Private luxury jets with low climate impact?

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There is some discussion whether the hangar expansion plans at Hanscom Field could be conditional on their use for low-carbon aircraft. The feasibility of such a proposal is discussed.

The USA and the Commonwealth of Massachusetts both have Climate Action plans that specify net zero GHG emissions for aviation by 2050. These plans also have intermediate goals for 2035. Greenhouse gas emissions due to private luxury aviation are affected by three factors: the volume of use, the efficiency of aircraft, and the greenhouse gas associated with fuel consumption. All plans are based on an expectation of eventual availability of low-carbon aircraft.

Aviation related fuels have no known replacement by 2035. Improvements in aviation efficiency on the order of a few percent are expected by 2035 as aircraft are replaced with more efficient models. Therefore, the ONLY possible way GHG emissions can be either limited or reduced by 2035 is by limitations on volume of air travel. Consider the following highly optimistic plan published in the [US National 2021 Aviation Action Plan:]()

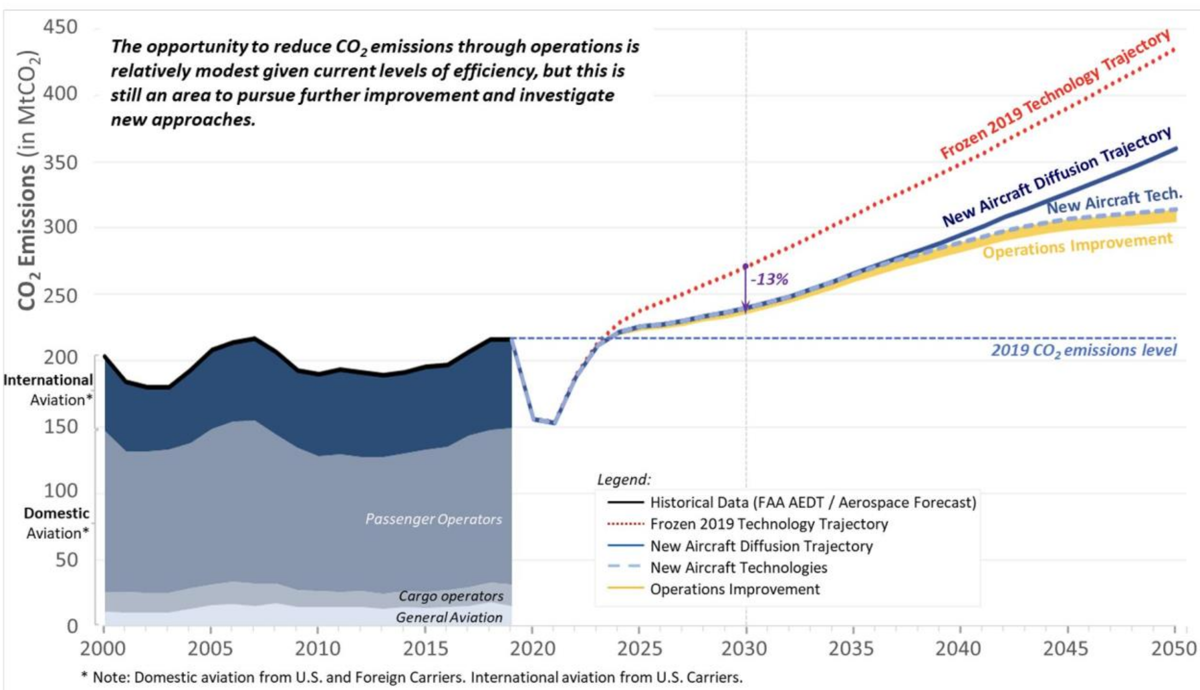

Figure 5. Analysis of Future Domestic and International Aviation CO_2 Emissions: Operations Improvement Scenario

