Special report on the impact of the COVID-19 pandemic on the U.S. and European ANS systems

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This report is a joint publication of the Air Traffic Organization of the FAA (FAA/ATO System Operations Services) and of EUROCONTROL (Aviation Intelligence Unit (AIU) on behalf of the European Commission in the interest of the exchange of information.

It is prepared in application of Appendix 2 to Annex 1 of the Memorandum of Cooperation NAT-I-9406A signed between the United States of America and the European Union on 13 December 2017 and managed by a joint European Commission-FAA Performance Analysis Review Committee (PARC).

PARC decided earlier this year to produce a special report on the impact of the COVID-19 pandemic on the U.S. and European ANS systems.

The objective is to pay special attention to the exceptional situation created by the COVID-19 pandemic and to make a factual high-level comparison of Air Traffic Management performance between the U.S. and Europe during the pandemic. It is based on a set of comparable performance indicators, developed jointly and reviewed over time. The indicators used in the special report are those that were also used in previous comparison reports. They allow creating a sound basis for factual comparisons between countries and world regions. The report combines for the first time comparisons regarding the impact of the pandemic on operational as well as economic performance in one single report.

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1.1 Background and context

Without a doubt, 2020 was a devastating year for the aviation industry around the globe. The aviation industry has been hit harder than many other industries as a result of the protective travel restrictions implemented by many States to contain the COVID-19 pandemic and the subsequent unprecedented drop in demand for air travel.

This special report is the seventh in a series of joint comparisons between the U.S. and Europe [1] [2]. It represents the fourth edition under the Memorandum of Cooperation (NAT-I-9406A) between the United States and the European Union (EU). The work is managed by the joint Performance Analysis Review Committee (PARC) under the Memorandum.

Building on commonly agreed metrics, the objective of the joint work conducted by the U.S. Air Traffic Organization (FAA/ATO) and EUROCONTROL on behalf of the EU is to compare, understand, and further improve air traffic management (ATM) performance in both systems. The FAA/ATO was created as the operations arm of the Federal Aviation Administration (FAA) in December 2000, to apply business-like practices to the delivery of air traffic services.

Building on established metrics from the previous operational [1] and cost-efficiency [2] comparison reports, this special report aims to understand how the two ATM systems in the U.S. and in Europe were affected operationally and economically by the COVID-19 pandemic.

1.2 Report scope

The analysis in this report focuses on the impact of the COVID-19 pandemic on both ATM systems and contrasts the situation before the pandemic unfolded in 2019 to the corresponding period in 2020 and the first part of 2021. The analysis addresses operations in the continental airspace and does not cover oceanic air navigation services, services provided to military operational air traffic (OAT), or airport landside management operations.

Unless stated otherwise, for the purpose of this report, "Europe" is defined as the geographical area where the Air Navigation Services (ANS) are provided by the EU Member States plus those States outside the EU that are members of EUROCONTROL, excluding the aforementioned oceanic areas, Georgia and the Canary Islands.

Figure 1-1 shows the geographical scope of this report. Unless otherwise indicated, "U.S." refers to ANS provided by the United States of America in the 48 contiguous States located on the North American continent south of the border with Canada plus the District of Columbia, but excluding Alaska, Hawaii and Oceanic areas (U.S. CONUS).

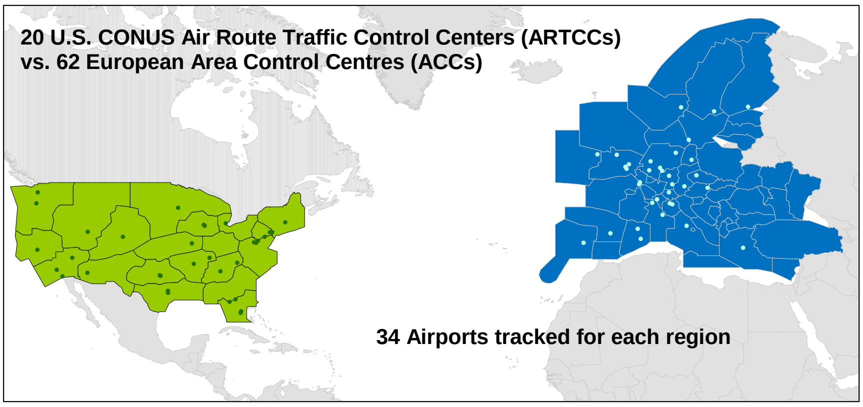


Figure 1-1: Geographical scope of the comparison in the report

1.3 The COVID-19 outbreak and the impact on global aviation

On 11 March 2020, the World Health Organization (WHO) declared COVID-19 a pandemic and many countries subsequently imposed restrictions on travel to curb the spread of infections. As a result, the number of flights dropped dramatically and revenues in the entire aviation value chain evaporated overnight. For 2020, the International Civil Aviation Organisation (ICAO) estimates a 60% reduction in passengers globally with terrible effects on the entire industry [3] (Figure 1-2). A drop of this magnitude has never been seen, even in previous shock events greatly affecting the air transportation system and associated air transport demand.

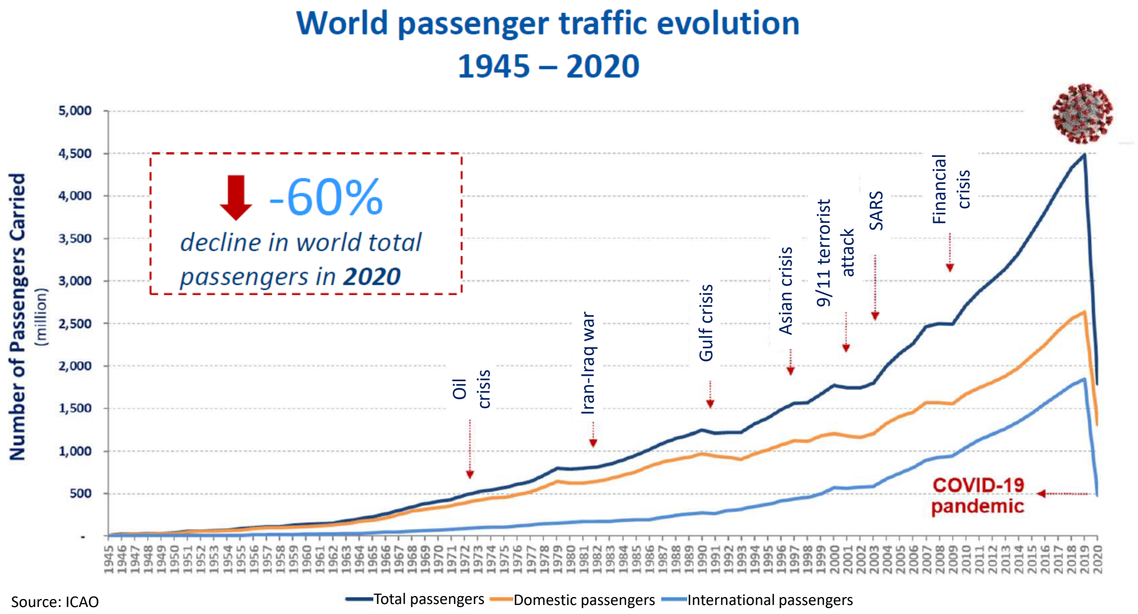


Figure 1-2: World passenger traffic evolution (ICAO 2021)

