



Halon Replacement

Global Environmental Footprint Impact Assessment

COMMERCIAL AIRCRAFT

CCHRAG - Cargo Compartment Halon Replacement Advisory Group
10th of September 2024

AIRBUS

Context

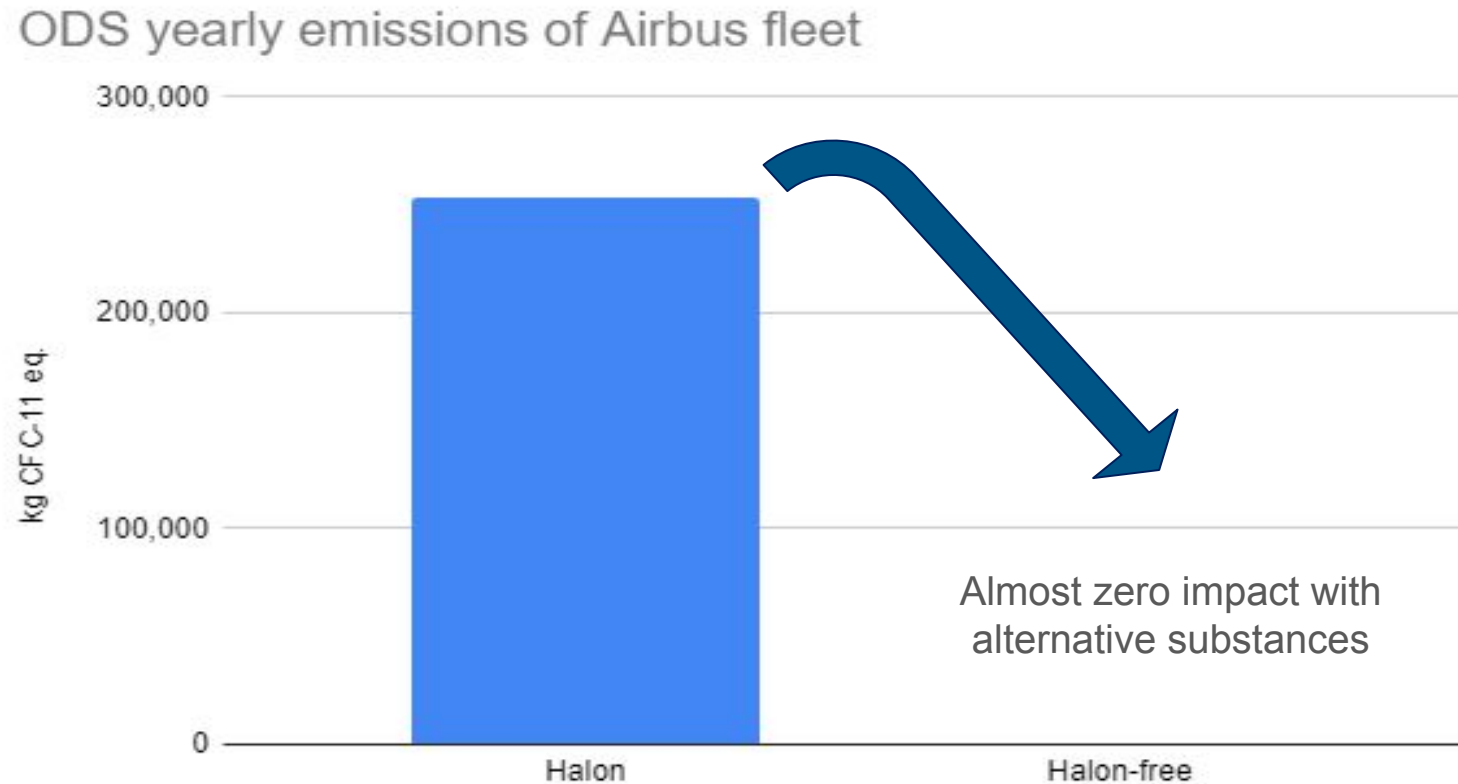
- Halons used as fire extinguishing agent for aircraft
 - Engine / Auxiliary Power Unit*
 - Lavatory*
 - Lower Deck Cargo Hold*
 - Cabin & Cockpit Handheld*
- Aviation sector committed since 90s to find alternatives *Halons being Ozone Depleting Substances*
- Numerous alternatives assessed over 30 years
 - To tackle aviation technical and safety challenges... ... many failed... ... few succeeded*
- Purposes of this presentation:
 - Overview of Halon alternatives
 - Environmental Footprint - Impact Assessment (*Facts & Figures*)
 - Global Overview

