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Corresponding author: SALGAS Antoine

e-mail of corresponding author: antoine.salgas@isae-superaero.fr

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Title

Modelling and simulation of new regulatory measures in prospective scenarios for air transport

Authors

Antoine SALGAS ^{1*}, Scott DELBECQ ², Thomas PLANÈS ³, Gilles LAFFORGUE⁴, Joël JÉZÉGOU⁵

* Corresponding author

¹ PhD Student, ISAE-SUPAERO, Université de Toulouse, 31055 Toulouse, France, antoine.salgas@isae-superaero.fr

² Researcher, ISAE-SUPAERO, Université de Toulouse, 31055 Toulouse, France, scott.delbecq@isae-superaero.fr

³ Associate Professor, ISAE-SUPAERO, Université de Toulouse, 31055 Toulouse, France, thomas.planes@isae-superaero.fr

⁴ Professor, Toulouse Business School, 31068 Toulouse, France, g.lafforgue@tbs-education.fr

⁵ Professor, ISAE-SUPAERO, Université de Toulouse, 31055 Toulouse, France, joel.jezegou@isae-superaero.fr

Abstract

Air transport contribution to annual anthropogenic CO₂ emissions is evaluated at 2.4 %, as well as additional climate impacts [1]. Despite continuous improvements in aircraft efficiency, emissions continued to grow before the COVID-19 pandemic. Several options exist to revert this trend, such as switching to low carbon fuels, better operations, or further improving aircraft energy efficiency. Assessing the impact of these different levers of action, from a technical, environmental or economic point of view, is a major issue concerning the transition of the aviation sector.

In order to address these research topics, the open-source CAST tool has been developed in previous works [2]. It allows simulating and evaluating prospective scenarios for air transport. For instance, it is possible to integrate new aircraft architectures, to modify the speed of the fleet renewal, to introduce alternative fuels to replace fossil kerosene. Moreover, the environmental impact of each scenario can be measured, in terms of carbon budget or energy resources consumption, and compared with global objectives or availability. Lastly, a specific module has been developed to evaluate the costs of the main alternative fuels such as biofuels, electrofuels and hydrogen [3]. The estimates are based on the concept of Minimum Fuel Selling Price (MFSP) and allow carbon abatement cost assessment.

The objective of this paper is to evaluate the potential role played by regulations within this framework. Setting stringent greenhouse gases emissions rules can be used to ensure airlines take on the necessary decarbonization actions at the right moment to respect a given target. The consequences of setting low-carbon fuels blending mandates and aircraft-level emissions targets on fleet wide scenarios and the optimal time to introduce those regulations will be investigated and integrated into CAST. Updating regulatory requirements with more stringent aircraft-level emissions target could lead to early aircraft replacement to improve fleet energy efficiency, whose cost will be quantified. This will allow, by combining it with the energy module already developed, to derive a shadow carbon price trajectory for each scenario created by CAST.

References

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