Unlike previous crises or outbreaks (e.g. SARS, MERS) which had V-shapes and were more regional (i.e. a sharp and brief decline followed by a strong recovery), the COVID-19 crisis is different. The magnitude and persistence of this global crisis is unprecedented and there is still great uncertainty about the shape and form of the recovery over the coming years. Moreover, varying policies in response to the pandemic and different regional approaches will impact the overall recovery in different regions.

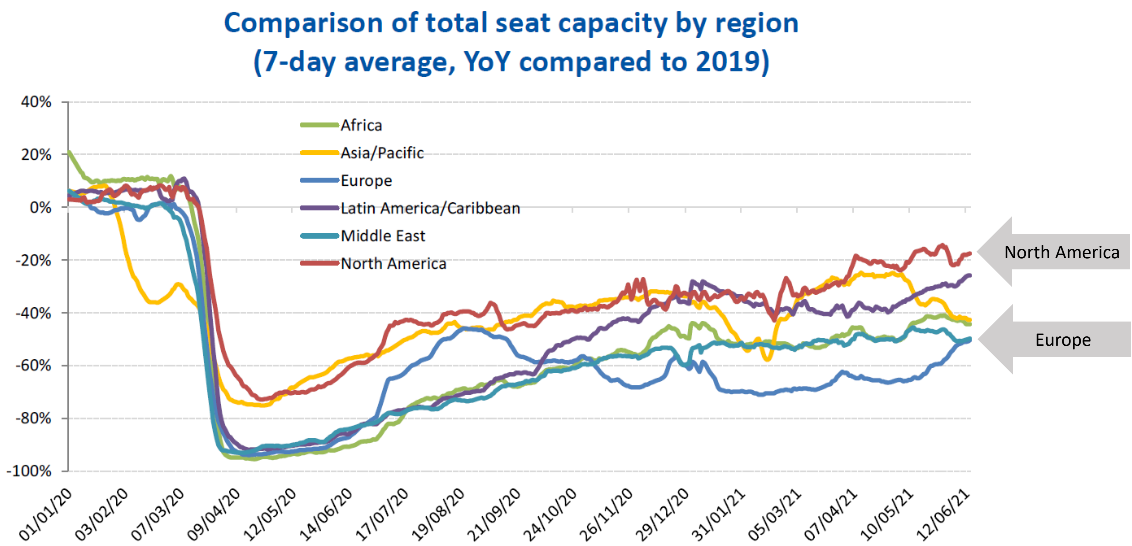


Figure 1-3: Comparison of seat capacity by world region (ICAO 2021)

The ICAO analysis of the evolution of total seat capacity compared to 2019 shows notable differences by world region in terms of passenger traffic. All regions show a dramatic drop at the beginning of the pandemic in April 2020 but with notable differences in magnitude and recovery path (Figure 1-3).

North America and Europe are on different sides of the spectrum. With one of the highest drops in seat capacity in April 2020 and a stagnating recovery path following an initial increase in summer 2020, Europe appears to be hit harder than other world regions. As of May 2021, seat capacity appears to also increase in Europe again. North America shows a lower initial drop in seat capacity at the beginning of the pandemic and a steady growth following the tipping point in April 2020.

A major concern since the beginning of the crisis is the survivability of the air transportation industry in light of the abrupt lack of demand.

In Europe, various countries provided financial support to airlines. This support was sometimes linked to environmental protection measures such as the need to reduce emissions or to phase out short haul flights which could be substituted by train. Additionally, the 41 Member States of EUROCONTROL approved in early April 2020 the temporary deferment of route charges bills in the EUROCONTROL Multilateral Route Charges System due in April, May, June and July 2020, with payments beginning in November 2020. With European Air Navigation Service Providers (ANSPs) primarily funded through specific en-route and terminal ANS charges of flights in controlled airspace, the dramatic drop in demand as a result of the COVID-19 crisis had also a major impact on ANSPs revenues and cash flow. Complementary to initiatives at country level, EUROCONTROL put in place a loan facility of €1.3 billion to support the ANSPs whose revenues have been decimated by the traffic collapse. Ten countries opted in to the loan facility. These loans are scheduled to be repaid by the end of March 2022.

In the U.S., the Coronavirus Aid, Relief, and Economic Security (CARES) Act (P.L. 116-136) was signed into law in March 2020 [4], providing financial support for highly-impacted industries. This stimulus deal offered $58 billion [5] of funds to airlines that agreed to operating a minimum level of service for communities served [6] pre-COVID-19 in addition to other regulations such as airline workforce retainment [7] until the end of September 2020. Airlines that accepted the funds could file exemptions [8] for serving specific points or communities to be considered by the Department of Transportation. Overall, the CARES Act reduced the impact of COVID-19 on airline schedules for when demand for air travel plummeted.

1.4 The COVID-19 and aviation industry impact

Without a doubt, 2020 was a devastating year for the aviation industry which has been hit harder than many other industries due to the measures implemented by the National Governments to contain the pandemic and the subsequent reduced demand for air travel in both Europe and the U.S.

According to the Airports Council International (ACI), European airports lost some 1.7 billion passengers (-70% vs 2019) which translates into an estimated reduction in revenues of around $43billion (€38B) in 2020 [9]. In November 2020, ACI-Europe also warned that nearly 200 European airports could possibly face insolvency in the short term if sufficient government support was not provided. At the same time, the top 446 largest U.S. airports lost 560 million passenger boarding enplanements in calendar year 2020[1] (-60% vs 2019). However, all-cargo landed weight increased by 10% to 200 billion pounds in calendar year 2020[1] from 2019 at the top 138 U.S. qualifying cargo Airports [10].

For European airlines, IATA forecasts a net post-tax loss representing 38.6% of their revenues in 2020, compared to a net profit margin of 3.1% in 2019 [11]. European airlines have adopted several

[1] Enplanement and cargo data is preliminary for calendar year 2020 and will be finalized in Mid-August 2021.

extraordinary measures to reduce their costs and some of them also benefited from large scale financial support from National Governments (e.g. recapitalisation, nationalisation, loans, and provision of government guarantees). At the same time, according to Airlines for America (A4A), U.S. passenger airlines incurred $35 billion (€31B) in net losses ($46 billion (€40B) pre-tax) due to collapse in demand for air travel in 2020 [12].

