Analysis of Aviation Pollution in the Selected Regions of the World

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Abstract. The focus of this paper is to find out the impact made by aircraft on the environment of Europe. In this paper, we will focus on how far aircraft are influencing and contaminating the environment. The paper cover-up the various case studies conducted by different authors to estimate the impact by various universal indicators and to ascertain the level of the impact made by the particular factors on the environment and comparing the EU facts and figures with that of policies put forward by the various governments which are U.S and Australia. Paper evaluates the facts and figures to identify the ascertain the environmental hazards caused by aircraft across the globe. The aviation industry is presently responsible for 12% of worldwide CO2 dis-charges. Aviation could represent up to 24% of worldwide outflows by 2050 except if there is a critical innovative move. Surveys hydrogen's potential as a greener method of impetus and talks about the significant difficulties for its appropriation.

Some studies find several broad ways in which the aviation industry's emissions could be decreased. The main advantage of using hydrogen technology is zero emissions. In addition, the hydrogen needed for operation is generated from renewable sources. Another advantageous hydrogen fuel cell vehicle and the growing interest is that it has comparable properties to conventional vehicles.

Keywords: Emission · Influencing and contaminating · Aircraft and environment

1 Introduction

Aviation sector had an important role in world over a decade due to its peculiarities. It is the fastest, safest and most reliable transportation mode due its high mobility. This acts as one of the main catalysts for the growth of world economy. The ability to move people and products all over the globe quickly and safely. At present, nearly half the global population are dependent on the world's airlines for mobility. Aviation contributes to quality of life by allowing us to visit friends and relatives, to travel, to experience new places, to explore the world.

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D. Perakovic and L. Knapcikova (Eds.): FABULOUS 2021, LNICST 382, pp. 229–239, 2021.
https://doi.org/10.1007/978-3-030-78459-1_17

As we look from the Economic perspectives, aviation industry is one of the fast means of transport and contributing a large share in terms of global trade, tourism, cultural exchanges, employment opportunities and so on. By the arrival of aircrafts, the mobility of trade got much easier than before. Aviation was a revolution and still the industry is undergoing huge innovational changes. In this paper we aim to find the Impact made by the aircrafts across the globe regarding climate changes. Even though the share of toxic gases from aircraft are comparatively very low comparing with the other factors. Aviation affects the environment in many ways. People living near airports are exposed to noise from aircraft and aircraft engines emit pollutants to the atmosphere.

In this paper we are mainly considering the impact made by these aircrafts in the environment. This paper describes the emission associated with commercial aviation and the health and welfare impacts that can result from those aviation emissions that degrade air quality which can in turn can cause environmental problems.

2 Methodology

The methodology part consists of details describing the purpose of the study and the related research questions and the various methods used in order to acquire the data needed for the research paper. In this part we will fix our aim to find the rate of impact made by aircrafts to the environment and the environmental hazards caused by the aircrafts apart from other factors. This paper aims to find out the various research questions such as:

What is the level of impact made by the aircrafts to the environment?

Do the regulatory policies set by different regions reduce the impact of air pollution caused by the aircrafts?

To measure the environmental impact made by aircraft, we will observe Air Quality, impacts on the Ozone layer, contributions to Climate Change, Waste Generation and reports general wellbeing made by the WHO.

To measure the environmental impact of aircraft we will be using a history of case studies and reports. We will first focus on literal emission figures, after that on various specific case studies which include other different parameters which we can take into consideration. Then we will look at existing solutions and regulations that various institutions have applied and measure their effectivity.

3 Theoretical Part

In this section it will be followed the analysis of emissions their impacts on the environment and mention some studies which they deal with survey how to decease CO2 emissions.

3.1 Case Studies and Findings

Emissions from the aviation industry are steadily increasing since the year 1990 [1]. Since then they have doubled and are projected to continue rising at an even faster pace.

