

## Environmental Assessment of Swiss Aircraft Fleet

In this work we present a life cycle assessment of the Swiss commercial aircraft fleet from 1990 to 2050. A parameterized model of 5 aircraft size categories is developed, including two scenarios that consider conservative and optimistic future technology developments. The model is found to accurately predict Swiss national aircraft fuel consumption to within 7% accuracy over a 25 year period, with the exception of 2002.

Results show that future technology improvements could reduce travel impacts by 40 to 70% per passenger kilometer. However, overall environmental burdens due to air travel are likely to continue increasing in the future due to rapidly increasing demand. Local air quality impacts in the areas surrounding airports are not expected to increase and may even decrease despite increasing air transport demand.

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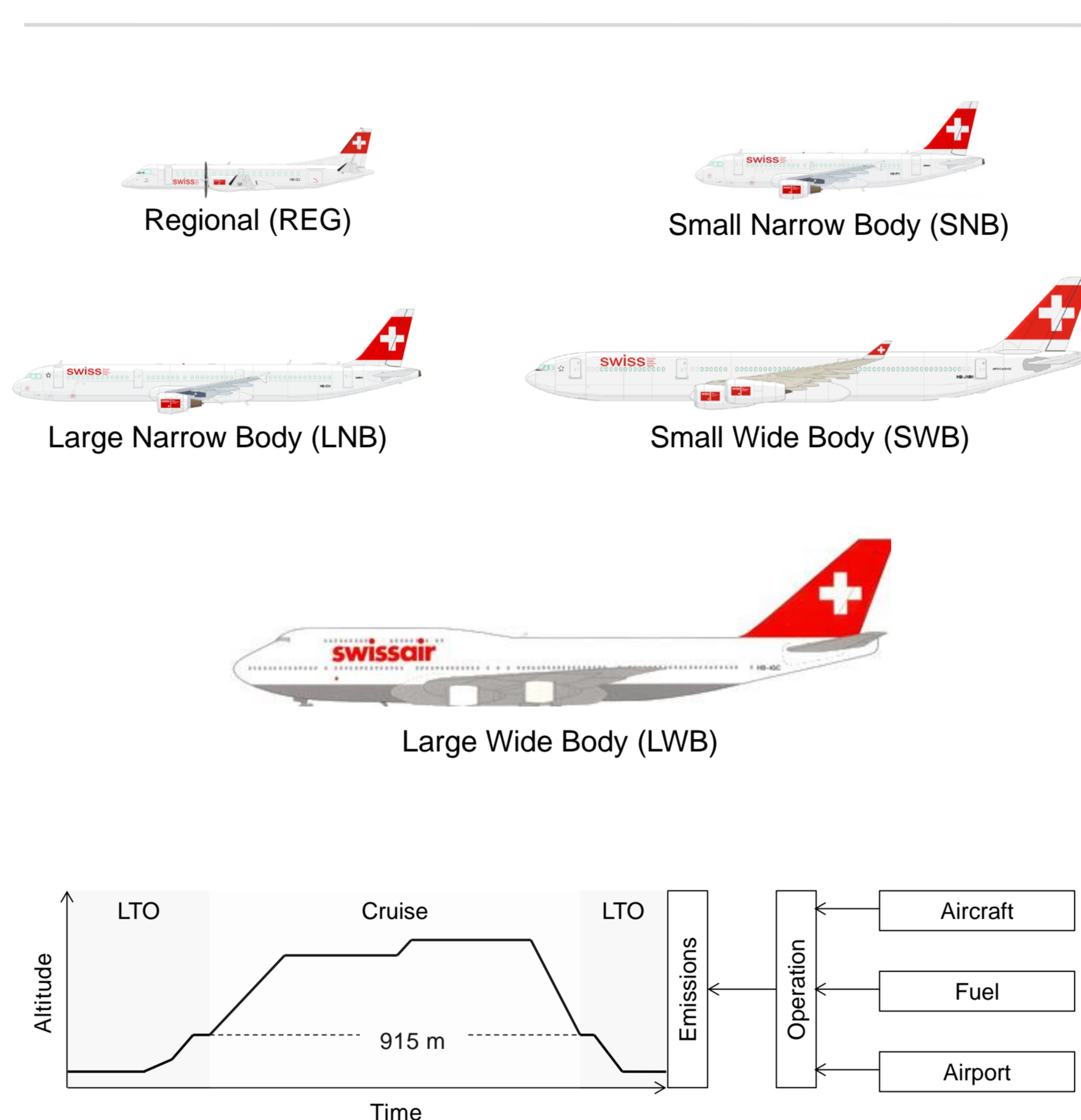
### Introduction

In Switzerland, international air transport accounts for approximately 10% of transport related CO<sub>2</sub> emissions. Air transport demand is expected to grow at a rate of 3.5-4% per year. Conversely, aircraft fuel efficiency has historically improved by roughly 1% annually. Additionally, airlines have also increased their efficiency, for example improving load factors and air traffic management.