Halon Alternatives Overview

Alternatives		Aircraft impact <i>Weight & Physical Integration</i>	Regulatory Risk <i>Environment / Health & Safety</i>	Airbus Technology Readiness Level
Engine & APU	KSA Powder	Low (TBC) / Medium Weight	Ok	TRL 4
	CF3i Liquid/Gas	Medium Weight	Risk ODS*; <u>CMR</u> ** 2	TRL 4
Cargo	Verdagent CO2 gas + 2-BTP liquid/gas	High Weight & Physical Int	Risk ODS*; PFAS***; <u>CMR</u> ** 1; ED****	TRL 6
	Inert Gases (such as N2) Gas	Very High Weight & Physical Int	Ok	TRL 5
Lavatory	HFC-236 Gas	Low Weight	Risk PFAS***	TRL 9
Cabin Handheld	2-BTP Liquid/Gas	Low Weight	Risk ODS*; PFAS***; <u>CMR</u> ** 1; ED****	TRL 9

(*) non-zero Ozone Depleting Substance; (**) Carcinogenic, Mutagenic and Reprotoxic substances; (***) EU per- and polyfluoroalkyl substances per OECD definition (****) suspected Endocrine Disruptor

Stratospheric Ozone Layer Protection

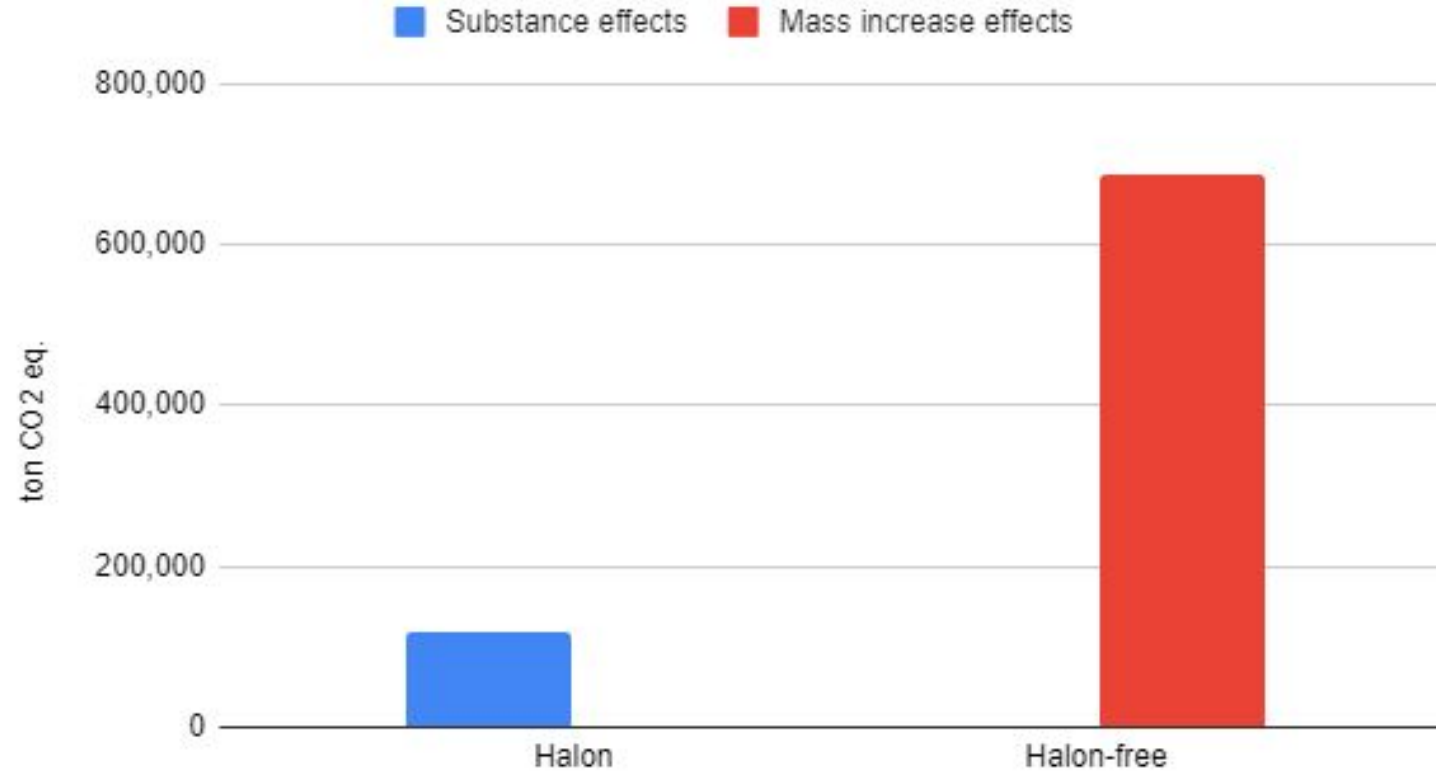


Considering around 12,000 A/Cs ; around 2 % of installed quantity yearly emissions
Halon free mass penalties between 100 - 400 kg depending aircraft type (~90% due to cargo)

Removing Halon 1301 from Airbus fleet would avoid emitting around 250 metric tons of CFC-11 eq. every year (corresponding to 0.08% of the 2010 humanity emissions)

Climate Change

CO₂ eq. yearly emissions of Airbus fleet



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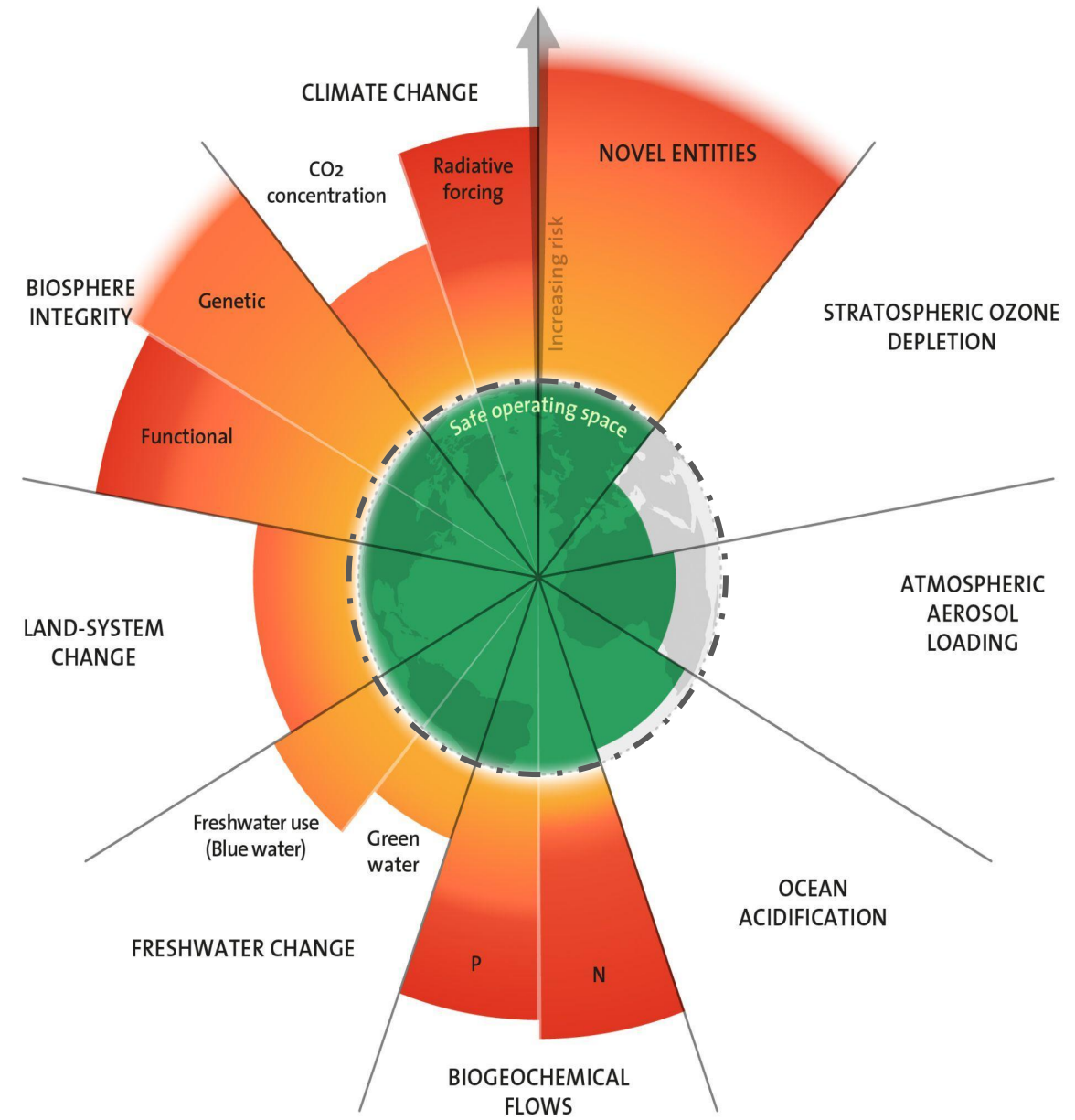
Substituting Halon 1301 from Airbus fleet would lead to increase emissions by around 600,000 metric tons of net CO₂ eq. every year *(corresponding to 0.001% of the 2010 humanity emissions)*

