Aviation Carbon Accounting for Climate Change Mitigation: The Case of Turkey

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Abstract: Global Warming has become one of the biggest challenges of our World. Aviation Industry as a major contributor, is expected to play its own part in fighting the Global Warming by accounting for its carbon emissions. This study examines the approaches and strategies of airline companies for carbon accounting and reducing their contribution to Global Warming. Turkish Airlines, Turkey's largest airline, is studied to reflect how Turkey's air transport industry addresses the challenges of global warming and accounts for its carbon emissions. The study aims to set an example for other countries and businesses by showcasing the approaches and strategies of Turkish airline companies on carbon accounting.

Keywords: Carbon Accounting, Climate Change, Emissions, Aviation.

Nomenclature

ATAG	: Air Transport Action Group
IATA	: International Air Transport Association
EU ETS	: European Union Emission Trading System
CORSIA	: Carbon Offsetting and Reduction Scheme for International Aviation
ICAO	: International Civil Aviation Organisation
DGCA	: General Directorate for Civil Aviation

1.Introduction

Air transport facilitates the development of tourism and other sectors by providing fast and safe travel. It supports the development of international trade, economies and social development, creating more than 87 million jobs and generating 3.5% of global GDP (*ATAG*, 2022a).

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Although air transportation has essential for economic and social activity, harmful emissions due to fuel use cause negative effects on the environment and air. Ever increasing air operations contribute to global warming by emitting about 814 million tons of CO_2, which is about 2% of man-made carbon emissions. However; if no action is taken, this rate might increase further due to the increase of the global air traffic (ATAG, 2022b).

Pressures are increasing day by day by environmentally sensitive circles to reduce emissions that cause climate change and air pollution. The Paris Agreement obligates 196 signatory countries to limit global warming to below 2 °C compared to pre-industrial levels. To achieve this long-term goal, all nations should undertake ambitious efforts to combat climate change (UN, 2022).

Despite the common need, there exist few studies in the literature that assess the challenges and mitigation strategies that aviation companies use to fight Global Warming. This study, by bridging the gap in the field, investigates the strategies and solutions that aviation companies use in reducing their contribution to the Global Warming.

The study uses Turkish Airlines as an example and highlights its strategies and solutions in reducing emissions that causes Global Warming. For this purpose, an in-depth literature review on the subject was conducted. Additionally, Sustainability Reports, Annual Reports and Company Web Pages of airports are studied using the Content Analysis Method.

2. Carbon Accounting

Atmospheric CO_2 concentrations are at the highest level for around 15 million years. Accurate carbon accounting is crucial for stakeholders and decision makers to control the rise (Nature, 2016).

The main purpose of carbon accounting is to mitigate carbon footprints by measuring and monitoring a company's carbon emission level (Gibassier & Schaltegger, 2015) (Ong et al., 2021).

The EU ETS is the world's first and largest carbon market for tackling climate change and targets around 40% of the EU's greenhouse gas emissions. With the EU ETS, facilities are allocated an upper limit for the the greenhouse gases that they can emit. The upper limit decreases over time so that the total emissions are reduced. Businesses receive emissions allowances that they can trade with each other. At the end of each year, a plant must surrender enough allowances to fully cover its emissions. If a facility reduces its emissions, it can keep spare allowances to meet its future needs or sell it to others with insufficient allowances. A carbon price for emissions also encourages investment in low-carbon technologies (EU, 2022b).

Aviation industry is included in the EU ETS since 2012. EU ETS requires all airlines operating in Europe to account for their emissions. The system enabled the aviation industry to reduce its carbon emissions by more than 17 million tonnes annually (EU, 2022a).

CORSIA is the first global market measure and a cooperative work to reduce aviation emissions. CORSIA complements the other emission reduction measures by offsetting the amount of CO_2 emissions that cannot be reduced through the use of technological improvements, operational improvements, and sustainable aviation fuels with emissions units from the carbon market (ICAO, 2022).

