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by Serap Zuvin, Simge Esendal and Başak Köksal Sağnak

Sustainable Aviation Fuels: Humankinds' Hope for Greener Skies

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1. Introduction

While we enjoy being able to travel thousands of kilometers only in just a few hours or receiving a product we order from the farthest end of the world delivered to our doorstep in couple of days, do we wonder about who pays the price for our comfort? The answer is simple: our environment. The luxuries the aviation industry provides to our daily lives are surely undeniable. What is also undeniable however is the fact that as one of the world's biggest industries, aviation produces 2.1% of global CO_2 emissions[1]. Industry experts from the Air Transport Action Group ("**ATAG**") expect that by 2050, over 10 billion passengers will fly 22 trillion kilometers each year, which would generate around 2,000 megatons of CO_2[2]. So, it's about time for the governments and the industry stakeholders to address this problem as the priority agenda item.

In fact, the issue is not a contemporary one, it was already predicted by the governments that rapid industrialization would increase CO_2 emissions causing hazardous environmental problems in the long run. Establishing international policies to overcome this problem were considered by many countries, and the United Nations Framework Convention on Climate Change ("**UNFCCC**") was signed in 1992 as a consequence of such considerations. UNFCC's main objective has been stated as *"stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system"*[3]. This was followed by the 2015 Paris Agreement which has been adopted to *"strengthen the global response to the threat of climate change by holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels"*[4]. In this regard, contracting parties have set 'net zero' targets aiming at decarbonizing all industries by 2050. With specific regard to aviation, it contains provisions on environmental protection. To deal with the carbon emissions caused by the aviation, International Civil Aviation Organization ("**ICAO**") has initiated a program called "Carbon Offsetting and Reduction Scheme for International Aviation" ("**CORSIA**") in 2016[5], which was adopted in the fourth volume of Annex 16 of the Convention on International Civil Aviation signed on 7 December 1944 and implemented as of January 1, 2019 by 193 countries, including ICAO member states, European Union ("**EU**") countries and Türkiye[6]. Under this program, aircraft operators that emit more than 10,000 tons of carbon dioxide per year on international flights are required to monitor, report and verify emissions[7], and sustainable eligible fuels have been identified that can be used to fulfill offsetting obligations of states[8].

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1 'Aviation and Climate Change' (aviationbenefit.org, October 2020) <https://aviationbenefits.org/media/167159/fact-sheet_2_aviation-and-climate-change.pdf> accessed 19 June 2023, 1.

2 'Aviation: Benefits beyond borders' (aviationbenefit.org) <https://aviationbenefits.org/media/167417/w2050_v2021_27sept_full.pdf> accessed 19 June 2023, 4.

3 Article 2 of the United Nations Framework Convention on Climate Change, entered into force on March 21, 1994.

4 Article 2 of the Paris Agreement, entered into force on 4 November 2016.

5 'CORSIA' (iata.org) <https://www.iata.org/en/iata-repository/pressroom/fact-sheets/fact-sheet---corsia/> accessed 19 June 2023, 1.

6 'CORSIA states for Chapter 3 State Pairs' (icao.int, July 2020) <https://www.icao.int/environmental-protection/CORSIA/Documents/CORSIA_States_for_Chapter3_State_Pairs_Jul2020.pdf> accessed 19 June 2023, 2.

7 'CORSIA Explained' (aviationbenefits.org) <https://aviationbenefits.org/environmental-efficiency/climate-action/offsettingemissions-corsia/corsia/corsia-explained/> accessed 19 June 2023.

8 'CORSIA Eligible Fuels' (icao.int) <https://www.icao.int/environmental-protection/CORSIA/Pages/CORSIA-Eligible-Fuels.

It is a fact that while it is essential to set out legal rules to combat high levels of CO_2 emissions and climate change, the intended results can only be achieved by effective implementation thereof by the relevant industry collaborators. Hence, it was an important step that the global stakeholders in the aviation sector announced in 2008 their commitments for decarbonization of the industry[9]. In its 65th Annual General Meeting, IATA set out three main industry goals, including a goal to reduce CO_2 emissions by 50% by 2050 relative to 2005 levels, which were also approved by other industry partners and presented to ICAO[10]. ATAG has made a further analysis to explore how the aviation industry can achieve this goal and compiled its findings under its Waypoint 2050 report[11]. As noted by ATAG, this commitment to halve the CO2 emissions of the aviation sector by 2050 was already in line with the long-term goal of the Paris Agreement to limit the increase in the average global temperature "to well below 2°C above pre-industrial levels". However, in light of the scientific evidence, to mitigate the worst effects of the climate change, it is key to reach net-zero emissions by 2050, so ATAG published the second edition of the Waypoint 2050 report to outline how aviation can reach net-zero emissions around 2050, this time more focused on the deployment of sustainable aviation fuels ("**SAF**")[12].

Governments and the global aviation stakeholders are fighting against climate change on multiple fronts. In this paper, we will take a look at what is going on in the SAF front; what does SAF mean, what are the advantages and disadvantages of using SAF instead of conventional fuel, what are some national regulations and initiatives in this field, in particular in Türkiye, and where are we globally in the efforts to expand the use of SAF in the industry.

2. The Net-Zero Commitment of the International Aviation Community with a Special Focus on SAF

The second edition of the Waypoint 2050 report revealed how important it is to achieve an urgent transition to SAF instead of conventional fuel in the aviation industry. All potential trajectories set out in the report to achieve net-zero CO_2 emission by 2050, require that 90% of the liquid fuel be composed of SAF by 2050. A mid-level estimate will require 480 billion liters (380 million tons) of SAF to be deployed by 2050[13]. According to the International Air Transport Association ("**IATA**"), global SAF production is estimated to have been between 300 to 450 million liters (240 and 380 thousand tons) in 2022[14]. Obviously, there is still too much to achieve in a limited timeframe. For that, the international aviation community has decided to accelerate their ongoing works to support SAF development and deployment.

Following the release of the second edition of the Waypoint 2050 report, ATAG members published a declaration on their commitment to net-zero CO_2 emission by 2050 in October 2021[15]. In their declaration ATAG members, by addressing to Waypoint 2050 report, announced that they are committed to increase the use of

aspx>accessed 19 June 2023.

9 'Industry Goals' (ease.europa.eu) <https://www.easa.europa.eu/eco/eaer/topics/introduction/industry-goals> accessed 19 June 2023.

10 'Environment - One Voice" (airlines.iata.org, Monday 12th January 2009) <https://airlines.iata.org/2009/01/12/environment-one-voice> accessed 19 June 2023.

11 'Aviation: Benefits beyond borders' (aviationbenefits.org, September 2021) <https://aviationbenefits.org/media/167417/w2050_v2021_27sept_full.pdf> accessed 19 June 2023

12 Ibid, 6.

13 'Assembly 41st Session - International Civil Aviation Organization (ICAO) Executive Committee' (icao.int, 2 September 2022) <https://www.icao.int/Meetings/a41/Documents/WP/wp_476_en.pdf> accessed 19 June 2023, 3.

14 'SAF deployment - IATA' (iata.org) <https://www.iata.org/contentassets/d13875e9ed784f75bac90f000760e998/saf-policy-2023.pdf> accessed 19 June 2023, 1.

15 'Commitment to Fly Net Zero 2050' (aviationbenefits.org, 5 October 2021) <https://aviationbenefits.org/media/167501/atag-net-zero-2050-declaration.pdf> accessed 19 June 2023.

SAF and to a transition away from fossil fuels by 2050. It was underlined in the declaration that the deployment of SAF particularly requires an acceleration of activity in the coming period to achieve the net-zero commitment. ATAG members stated that the coordinated efforts of the aviation stakeholders and governments is the key to achieve this goal and called on ICAO member states to support this long-term commitment at their 41st ICAO Assembly.

Indeed, a year later in October 2022, at 41st ICAO Assembly, ICAO member states adopted a collective long-term global aspirational goal of net-zero carbon emissions by 2050, and addressed the deployment of SAF among the measures necessary to achieve this goal. At the same time, they announced their full support for the ICAO Assistance, Capacity-building and Training for Sustainable Aviation Fuels program[16], which was launched in June 2022 to provide tailored support for the ICAO member states in various stages of SAF development and deployment, facilitate partnerships and cooperation on SAF initiatives and facilitate the share of knowledge and recognition of all SAF initiatives around the globe[17]. Back to the discussions at 41st ICAO Assembly on the SAF deployment, in the working paper of the Executive Committee titled "ICAO's Role in Supporting the Energy Transition to Sustainable Aviation Fuels"[18], ICAO member states set out some of the actions ICAO can take to enhance the ongoing work on the deployment of SAF and introduced certain enabling factors to support the governmental and industry efforts to achieve the necessary transition by 2050. The paper concludes with addressing the 3rd ICAO Conference on Aviation Alternative Fuels to set more tangible goals and a globally harmonized ambition to accelerate global SAF deployment.

Other examples of global aviation communities that have committed themselves to net-zero CO_2 emissions goal by 2050 are IATA[19] and the International Business Aviation Council together with the General Aviation Manufacturers Association[20], all acknowledging the urgent needs to enhance the SAF development and deployment.

3. What is SAF?

Evidently, governments and industry stakeholders are committed to enhance the deployment of SAF but what exactly is SAF? SAF is introduced to the aviation industry as a replacement of the fossil-based jet fuel that generates a significant amount of CO_2 not only when burned, but also during its production, transport and refining[21]. SAF is produced from feedstock that absorbs CO_2 and it is said to provide a net reduction in CO_2 emissions when compared to fossil fuels[22].

SAF is produced from different types of feedstock including waste oil and fats, municipal solid waste coming from households and businesses, cellulosic waste coming from excess wood or agricultural waste, cover crops, algae green energy and electricity[23].

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16 'States Adopt Net-Zero 2050 Global Aspirational Goal for International Flight Operations' (icao.int, 2022) <https://www.icao.int/Newsroom/Pages/States-adopts-netzero-2050-aspirational-goal-for-international-flight-operations.aspx> accessed 19 June 2023.

17 'ICAO Assistance, Capacity-Building and Training for Sustainable Aviation Fuels (ICAO ACT-SAF)' (*icao.int*) <https://www.icao.int/environmental-protection/Pages/act-saf.aspx> accessed 19 June 2023.