U.S. airlines reported a $14.7 billion net profit in 2019 followed by a $35.0 billion net loss in 2020. In response to the reduced demand, airlines had to cut costs and modify their revenue streams. For example, ancillary fees have generated an increasing portion of U.S. airline revenues over the past decade. Due to COVID-19 and travel restriction uncertainties when trip planning, several airlines waived change and cancellation fees, meaning airlines had to rely on other measures for revenue. Certain cost-cutting strategies were not available to airlines in the first months of COVID-19 as the CARES Act prevented airlines that accepted the stimulus funds from laying off workers before October 2020.

Given the magnitude of the crisis and the uncertainty surrounding recovery in traffic, airlines have also moved to cancel aircraft orders or postpone their delivery, impacting the whole supply chain. For example in 2020 Airbus received only 383 aircraft gross orders, compared to 1 131 in 2019. In the meantime, Airbus delivered a total of 566 commercial aircraft in 2020, some 34% less than in 2019 [13]. At the same time Boeing also reported some 59% reduction in aircraft deliveries with only 157 commercial aircraft delivered in 2020 (compared to 380 in 2019 and 806 in 2018) [14]. In May 2020, the CEO of Boeing predicted air traffic recovery to pre-pandemic levels would take 3-5 years.

The next section will explore the COVID-19 cases and measures taken specifically in the U.S. and in Europe in order to better understand the impact on aviation and on ANS-related operational performance in each region.

The economic impact of the COVID-19 crisis on air navigation services in the U.S. and in Europe is evaluated in more detail in Chapter 4 of this special report.

1.5 The COVID-19 outbreak in the U.S. and in Europe

Government response in both regions followed similar patterns. With the rapidly evolving health situation (surge in infection rates), an initial focus was on restricting the further spread of the COVID-19 virus through limiting travel to and from countries and territories with a high number of cases. At a national level, governments enacted protocols to limit social contact ranging from restrictions to lockdowns. With the restrictions and constraints for passenger travel, programmes for the transport of essential goods were enacted. Therefore, COVID-19 impacted passenger demand differently than cargo demand.

The first European COVID-19 case was reported in France on 24. January 2020. The EU activated the civil protection mechanism for EU citizens in Wuhan, China. Major European airlines reduced and eventually stopped their operations to China by the end of January 2020. Beginning February 2020, a set of repatriation flights from China were operated. In solidarity with China, the EU and European states started providing support to increase preparedness and contain the spread by providing protective equipment starting the 2nd half of February 2020. At the same time, many other European states started reporting cases of people infected. In particular, Italy reported a surge in COVID-19 cases.

On 11 March 2020, the WHO declared COVID-19 a pandemic and many countries started to impose travel restrictions. Given the continuing spread of the virus in Europe, the U.S. suspended on 13 March 2020 all incoming travel for foreign nationals from the European Schengen zone, in the beginning excluding UK and Ireland for a short while. The EU initially rejected the idea of suspending the Schengen free travel zone, which abolishes internal borders to enable free movement of citizens within the

Schengen area. However, as Member States announced the closure of their national border to foreign nationals, the European Council agreed on 17 March 2020 to the implementation of travel restrictions. A boost of repatriation flights towards end of March 2020 were operated within Europe and arrangements were put in place to ensure the continual flow of essential freight by air. Further provisions for critical workers needing to travel between European countries were enacted (including air travel).

Across Europe, an initial relaxation of the COVID-19 measures was introduced mid-2020 to support the summer season. In light of increasing infection rates, various measures were introduced for air travel between different European countries and/or city pairs (travel bubbles). Despite the travel constraints and quarantining rules, a 2nd wave of COVID surged through Europe and resulted in renewed lockdowns for November and December 2020. The preparatory action and rollout of vaccination campaigns slipped into early 2021 for the majority of European States.

The events in the U.S. mimicked those that occurred in Europe by first reducing international travel, but followed a different timeline. On 21 January 2020, the first U.S. COVID-19 case was confirmed in Washington state. By 2 February 2020, a ban restricted travel between the U.S. and China. This was followed by travel restrictions with Iran (2 March 2020) and Europe (13 March 2020, c.f. above). Individual states followed suit, imposing stay at home orders for residents and quarantining requirements for those traveling from out-of-state. Many states required 14 days of quarantining for interstate visitors. In addition to safety concerns, air travel in the U.S. became increasingly difficult as regulations were inconsistent across states and impacted travellers' length-of-stay, making trips less than 2 weeks infeasible in many situations.

Individual states reopened mid-2020 (starting with Georgia in April 2020), reducing regulations on non-essential businesses and travel. Most states waited until summer 2020 to reopen, causing a second wave of COVID-19. By August 2020, the Centers for Disease Control and Prevention (CDC) removed its 14-day quarantine recommendation for international travellers. Holiday travel in November and December 2020 sparked a third wave of COVID-19, which was mitigated with the vaccine rollout starting in December 2020.

Figure 1-4 shows the average daily new confirmed COVID-19 cases per million people (7 day rolling average) and the share of the population fully vaccinated against COVID-19 on the right axis.

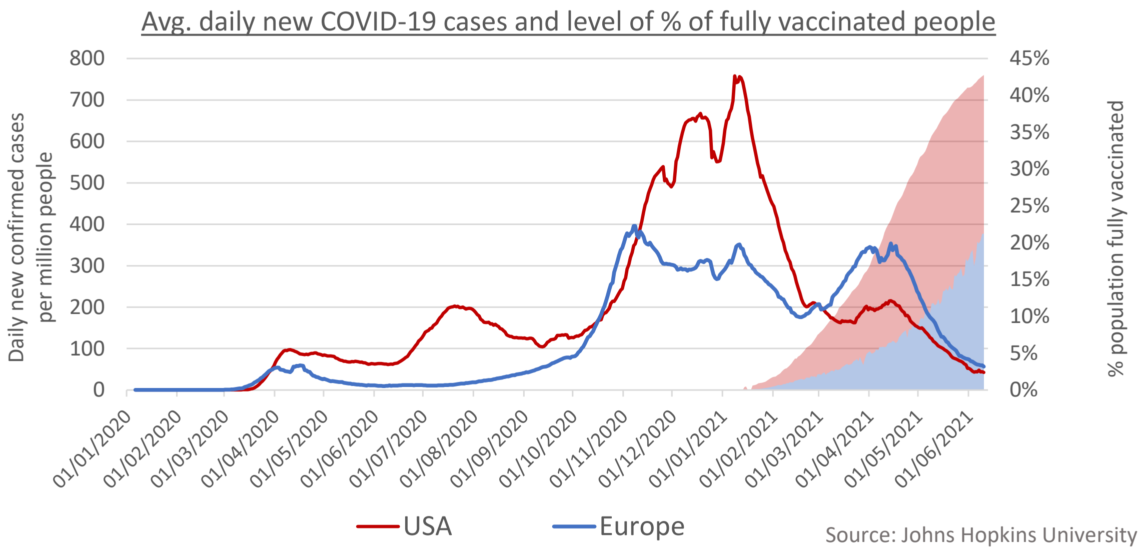


Figure 1-4: Avg. daily new COVID-19 cases and vaccination rate in the US and in Europe