Carbon taxes, on the other hand, levies taxes on greenhouse gas emissions and effectively reduce emissions. Its been argued that carbon taxes are the most efficient way to fight climate change (WSJ, 2019). (Metcalf & Weisbach, 2009) suggested that if the US adopted a well-designed carbon tax on greenhouse gas emissions, it could capture about 80% of US emissions by taxing only a few thousand taxpayers. As of 2019, carbon taxes have been implemented or scheduled for implementation in 25 countries (World Bank, 2019).

3. Strategies to Reduce Greenhouse Gas Emissions

As the representative of the air transport industry, IATA has set three global targets to reduce its impact on the climate (IATA, 2020):

Achieve a 1.5% improvement in annual average fuel efficiency from 2009 to 2020.

Stabilize CO_2 emissions by achieving carbon neutral growth after 2020.

Reduce aviation's net CO_2 emissions to half of 2005's by 2050.

The chart in Fig. 1 illustrates IATA's three goals to address the global aviation industry's climate impacts.

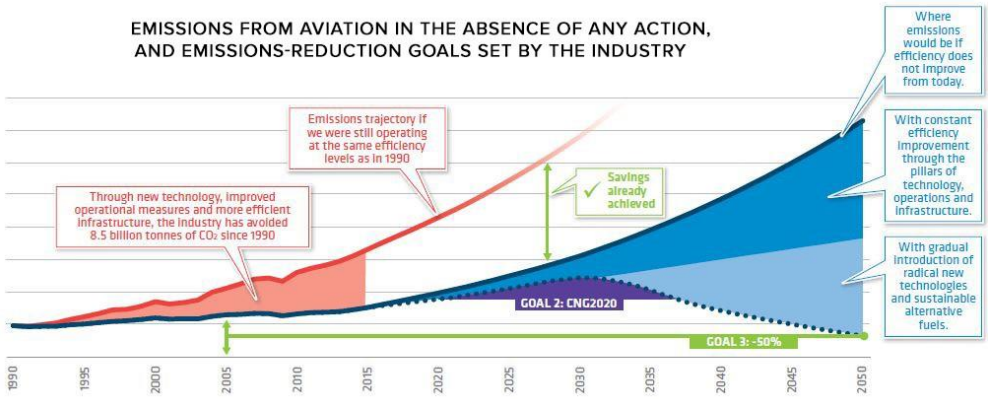

Fig.1. IATA's three goals to address the aviation's climate impacts (IATA, 2022a).

Aviation Industry, in line with industry objectives, uses a four-pronged strategy, as seen in Fig. 2, to reduce their climate-changing emissions (IATA, 2020).

Technology improvements significantly improve fuel efficiency and reduce emissions by introducing new and more efficient aircraft and engines. Modern

airplanes consume 15-20% less fuel than older models (Turkish Airlines, 2020). Most importantly, sustainable aviation fuels, with certain technological maturity, will enable emission reductions up to 65% (IATA, 2022b).

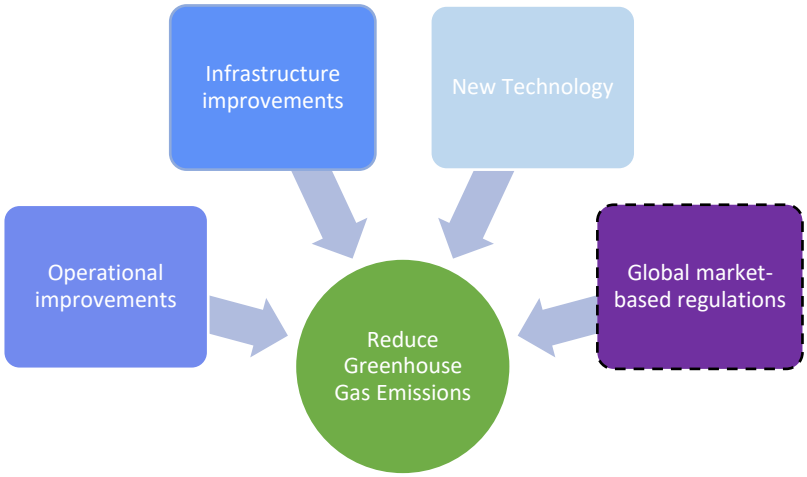

Fig.2. Four-pronged strategy for aviation emissions.