The goal of this project is to develop a bottom-up life cycle assessment of Swiss air transport from 1990-2050, with differentiated plane sizes, construction years and flight distances.

This model will be used in Swiss transport sector level investigations of future transport scenarios.

### Aircraft Assessed



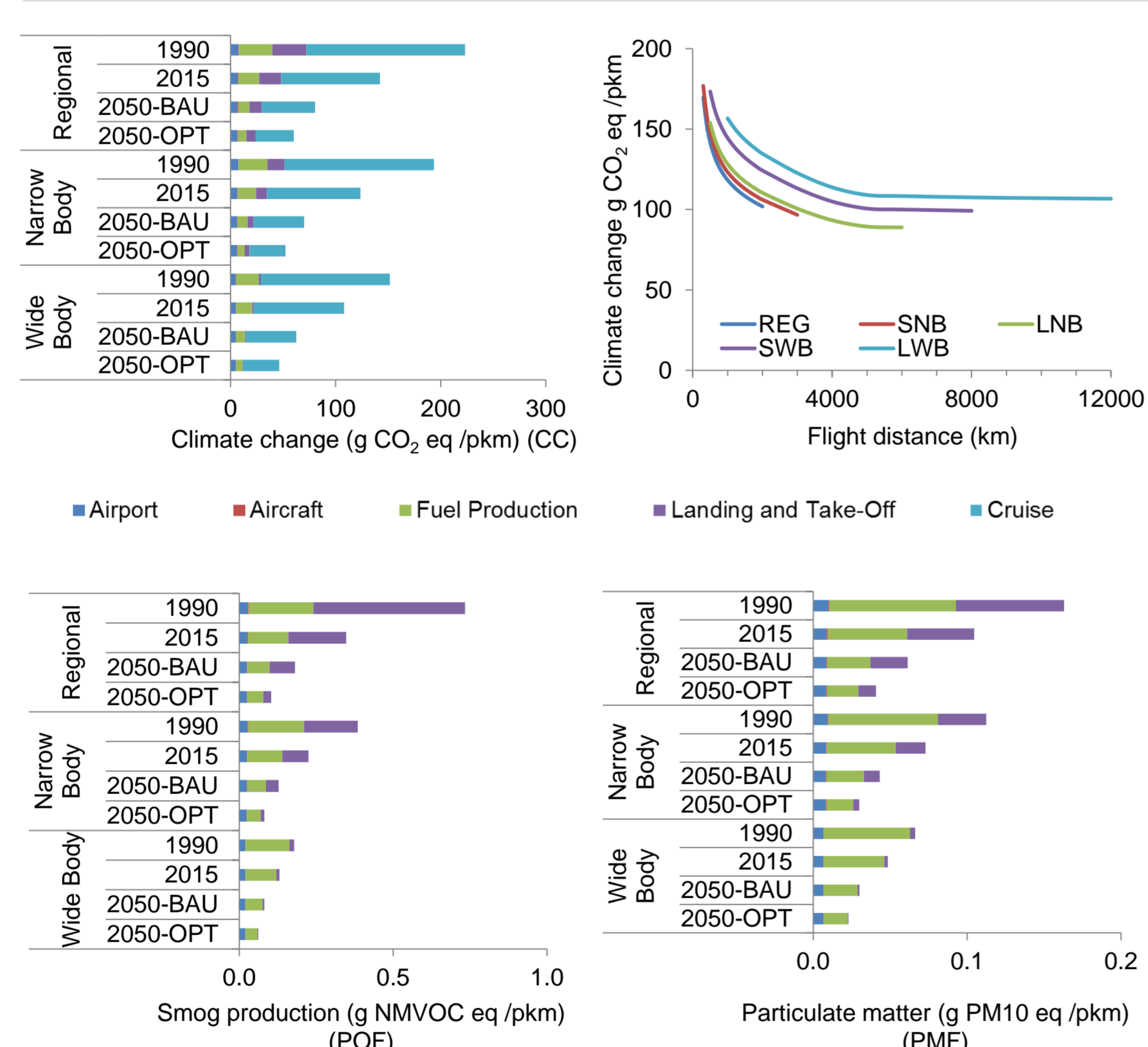
### Aircraft Fleet Modelling

Individual aircraft performance and emissions are modelled using a database of 70 commercial aircraft, corrected for aircraft production year, weight and flight distance. Future aircraft performance and emissions are modelled using historic improvement rates and reports by aircraft manufacturers for business as usual (BAU) and optimistic (OPT) scenarios.

All flights that start in Switzerland, regardless of destination or passenger nationality are considered to be part of Swiss air travel demand.

The Swiss aircraft fleet is considered to include all aircraft departing from Switzerland. The fleet is modelled using five representative aircraft types, with an age distribution based on historic fleet turnover.