Per- and polyFluoroAlkyl Substances - PFAS

- European **CH**emical **A**gency issued February 2023 a **regulation proposal** on Per- and polyFluoroAlkyl Substances - **PFAS** - relying on OECD(*) definition.
- **HFCs** and **2-BTP** (*with its associated degradation product **TriFluoroacetic Acid** - **TFA***) appear targeted for phase out at horizon of ~2040 for fire suppression function.
- According to **recent degradation assessment** communicated by manufacturer, **2-BTP**:
 - **Degrades** rapidly **in** a couple of **days** once released **in the atmosphere**
 - **Leads to** only **0.3%** of **TFA** formation per mole of 2 BTP emitted.

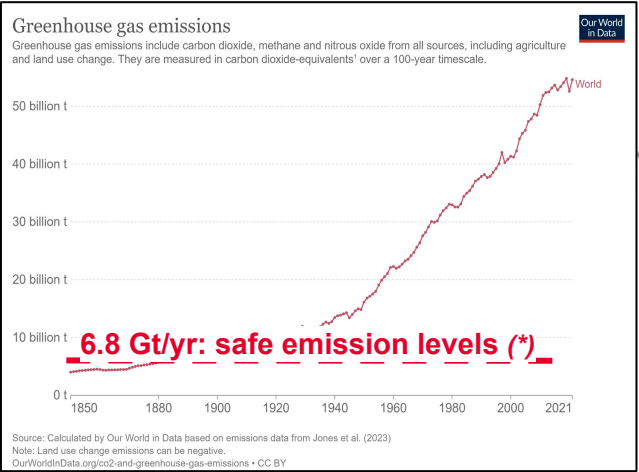
Global Overview *Interest in Planetary Boundaries*

- **Planetary boundaries** - scientific framework defined in 2009 by the Stockholm Resilience Center.
- Defines **quantified limits** of emissions, impacts or offtakes from natural systems, **beyond which the environment may not be able to self-regulate.**
- As an example, **safe operating space** is provided for
 - **Ozone depletion,**
 - **Climate change,**