Operational improvements focus on making aircrafts lighter by eliminating certain weight items. Lighter aircrafts consume less fuel, emit less carbon and reduce costs. Airlines replace aircraft seats and cabin equipment with lighter models and switch to tablet computers by replacing heavy pilot manuels. Other operational improvements include fuel saving practices like single-engine taxi, idle reverse thrust, and optimization of ATC procedures. Improved ATC procedures eliminates extra waiting times and delays during airport operations.

Infrastructure improvements aim to shorten flight times and eliminate unnecessary waiting times by improving navigation and flight operations, optimizing air traffic and flight routes and better use of airport capacity and making airport layout more efficient.

Global market-based regulations support these three pillars until the emission levels achieved.

The detailed study on the Turkish Airlines Sustainability and Environment reports has revealed some main focus areas and mitigation activities that are organized and presented in Table 1.

Table 1: Main Focus Areas for emission reduction and mitigation activities

Main Focus Areas	Mitigation Activities
Flight operation practices	Low flap configuration implementation Short route requests APU Use Optimization ''idle reverse'' pilotage implementations One motor taxi procedure
Flight planning practices	Zero Fuel Weight sensitivity Route Optimization Fuel management information system software (FMIS)
Technical maintenance implementations	Increasing motor washing intervals and reviewing aircraft maintenance. Use of fuel planning modeling
Reducing aircraft weights by disposing unnecessary weights	Fly away kits, magazines, containers, drinking water, catering equipment
Technology improvements	New or upgraded aircraft and engines Aircraft modifications (Winglet and sharklet kits) Sustainable Aviation Fuels
Carbon offseting	EU ETS CORSIA TS EN ISO 14064-1 Carbon Credit Agencies
Sustainability training for employees	Awareness training on greenhouse gas emissions
Infrastructure improvement	Improve the air traffic management system in collaboration with air navigation service providers. Researches on the most appropriate flight routes Participation in the SESAR (Single European Sky ATM Research) project. Airport improvements, construction of new parking area Improved approach procedure

4. Results

Turkish Airlines emission reduction plan follows the EU ETS and CORSIA requirements and is based on following 5 steps in Fig. 3 (Turkish Airlines, 2020):

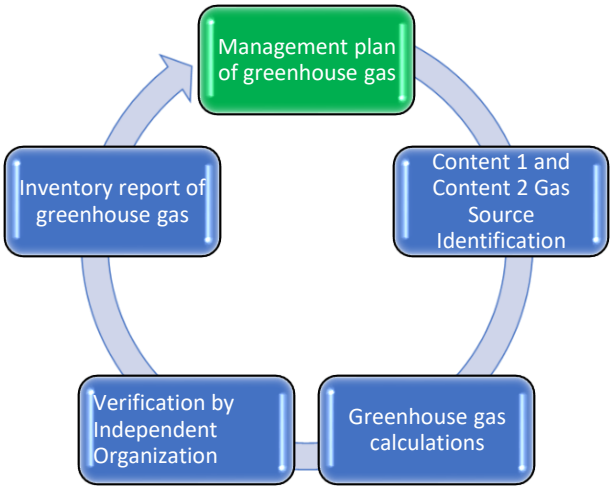

Fig.3. Turkish Airlines four-pillar strategy for aviation emissions (Turkish Airlines, 2020).

Greenhouse gas sources are identified into two groups as Content 1 and Contenet II emissions. Content I emissions are the emissions from the sources owned or controlled by the Company (Flight activities, burner boilers, land vehicles). Content II emissions are the emissions due to production of electricity, heat or ventilation that are procured externally for the Company.

Greenhouse gas emissions are calculated in accordance with the TS EN ISO 14064-3 Greenhouse Gas Calculation and Verification Standard. Amount of emissions from the following sources are calculated as tCO_2e.