Even reductions in average fuel burn did not help decrease total emissions. This fact illustrates the upwards trend of increasingly more people using airlines as they become more accessible and crucial to many people's lives.

Apart from air pollutants emitted by aircraft travel, we also have to take into consideration the noise pollution created by the aircrafts. There are not yet any universal international regulations for aircraft emissions [2]. They are being created by specialized U.N. bodies which have faced criticism for being too slow which in turn has caused a slower adaptation to the necessary regulations all over the world with some countries pushing their own in the meantime creating a chain of chaos in the atmosphere causing climate changes and other destructive environmental calamities.

Until recently, airlines and water transport were excluded from the Paris agreement, Kyoto Protocol and similar efforts [3]. This has led to a worldwide delay in deciding and applying universal standards. International standards were first proposed in 2017 and are projected to come into full effect by 2028 [4].

3.2 Hydrogen Alternative Propulsion

Comparing to conventional fuels and SAFs, hydrogen is better because it eliminates carbon dioxide emissions quit but also has the eventual to reduce other GHG emissions. Comparative with batteries, hydrogen has a high energy thickness, both in gravimetric and volumetric measures. Moreover, hydrogen is probably going to enter into different businesses, which could accelerate the advancement of power devices and capacity frameworks, advance downstream foundation and push down inventory network costs. Two principle choices for hydrogen-energized aircraft exist. In a hydrogen ignition airplane, the push is created through the burning of hydrogen in an adjusted stream motor, which kills most yet not all GHG emanations. Generally, the progress would require less airplane and motor upgrade than hydrogen energy component drive, making it to some degree less troublesome to the current arrangement of the aeronautic trade Hydrogen fuel cell (HFC) aircraft could offer a "true zero" solution for GHG emanations as the lone yield of power devices is water fume, the effect of which can be limited through cautious airplane activity. Studies show that hydrogen power device aircraft would be 20–40% more effective than hydrogen ignition plans. Although more than a dozen companies are involved in the development of electric aircraft, the relatively low energy density of batteries limits the range of action of such machines. In the near future, therefore, only smaller battery-powered electric aircraft can be expected, which can be used for short-haul flights - in the order of several hundred kilometers. The reason is the mentioned energy density, which is currently around 300 Wh/kg for high-end Li-ion batteries. Although hydrogen does not reach the energy (mainly volume) density of gasoline, compared to batteries, its energy density is significantly higher. From one kg of hydrogen we can obtain 120 to 142 MJ of energy by combustion, which corresponds to an energy density of about 33 to 39 kWh/kg. That's 100x more than Li-ion batteries allow. When obtaining electricity from hydrogen in fuel cells, although part of the energy is lost or released in the form of heat, it is still an energy-efficient source. And that is essential in air transport. The environmental aspects of air transport are becoming increasingly important. Already today, aviation emissions account for 12% of CO2 production in the entire transport segment, and this share is growing rapidly. By 2050, it should be doubled.

Electric aircraft and especially hydrogen-electric aircraft will therefore be a welcome benefit. In principle, there should be nothing to prevent the production of large-capacity hydrogen fuel cell aircraft in the future. It will not be supersonic machines, but the environment will deviate from major polluters (Fig. 1).

