



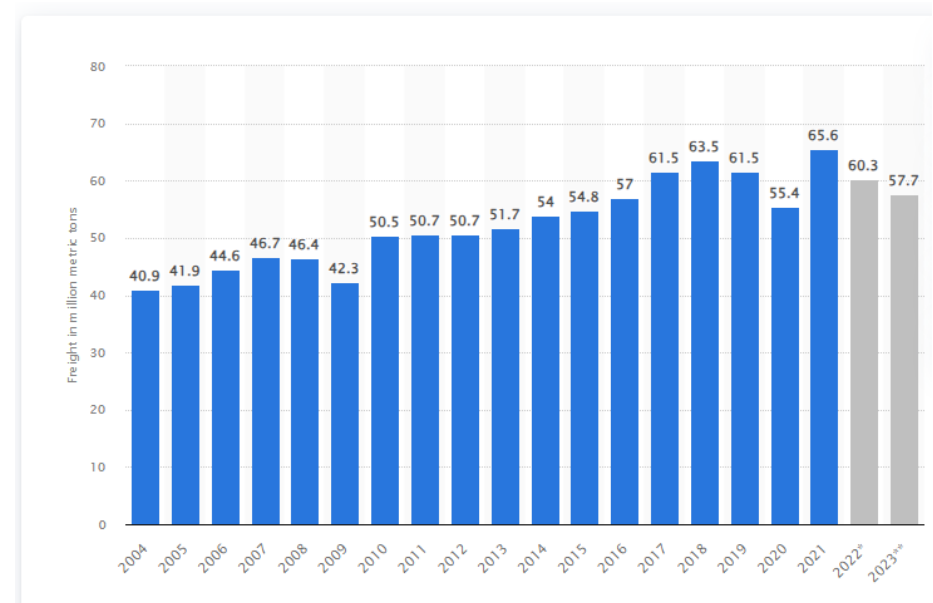
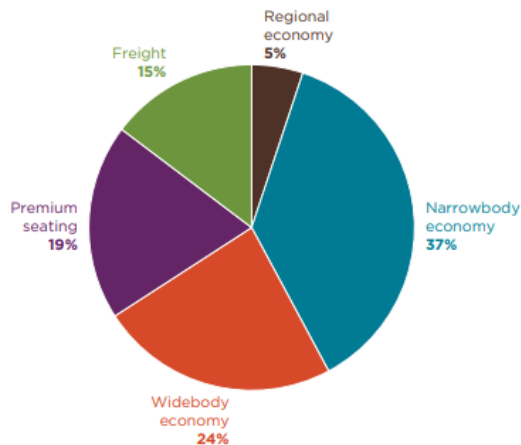
Air Freight and Climate Impacts

European Aviation Conference 2023



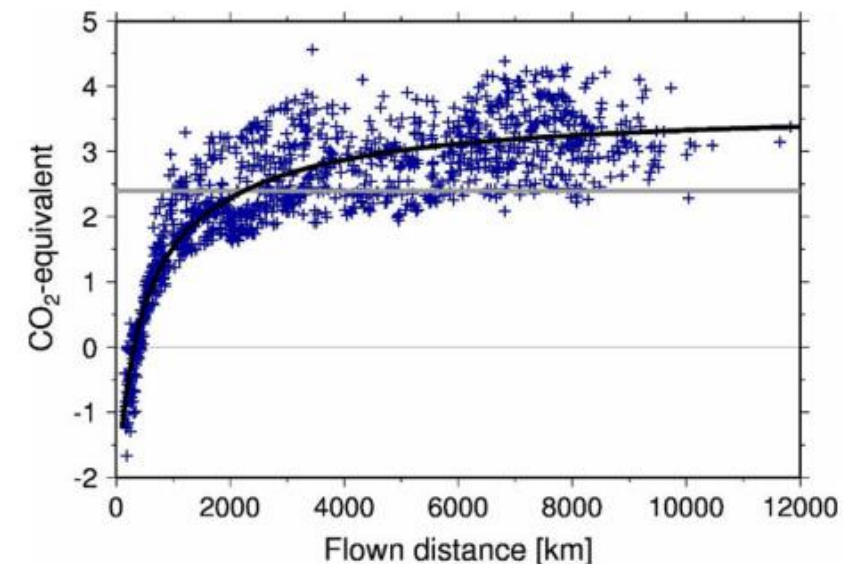
Air freight development - volumes and CO₂ emissions

- Worldwide air freight increased by 50% between from 2004 and 2019
- In 2019 approx. 250 billion cargo tonne-kilometres (CTKs)
- In 2019 air cargo carriage emitted 135 Mt CO₂ (50% belly, 50% dedicated freighters)
 - 15% of global aviation emissions
 - 0.36% (tank-to-wing) of global CO₂ emissions
 - 0.6% (WTW) including fuel production



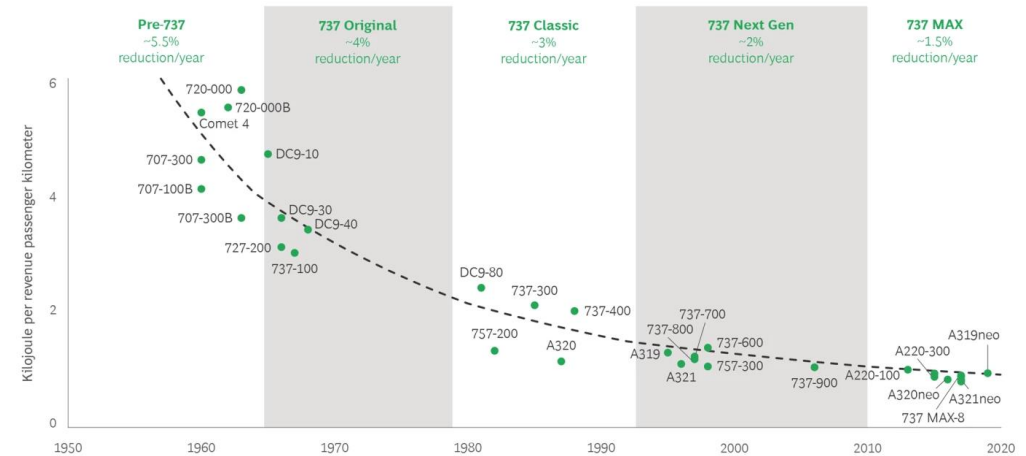
Non-CO₂ emissions of air cargo

- Non-CO₂ effects of aviation are responsible for 2/3 of the total aviation climate effect
- Largest effects by contrail cirrus and NO_x (short-term ozone increase)
- Time horizon of non-CO₂ is much shorter than CO₂ (break down quicker through chemical reactions)
- Non-CO₂ route dependence, CO₂-equivalents:
 - Increase with flight distance
 - Increase with latitude (highest at poles)
 - Slightly decrease with aircraft size
- Air cargo has higher than average non-CO₂ impact due to long distances



Decarbonization of aviation - challenges for cargo

- Air cargo is mainly long-haul
- Fuel efficiency gains of conventional propulsion is reaching natural limits
- Alternative propulsion technologies (electric, hydrogen) not realistic in near future
- Traffic and payload efficiency have potential, but are no game changers
- Sustainable aviation fuels (biofuels and e-fuels) only feasible option for the next decades
 - Need immediate ramp-up
 - Feedstocks for biofuels and clean energy are scarce resources
- Ocean shipping is a cheap (-92%) but slow alternative which emits only 1.2% of CO₂ per ton-km compared to air cargo



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