AEROSPACE TECHNOLOGY INSTITUTE

NON-CO_2 EMISSIONS COMPARISON

Emission	Current understanding of climate impact	Level of confidence on warming impact	Duration of impact
Carbon Dioxide (CO_2)	CO_2 makes up around 80% of greenhouse gas emissions from human activity but some research suggests it accounts for less of aviation's warming contribution than non-CO_2 impacts.	High	Hundreds of years
Non-CO_2			
Oxides of Nitrogen (NO_x)	NO_x comprises several different gases containing nitrogen and oxygen. These interact with other gases including ozone, methane and water vapour in complex ways. The net effect is currently thought to be warming but without further work this is uncertain.	Low-Medium	Days
Water Vapour (H_2O)	Water as water vapour has a small direct greenhouse gas effect, although in high humidity regions where it can form of persistent contrails, the impact is much larger (see 'Contrails' below).	Medium	Days to years before water vapour falls as precipitation
Contrails	Contrails can form when water vapour in the warm aircraft engine exhaust meets cold humid ambient air, condenses and then forms ice crystals. Whilst persistent contrails can be both cooling and warming, the net effect is currently believed to be strongly warming.	Low	Minutes to hours
Soot & Particulates	Aircraft emit soot and particulates from incomplete combustion of fuel in the engines. The direct warming effects from absorption, scattering and reflection of radiation are currently estimated to be small. There are no widely accepted estimates of the climate effect of aircraft soot-cloud interactions.	Very Low-Low	Days to months
Sulphur	Sulphur in aircraft fuels is released in the form of sulphur oxides (SO_x) or aerosols. The direct effects of sulphur emissions are thought to be mildly cooling. There are no widely accepted estimates of warming or cooling from sulphur interacting with clouds. Sulphur potentially plays a role in contrail formation.	Very Low-Low	Hours to weeks depending on form
Unburnt Hydrocarbons	With modern efficient aero engines, the quantity of unburnt hydrocarbons is small.	Medium	Days to months