In Europe, new COVID-19 cases decreased after the first wave in April 2020 but increased again exponentially in October 2020. After a decrease between October 2020 and February 2021, new COVID-19 cases surged again resulting in a third wave until May 2021. Since May 2021, new COVID-19 cases started falling again. At the same time, the vaccination campaigns in the different European states gained momentum which contributed together with the seasonal effect to the observed decrease in the new case numbers.

In the U.S. there were three waves of new COVID-19 cases following a different pattern. After the first wave in April 2020, there was a second wave in summer 2020 before cases increased exponentially in October 2020 and reached a peak in January 2021 when new cases started to decrease notably. The vaccination campaign started earlier in the U.S. with impressive growth rates. By the end of May 2021, 41% of the population in the U.S. were fully vaccinated compared to 19% in Europe.

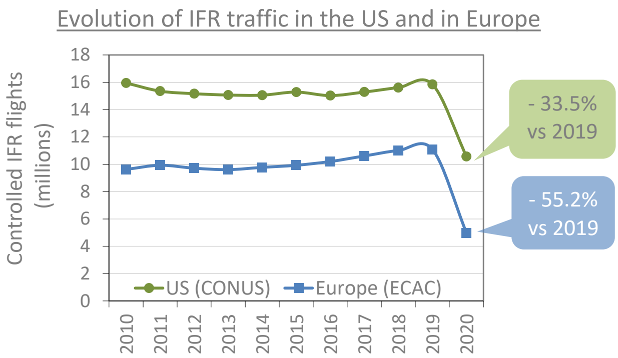
Because of the progress in terms of vaccination and reduced new cases, EU member states added the U.S. to the list of countries and territories from which travellers can enter Europe on 17 June 2021.

2 Air traffic evolution and outlook

2.1 Air traffic evolution in the U.S. and in Europe

As examined in previous comparison reports [1], the U.S. CONUS airspace is 10% smaller than the European airspace but the U.S. controlled in 2019 approximately 43% more flights operating under Instrument Flight Rules (IFR). In terms of traffic evolution, a decoupling between the U.S. and Europe is visible over the past 10 years. While U.S. traffic in 2019 was comparable to the level in 2010, traffic in Europe increased over time by 1.5 million flights to reach a peak in 2019.

Figure 2-1 shows the traffic evolution over the past decade. It also visualises the unprecedented reduction in flights in the U.S. and in Europe that followed in 2020 due to the travel constraints as a result of the COVID-19 pandemic. In the U.S., traffic decreased by 33.5% compared to 2019 which corresponds to 5.3 million fewer flights in 2020.



Source: EUROCONTROL-PRU / FAA-ATO

Figure 2-1: Annual evolution of IFR traffic in the U.S. (CONUS) and in Europe

Compared to 2019, the number of flights in Europe (ECAC[2]) decreased by 55.2% in 2020 which corresponds to 6.1 million fewer flights.

The annual perspective in Figure 2-1 hides the monthly evolution and the dynamic of the COVID-19 crisis unfolding in early 2020. Figure 2-2 shows the 7 day moving average of the daily flights in the U.S and in Europe including the reported new COVID-19 cases per million people.

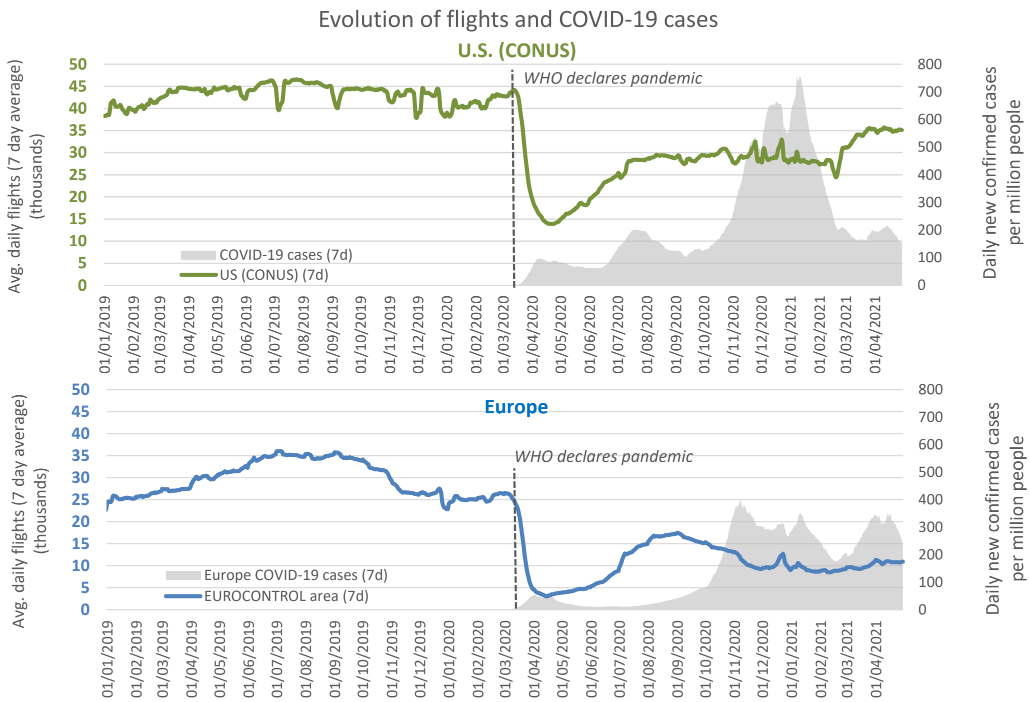


Figure 2-2: Traffic and COVID cases in the U.S. and in Europe (7 day average)

2 The European Civil Aviation Conference (ECAC) is an intergovernmental organization which was established by ICAO and the Council of Europe. ECAC now totals 44 members, including all 27 EU and all 41 EUROCONTROL Member States.