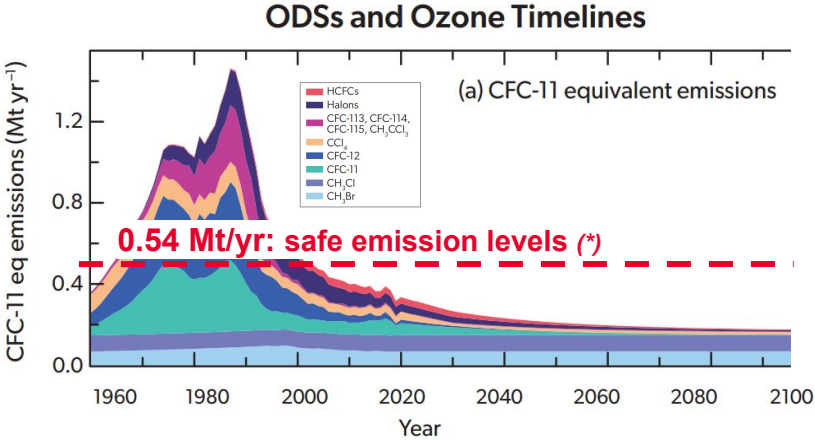
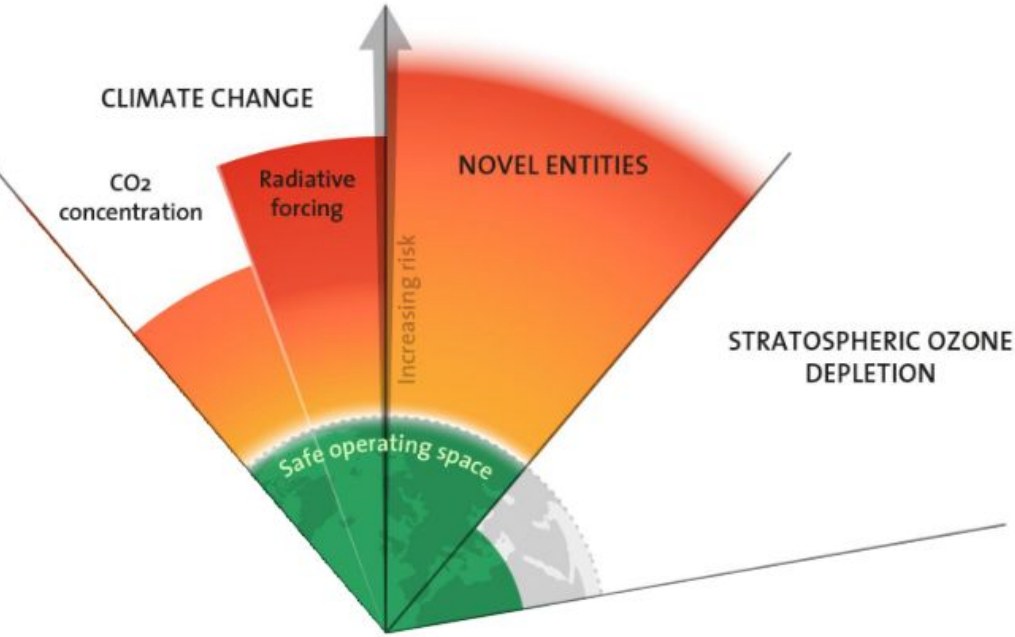


The 2023 update to the Planetary boundaries - [Link](#).

Credit: "Azote for Stockholm Resilience Centre, based on analysis in Richardson et al 2023". Licensed under CC BY-NC-ND 3.0.



Source: Our world in Data



Source: WMO 2022 report

At Airbus fleet level, per year, substituting Halon by currently identified agents would lead to:

Stratospheric Ozone Depletion

- 250 metric tons CFC-11 eq

Climate Change

+ 600,000 metric tons CO2 eq

Novel Entities (incl. PFAS)

+ ~4 metric tons 2-BTP (+ ~10 kg of TFA)

Substituting Halon 1301 would induce an impact transfer
from Ozone Layer protection area (*within safe operating space*)
to Climate Change and Novel Entities (*outside safe operating space*)

Global Environmental Footprint Impact Assessment *(Airbus current understanding)*

- Aircraft **Halon Replacement induces** an **impact transfer from Ozone Layer protection area *(within safe operating space)* to Climate Change and Novel Entities *(outside safe operating space)*.**
 - **Mainly** driven by **Cargo** Halon substitution and **marginally** by **Cabin** Lavatory and Handhelds.
 - **Important Note - No negative impact transfert** for **Eng / APU** perimeter is foreseen *(induced mass penalties stays sufficiently low and studied alternatives are not identified as PFAS per OECD definition)*.
- **Based on recent scientific framework** *such as Planetary Boundaries*, Airbus is
 - **Wondering** on several **Halon alternatives acceptability according to Montreal protocol / Ozone Depleting Substance international regulations criteria.**
 - **Interested** in further exchanges with industry and relevant authorities **to avoid** as much as possible mid/long term **regrettable Halon substitutions.**

Thank you

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