# Data Science for Aviation Decarbonization

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I– An Airbus Plan to Reduce Aviation Environmental Impact

High5+ is an Airbus Programme that aims a significant reduction of Airbus environmental footprint in manufacturing activities covering the five most material environmental aspects for Airbus.

Figure 1 : Airbus Emissions Aims for 2030 compared to 2015

CO2	ENERGY	WASTE	WATER	VOC
- 63 %	- 20 %	- 20 %	- 50 %	-100 %
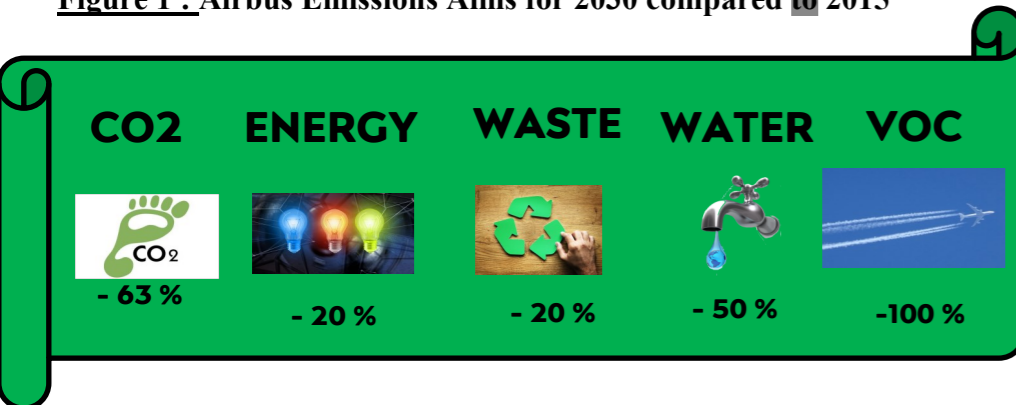
II– Me as Data Scientist Apprentice at Airbus

1V (Flight and Integration Test) is the part of the company responsible for testing new aircraft and new programs or technologies before their commercial use.

As a Data Science Apprentice at Airbus, my role involves analyzing 1V databases. The goal is to identify and quantify the impact of relevant keys and measures that need to be taken to reduce the CO2 emissions of 1V operations.

Examples of relevant measures :

Fuel On Board   Optimal Speed   Optimal Flight Duration

III– Linear Regression for quantifying Impact of Fuel on Board on Co2 Emissions

One way to quantify the impact of Fuel on Board on the Fuel Consumption is to consider a Linear Regression model for every type of Airplane :
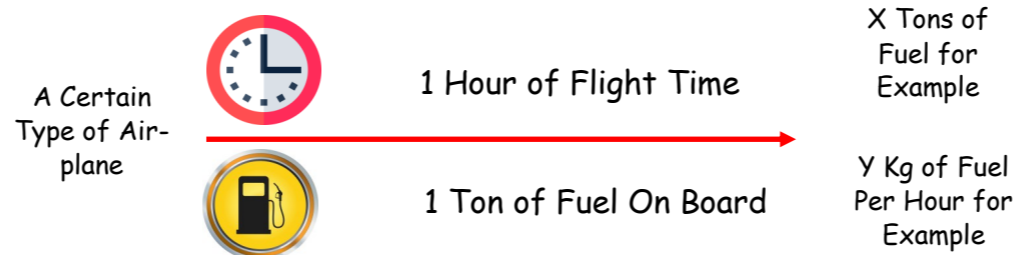
Figure 2: An example of Linear Regresion Model

$$\text{FUEL USED}_i = a + b \times \text{FLIGHT DURATION}_i + c \times \text{FUEL ON BOARD}_i + d \times \frac{\text{FUEL ON BOARD}_i}{\text{FLIGHT DURATION}_i} + \varepsilon_i$$

This model is justified by 3 reasons:

- Fuel consumption increases with flight duration.
- Heavier airplanes consume more fuel for a given flight duration.
- For a fixed difference in fuel on board, the difference in fuel consumption between two planes increases with flight duration.

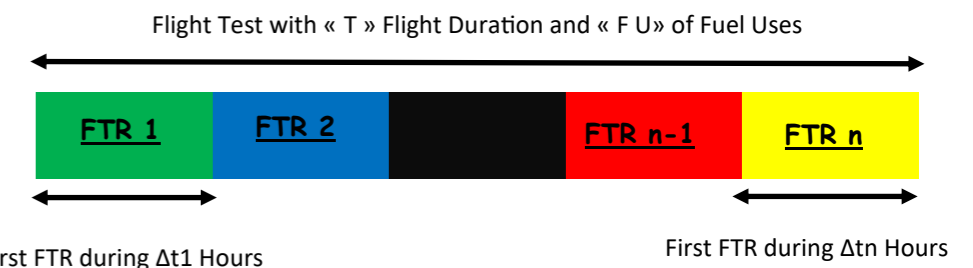## IV– The data confirms the Impact of Fuel On Board

The Linear Regression Model enabeled us to quantify the Fuel consumption (Co2 emisions) that we can save !

A Certain Type of Airplane

1 Hour of Flight Time → X Tons of Fuel for Example

1 Ton of Fuel On Board → Y Kg of Fuel Per Hour for Example

The Linear Regression Model enables to verify through data the Hourly Fuel Consumption of each type of Airplane.

V– Flight Tests and FTRs

Each flight test is made up of several sub tests called (Flight Test Request). Each FTR is made during a specific phase of the Flight. Therefore, they can consume differently.

Flight Test with « T » Flight Duration and « F U» of Fuel Uses

FTR 1	FTR 2		FTR n-1	FTR n

First FTR during Δt1 Hours   First FTR during Δtn Hours

Being able to determine the Hourly Fuel Consumption of each FTR, would enable us to know which FTR are the most consuming.

Figure 3: Ridge Linear Regression for determining the FTR's Hourly Fuel Consumption

$$f = \arg\min_{\theta \in (\mathbb{R}_*^+)^P} \frac{1}{2}\|F - \Delta t\theta\|_2^2 + \lambda\|\theta\|_2^2$$

VI– Some biais in Ridge Regression Results

- The matrix Design being singular, using Ridge Regression is required. The parametre λ is determinded via Cross Validation.

- The model estimated quite well the hourly fuel consumption of each FTR. However, despite using Corss Validation Ridge Regression introduces some biais to the estimates.