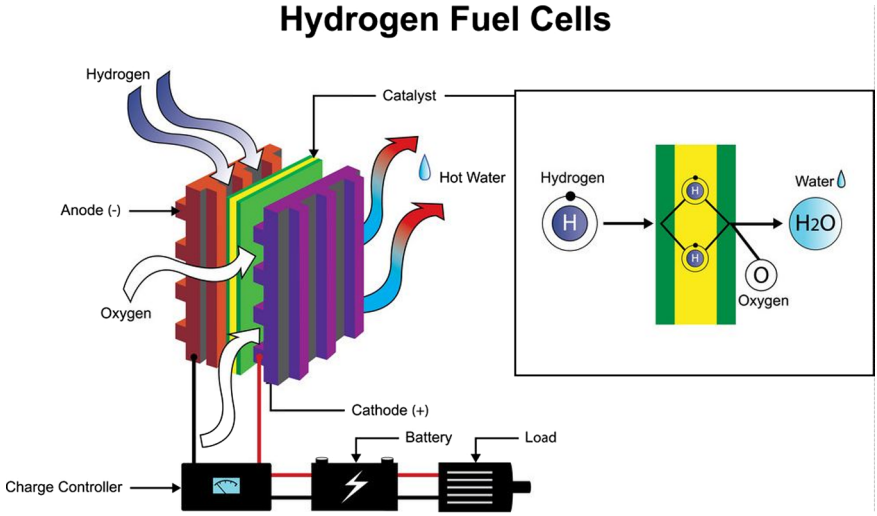

Fig. 1. Hydrogen fuel cells [14].

The aviation industry is presently responsible for 12% of worldwide CO2 discharges. Aviation could represent up to 24% of worldwide outflows by 2050 except if there is a critical innovative move. Surveys hydrogen's potential as a greener method of impetus and talks about the significant difficulties for its appropriation. Some studies find several broad ways in which the aviation industry's emissions could be decreased. These range from incremental evolutionary improvements, to net-zero solutions, to "true zero" solutions, which have no impact on the environment at all [14, 18]. Unsurprisingly, the methods that offer the greatest emissions reductions also present the most complex challenges. The main advantage of using hydrogen technology is zero emissions. A truck or bus produces only water. In addition, the hydrogen needed for operation is generated from renewable sources. Another advantageous hydrogen fuel cell vehicle and the growing interest is that it has comparable properties to conventional vehicles. However, as with any new technology, there are many challenges. The technology is not yet fully developed. A big step needs to be taken in the short term. Solve fuel cell degradation and life (Fig. 2).

To make hydrogen technology seems to be the solution for the aerospace industry. However, this technology requires extensive innovation. Modification and reworking of the aircraft, from the engine unit to the tanks and refueling itself. Improvements in light storage tanks and cryogenic refrigeration systems to take advantage of high hydrogen energy density. Significant improvements have been made in "green" hydrogen and/or

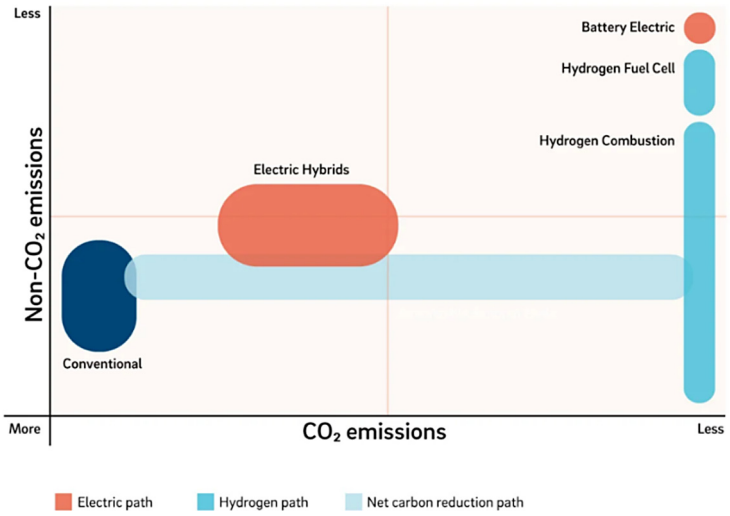

Fig. 2. Environmental impact [14].

carbon capture and storage (CCS) to increase the share of anhydrous hydrogen production. The infrastructure for hydrogen fuel supply to airports and refueling at airports would need to be redesigned. Due to the still complex production, cheaper hydrogen production needs to be transported in order to compete with fossil fuels. If we compare the advantages and disadvantages of hydrogen compared to other sustainable aviation technologies, it will probably be a very important sector of the narrow body/middle market, where hydrogen will be a strong candidate for future propulsion. Manufacturers will need to demonstrate that the introduction of hydrogen as an alternative fuel is a competitive fuel and better than hybrid propulsion solutions such as a hybrid or mild hybrid where operation requires a battery [15, 18].