18 'Assembly 41st Session - International Civil Aviation Organization (ICAO) Executive Committee' (icao.int, 2 September 2022) <https://www.icao.int/Meetings/a41/Documents/WP/wp_476_en.pdf> accessed 19 June 2023.

19 'Resolution on the industry's commitment to reach net zero carbon emission by 2050' (iata.org) <https://www.iata.org/contentassets/dcd25da635cd4c3697b5d0d8ae32e159/iata-agm-resolution-on-net-zero-carbon-emissions.pdf> accessed 19 June 2023.

20 'Business aviation declaration on net-zero carbon emissions by 2050' (ibac.org, 22 September 2021) <https://ibac.org/app/ibac/files-module/local/documents/Declaration%20on%20NZE%202050%20210922%20Final.pdf> accessed 19 June 2023.

21 'Beginner's Guide to Sustainable Aviation Fuel' (aviationbenefits.org, 4 April 2023) <https://aviationbenefits.org/media/168027/atag-beginners-guide-to-saf-edition-2023.pdf> accessed 19 June 2023, 5.

22 Ibid, 5.

23 Ibid, 15.

As the chemical and physical characteristics of SAF are almost the same as that of the fossil-based jet fuels, SAF and conventional fossil-based fuel can be mixed safely to varying degrees, they use the same supply infrastructure and they do not require the adaptation of aircraft and engines currently in use[24].

SAF comprises of three key elements[25]:

i. **Sustainability:** it is sustainable in the sense that it can be continuously supplied in a manner consistent with economic, social and environmental aims by avoiding depletion of natural resources.

ii. **An alternative to conventional fuels:** it is not produced from fossil-based resources such as oil, coal and natural gas but instead from various feedstock. It is also processed to jet fuel through alternative pathways[26].

iii. **Qualified as a jet fuel:** it fulfills the technical requirements to be used as a jet fuel in commercial aircrafts.

Nevertheless, one should note that not every jet fuel comprising the above elements can be qualified as SAF. The SAF, which is necessary to achieve net-zero commitments of the industry, must be demonstrating a net carbon reduction through a lifecycle analysis. Therefore, to be qualified as SAF, the respective jet fuel must first go through a sustainability certification by accredited institutions, which will establish that the fuel meets necessary sustainability standards such as US Renewable Fuels Standard, the EU Emissions Trading Scheme, the EU Renewable Energy Directive and CORSIA[27]. Sustainability certifications is also determinant in terms of eligibility to governmental initiatives and exemptions in the US and EU member states[28]. These are of great use especially to alleviate the high costs of using SAF in lieu of conventional fuel, which may be by far the most prominent disadvantage of SAF as elaborated more in detail in the next section.

4. Key Benefits and Drawbacks of SAF

SAF has become favorite of the aviation industry, especially due to its following benefits:

- As explained above, usage of SAF has proven to be one of the most useful measures to reduce carbon emissions. According to the 2016 trend assessment of ICAO, a complete substitution of SAF for aviation fuel could mitigate 63% of CO_2 emissions from international flights by 2050[29].

- Today, the dependence of the aviation sector on traditional fossil fuels makes it susceptible to price fluctuations, owing mostly to changing prices of crude oil and supply availability. Conversely, SAF is appealing since its feedstocks are not geographically limited like fossil fuel sources from natural

24 'What is SAF' (iata.org) <https://www.iata.org/contentassets/d13875e9ed784f75bac90f000760e998/saf-what-is-saf.pdf> accessed 19 June 2023, 1.

25 Ibid, 1.

26 'Beginner's Guide to Sustainable Aviation Fuel' (aviationbenefits.org, 4 April 2023) <https://aviationbenefits.org/media/168027/atag-beginners-guide-to-saf-edition-2023.pdf> accessed 19 June 2023, 17.

27 'Sustainable Aviation Fuel - Fact 5' (iata.org) <https://www.iata.org/contentassets/d13875e9ed784f75bac90f000760e998/saf-and-sustainability.pdf> accessed 19 June 2023, 1.

28 'Beginner's Guide to Sustainable Aviation Fuel' (aviationbenefits.org, 4 April 2023) <https://aviationbenefits.org/media/168027/atag-beginners-guide-to-saf-edition-2023.pdf> accessed 19 June 2023, 19.

29 'What is SAF' (iata.org) <https://www.iata.org/contentassets/d13875e9ed784f75bac90f000760e998/saf-what-is-saf.pdf> & 'Sustainable Aviation Fuels Guide' (icao.int) <https://www.icao.int/environmentalprotection/Documents/Sustainable%20Aviation%20Fuels%20Guide_100519.pdf> accessed 19 June 2023, 9.

deposits[30]. As SAF supply grows and scales, countries who are currently net importers of jet fuel will reap the advantages from a more diverse geographic supply along with a potential for energy security[31].

- Since the plants that are used as biomass for SAF can be grown during the vacant periods of the crop cycle, a double-benefit scenario is possible, whereby farmers earn extra off-season income, and soil fertility levels may be increased due to the profitable crop rotation[32].
- Moreover, SAF, also known as a 'drop-in alternative fuel', can use the infrastructure that has been developed for the supply and distribution of conventional jet fuels, which is more cost effective than other routes that would require a complete change of equipment[33]. Owing to this, it is reasonable to assume that a smooth transition to SAF using the existing infrastructure could be possible.
- SAF also has numerous economic advantages for developing countries. It is estimated that the transition from conventional jet fuels to SAF will create new jobs and employ around 14 million people. As previously stated, although fossil fuels are only available in a few countries, sustainable alternatives may be produced in nearly every country. Employment opportunities exist in production facilities, plant construction, raw material gathering, supply chain, and logistics[34].
- As time goes by, in addition to increases in the cost of using fossil fuels, SAF is expected to become economically viable and competitive with fossil fuels as costs are reduced through improvements in production technology, the use of lower-cost feedstocks and economies of scale in production[35].

Despite all the advantages of SAF, there are also some challenges in front of its adoption by states. It must be noted that the large number of flights operated with SAF by more than 50 different airlines so far, shows that the hurdles to SAF deployment are not technical, but rather economic and political[36]. The key economic and political drawbacks can be listed as follows:

- SAF is more expensive to produce than traditional fossil fuels, which could lead to higher ticket prices[37]. It may also be a significant deterrent that may hinder the realization of net-zero commitments by 2050. According to IATA, the SAF production in 2022 (which only covered 0.1% to 0.15% of total jet fuel demand) came at an additional cost to the industry of between USD 322 million to 510 million

30 'Deployment of Sustainable Aviation Fuel in the United States' (airlines.org, August 2019) <https://www.airlines.org/wp-content/uploads/2019/08/A4A-Sustainable-Fuel-Report_FINAL.pdf> accessed 19 June 2023, 4.

31 'What is SAF' (iata.org) <https://www.iata.org/contentassets/d13875e9ed784f75bac90f000760e998/saf-what-is-saf.pdf> accessed 19 June 2023, 2.

32 'Sustainable Aviation Fuels' (energy.gov) https://www.energy.gov/eere/bioenergy/sustainable-aviation-fuels accessed 19 June 2023.

33 'Guidance on Potential Policies and Coordinated Approaches for the Deployment of Sustainable Aviation Fuels' (icao.int, June 2022) <https://www.icao.int/environmental-protection/Documents/SAF/Guidance%20on%20SAF%20policies%20-%20Version%201.pdf> accessed 19 June 2023, 3.

34 'Sustainable Aviation Fuels' (energy.gov) https://www.energy.gov/eere/bioenergy/sustainable-aviation-fuels accessed 19 June 2023.

35 'Current Landscape and Future of SAF Industry' (ease.europa.eu) <https://www.easa.europa.eu/eco/eaer/topics/sustainable-aviation-fuels/current-landscape-future-saf-industry#overall-co2-emissions-reductions>accessed 19 June 2023.

36 'Beginner's Guide to Sustainable Aviation Fuel' (aviationbenefits.org, 4 April 2023) <https://aviationbenefits.org/media/168027/atag-beginners-guide-to-saf-edition-2023.pdf> accessed 19 June 2023, 28.

37 Shahriar MF and Khanal A, 'The Current Techno-Economic, Environmental, Policy Status and Perspectives of Sustainable Aviation Fuel (SAF)' (2022) 325 Fuel 124905.

in single year[38].

- The second downside to the SAF adoption is the lack of resource and feedstock availability. Unfortunately, infrastructure for the production, storage and distribution of SAF is still insufficient, which slows down the transition from conventional jet fuels to SAF[39]. Furthermore, since the feedstocks are needed by many sectors other than aviation, such as agriculture and food production, a competition for limited supply takes place between these sectors and aviation fuel[40].

- Another drawback is the absence of government policies[41] that provide useful incentives and production support. Undoubtedly, the transition to SAF requires large investments and therefore high costs of financing. Only in Europe, experts estimate that the total capital of investment in SAF plants will be EUR 15 billion per year by 2050. For SAF to be an attractive investment, governments need to adopt policies that reduce risks and provide certainty and predictability to investors[42].

- It is also note-worthy to mention that there is currently no harmonized international approach with regard to the SAF mandate and decarbonization roadmap. As a consequence, progress on SAF remains at the regional level for now. This raises concerns among NGOs and the aviation industry about the achievement of carbon neutrality targets[43]. Thus, it may be inevitable that environmentally concerned sector players may feel "short-changed", and others may feel hesitant to follow suit.

- Although most limitations are financial in nature, there also exist technical hurdles to be overcome. Owing to concerns regarding caloric-yield and reliability, maximum blending limit of SAF (Which is dependent on the production method and used feedstock as well) is 50%. This necessitates that airports wishing to utilize SAF must stock both SAF and conventional jet fuel in their reserves[44]. However, industry stakeholders and fuel producers are currently working to increase this ratio to 100% by 2030[45].

- It is also pointed out that the certification process of SAF is complicated, time-consuming[46] and costly, as it requires a performance test in the combustion chamber and engine[47].

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38 'SAF deployment – IATA' (iata.org) <https://www.iata.org/contentassets/d13875e9ed784f75bac90f000760e998/saf-policy-2023.pdf> accessed 19 June 2023, 1.