In years unaffected by COVID-19 (2019), the seasonal variation in air traffic is higher in Europe than in the U.S. Flight counts in Europe show a clear increase in summer (+15% vs average), mainly because of flights to holiday destinations in southern Europe. In the U.S., the seasonal variation is more moderate and skewed by the high summer traffic in northern states offsetting the high winter/spring traffic in the South.

Shortly after the WHO declared COVID-19 a pandemic in mid-March 2020, air traffic dropped dramatically on both sides of the Atlantic because of the travel restrictions imposed by many countries.

Figure 2-3 shows the evolution of flights (7 day moving average) in the U.S. and in Europe compared to the 7 day moving average in 2019 to understand the magnitude of the impact. Following the shock in March 2020, the 7-day moving average reached its lowest point in Europe in mid-April 2020 when traffic was 90% below the level of 2019. In the U.S., the lowest point was also in mid-April when traffic was 65% below the comparable traffic level in 2019.

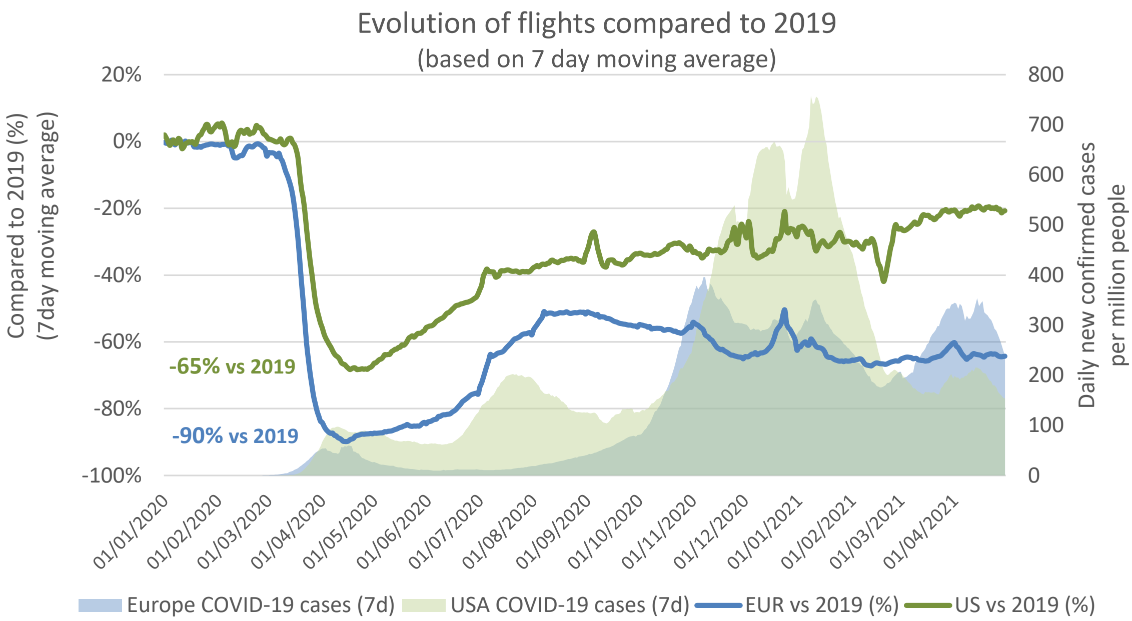


Figure 2-3: Traffic evolution compared to 2019 baseline (7 day average)

After passing the turning point in April 2020, traffic in the U.S. and in Europe increased continuously during the summer, despite a second COVID-19 wave in the U.S. between July and September 2020. The increase in traffic in Europe during summer 2020 was partly driven by flights to holiday destinations (Spain, Italy, Greece and Turkey) combined with a low level of COVID-19 cases and several governments relaxing their initial travel and lockdown restrictions.

Following the resurgence of COVID-19 cases in October 2020 and the subsequent tighter travel restrictions implemented by European states, traffic started to decrease again in Europe with only a small increase during the holiday season at the end of 2020. Air traffic in Europe stagnated broadly at around 65% below 2019 levels in the first quarter of 2021.

In the U.S., traffic was reduced by 65% compared to 2019 levels during the first wave in spring 2020. With the help of the CARES Act funding and reduced travel restrictions in summer 2020, the U.S. saw a steady recovery in flight levels, which continued to grow at a moderate rate to reach around 80% of the 2019 traffic level at the end of April 2021.

Zooming in even further, the analysis by market segment reveals further insights on the dynamics of the crisis.

Figure 2-4 shows the share of domestic and international flights in the U.S. and in Europe in 2019.

The share of international flights to and from the respective region is slightly higher in Europe but in both cases below 20% of total flights (dark orange).

Whereas in the U.S. the remaining 85.6% is domestic traffic within the U.S CONUS area, the situation in Europe is different.

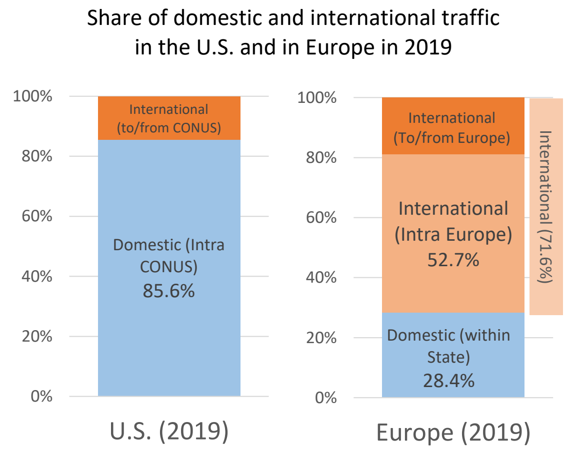


Figure 2-4: Share of domestic and international traffic in the U.S. and in Europe (2019)

The European region is characterised by individual member states collaborating to ensure a harmonised air navigation region. However, more than 50% of the traffic represents intra-European services and therefore accounts as international traffic (i.e. non-domestic traffic). Travel restrictions imposed by countries to fight the pandemic affected heavily this intra-European traffic share. The remaining 28% are domestic flights, i.e. operating exclusively within the respective European countries.