In this Climate forecast, despite the stated goal to reach net zero by 2050, note that the emissions are not decreasing, but instead are inexorably increasing with time. The red line is the expected growth without technical improvement. The growth in emissions is entirely due to predicted increases in air travel. The additional lines on the chart, which depend on technology improvements that are uncertain, represent improvements in efficiency, and include the introduction of some electrical aircraft by 2045. Also, note that the measurements on the chart only include CO2, but the GHG impacts of jet travel include other factors; to get total CO2e impacts these number must be approximately doubled.[1]

Hydrogen powered aircraft

The Federal Action Plan states that “Simply put, there is no realistic option that could replace liquid fuels in the commercial aircraft fleet in the coming decades.” The use of hydrogen for aviation fuel remains theoretical, with significant technical challenges. Such fuel is not envisioned to be compatible with existing aircraft engine technologies. The federal report notes that the “timeline is insufficient to meet the U.S. goal of net-zero emissions by 2050.”

Sustainable Aviation Fuel

To develop a net zero scenario, the federal plan adds a hypothetical plan assuming Sustainable Aviation Fuels (SAF) can be developed and mass produced. In principle, such fuel can substitute for jet fuel in existing aircraft without modification. The federal plan uses this hypothetical supply of clean fuel to get to net zero, as shown:

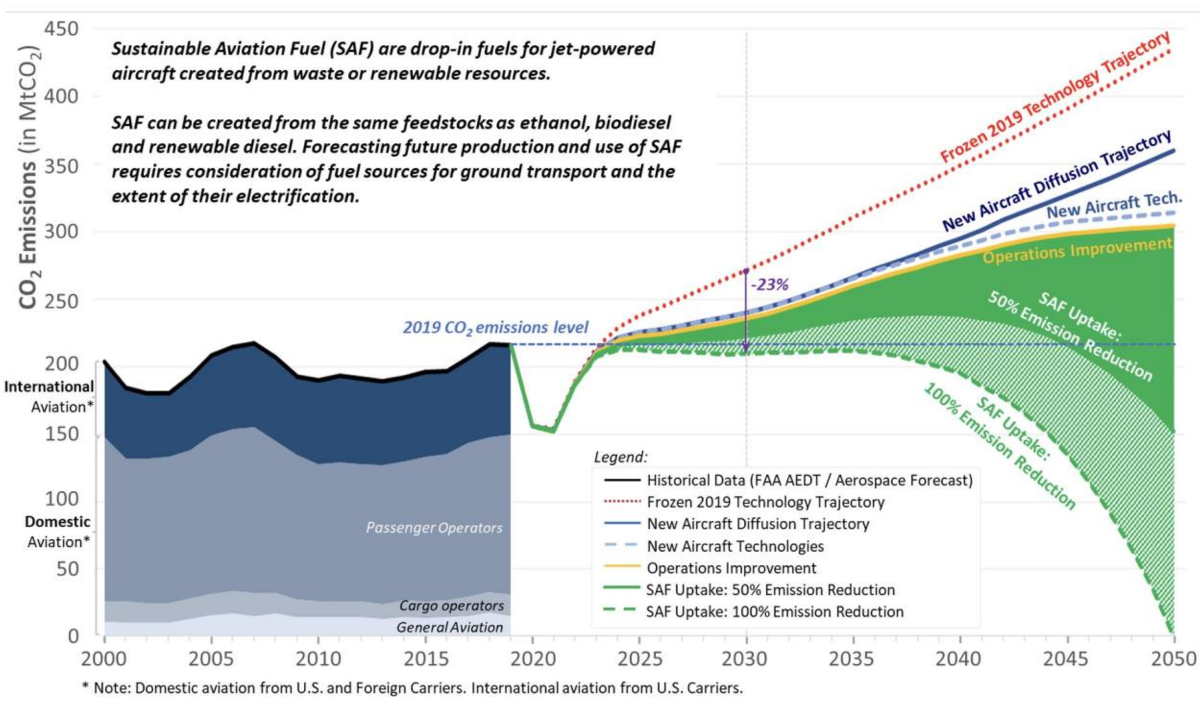

Figure 6. Analysis of Future Domestic and International Aviation CO_2 Emissions: SAF Uptake Scenario

The graph shows that essentially all of the GHG reductions that are planned under this hypothetical scenario are due to zero-carbon sustainable fuels. If zero-carbon SAF is not available, then the GHG contributions of Aviation will not decrease, but will increase by over 30%.