39 'What Is Sustainable Aviation Fuel and Its Challenges?' (indiatimes.com, 14 May 2023) <https://www.indiatimes.com/explainers/news/what-is-sustainable-aviation-fuel-and-its-challenges-602193.html> accessed 19 June 2023.

40 'Clean Skies for Tomorrow' (mckinsey.com, November 2020) <https://www.mckinsey.com/~/media/mckinsey/industries/travel%20transport%20and%20logistics/our%20insights/scaling%20sustainable%20aviation%20fuel%20today%20for%20clean%20skies%20tomorrow/clean-skies-for-tomorrow.pdf> accessed 19 June 2023, 22.

41 'SAF deployment – IATA' (iata.org) <https://www.iata.org/contentassets/d13875e9ed784f75bac90f000760e998/saf-policy-2023.pdf> accessed 19 June 2023, 1.

42 'Clean Skies for Tomorrow' (*weforum.org*, November 2021) <https://www3.weforum.org/docs/WEF_Clean_Skies_for_Tomorrow_Sustainable_Aviation_Fuel_Policy_Toolkit_2021.pdf> accessed 19 June 2023, 8.

43 Ibid.

44 'Bridging the gaps from fossil fuels to SAF' (topsoe.com) <https://www.topsoe.com/saf-certification-and-blending-limits> accessed 19 June 2023.

45 'Sustainable Aviation Fuels' (ease.europa.eu) <https://www.easa.europa.eu/eco/eaer/topics/sustainable-aviation-fuels#:~:text=Currently%20certified%20SAF%20are%20subject,of%20100%25%20SAF%20by%202030.> accessed 19 June 2023.

46 'What Is Sustainable Aviation Fuel and Its Challenges?' (indiatimes.com, 14 May 2023) <https://www.indiatimes.com/explainers/news/what-is-sustainable-aviation-fuel-and-its-challenges-602193.html> accessed 19 June 2023.

47 'Assembly 41st Session - International Civil Aviation Organization (ICAO) Executive Committee New Certification Procedures for Sustainable Aviation Fuels' (icao.int, 13 September 2022) < https://www.icao.int/Meetings/a41/Documents/WP/wp_503_en.pdf > accessed 19 June 2023, 2.

That being the case, it is argued that the above-mentioned challenges can be overcome through government policies and the advancement of technologies[48]. IATA draws attention to the importance of governmental policies in encouraging the SAF deployment. According to IATA, such policies should be harmonized across countries and industries, stable and predictable, technology-neutral, feedstock agnostic, setting globally recognized sustainability standards, facilitating the certification of SAF supply chains subject to internationally agreed sustainability standards and allowing multiple initiatives.25 Airlines can also develop policies to address certain of those downsides. For instance, to tackle the soaring ticket prices, they can provide long-term fixed price certainty and seek to de-risk their SAF investments as much as possible[49]. In the next section, we will take a look at some of the governmental policies on SAF but our focus will be on that of Türkiye.

5. Governmental Policies and Initiatives on SAF Deployment

5.1. United States of America

The California Low Carbon Fuel Standard ("**CA-LCFS**"), which aims to reduce greenhouse gas emissions in the transportation sector, was amended in 2019 to recognize SAF as an eligible fuel to benefit from the initiatives thereunder[50]. The California state is already a global leader in SAF production, which produced around 8 million gallons of SAF in 2021[51]. This is significant especially because California is responsible for one-fifth of US jet fuel use[52]. However, the fact that CA-LCFS provides for an opt-in compliance with SAFs is said to be a potential barrier for wider adoption of SAF deployment[53]. Another instrument, which incentivizes the production of SAF on an opt-in basis is the US Renewable Fuel Standard ("**RFS**")[54].

In May 2021, the US Congress introduced the Sustainable Skies Act, which incentivized SAF in the form of a credit of USD 1.50 per gallon for blenders that supply SAF with a demonstrated 50% or greater lifecycle greenhouse gas savings. Only the SAF, which meets the full set of CORSIA criteria is considered eligible to the incentives under the Sustainable Skies Act[55].

In September 2021, SAF Grand Challenge was announced by the US departments of Energy, Transportation and Agriculture to set a new goal to increase SAF production to 3 billion gallons by 2030, and to 35 billion gallons by 2050[56].

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48 'SAF deployment - IATA' (iata.org) <https://www.iata.org/contentassets/d13875e9ed784f75bac90f000760e998/saf-policy-2023.pdf> accessed 19 June 2023, 3.

49 'Sustainable Aviation Fuel – Ready for lift off' (assets.kpmg.com) <https://assets.kpmg.com/content/dam/kpmg/uk/pdf/2022/11/sustainable-aviation-fuel.pdf> accessed 19 June 2023, 8.

50 'Fact sheet: EU and US Policy Approaches to advance SAF production' (iata.org) <https://www.iata.org/contentassets/d13875e9ed784f75bac90f000760e998/fact-sheet---us-and-eu-saf-policies.pdf> accessed 19 June 2023, 1.

51 'A roadmap for decarbonizing California in-state aviation emissions' (theicct.org, January 2023) <https://theicct.org/wp-content/uploads/2023/01/ca-aviation-decarbonization-jan23.pdf> accessed 19 June 2023, 2.

52 Korkut E and Fowler LB, 'Regulatory and Policy Analysis of Production, Development and Use of Sustainable Aviation Fuels in the United States' (Frontiers, 22 October 2021) <https://www.frontiersin.org/articles/10.3389/fenrg.2021.750514/full#:~:text=Congress%20introduced%20the%20Sustainable%20Skies,reductions%20(Hubbard%2C%202021> accessed 19 June 2023.

53 'A roadmap for decarbonizing California in-state aviation emissions' (theicct.org, January 2023) <https://theicct.org/wp-content/uploads/2023/01/ca-aviation-decarbonization-jan23.pdf> accessed 19 June 2023, 2.

54 Fact sheet: EU and US Policy Approaches to advance SAF production' (*iata.org*) <https://www.iata.org/contentassets/d13875e9ed784f75bac90f000760e998/fact-sheet---us-and-eu-saf-policies.pdf> accessed 19 June 2023, 1.

55 Ibid, 2.

56 'Memorandum of understanding sustainable aviation fuel grand challenge' (energy.gov.tr) <https://www.energy.gov/sites/default/files/2021-09/S1-Signed-SAF-MOU-9-08-21_0.pdf> accessed 19 June 2023, 2.

The 2022 Inflation Reduction Act is another US policy incentivizing SAF production by granting a tax credit of up to USD 1.75 per gallon through 2027, which can also be combined with other initiatives under the CA-LCFS and the RFS[57].

5.2. European Union

In July 2021, the European Commission published its proposal for a Regulation of the European Parliament and of the Council on ensuring a level playing field for sustainable air transport (“**ReFuelEU Regulation**”), which, once come into force, will be the first to govern SAF deployment within the EU. The ReFuelEU Regulation imposes obligations on the fuel suppliers to contain a certain volume of SAF in the fuel they supply to the EU airports, which starts with 2% in 2025 and gradually increases up to 63% in 2050. The ReFuelEU Regulation also requires aircraft operators to ensure that the yearly quantity of fuel uplifted at any EU airport will be at least 90% of the yearly aviation fuel required, so that the operators will need to refuel each time only in the volume required for a safe flight. This is to prevent additional CO2 emissions resulting due to the extra weight of the aircraft carrying excessive amounts of fuel. It will also ensure that all flights that are departing from an EU airport will carry a minimum amount of SAF[58].

Certain EU member states such as France, Denmark, the Netherlands, Spain and Sweden have introduced individual national policies and initiatives to enhance the development and deployment of SAF. For example, the Danish government launched a climate partnership in 2019 and invited the sector stakeholders to contribute to the reduction of emissions. Accordingly, it was decided to create a special fund for scaling up SAF[59]. Also, the Spanish government established a public-private value chain platform in 2011 as an incentive mechanism to devise a roadmap for SAF and to accelerate research and development efforts[60].

5.3. Türkiye (Turkey)

Türkiye is one of the countries which attributes great importance to the use of SAF as an alternative fuel for the achievement of its commitment to which it undertakes according to the Paris Climate Agreement[61]. As indicated in the air traffic statistics of the European Organisation for the Safety of Air Navigation (EUROCONTROL)[62], Türkiye is a significant partner for many countries as it hosts many airlines and welcomes passengers from all around the world. However, it must be underlined that the rate of carbon emissions is higher than other countries, since Turkish airports attract a very significant volume of flights of which almost all are carried out with ozone-depleting substances. In order to gradually overcome this issue and provide a healthier environment, Turkish authorities have been holding meetings with the global and national civil aviation authorities and exchanging their views on the implementation of SAF-related policies[63]. Recently, the govern-

57 ‘A roadmap for decarbonizing California in-state aviation emissions’ (theicct.org, January 2023) <https://theicct.org/wp-content/uploads/2023/01/ca-aviation-decarbonization-jan23.pdf> accessed 19 June 2023, 2.

58 ‘Refueleu Aviation Initiative - European Parliament’ (europarl.europe.eu) <https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/729457/EPRS_BRI(2022)729457_EN.pdf> accessed 19 June 2023.

59 ‘SAF’ (eurocontrol.int) <https://www.eurocontrol.int/shared/saf/> accessed 19 June 2023.

60 ‘Fomento, Iberia y Airbus firman un acuerdo para favorecer el uso de biocombustibles en aviación’ (mitma.gob.es, 2011) <https://www.mitma.gob.es/recursos_mfom/11033001.pdf> accessed 19 June 2023.

61 Türkiye has ratified the Agreement by the Law No. 7335, dated 6 October 2021, published in the Official Gazette No. 31621 and dated 7 October 2021.

62 ‘Top 5 Airports as of 18 June 2023 based on last 30 days of traffic’ (eurocontrol.int), <https://www.eurocontrol.int/our-data#> accessed 19 June 2023.

63 See ‘Global Cooperation for Sustainable Aviation’ <https://web.shgm.gov.tr/tr/haberler/1630-kuresel-duzeyde-surdurulebilir-

ment announced its intention to participate in the CORSIA[64]. Under this scheme, the Directorate General of Civil Aviation ("**DGCA**") created a regulatory framework to integrate the rules and procedures with regard to the monitoring, reporting and verification of CORSIA eligible fuels.