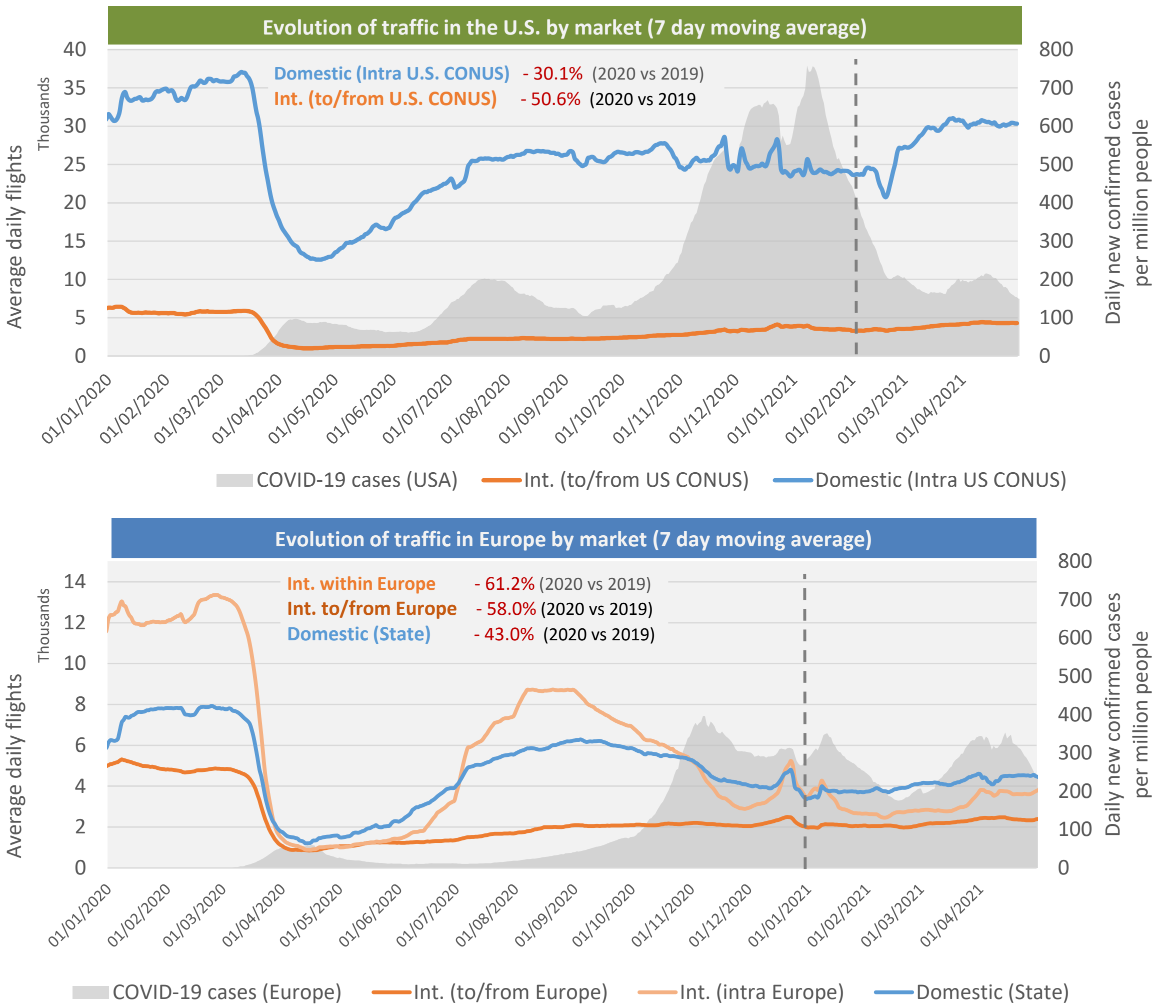


Figure 2-5: Evolution of traffic in the U.S. and Europe by market (avg. daily flights)

Figure 2-5 and Figure 2-6 show the evolution of the domestic and international traffic in the U.S. and in Europe since the beginning of the pandemic. In the U.S., the large domestic market recovered quicker than the international markets, reaching around 80% of the 2019 level at the end of April 2021.

In Europe, intra-European flights and domestic flights within countries recovered quicker in summer 2020 but dropped again as of September with airlines adjusting their schedules as a result of the second wave of the COVID-19 pandemic hitting Europe. The high international share of traffic in Europe (71.6% in 2019) adds to the difficulty on the way to recovery because of the large number of different rules in terms of quarantine and testing requirements which proved to be a major obstacle for passengers to fly.