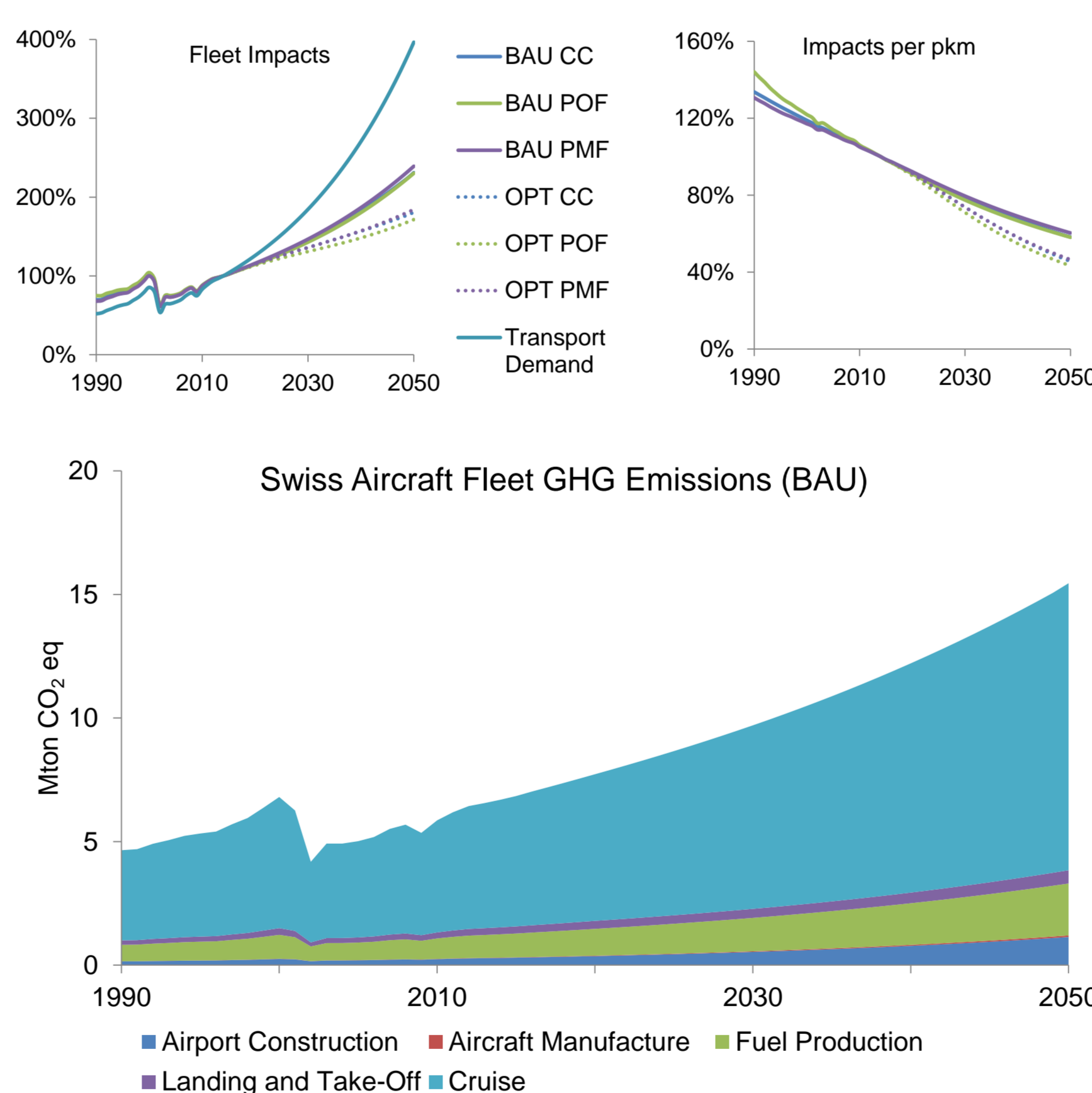
### Aircraft Results



Individual aircraft results vary strongly; newer aircraft perform much better than older ones, and impacts per passenger kilometer (pkm) depend strongly on flight distance. For the same distance, larger aircraft are more efficient.

### Fleet Results

Future impacts per passenger kilometer are found to greatly decrease in all categories. However, these improvements are outpaced by growing demand.



### Expected Impact

Swiss air transport demand is expected to reach nearly four times that of current levels by 2050. Depending on future technology developments, fleet level climate change contributions are expected to increase by between 80% and 130% in the same time frame.

Air transport will likely prove to be the transport mode that is most difficult to decarbonize. Weight and volume requirements severely limit batteries and hydrogen as potential energy carriers, leaving only biogenic and synthetic liquid hydrocarbon fuels as low carbon alternatives.

Swiss biomass resources are far too small to replace aviation kerosene demand and synthetic jet fuel based on other renewables would be complex and expensive.

Without limits to demand growth, the GHG emissions air transport sector are likely to double by 2050.

### References

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