Furthermore, in 2022, the DGCA published a draft directive regarding SAF called "SHT-SAF Directive on Sustainable Aviation Fuels" ("**Draft Directive**")[65], which is still open for the contribution and comments of industry stakeholders[66]. The Draft Directive regulates the use, distribution and promotion of SAF. It is applicable to all national and international aircraft operators, fuel companies, airport operators and fuel refineries. Flights undertaken for humanitarian aid, medical and fire-fighting purposes are excluded from its scope. Under the Draft Directive, SAF is defined as fuels produced from renewables or waste-derived raw materials that meet sustainability criteria and can be consumed in aircraft without requiring any hardware modifications. For international flights departing from Türkiye, all aircraft operators falling under the scope of this Directive are obliged to use SAF blend to jet fuel at the rates of:

a) 1% for 2025 and 2026,

b) 2% for 2027,

c) 3% for 2028,

d) 4% for 2029,

e) 5% for 2030.

The fuel supplier is obliged to supply blended jet fuel to the aircraft operators who are obliged to use SAF in accordance with the Draft Directive. According to the Draft Directive, SAF must meet the standards and requirements set out under CORSIA. Aircraft operators and fuel suppliers should periodically check that they meet SAF-related standards and requirements and keep copies of relevant documents in their archives. Refineries producing under the Draft Directive are permitted to sell only SAF that is produced from a raw material originating in Türkiye or from wastes generated in Türkiye. However, this rule is not applicable for the Low Carbon Aviation Fuels under CORSIA. According to the Draft Directive, the sale and supply of SAF shall only take place at certified airports. Aircraft operators, fuel shippers, fuel suppliers, fuel blenders and intermediate receivers are subject to auditing by the DGCA in accordance with the procedures and principles set out in the Draft Directive.

6. Where are we in the deployment of SAF globally?

Currently, in commercial flights, SAF is blended with conventional jet fuel kerosene in ratios of up to 50%[67]. The first ever test flight was performed by Swedish airline BRA in June 2021 with a commercial regional aircraft powered by 100% SAF supplied by Neste[68] .The tests are still ongoing to ensure that SAF is absolutely

havacilik-icin-isbirligi>; 'Türkiye Energy Summit' <https://biyodizel.org.tr/bulten/surdurulebilir-havacilik>

64 Annex 16 - Environmental Protection Volume IV, ICAO, 2018 <https://www.icao.int/environmental-protection/CORSIA/Pages/SARPs-Annex-16-Volume-IV.aspx> accessed 19 June 2023.

65 'Sürdürülebilir Havacılık Yakıtı Talimatı (Sht-Saf)' (web.shgm.gov.tr) <https://web.shgm.gov.tr/documents/sivilhavacilik/files/mevzuat/sektorel/taslaklar/2022/SHT-SAF.pdf>

66 'Sürdürülebilir Havacılık Yakıtı Talimatı (SHT-SAF) Taslağı Hazırlanmış Olup Sektör Görüşlerine Açılmıştır' (web.shgm.gov.tr, 3 August 2022) <https://web.shgm.gov.tr/tr/s/6912-surdurulebilir-havacilik-yakiti-talimati-sht-saf-taslagi-hazirlanmis-olup-sektor-goruslerine-acilmistir> accessed 19 June 2023.

67 'Beginner's Guide to Sustainable Aviation Fuel' (aviationbenefits.org, 4 April 2023) <https://aviationbenefits.org/media/168027/atag-beginners-guide-to-saf-edition-2023.pdf> accessed 19 June 2023, 5.

68 'First Flight in History with 100% Sustainable Aviation Fuel (SAF) on a Regional Commercial Aircraft This Summer - Co_2 Value' (co2value.eu, 12 September 2022) <https://co2value.eu/first-flight-in-history-with-100-sustainable-aviation-fuel-saf-on-a-regional-commercial-aircraft-this-summer/#:~:text=Early%20this%20summer%2C%20sustainable%20aviation,on%20a%20

safe before switching to 100% SAF use in commercial flights. So far, 496,807 commercial flights have been operated using SAF since 2011[69].

According to ICAO figures, currently 65 airports are distributing SAF including Dubai, Munich, Los Angeles, Schiphol, Stockholm, Singapore, Toronto-Pearson and Tokyo airports in addition to 4 biggest international airports in Türkiye namely Istanbul, Sabiha Gökçen, Ankara and Izmir Adnan Menderes airports[70]. There are 42.3 billion liters of SAF under offtake agreements[71]. According to ATAG, as of early 2023, the value of the SAF purchase agreements entered into by the airline companies is around USD 40 billion[72].

How about Türkiye? In Türkiye, SAF-related activities had long been underway. For instance, Pegasus Airlines – a Turkish low-cost air carrier - operated its first SAF fueled flight between Izmir Adnan Menderes Airport and Sabiha Gökçen on March 1, 2022[73]. Pegasus later announced that it will operate a domestic flight from Izmir with SAF every day throughout March[74]. In addition, recently, Pegasus and fuel supplier Petrol Ofisi have decided to strengthen their cooperation even further. With the new agreement, Pegasus will increase the volume of SAF to be purchased from Petrol Ofisi in 2023 and 2024, and will continue to operate domestic flights using SAF. Thus, it is aimed to expand the airports where SAF flights are operated, and it is envisaged that the volume of SAF used in 2022 within the scope of cooperation will increase by three times in 2023 and up to ten times in 2024[75]. Turkish Airlines – the leading airline in Türkiye – also operated its first flight between Istanbul and Paris with SAF on February 2,2022[76].

Furthermore, Tüpraş – one of the well-known petrol refinery companies in Türkiye - signed a license agreement with Honeywell, a technology company, as part of its plan to produce SAF. According to the statement made by the company, Tüpraş will transform waste raw material into SAF, renewable diesel and other products at the Universal Oil Products (UOP) Ecofining facility planned to be established[77].

Last but not least, very recently Turkish Airlines, Boeing and Istanbul Technical University have announced their collaboration on the establishment of the first sustainable aviation platform[78] to support the transition

commercial%20regional%20aircraft.> accessed 19 June 2023.

69 'Sustainable Aviation Fuel' (aviationbenefits.org) <https://aviationbenefits.org/environmental-efficiency/climate-action/sustainable-aviation-fuel/> accessed 19 June 2023.

70 'Airports' (icao.int) <https://www.icao.int/environmental-protection/GFAAF/Pages/Airports.aspx> accessed 19 June 2023.

71 'Sustainable Aviation Fuel (SAF)' (icao.int)) <https://www.icao.int/environmental-protection/pages/SAF.aspx> accessed 19 June 2023.

72 'Beginner's Guide to Sustainable Aviation Fuel' (aviationbenefits.org, 4 April 2023) <https://aviationbenefits.org/media/168027/atag-beginners-guide-to-saf-edition-2023.pdf> accessed 19 June 2023, 26.

73 'Pegasus Expands the Use of Sustainable Aviation Fuel (SAF) on Domestic Flights' (aviationturkey.com, 2023) <https://www.aviationturkey.com/en/content/pegasus-expands-the-use-of-sustainable-aviation-fuel-saf-on-domestic-flights-722#:~:text=Pegasus%20Airlines'%20first%20domestic%20flight,in%20cooperation%20with%20Petrol%20Ofisi.> accessed 19 June 2023.

74 'Pegasus, Sürdürülebilir Havacılık Yakıtı (SAF) ile Türkiye'de ilk uçuşunu gerçekleştirdi' (petrolofisi.com.tr) <https://www.petrolofisi.com.tr/haberler-ve-duyurular/pegasus-surdurulebilir-havacilik-yakiti-saf-ile-turkiyede-ilk-ucusunu-gerceklestirdi> accessed 19 June 2023.

75 'SAF Kullanımını Arttırıyor' (flypgs.com) <https://www.flypgs.com/basin-bultenleri/pegasus-ic-hat-ucuslarinda-surdurulebilir-havacilik-yakiti-safkullanimini-artiriyor> accessed 19 June 2023.

76 'Havacılık sektöründe SAF ile ilk uçuşlar başladı' (uplifers.com, March 2023) <https://www.uplifers.com/havacilik-sektorunde-saf-surdurulebilir-havacilik-yakiti-ile-ilk-ucuslar-basladi/> accessed 19 June 2023.

77 'Tüpraş, Türkiye'nin ilk sürdürülebilir havacılık yakıtı üretim tesisini hayata geçirecek' (aa.com.tr, 7 July 2022) <https://www.aa.com.tr/tr/sirkethaberleri/sanayi/tupras-turkiyenin-ilk-surdurulebilir-havacilik-yakiti-uretim-tesisini-hayata-gecirecek/674176> accessed 19 June 2023.

78 'ITU, THY and Boeing Team Up for "Sustainability in Aviation' (haberler.itu.edu.tr, 2 June 2023) <https://haberler.itu.edu.tr/en/newsdetail/2023/06/02/itu-thy-and-boeing-team-up-for-sustainability-in-aviation> accessed 19 June 2023.

to sustainable aviation in Türkiye. It is expected that this platform will encourage industry-wide collaboration, leading to higher awareness on sustainable aviation practices, as well as explore Türkiye's SAF potential. It is also planned that the platform partners will prepare a roadmap as a recommendation for the promotion of SAF in Türkiye. Finally, it is also aimed to increase knowledge and awareness in this field through training programs and social activities[79].

7. Conclusion

Year after year, climate change targets are tightening and reducing carbon emissions is becoming more important for many sectors. Although specific targets for almost every individual sector exists, it is without a doubt more pressing and crucial to prioritize these efforts in sectors that contribute significantly to global carbon emission rates and among them is aviation. Although there are many efforts on sustainable aviation, the most important concept on the agenda of airline companies, policy makers and passengers today is the performance of flights with SAF. While it has many environmental advantages, it has also been criticized for some of its economic and logistical shortcomings. However, most of the difficulties encountered in its production and widespread use can be overcome with sound governmental policies and advanced technology. In this regard, a number of policy recommendations are being made both regionally and internationally to make SAF more attractive to investors. To this end, Türkiye, like the US and many other European countries, has started to take concrete steps to put SAF production, sales and achieving SAF targets on a legal basis. The first flights with SAF have been realized by base airlines and initiatives have been started to develop SAF production technologies. However, it should not be forgotten that the development of SAF is not possible with the efforts of a single country or region. In this regard, countries need to create policies in harmony with each other, raise awareness of passengers and encourage stakeholders to play a role in this issue. The way things are, the world may soon be forced to accept that either SAF shall take off, or humanities hopes for a greener future will land - permanently.