SAF as currently envisioned is derived from some other form of carbon, such as industrial waste, food waste or agriculture. These are transformed with an energy intensive process and refined to blend with or replace jet fuel. Agricultural waste sources are the best as using them for fuel avoids the landfill high CO2e methane emissions. Unfortunately, such waste streams are quite limited and cannot be depended on to replace a fraction of the volume of worldwide jet fuel required. Furthermore, while they represent an improvement in CO2e when compared with jet fuel, they are nowhere near zero emissions. In the case of biofuels, there remains a considerable debate on whether they represent any reduction in CO2e.

The ultimate form of zero-carbon SAF would be wholly synthetic fuel generated with electricity and a low-carbon heat source such as a high temperature gas nuclear reactor. Such a process could work with catalysts to generate fuel from raw materials or even from CO2 taken from the air. There is no expectation that this proposed technology would be proven or in production by 2050.

Today, sustainable Aviation Fuels with zero carbon at reasonable cost are only a theory. Currently, the government classifies any fuel that achieves a 50% reduction in emissions to be "sustainable". However, this test does not include many production factors. According to a recent study, many qualifying fuels have *higher* total CO2 emissions than jet fuel. Therefore, even if we created fuel to the "sustainable" standard, we might not achieve any overall reduction of CO2e as required under the 2050 scenario.

Electric Aircraft

The federal report states that "These technologies are most likely to first be introduced as small aircraft and are decades away from adoption, to the degree they are viable, in large commercial aircraft. While there is a potential that autonomous all-electric flight vehicles could be used for "last-mile" freight deliveries and passenger movements over short distances, further investigation is needed to understand the potential life cycle emissions tradeoffs, and whether flights would result in additional or reduced emissions."

The US report says "they are not expected to provide a solution for the medium- and long-haul flights that generate most of the aviation sector's carbon emissions by 2050." The ICAO has stated that "all-electric propulsion systems are not likely **even for business jets** by the 2037 timeframe." The aircraft manufacturer Airbus states in the US report that "larger commercial aircraft would be operating on liquid fuels through 2050."

Even the optimistic federal report does not expect electric aircraft to have any impact on aviation emissions by 2050. It would first be implemented on very short haul flights and displace the operations of small propeller aircraft. However, even where implemented, the electricity must still be generated, transmitted, and stored, so it may not decrease emissions in any meaningful way.

In the 2050 timeframe, no climate plans depend on electric aircraft to achieve reductions, and there is very little chance they would serve as a replacement for private luxury jets.

Conclusion

If the proposed hangar development at Hanscom Field were reserved for low-carbon aircraft, the hangars would be unused for the foreseeable future. Therefore, it would be uneconomic to build the project today. If and when plans based on yet-undiscovered technology were to yield either low-carbon jet fuel, or low carbon aircraft, then the hangar project would become economically feasible at that time. Therefore, such a low-carbon hangar project should wait until such technology is available. Aggressive scenarios indicate that such low-carbon solutions might be available by 2045.

Current plans based on known technology show US aviation emissions increasing by 50% by 2050. The only steps that can affect reduction of emissions are those associated with decreased flights. To hold emissions at current levels would require constraining air travel. Such constraints on air travel should focus on flights that have the worst emissions and lowest societal value, starting with private luxury jets. The use of such jets is a luxury that we cannot afford.

At this time, we should not mindlessly expand private jet travel, build more aircraft, and construct more support infrastructure with the expectation that an undiscovered technology will save us. The only logical and socially just path is to halt super-emitters until a technology that avoids the associated emissions is available.

1. Various studies, including by the IPCC, have determined that the total effect of jet aircraft is within 2 and 4 times that of CO_2 alone (6.9 to 12.6 kg CO_2e/kg). Papers suggest a consensus value of 7.8kg CO_2e for each kg of jet fuel burned.;