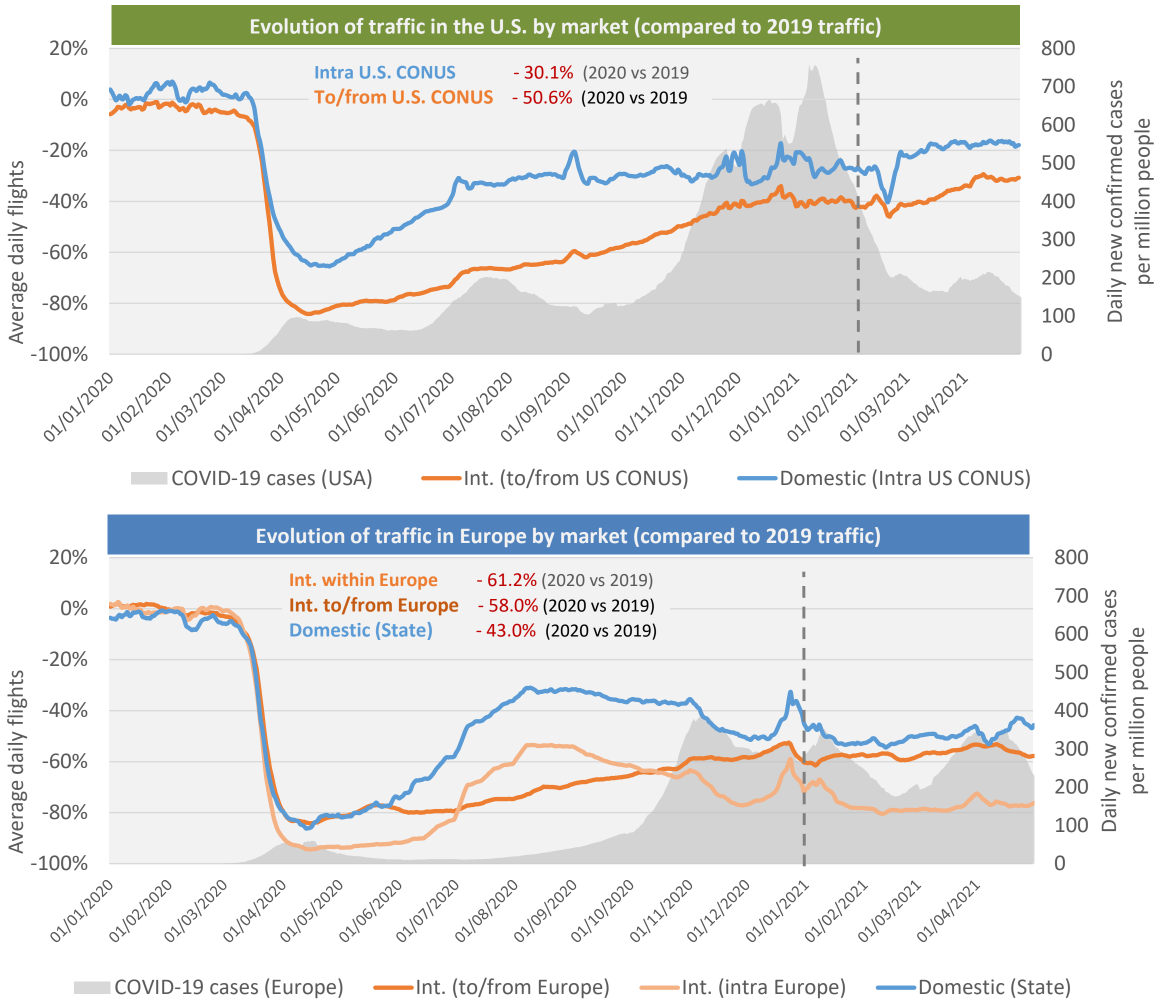


Figure 2-6: Evolution of traffic in the U.S. and Europe by market (vs. 2019 traffic)

The analysis shows that domestic traffic is less affected than international traffic on both sides of the Atlantic. However, the share of the domestic traffic in the U.S. is with 85.6% much higher than in Europe (28.4%) which contributed to lower overall traffic reduction in the U.S. (see also Figure 2-3).

Although cargo flights in Europe account for a comparatively small share of the total flights, the need for goods and equipment to fight the pandemic resulted in a +1.9% increase of all-cargo flights in 2020 [15]. Traditional scheduled airlines and low cost carries account for the largest share of traffic in Europe. This segment was heavily affected by measures implemented by countries to contain the pandemic and as a result traffic decreased in 2020 by 62% compared to 2019. Compared to 2019, business aviation in Europe decreased by 24.4% in 2020 which is much less than scheduled traffic.

Figure 2-7 shows a breakdown of traffic by aircraft class (combination of weight turbulence category and engine type) in 2020 and the corresponding change compared to 2019 in the U.S. and in Europe. Overall, airspace users responded to the decline in air traffic demand by retiring larger aircraft to reduce overall operating costs. The slightly higher share of international long-range traffic for Europe is reflected by the higher number and share of removed large aircraft. The overall higher regional air transport demand in the U.S. can also be derived from a higher utilization rate of the light and medium Jet fleet in comparison to Europe.

	U.S.		Europe	
	Avg. daily flights 2020	% change vs 2019	Avg. daily flights 2020	% change vs 2019
Jet Heavy (>136t)	2,123	-31.0%	1,961	-48.6%
Jet Large (50t<>136t) +757	8,840	-44.8%	7,269	-62.1%
Jet Medium, Light (>50 t)	9,519	-34.1%	1,795	-46.1%
Turboprob	3,442	-20.7%	1,854	-43.7%
Piston	3,017	-14.8%	524	-9.2%
Total	26,941	-34.9%	13,403	-55.6%

Figure 2-7: Traffic by aircraft class in 2019 and 2020 in the U.S. and in Europe (all traffic)

Figure 2-8 shows the evolution of the average number of seats per scheduled flight in the U.S. and in Europe, based on data for passenger aircraft.

The drastic reduction in travel demand forced many aircraft operators to reconsider their flight schedules and fleet utilisation. This resulted in a withdrawal of a significant part of their fleet from service.

Figure 2-8 shows the share of idled aircraft (inactive for the previous seven days) of the main passenger airlines in the U.S. and in Europe in the first half of 2020.

There was a substantial increase in inactive passenger aircraft in the U.S. and in Europe following the implementation of travel restrictions in March 2020 and the subsequent drop in demand.

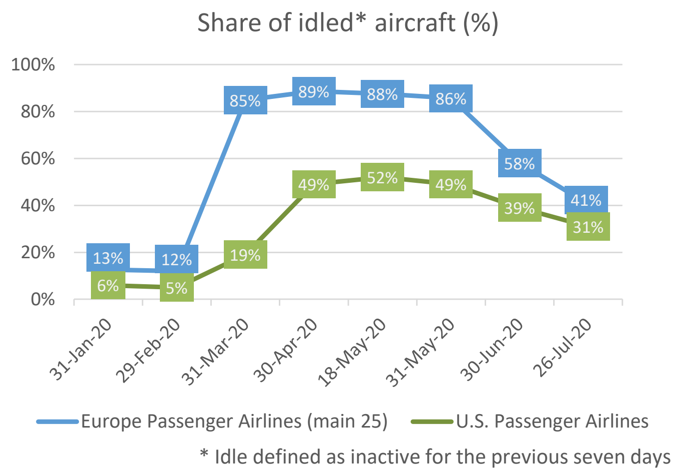


Figure 2-8: Share of idled aircraft of passenger airlines in the first half of 2020

However, there was a notable difference between the U.S and Europe in the share of inactive aircraft. On both sides of the Atlantic a large share of the long haul fleet was taken out of service because of the suspension of international long haul services. However, the large domestic U.S. market (see also Figure 2-4) and CARES Act minimum service requirements seem to have enabled U.S. passenger airlines to keep more aircraft in service than their European counterparts which were much more affected by restrictions on international travel - even within Europe.

2.2 Traffic Outlook

Following the deep global shock in 2020, there is still great uncertainty about the shape and form of the regional and global recovery over the coming years. This uncertainty impacts the traffic outlook for the coming years as the recovery depends on many factors, including government policies on travel restrictions, vaccine effectiveness and availability, passenger behaviour and trust as well as the evolution of the general economic climate.

Commercial air traffic is particularly vulnerable to the aforementioned factors and with the pandemic continuing there is a possibility of more permanent structural changes in consumer behaviour (e.g. video conferencing, modal shifts, etc.).

Figure 2-9 shows the longer term forecast up to 2024 for Europe, produced by STATFOR in May 2021 [16]. It is based on traffic trends, economic forecasts and expert judgement and includes three scenarios (1) Vaccine widely available for travellers by Summer 2021 (2) Vaccine widely available for travellers by Summer 2022, and (3) Lingering infection and low passenger confidence.