79 'Türkiye Sürdürülebilir Havacılık Platformu'nun kurulması için imzalar atıldı' (brandmap.com.tr, 31 May) <https://www.brandmap.com.tr/post/t%C3%BCrkiye-s%C3%BCrd%C3%BCr%C3%BClebilir-havac%C4%B1l%C4%B1k-platformu-nun-kurulmas%C4%B1-i%C3%A7in-imzalar-at%C4%B1ld%C4%B1> accessed 19 June 2023.

Space

Introducing the Global Navigation Satellite System into the Railway Environment with the Italian Space Agency: a Story That Comes From Afar
by Mauro Cardone, Alberto Tuozzi and Luisa Santoro

High Time for an EU Space Strategy for Security and Defence
by Mathieu Bataille

Introducing the Global Navigation Satellite System into the Railway Environment with the Italian Space Agency: a Story That Comes From Afar

by Mauro Cardone, Alberto Tuozzi**, Luisa Santoro****

Abstract

In 2019 about 1500 railway accidents were reported in Europe, a number that could have been much lower with the use of space data and technologies, since they can facilitate and accelerate the digitisation of railways by providing scalable solutions for accurate positioning, thus enhancing not only safety, but also the users' and freight customers' experience.

This article explains how the introduction into the railway sector of advanced safety and control systems based on satellite navigation will reduce the complexity of traditional ground-based infrastructures, paving the way for a rapid adoption of modernized standards for train control and improving the quality and safety of our journeys on railway tracks.

1. Introduction

Space exploration has always been an important activity for humans, not only to gain knowledge about what exists beyond the Earth, but also as a source of inspiration capable of forging a possible alternative future beyond it, possibly improving everyday living conditions. So, over the centuries many of the inventions and technologies developed to explore the universe have been adapted to versions that have proved to be beneficial to our daily life.

Orbiting satellites, for instance, enable the provision of a great number of services that today are fundamental for our activities on the Earth: from meteorological satellites delivering information on short- and long-term weather patterns or Earth-observation (EO) satellites capable of remotely sensing lands, rivers and oceans, thus improving the management of Earth's resources and helping understand global climate change; to telecommunications satellites, which allow to instantaneously transfer images and data, or to satellites providing precision navigation, positioning and timing information that today is essential to many terrestrial service-providers and users, complementing sea, air and land data, not only in terms of precision, but also of security and safety.

In 2019 about 1500 railway accidents were reported in Europe[1], a number that could have been much lower with the use of space data and technologies, since they can facilitate and accelerate the digitisation of railways by providing scalable solutions for accurate positioning, improving not only safety, but also the users' and freight customers' experience. In other words, space technologies can potentially address major challenges facing the railways sector: "*reducing rail system costs by a factor of 10, increasing system capacity with smart technology and meeting the mixed traffic challenge where slow freight and higher speed passenger ser-*

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1 Rail accidents by type of accident, https://ec.europa.eu/eurostat/databrowser/view/tran_sf_railac/default/table?lang=en.

vices must share tracks"[2]. In this sense, high-speed passenger and cargo lines represent priority targets to be upgraded with space solutions. However, due to the present infrastructures of regional and remote railways lines - which are dotted with expensive (to procure, and even to install and maintain) electronic beacons (or "*balises*"), track circuits, cablings, GSM-R network, etc - so far, the adoption of advanced traffic management systems for railways has been slow.

But the introduction of advanced safety systems along this type of lines has always been - and remains - a priority both for railways and train operators, who are looking for ERTMS[3]-compatible solutions based on Satellite Navigation and Communication (SatNav and SatCom respectively) to complement or even replace the ground-based infrastructure.

2. Introducing the Global Navigation Satellite System into the railway environment

Rail transport systems are rapidly evolving thanks to the digital railway agenda, which includes not only the already mentioned ERTMS, but also Automated Train Operations (ATO), 5G communications, digital exchanges, cybersecurity, train automatic coupling, the Global Navigation Satellite System (GNSS)[4], etc. In particular, the adoption of the standard ERTMS/ETCS (European Train Control System) has proved to be fundamental.

ERTMS already represents an interoperable standard solution widely adopted worldwide and, to date, the most advanced solution for rail traffic management at the European level. It was conceived back in 1989 by the EU, with the support of railway operators, in order to create a standard control mechanism that could replace the 24 (sometimes incompatible with each other) rail transport and safety systems used in Europe in order to guarantee interoperability.

So far, great progress has been made in Europe - and particularly in Italy - to switch to the new traction control system, so that on the Rome-Florence direct line, for example, the traffic regime has been resorting to ERTMS-ETCS level 2 (L2) radio blocks since 28 December 2022.

In Italy, thanks to the substantial investments planned for the next few years as part of the ERTMS Accelerated Plan, 6,000 km of the overall tracks will be "*radio-based*" and properly equipped with rolling stock by 2027[5]. In particular, ERTMS/ETCS entails exchanging data and information between devices installed on the trains, radio buoys placed on the ground - along the tracks - and a Radio Block Centre (RBC) located on the ground, too. Localization and control of the wagons' integrity take place thanks to the ground control system, which utilizes the data coming from the trains and/or from the interlocking and tracking circuits of the signalling system.

At the same time, in the medium term, the evolution to level 3 (L3) remains a primary goal. At L3, localization and integrity control data calculated on-board the train will be used to guarantee a suitable distance between trains without any other devices on-board. This will optimize travel time by increasing the density of trains on railway lines thanks to mobile blocks or reduced fixed blocks.

The ERTMS system requires the installation and use of special transponders (Eurobalise buoys) for train localization functions. Although the buoy-based system works very well, it is still accompanied by a series of

2 https://www.globalrailwayreview.com/article/88578/can-space-technology-be-used-to-transform-the-future-of-rail/

3 ERTMS (European Rail Traffic Management System) is "an interoperable European standard, which not only allows speed limits to be transmitted to the driver, but can also continuously monitor the driver's response to this information. An on-board computer effectively compares the speed of the train with the maximum permitted speed and automatically applies the train's braking, if the limit is exceeded. The wider implementation of the ERTMS requires significant investments in ground infrastructure (used for both positioning and telecommunication purposes)", https://sdg.esa.int/activity/3insat-3983.

4 https://institutdelors.eu/en/publications/challenges-for-european-rail/

5 https://www.mit.gov.it/nfsmitgov/files/media/notizia/2022-06/Piano%20Accelerato%20ERTMS-ACC%20Rev.P.pdf , pg. 40.

drawbacks, such as installation and maintenance costs, as well as a waste in terms of energy and operating efficiency.

In the long term, the next step is already being worked on: signaling will be completely suppressed and all messages will be exchanged via radio (so-called "post ERTMS" phase, with working groups and projects such as RCA[6] and OCORA[7] already in place), while new advanced functions such as Autonomous Train Operations (ATO) and Virtual Coupling (railway platooning) will be implemented.

In this framework, GNSS represents one of the disruptive technologies to be introduced in the future ERTMS specifications at L2 and L3, as well as in the post-ERTMS phase, in order to improve train positioning and enable new rail services to overcome the current drawbacks of the ERTMS system.

As to extra-European countries, satellite navigation is already successfully used on many railway lines in Australia, China and the United States.

In particular, in the United States satellite technologies have already been integrated into the Positive Train Control system (PTC).

At European level, the European Commission strongly supports synergies between ERTMS and satellites as a key factor to favour the penetration of ERTMS in Europe[8]. ERA, the European Union Agency for Railways, has also classified this technology as a "*key*" or "*game-changing*" innovation for the ERTMS system.

Over the last ten years a great number of R&D activities have been implemented in this domain in different countries worldwide, as, for instance, Shif2trail and UNISG satellite Working Group[9]. In particular, however, the Next Generation Train Control-NGTC project (2017) is worth mentioning in more detail, since it resulted in the identification of factors of innovation and convergence between urban (CBTC[10]) and extra-urban (ETCS) trains such as ATO functions, the use of the Internet Protocol (IP) for the adoption of moving blocks and satellite positioning, thus greatly improving the operational efficiency of the entire rail transport network and reducing relevant life-cycle costs.

During the European Rail Summit on 21/2/2022 organized by the Société Nationale des Chemins de Fer Français (SNCF) in the framework of the French presidency of the European Union, the European Rail Joint Undertaking (ERJU) was officially launched, i.e. the largest European railway research and innovation program - worth 1.2 billion euro -, which is aimed, among others, at boosting both the digitisation and automation of European railway services via an integrated approach combining satellite applications, 5G, automation and synergies with Smart Road technologies[11].

In order to adopt and operate the satellite technology, however, the current standards described in the Technical Specification for Interoperability of the Control, Command and Signaling system (CCS TSI) will have to be integrated; for this reason, at the end of 2019, a Change Request was submitted to ERA (CR 1368) by the

6 https://ertms.be/workgroups/ccs_architecture

7 https://www.linkedin.com/pulse/ocora-european-initiative-on-board-etcs-systems-future-rolf-m%C3%BChlemann?utm_source=share&utm_medium=member_android&utm_campaign=share_via

8 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52021IP0327 , see art. 34.

9 For a state of the art of the GNSS application in railway signaling see Juliette Marais et al, 2018 (https://scholar.google.com/citations?view_op=view_citation&hl=ca&user=HTiKi1cAAAAJ&citation_for_view=HTiKi1cAAAAJ:KxtntwgDAa4C9.

10 "Communications-Based Train Control (CBTC) is a railway signaling system that makes use of the telecommunications between the train and track equipment for the traffic management and infrastructure control. By means of the CBTC systems, the exact position of a train is known more accurately than with the traditional signaling systems. This results in a more efficient and safe way to manage the railway traffic. Metros (and other railway systems) are able to improve headways while maintaining or even improving safety." (https://railsystem.net/communications-based-train-control-cbtc/).

11 For more information see https://vrioeurope.com/en/smart-road-technology-digital-highways-of-the-future/ .

ERTMS User Group-EUG (a European Economic Interest Grouping including various railway administrations) outlining the objectives to be achieved.

