be carried[3]. This increases the average CO_2 emissions per passenger-km. South Pole follows UK BEIS guidance and applies the following seating class multipliers (for more details see South Pole's "Flight Emissions calculation methodology: detailed", Section 5: Seating Class Factors):

- For **short-haul** flights, only Economy class is considered.
- For **medium-haul** flights, First and Business class are considered equal to 1.5 economy seats.
- For **long-haul** flights, the Premium Economy or Economy+ class is considered equal to 1.6 economy seats, the Business class is equal to 2.9 and First class is equal to 4 economy seats.

Finally, South Pole's methodology also takes into account indirect emissions such as Well-to-tank (WTT) emissions from the aviation fuel lifecycle (i.e. production and distribution), and a Radiative Forcing Index (RFI) multiplier of 1.9 to account for non-CO_2 climate change effects from air travel. This includes contrails, water vapour, NOx emissions, etc. UK BEIS recommends a multiplier of 1.9 as a central estimate, based on research from the European Assessment of Transport Impacts on Climate Change and Ozone Depletion (ATTICA, http://ssa-attica.eu)[4] and analysis by Lee et al (2009) reported on by the Committee on Climate Change (2009)[5]. For more details see South Pole's "Flight Emissions calculation methodology: Detailed" document, Section 5: Non-CO_2 Impacts and Radiative Forcing (RF).

As new GHG emissions research becomes available (incl. conversion factors from the UK BEIS), South Pole updates its emission factors yearly to incorporate the best available data for the calculation of flight emissions and to account for improvements from the aviation industry in recent years.

[3] UK BEIS, 2018. Government GHG conversion factors for company reporting: methodology paper for emission factors, available at: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2018
[4] R. Sausen et al. (2005). Aviation radiative forcing in 2000: An update on IPCC (1999) Meteorologische Zeitschrift 14: 555-561, available at: http://elib.dlr.de/19906/1/s13.pdf
[5] CCC (2009). Meeting the UK Aviation target – options for reducing emissions to 2050, available at: http://www.theccc.org.uk/publication/meeting-the-uk-aviation-target-options-for-reducing-emissions-to-2050