In addition to electric propulsion, the authors of Roland Berger's study have a clear role for hydrogen in solving sustainable aviation problems and recommend that managers allocate resources to ensure that its potential is realized [13, 14].

3.3 Facts and Figures

In total the aviation industry contributes about 2% to the total amount of all CO2 emissions produced across the globe [5].

It has a share of 12% in CO2 emissions from when we are taking in concern regarding the total of emission rate out of all transport mediums. [6].

From "Fig. 3," when we closely examine graph, we can identify that from the year 1990 till 2020 the emission rate was nearly a doubled figure when comparing with the figures from 1990. From that we can identify the impact of aircraft industry across the globe and the increased mobility through air. As we closely look into the figure, we can find that there is a uniformity in the emission rate from the year 2005 till the year 2017. As a result of technological revolution and huge innovational changes occurred to the aircraft industries at this period of time, the emission rate was controlled or regulated

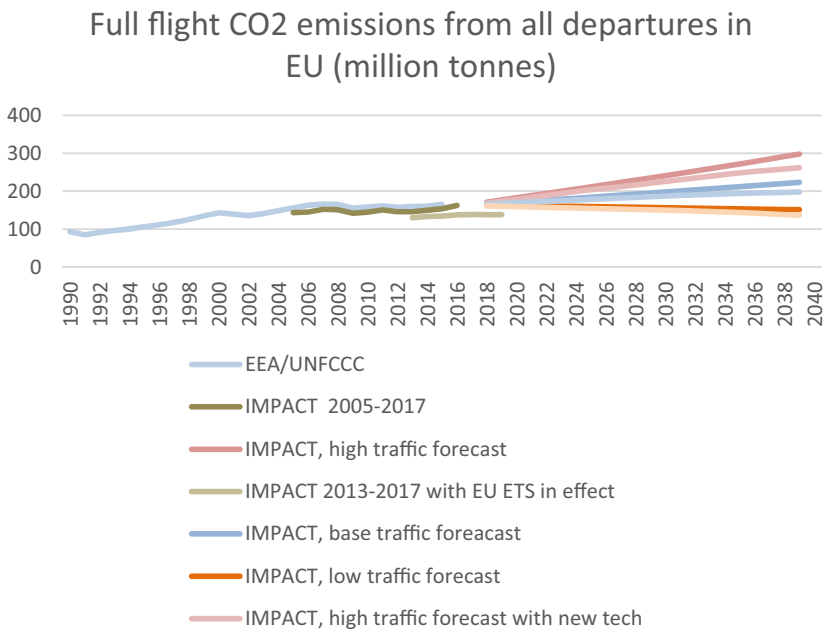

Fig. 3. Emissions in the EU over time (EU aviation report 2019).

with the necessary set of standards which reflected in a moderate rate of emission rate when compared to the other factors causing emission.

4 Analysis and Comparison

Comparing between 3 content EU, US and AU show the difference of CO2 percentage for each content and the universal indicators.

4.1 Comparison Between EU and US

Comparing emission data from the U.S and E.U, the U.S has 10% more emissions (180MT vs 200MT). The US also has the biggest aviation industry. Since U.S aviation policies are more favorable to the aviation parameters there are no particular set of standards as we are comparing with the E.U

The E.U has been working on limiting emissions by implementing the Emissions Trading System (ETS) [7]. Each airline operator receives a set amount of free, tradeable emission allowances in addition to which they can buy more at an auction. This allows airlines to operate at maximum capacity without negatively affecting the environment too much and making compromises possible in special cases.

The U.S has stated in 2019 that it has been implementing regulations for aircrafts too, but at a slower pace [8].