At present, various possibilities for introducing GNSS in ERTMS are being investigated, such as Advanced Odometry - to reduce confidence intervals due to odometer errors; Absolute Positioning based on a multi-sensor positioning system independent of on-board ETMS core, as well as on EGNOS[12] v3; and Virtual Balises (VB) combined with local augmentation networks (see Fig. 1: VB on the right side vs. the ERTMS standard with physical balises on the left side).

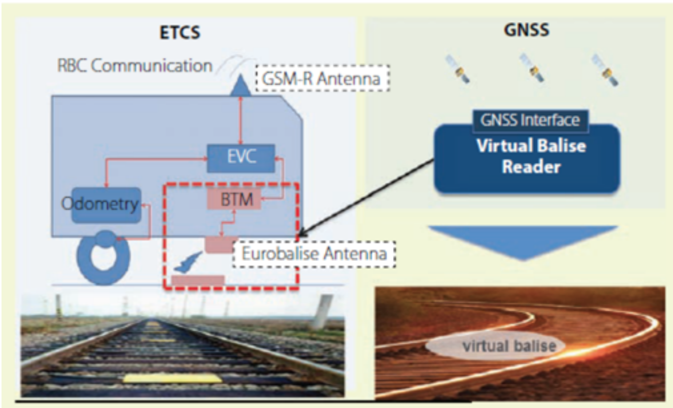

Fig. 1: The rise of satellite technology appeal for train control Systems, 2018.
Credits: F. Rispoli, Radiolabs.

3. Introducing the Global Navigation Satellite System into the railway environment with the Italian Space Agency (ASI)

From a national perspective, in the short to medium term, ASI has supported innovative solutions aimed at improving the performance and consolidation of ERTMS, rather than the development of new concepts which would not be backwards-compatible (with the risk of not being approved by ERA because they do not comply with the current ERTMS architecture/ETCS). In particular, following a long tradition of Italian excellence in the satellite localization domain related to ERTMS/ETCS, ASI will be conducting studies and prototyping activities for railway GNSS localization systems such as, for instance, the advanced Location Determination System (LDS), or the implementation of ATO and ATS for urban railway lines, with tests on track and in lab, in collaboration with Italian centres of excellence such as the RFI laboratories[13].

The nationally shared strategy of the Agency aims, therefore, at enhancing new satellite technologies based on plug-and-play solutions for the virtualisation of physical balises (VB), targeting such solutions up to L3. This would make it possible to offer technologically advanced services in the field of train movement control (ATP), at low costs and integrating the current equipment on-board and on the tracks, with minimal impacts on the current instrumentation and reduced certification costs. A solution that capitalises on the long-standing Italian expertise in the sector aimed at train localisation based on the concept of Virtual Balises with local augmenta-

12 "The European Geostationary Navigation Overlay Service (EGNOS) is Europe's regional satellite-based augmentation system (SBAS) that is used to improve the performance of global navigation satellite systems (GNSSs), such as GPS and Galileo. It has been deployed to provide safety of life navigation services to aviation, maritime and land-based users over most of Europe." (https://www.euspa.europa.eu/european-space/egnos/what-egnos).

13 https://www.asi.it/wp-content/uploads/2022/05/2022_04_28-DEL-052-PTA-2022-2024.pdf , pg. 34.

tion networks, as already tested on the Cagliari-San Gavino trial site (see Fig. 2) and on the Novara-Rho pilot line. ASI, indeed, has been promoting the adoption of game-changing railway technologies since 2012, supporting projects such as 3InSat[14], ERSAT-EAV[15], RHINOS[16] and Voliera[17], just to name a few.

Regarding the future, ASI's action is being implemented according to two main pillars and specific procurement actions. Such pillars are: a national augmentation network[18] and a new kind of advanced railway receiver; both of them will be soon followed by ad-hoc calls for tender.

As to the first pillar, ASI has already launched a program for the creation of a national augmentation network that can be integrated with EGNOS in a two-level correction system. In fact, in order to guarantee safe modern mobility, a national infrastructure is needed that provides a navigation service (PVT) with augmented real-time precision, as well as availability and integrity to users driving highly automated vehicles[19].

Regarding the second pillar, as envisaged in its Three-Year Activity Plan-PTA 2022-2024[20], ASI is studying an innovative modular on-board train localisation system, interoperable at European level, which will be able to meet both the Virtual Balise and the Absolute Positioning concepts, as well as the short term and mid-term modernization needs of the railway business.

This architecture will be fully compliant with Recommendation of the European Parliament n. 0327 of 2021[21] where "*[The European Parliament]… 34. Points out the need to ensure synergies between the ERTMS and the European Global Navigation Satellite System (GNSS) as soon as possible, especially since GNSS signal availability relies on virtual balises, which would be less costly to deploy and to maintain, since it would speed up the ERTMS roll-out and since it would enhance the competitiveness of the ERTMS outside the EU*".

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14 3InSat was aimed at developing a new satellite-based platform for integration into an ERTMS system, that was later validated on a specific 50-km test site in Sardinia: without altering the ERTMS architecture, the new satellite-technology-based platform "virtualised" balises, balise readers and multi-bearer telecom, thus reducing equipment along tracks and lines, maintenance, energy, unnecessary braking and CO2 emissions, improving overall reliability of speed monitoring and communication, as well as the capacity of transportation networks by extending the ERTMS+SAT system on secondary lines and urban nodes. Based on a multi-sensor location detection system using GPS, GLONASS, EGNOS and Galileo, the new platform also guaranteed compliance to the stringent SIL4 safety requirements, and - on the telecommunication part - integrated SatCom (e.g. mobile satellite services) and terrestrial (e.g. TETRA, public GSM) systems for full coverage along the rail tracks.

15 Launched in 2015 by GSA - the European Agency for Global Navigation Satellite Systems, that in 2021 was replaced by the European Union Agency for the Space Programme-EUSPA -, the "ERTMS on Satellite – Enabling Application and Validation" project, or "ERSAT EAV", aimed "to assist EGNSS (EGNOS and Galileo) uptake in the rail sector in Europe and beyond, fostering competition and innovation in the European space and rail industry and research community" (M. Ciaffi, "Plan for introducing GNSS-based localization solutions in the ERTMS", 2023).

16 A European project under GSA responsibility, RHINOS was aimed at the definition of new standards for GNSS-based railways.

17 Co-funded by the ESA – NAVISP – 2 program, VOLIERA was aimed "to develop an innovative multi-sensor component aimed at providing relative and absolute position and odometry information suitable for the railway environment." (http://www.radiolabs.it/en/radiolabs-is-partner-of-voliera-project/).

18 https://www.asi.it/bandi_e_concorsi/bando-per-laffidamento-dei-servizi-per-progetti-di-ricerca-e-sviluppo-a-tematiche-disciplinari-relative-a-infrastrutture-per-la-navigazione-satellitare/

19 Ib.

20 https://www.asi.it/wp-content/uploads/2022/05/2022_04_28-DEL-052-PTA-2022-2024.pdf

21 (2021)0327 Railway safety and signalling: Assessing the state of play of the ERTMS deployment European Parliament resolution of 7 July 2021 on railway safety and signalling: assessing the state of play of the European Rail Traffic Management System (ERTMS) deployment (2019/2191(INI)).

Fig. 2: GNSS for ERTMS Train Localiza@on: a step-change technology and new business model, April 2017. Credits: F. Rispoli (Radiolabs) et al.

4. Conclusions

Satellite telecommunications and navigation services enable a large number of applications that today have become crucial for our daily lives. It is a phenomenon bound to grow further in the coming years, in conformity with the development of the digital society and the improvement of the space infrastructures. Just as an example, in France a law has recently entered into force which prohibits some air routes that can be replaced by trains, while maintaining a reasonable travel time which must not exceed two hours and a half. This ban had actually already been proposed by the country's government in 2021, with the aim of limiting air travelling and reducing emissions[22].

The railway sector represents an area that more than others will benefit from the innovations enabled by space technologies and destined to have a significant impact on the quality of our everyday activities.

Indeed, applications and services based on navigation and satellite telecommunications for rail transport promise to increase safety and efficiency by requiring limited investments compared to traditional transport control systems. Such positive economic impact concerns both the updating activities of the systems and their operational management. The maximum expected advantage will concern the regional railway lines, in terms of both efficiency and safety, since regional lines, in Italy, transport - on average - more than half of the total number of passengers.

For several decades, Italy has been one of the most advanced countries for the development of space-based applications. In the satellite navigation domain, where the infrastructure is European, Italy expects to make full use of current assets, considering them ready to appropriately enable services. In this regard, action at European level will be needed in order to tailor EGNOS to railway needs. This is an ongoing action that ASI has been supporting for a long time, in coordination with the national railway operator (Rete Ferroviaria Italiana-RFI) and research centres, in the appropriate international *fora* and mainly in the context of its participation in the EUSPA Board of Directors, in the Space Committee of the European Commission and in the ESA PB-NAV and JCB Committees.

With reference to ASI's mandate to improve the citizens' quality of life through the use of space infrastructures, the railway transport improvement program undoubtedly represents a primary objective.

22 AirPress – May 2023, n. 144.

High Time for an EU Space Strategy for Security and Defence*

*by Mathieu Bataille***

Announced in the 2022 Strategic Compass, the *EU Space Strategy for Security and Defence*[1] has been published by the European Commission and the European External Action Service (EEAS) on 10 March 2023. Although this publication is the result of a long-lasting process, its release happens slightly more than a year after a cyberattack against the KA-SAT satellite[2] damaged hundreds of terminals on EU soil, strongly affirming the need for prompt implementation of the upcoming Strategy. This Brief presents the views elaborated by ESPI on this topic, which were provided as an input to the public Call for Evidence launched by the European Commission early 2023. As such, it highlights the expectations of the Institute with regard to the content of the Strategy and its implementation.

1. An evolving context calling for prompt action

The 2016 EU Global Strategy[3] and the 2016 EU Space Strategy[4] already acknowledged the competitive and contested character of the space domain, as well as the increasing dependency of Europe on space systems and services. The 2022 Strategic Compass[5] further emphasised these points and called for a dedicated strategy to address the threats faced by European space assets. In parallel, the security and defence activities of the European Union (EU), such as the European Defence Fund and the Permanent Structured Cooperation (PESCO), have increasingly integrated space in recent years.