Greenhouse Gas Emission Report is submitted for CORSIA, EU ETS and Turkish DGCA requirements.

Greenhouse Gas Emission Report is verified by an independent organization certified by ICAO.

Greenhouse gas emissions, associated with the EU-ETS flights are ofsetted with carbon credits provided by the carbon credit agencies.

Fuel burned for Aircraft operations is the primary sources of aviation emissions and contribute to Global Warming. Therefore, aviation companies pursue fuel saving initatives to reduce their greenhouse gas emissions and their contribution to climate change. Increased fuel efficiency results in reduction in both costs and emissions. Turkish Airlines Fuel Policy is built on three principles: optimizing the operations, new technology investmens and infrastructure improvements. A Fuel Steering Committee leads the researches and works to find fuel saving measures (Turkish Airlines, 2020).

Turkish Airlines managed to avoid 138,522 ton carbon emission and 43,975 ton fuel consumption in 2016 due to its fuel saving initatives. Major initatives such as Flight Operation Implementations, Dispatch Improvements, Technical Maintenance

Improvements and Ground Operation Improvements resulted in the fuel savings that are shown in Fig. 4 (Turkish Airlines, 2016).

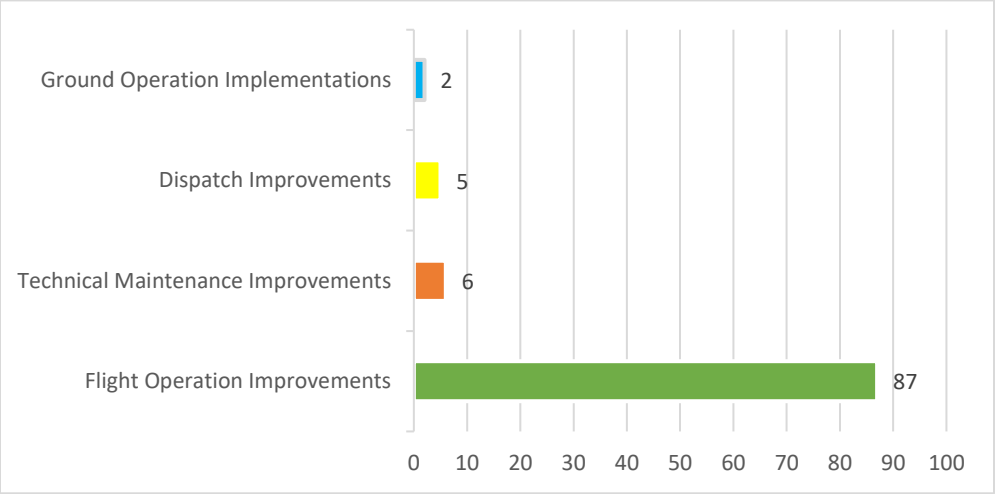

Fig.4. Turkish Airlines fuel saving initatives and results (Turkish Airlines, 2016)

5. Conclusion

Global Aviation Industry, being under scrutiny for its emissions, is in track with the accounting for its carbon footprint and achieve the industry targets.

Turkish Airlines fully comply with the EU ETS and CORSIA requirements to account for its greenhouse gas emissions. Turkish Airlines emission reduction plan follows 5 steps: Gas Source Identification, Greenhouse Gas Calculations, Verification by Independent Organization, Inventory Report for Greenhouse Gases, Preperation of Greenhouse Gas Management Plan.

Turkish Airlines managed to avoid 138,522 ton carbon emissions and 43,975 ton fuel consumption in 2016 due to its fuel saving initatives. Major focus areas for fuel savings consisted of Flight Operation Improvements, Dispatch Improvements, Technical Maintenance Improvements and Ground Operation Improvements.

Increasing fuel efficiency and integration of local carbon markets into the global markets like CORSIA and EU ETS are critical for accurate carbon accounting. In addition, more user-friendly mechanisms are needed for carbon credit transactions between airlines and other market players.

Sustainable Aviation Fuels will have the key role in achieving the net zero target by 2050, followed by new technologies like use of electric and hydrogen power.

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