4.2 Comparison Between EU and Australia

Compared to the E.U, Australia has a relatively small aviation market which emits about 24MT (vs 180MT (**metric tons)** EU).

Similar to the E.U, Australia has been making efforts for regulation since the year 2012 with the release of their Action Plan. They are also partaking in the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) proposed by the International Civil Aviation Organization (ICAO) similarly to the E.U. Start of the phased implementation is projected to 2021 [9].

There also have been efforts to make airports carbon-neutral which has already seen success in some places.

4.3 Universal Indicators Followed in the US

Until recently, the U.S government didn't make any steps in regulating Aircraft emissions. Until mid-2020, the market was completely unregulated. Because of that, airlines have seen an increase in fuel consumption paired with diminishing increases in fuel efficiency. It took several years and lawsuits for the U.S government to finally start taking action.

4.4 Universal Indicators Followed in Australia

The Australian government has been implementing measures since the introduction of the 2012 Action Plan. They are also partaking in the CORSIA plan with planned implementation starting in 2021. They plan to gradually improve all parts of the aviation industry including Air Traffic Management and Airports [10–12]. They already have deployed some measures such as renewing their fleet to use the latest advances in technologies or investing into research and market development of sustainable biofuels 16.

5 Proposal Part

In this part its fuscous in some conclusion from the survey and analysis for future. The aircraft traffic tries keep increasing of emissions,

5.1 Findings and Observations

From our research and analysis, we have come to a few conclusions and projections for the future. Totally aircraft contribute only very small percentage to the total amount of human-induced emissions, 2% from recent observations. It has a share of 12% in emissions from all transport (Fig. 4).

Aircraft traffic is projected to keep increasing in volume, following the trend of over a 40% increase compared to the 2005 levels. The trend also keeps accelerating, projected to an additional 60% or more increase in traffic and emissions going into the year 2032.

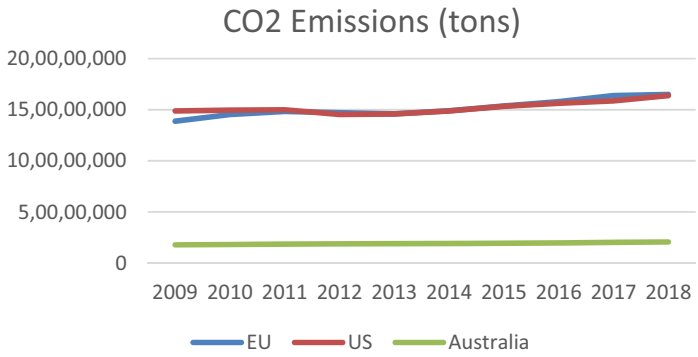

Fig. 4. Comparison on the basis of CO2 emissions (own elaboration).

Up until recently, there was little work done to implement an international standard. Many countries, including the US, did not have any regulations regarding aircraft emissions up until now. It is crucial that countries collaborate and make an effort to unify the industry and its regulations for healthy grow.

The CORSIA scheme proposed by the ICAO is set to begin its gradual implementation in the year 2021 following complete implementation by the year 2028. Their proposals, which aims to reduce emissions and other environmental hazards from aircraft, is deemed dated by some. That is mainly because today's aircrafts are already meeting their limits which they proposed a few years by default. Their main aim is to keep aircraft emissions at 2020 levels while still allowing for growth of the industry. The main areas of optimization are novel fuels, modern aircraft, carbon-neutral airports and carbon offset schemes.

Currently more than 70 countries are participating including Australia, all EU member countries and recently the US.

The initiative to increase fuel efficiency won't be enough to offset the continuously accelerating grow of the industry. Alternative methods such as biofuels from sustainable sources or significant advances in technologies are needed to make the industry carbon-neutral.

The E.U has been probably the most efficient in controlling emissions and other environmental factors. It is already using its ETS to regulate emissions. It's also closely working together with international organizations to help create a plan.