The evolution of the EU approach to space security and defence is in line with the EU's increased transversal relevance in the field of security and defence, but also with developments in the international environment. In the past decade, all major space powers (United States, Russia, China, but also Japan and India) have proceeded with a restructuring of their security and defence space activities[6], namely:

- the reorganisation of military space establishments;
- the development of new capabilities for security and defence purposes;
- the elaboration of new strategic postures, including the extension of the operational domain to cislunar space.

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1 European Commission and High-Representative of the Union for Foreign Affairs and Security Policy, Joint Communication to the European Parliament and the Council – European Union Space Strategy for Security and Defence (Link).
2 Viasat, KA-SAT Network cyber attack overview (Link).
3 European External Action Service, Shared Vision, Common Action: A Stronger Europe - A Global Strategy for the European Union's Foreign and Security Policy (Link).
4 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Space Strategy for Europe (Link).
5 European External Action Service, A Strategic Compass for Security and Defence (Link).
6 European Space Policy Institute, ESPI Report: Europe, Space and Defence (Link).

2. An expanding perimeter of space security & defence

The EU Strategy will be a steppingstone towards an action-oriented roadmap, along three dimensions:

- fostering the use of space systems and services for terrestrial security and defence activities;
- addressing the security of European assets in space;
- aligning Europe's political, operational, diplomatic and governance dimensions.

Besides, the Strategy should note that there is a difference between the "*safety & sustainability*" and the "*security & defence*" aspects of space activities. When dealing with activities in space, the Strategy should focus on "*security & defence*", which addresses the protection of space assets against threats, even if it can sometimes be at odds with "*safety & sustainability*" concerns.

Similarly, the Strategy should give due consideration to the expansion of the security interest of the EU and its Member States beyond LEO, MEO and GEO (the current location of EU and national public and commercial assets), reaching cislunar space and the lunar surface.

Five distinct dimensions should receive due consideration in defining the EU Strategy and in its future implementation:

2.1. Seizing opportunities offered by streamlined European collaboration

The main added value of establishing an EU strategy is to encourage and frame the cooperation between all EU Member States, including those that have a long history in military space, those that are new to this domain, those that are primarily users rather than suppliers of solutions, and those perhaps less aware of its importance.

It is therefore crucial that the Strategy addresses the coordination of EU and national stakeholders. Given the central role of national assets and multilateral cooperation in the security domain, the EU should find ways to contribute to streamline and/or coordinate the use of national assets for military purposes, including to protect other Member States' assets. In this context, a number of questions should be addressed:

- **Inclusivity of collaboration:** define the scope of collaboration that is appropriate between EU Member States for its implementation. In particular, balancing the benefits of an extensive collaboration (with as many countries as possible) and of a more restricted one (starting with countries that are willing and able to contribute) may be relevant.

- **Depth of collaboration:** define a level of collaboration that is appropriate between EU Member States to implement the Strategy (dialogue, coordination, cooperation, integration…), keeping in mind that some mechanisms require stronger commitments. In this context, the EU could support coordination between its Member States.

- **Foster EU collaboration:** define incentives to make EU-wide cooperation more attractive than current bilateral or multilateral partnerships among EU nations or between EU and non-EU countries.

- **Improve internal EU coordination:** establish mechanisms to ensure greater integration between various EU institutional stakeholders, based on their respective mandates. Involved entities should be both those in charge of managing EU space activities and providing space services (e.g. DG DEFIS, EUSPA, EU Satellite Centre, EU SST) as well as users of such services for security and defence purposes (e.g. EEAS, EMSA, Frontex, DG HOME, DG ECHO, etc.).

2.2. Garnering credibility through robust threat response mechanisms

An important element of the Strategy, to develop further during its implementation, is to define and clarify when and how the EU would reply to a potential threat against its space assets. To this end, robust processes need to be set up, and responsibilities delineated. This would allow the EU to react in a timely manner and be perceived as a credible actor internationally. Fortunately, the EU already has a starting point through the work performed and mechanisms established in the past.

- **Define an attack:** the Strategic Compass states that the EU and its Member States "aim to also further strengthen solidarity, mutual assistance and crisis response in case of attacks originating from space or threats to space-based assets, including through exercises". Therefore, the Strategy should define the conditions for common action: when should such an action take place? In other words, what is the threshold defining an attack? Alternatively, what should be the threshold from which the EU and its Member States reserve the right to retaliate under "self-defence" as described in the UN Charter? This should be defined keeping in mind discussions at NATO level. It should also be decided whether this definition should be openly shared or not, as the latter would reinforce strategic ambiguity and allow Europeans to keep a margin of manoeuvre in case of crisis.

- **Establish operational processes:** the Strategy should address how a collective reaction to a hostile action against EU or Member States assets unfolds. More precisely, what should be the distribution of responsibilities in case of crisis: who is in charge of detecting the threat, sharing information (and with whom), and responding? There is the need to define resilient and timely operational processes, while relying on existing mechanisms, in particular Council decision 2021/698[7].

- **Assess the costs and benefits of the envisaged processes:** furthermore, in case of crisis, what would be the consequences on EU societies and economies of triggering the established response mechanism in comparison with the level of threat faced by space systems and services? The Strategy should make sure that the response does not inflict more harm than the threat at stake.

- **Identify the assets to protect:** the Strategy should address the protection mechanisms to ensure the security of EU assets, and be open to also protect national assets if required. Similarly, the Strategy should clarify the extent to which commercial assets, in particular those that support military operations by EU Member States as well as EU Training Missions and Monitoring Missions, would benefit from these mechanisms.

2.3. Accelerating the development of EU capabilities

The scope and impact of further EU action in the domain of space security and defence will be dependent on the capabilities that Europe is able to leverage and on its autonomy of action. To reinforce EU means of action, dedicated research and development programmes and innovation-support mechanisms should be put in place. Ensuring the capacity of EU industry to indigenously develop and ensure the supply of critical technologies that are necessary for space security and defence is key.

- **Optimise the use of current assets and leverage them for operation and future innovation:** the EU should leverage its existing organisations to the best extent possible before creating new entities. This is for instance the case of the EU Satellite Centre, which has strong operational links with the intelligence and military communities, as well as with commercial providers, at EU and national level, and with ESA for innovation in dual-use technologies.

- **Further relations with ESA:** with regard to fostering innovation for the conduct of security missions on Earth, the EU could further its partnership with ESA, leveraging the latter's activities such as the "Civil Security from Space" programme[8] and the "Rapid and Resilient Crisis Response" Accelerator[9], as well as other programmes with potential security uses. The R&D activities of the Agency would indeed provide added value to the EU capability development efforts.

- **Support the cross-fertilisation of EU activities:** to strengthen European capabilities, the Strategy should leverage the dual-use dimension of space. To this end, the upcoming Strategy for EU Space R&I is an opportunity to ensure further synergies between R&I activities in the space and defence sectors (and could help fulfil the ambitions announced in the Action Plan on Synergies between civil, defence and space industries[10]).

- **Improve space situational awareness:** the recent strengthening of EU SST membership is a positive step to ensure better space situational awareness and protect European space assets. The further

7 Council of the European Union, Council Decision (CFSP) 2021/698 of 30 April 2021 on the security of systems and services deployed, operated and used under the Union Space Programme which may affect the security of the Union, and repealing Decision 2014/496/CFSP (Link).

8 European Space Agency, Civil Security from Space (Link).

9 European Space Agency, Rapid and Resilient Crisis Response (Link).

10 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Action Plan on Synergies between civil, defence and space industries (Link).

enlargement of the Partnership as well as the increased development, by Member States, of their SSA capabilities, should be encouraged.

- **Monitor global technology development:** the Strategy should take stock of the technological developments and investigations made by other powers. The EU should move towards more distributed architectures, in particular multi-orbit and multi-system constellations, for example through studies on how Galileo could be complemented with LEO systems (e.g. leveraging ESA activities on LEO PNT).

- **Develop a position on the development of counterspace capabilities:** as part of its capability planning, the EU should assess whether it wants to develop its own deterrence or counterspace means (e.g. “bodyguard” satellites, non-destructive ASAT systems).

- **Define the spatial perimeter for EU actions:** the Strategy should clarify in which orbital regimes and environments the EU and its Member States aim to conduct their security and defence activities, and plan accordingly the development of capabilities. In this context, the EU would better protect its interests if, like other space powers, it gives proper consideration to cislunar space as a strategic domain. Such an approach would also have a technological impact on the whole space ecosystem, for instance in terms of SSA/SST, satellite propulsion, launchers.

2.4. Increasing the scale, availability and flexibility of financial resources

It is fundamental that sufficient resources can be accumulated and targeted towards the acute security needs of the EU and its Member States. To do so, the scale, availability and flexibility of resources should be ensured, as response mechanisms and capability-development addressed in preceding sections can only become meaningful if given the fuel to emerge, be maintained and be relied upon when needed.

- **Flexibility of EU funding:** given the quickly evolving security context, adapting current EU financial frameworks and rules to the new scale and pace of the new threats is required. The implementation phase will have to deploy the means to fund the actions identified by the Strategy. Given recent developments, notably the war in Ukraine and its consequences, mechanisms to improve the flexibility of EU funding already at the stage of the Multiannual Financial Framework’s (MFF) mid-term review need to be considered, rather than waiting for the start of negotiations on the next MFF.

- **Scale of funding:** dedicated EU funding lines for space security and defence both in terms of innovation, capability development and operational applications should be established. Notably, further expanding the scope of space-related calls under the European Defence Fund and ensuring long-term funding consistency for themes already addressed (responsive space, persistent & reactive ISR, early warning). Secondly, it could be envisaged to pool service requirements of the EU and its Member States to move towards joint multi-annual procurement commitments of space security and defence systems and services in satellite imagery and analytics, space situational awareness, satellite communications, and combined capabilities.