Australia is also already efficient in regulating its aircraft emissions by starting implementation of the system back in the year 2012. They also have multiple voluntary running initiatives to make their airports carbon-neutral and are actively investing into research and development of alternative biofuels together with the facilities and infrastructure needed for it [17, 19].

The US has not up until recently, despite having the biggest aviation market, been working together with the U.N. on its regulations plan for aircraft and shipping markets. That resulted in an uncontrolled market for a considerable amount of time which will take some effort to clean up.

5.2 Discussions and Proposals

Despite long periods of no action, in the recent year's efforts to regulate the aircraft industry have been put forward with some countries taking the lead and some falling behind.

Currently there are no universal standards and also no global ETS. Standards are being worked on and their implementation already started in some countries. A global ETS is not yet implemented.

The focus currently is on the implementation of the existing CORSIA program with many (over 90% of the market) countries participating. Some countries which for example have a small aviation industry can be excluded from this program).

Another area of optimization is a global ETS. This system is already applied in some countries and regions. At the moment the biggest market is the EU.

To reduce other negative factors (such as noise pollution), regulations should be developed and applied. There are also no regulations except general noise regulations. These are likely not suited for a situation like an airport, where the noise is very frequent.

5.3 Results

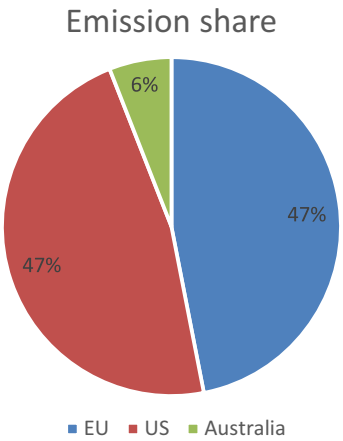

Fig. 5. Graphic representation of the emission shares of E.U, U.S & Australia (own elaboration).

As from the results obtained from our research indicates the emission share of Australia is lower (6%) when comparing with the other two regions such as E.U and U.S. Which clearly indicates that from the "Fig. 5", Australian aircraft authority implemented strong measures to regulate the traffic and closely kept monitoring the factors like emission rate, sound pollution and other factors caused by the aircrafts which resulting in there growth in aircraft industries. Similarly, E.U had set up various schemes and regulations to control the air traffic and to put a control over the factors causing environmental damages. As far as concerned, U.S has recently agreed to draw some attention regarding the aircraft emissions and the tremendous increase in their air traffic as a result we can

expect that in near future U.S will come up with an authority to govern the air traffic and environmental hazards caused by aircrafts.

Recent developments and discoveries in engine and biofuel technology coupled together with a global ETS alongside improvements in places such as airports, production facilities e.g. have shown that the targets set by the CORSIA project are achievable and being worked on. These achievements can make a huge impact in terms reducing the level of pollution and to restore the environment.

Other factors (such as noise) are not being effectively regulated (except general regulations) in most places yet but are also being taken into account in the recent years with research showing them being significant factors in general wellbeing and therefore health.

6 Conclusion

Our conclusion is that the authorities should focus on the implementation of global systems for ease of tracking and trading emissions. From the above study we understood that the world is already moving on a faster pace on terms of technology advancement and the aircraft industry across the globe is experiencing strong innovational changes. In addition, innovation in technology and approaches are essential to redefining mobility. Across the world, consensus is being formed and countries are gradually implementing new regulations and innovating their technologies. Cutting-edge technology, such as autonomous devices and ultralight materials, creates opportunities to transform the mobility system by enabling new business models and mobility services. Innovations in aviation industry such as artificial intelligence, biometrics, robotics, block chain, alternative fuels and electric aircraft are booming in the market. Aviation is therefore ideally positioned to support the innovation discourse and its potential impacts on new mobility. After that all focus should be shifted to implementing and enforcing so-called regulations using data from the global systems to reach the projected milestones.

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