- **Ensuring availability of assets:** even if some assets and capabilities might only be relied upon sporadically, if ever, for the purposes addressed in the EU Space Strategy for Security and Defence, their strategic value is such that their availability must be secured and maintained. When such assets are commercially sourced or procured, public actors need to ensure resilience, i.e. that their availability is guaranteed at any time for missions and operations of strategic importance. In that context, it is crucial to ensure, through financial and other incentives or regulations, that:

- commercial assets critical to security and defence interests of the EU and its Member States, remain available beyond their commercial viability, if no alternative is readily available;
- EU and its Member States have priority on the use of commercial assets they rely upon to serve their strategic objectives and critical operations, whenever they need to activate them.

2.5. Cultivating partnerships and international cooperation

The international dimension is a core topic that the Strategy will have to address. Here, the EEAS will play a major role in providing its expertise in dealing with international partners and addressing international *fora*. Cooperation with other European actors should be the primary focus, but the posture to adopt vis-à-vis non-European stakeholders is also a key element to define. Finally, building on the current dynamics in the space ecosystem, the role of and relations with private actors need to be clarified.

- **Perception of the European posture:** the Strategy should be clear in defining its tone and establish whether it plays a role as a deterrence tool or displays an engaging character. Balancing the imperatives of ensuring deterrence, while promoting the safety and sustainability of space activities, need to be kept as two intertwined but separate objectives, recognising their different, at times opposing, drivers.

- **Relations with key non-EU countries:** the Strategy should explicitly address the space security and defence relation that the EU wants to establish with other European states, e.g. the United Kingdom, Norway and Switzerland. In particular, the first two are currently developing their military space capabilities and could become important and reliable partners.

- **Relations with the United States and NATO:** the position vis-à-vis the United States and NATO should be determined and represented in international space *fora* either on a national basis or through an established coordination mechanism, or any other relevant means. Moreover, the EU should take stock of the renewed dynamism of NATO since the start of the war in Ukraine and, in particular, ensure consistency between its Strategy and NATO's Space Policy.

- **Relations with private actors:** European industry plays a critical role in enabling space security and defence and the dynamism and progress of traditional and emerging commercial actors could be further leveraged. While allowing commercial activities (appropriately regulated), it is yet crucial to ensure that the search for public-private synergies is designed in a way that adequately protects the security and defence interests of EU and Member States institutions.

- **Establishment of alliances, beyond traditional partnerships:** the Strategy should establish which countries or regions the EU and its Member States can rely on as partners, beyond traditional alliances. In particular, European stakeholders should identify the missions that may be open to cooperation and those that should be restricted to European stakeholders. How can the EU benefit from such alliances (including to enhance its resilience) without becoming too dependent and how can it promote the use of its own assets by partners?

3. A Strategy to protect European assets & ensure international stability in space

The EU Space Strategy for Security and Defence will be a major milestone in the future of military space activities in Europe. The process leading to the elaboration of this Strategy has given the opportunity to raise awareness of all states on the relevance of space security and defence. Its implementation can help creating a common vision and encourage Member States to step up their investments.

A key element of the implementation process will be to ensure that EU activities fit and coordinate with efforts conducted at national, multilateral and intergovernmental level, in order to multiply the capacity of European stakeholders to act decisively in this domain and increase the credibility and leverage of the EU and its Member States in global engagements and international *fora*.

Miscellaneous Material of Interest

World Bank Group, Air Transport Annual Report 2022

report review by Carla Bonacci

World Bank Group, Air Transport Annual Report 2022

*report review by Carla Bonacci**

1. Introduction

The aviation industry is recognised by the World Bank Group (WBG) as one of the most important enablers in achieving economic growth, thanks to their inputs to interconnectivity, global economy and vital mobility.

This, since air transport plays an important role in fostering development, in facilitating economic integration, in generating trade, in promoting tourism and creating employment opportunities.

For over sixty years the World Bank Group has financed aviation-related R&I projects and allocated funds and resources for the development of air transport safety, airport infrastructures and institutional and industrial strengthening. In order to/To establish a safe, functional, efficient, affordable, and reliable air transport economic network, the WBG is mandated to undertake several activities[1] that are detailed in a comprehensive annual report.

2. The Air Transport Annual Report 2022

On the 12th of June 2023, the WBG published the Air Transport Annual Report for 2022[2]. The report highlights that in financial year 2022, despite low rates of growth in some World regions, the global recovery of the aviation sector has been considerable after the COVID-19-induced decline of air traffic. The report shows that global air travel level increased in 2022, from 41.7% Revenue Passenger Kilometers (RPKs) in 2021 to 68.5% in 2022. Nevertheless, while in 2021 the air cargo traffic reached the 2019 annual Cargo Tons Kilometers (CTK) level of 7.2%, in 2022 it fell slightly to the pre-pandemic levels after declining by 8.3%[3].

3. Projects

In FY2022, WBG's aviation portfolio amounted to $ 1,018 million, an increase of 9% from the previous fiscal year; a positive result after the COVID-19 pandemic crisis and the closure of major airport infrastructure projects. The air transport segment of the WBG portfolio constitutes about the 2.65% of WBG's total transport portfolio of $38.32 billion.

In FY2022, the Air Transport portfolio included 27 loaning and non-loaning projects and/or project components, developed through the International Bank for Reconstruction and Development (IBRD) and International Development Association (IDA), while International Finance Corporation (IFC) included 11 active operations in its investment portfolio and supported 6 Advisory Mandates[4].

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1 Such as operational work through R&I projects and technical assistance, economic analysis, knowledge dissemination on air transport related issues, development of external relations and collaboration with international organizations.

2 Available at: http://documents1.worldbank.org/curated/en/099614406122338723/pdf/IDU07cdd3e27044ec0491f089250038d36dc0460.pdf. All rights reserved to World Bank Group.

3 According to the latest traffic data released by Eurocontrol, European Aviation Overview, 2 June 2023, p. 2, in the week from the 24th to the 30th of May 2023, 30.231 average daily flights were recorded in Europe, a +6% compared to 2022 and a +4% compared to the previous week; operators continue to expand their flight capacities steadily and Friday the 26th of May 2023 was the fourth busiest day (with 32.111 flights) since the start of the COVID-19 pandemic.

4 See p. 8 of the report. More detailed information about the projects are available at p. 37 ad ff.

4. Research and Relations

Along with the funding and development projects, in 2022 the WBG continued to participate at various aviation transport conferences and events[5]. In 2022, research and internal and external knowledge dissemination have been provided by the WB's Aviation Knowledge Area (AVKA). The main results of such activities were:

I. a report on Sustainable Aviation Fuel (SAF), The Role of Sustainable Aviation Fuels in Decarbonizing Air Transport Mobility, which highlights SAF as the primary mitigation strategy that can most quickly achieve significant greenhouse emission reductions for aviation in the medium term and it evaluates and quantifies global aviation decarbonization options up to 2050;

II. a study that examines the impact of bilateral air service agreements on African air passenger transport, quantifies the consumer welfare effects of air transport liberalization and estimates the extent to which liberalization of bilateral air service agreements affects the following: i) passenger travel, ii) average airfares, iii) flight frequency and iv) market competition, through the observation of 71 African countries performed between 2011 and 2019;

III. a study on Remotely Piloted Aircraft (RPA, or drones) projects and operations in Haiti, Guatemala and Brazil, with the goal of identifying key drivers and market fundamentals for commercial operations, as well as opportunities, regulatory frameworks, market players and barriers for the future development of drones' applications in the Latin American context;

IV. the Handbook for the Development of the Air Transport Sector to build, expand and disseminate core sector concepts and good practices fundamental to the development of air transport.

For more detailed information on the Annual Report and its contents click here.

5 Such events included the ICAO Global Implementation Support Symposium (GISS) in Istanbul, the FRA Air Cargo Conference, the 41st ICAO Assembly in Montreal and the 2022 GAD World Conference in Amsterdam.

Events

European Air Law Association (EALA) 35th Annual Conference
Stockholm, 9 - 10 November 2023

International Bar Association (IBA) Annual Conference
Paris, 29 October - 3 November 2023

European Air Law Association (EALA) 35th Annual Conference

Stockholm (Sweden)
9 - 10 November 2023

The European Air Law Association (EALA) has announced its 35th Annual Conference that will be held in Stockholm (Sweden) on the 9th and 10th November 2023.

Details will be confirmed soon and you can sign up to get the latest news about the event HERE.

The International Bar Association (IBA) Annual Conference

International Bar Association
the global voice of the legal profession

Paris
29th October - 3rd November 2023

The International Bar Association (IBA) Annual Conference is the leading conference for legal professionals worldwide to meet, share knowledge, build contacts and develop business.
It serves to advance the development of international law and its role in business and society, to provide members with world-class professional development opportunities to enable them to deliver outstanding legal services.
Below, the Aviation Law Committee (ALC) panels during the Annual Conference:

Monday October 30, 2023 (11:15am – 12:30pm)
Session Topic: Update on airport liability, emerging aviation insurance issues and major aviation litigation
Session Description: This international panel will discuss major litigation involving aviation law issues. It will also provide an update on various airport liability issues and emerging aviation insurance issues (such as those arising from climate change, international conflicts, and the Covid pandemic).
Session Chair: Alan Reitzfeld

Monday October 30, 2023 (4:15pm – 5:30pm)
Session Topic: The future of mobility
Session Description: Autonomous vehicles and passenger drones are coming to us soon, and expected to forever change the way we commute, travel, and even entertain. Various legal issues will be triggered, including data privacy, consumer protection, and AI regulation. The panel will discuss the challenges and the benefits from legal and practical perspectives.
This is a joint session is led by Asia Pacific Regional Forum in collaboration with the Aviation Law Committee, European Regional Forum and Technology Law Committee
Session Chair: Ramesh Vaidyanathan

Wednesday November 1, 2023 (2:30pm – 3:45pm)
Session Topic: Conversations and fireside chats
Session Description: This panel will discuss recent legal, regulatory, and policy issues relating to the aviation industry, including sustainability, and will take a deep dive into some current issues affecting the industry.
Session Co-Chairs: Laura Pierallini and Benjamin Graham-Evans

Thursday November 2, 2023 (11:15am – 12:30pm)
Session Topic: Aviation roundtable - hot topics and global trends –
Session Description: This aviation roundtable discussion is being led by industry experts and will cover global trends in aviation, repercussions to the industry and developments in finance and leasing laws.)
Session Co-Chairs: Linda Lee and Jim Tussing

For more information and details click HERE.

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