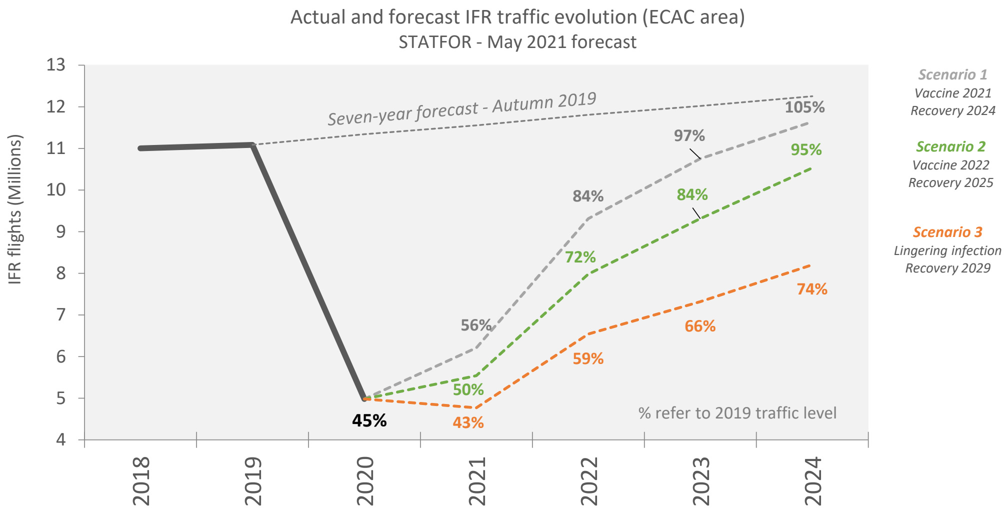


Figure 2-9: EUROCONTROL traffic forecast 2021-2024

The most optimistic scenario for Europe is that air traffic returns to 2019 levels by 2024. In the second scenario, 2024 traffic would be at 95% of the 2019 figure. In the most pessimistic scenario, traffic in 2024 would be 74% of the 2019 figure and would not reach 2019 levels until 2029.

Uncertainties about the further development exist in both regions. The European traffic scenarios form a basis for further planning. In the U.S. it is estimated that recovery may take 3-5 years based on a statement by the CEO of an aircraft manufacturer (April 2020). Accordingly, the air transport sector in the U.S. and Europe face similar challenges and associated timeframes.

3 Impact of COVID-19 on operational performance

This chapter evaluates changes in ANS operational performance in the U.S. and in Europe as a result of the COVID-19 pandemic and the dramatic drop in air traffic, based on the established indicators used in the previous operational comparison reports [1].

To ensure comparability based on a common set of data sources with a sufficient level of detail and coverage, the analysis was limited to flights to or from the main 34 airports for IFR traffic[3] in the U.S. and in Europe in 2019. The samples are more comparable in terms of traffic as this removes a large share of the smaller aircraft (general aviation traffic), particularly in the U.S.

3.1 Operations at the main 34 airports in the U.S. and in Europe

Figure 3-1 shows the evolution of the average number of daily IFR departures at the 34 main U.S.[4] and European airports at the top and the change at each airport during the most affected period from May to July each year at the bottom.

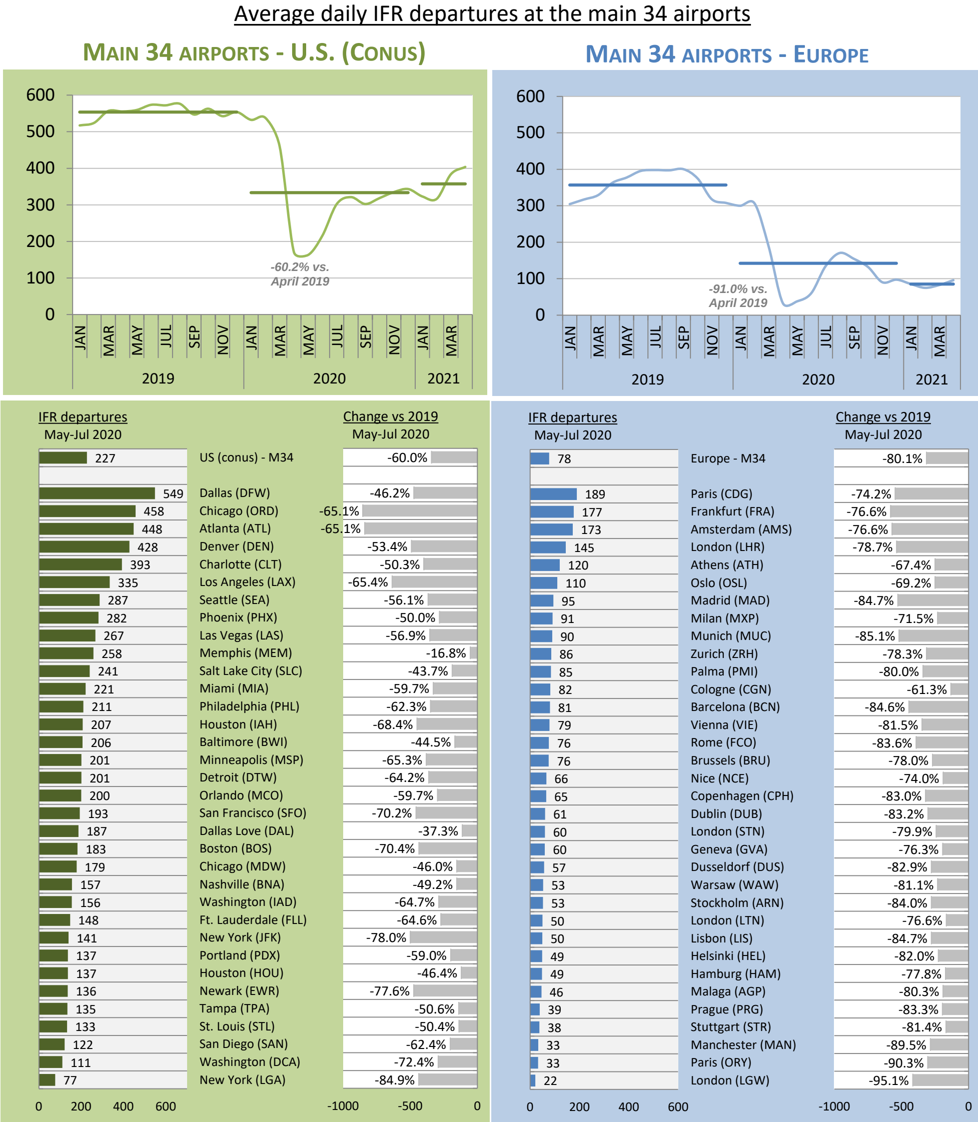


Figure 3-1: Change in IFR departures at the main 34 airports due to COVID-19

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3 Please note that the Turkish airports could not be included in the analysis due to data availability issues.

4 Only IFR flights are included. Some airports – especially in the U.S. – have a large share of additional VFR traffic.

On both sides of the Atlantic, the highest decrease compared to 2019 is observed in April 2020. At the 34 main U.S. airports, departures in April 2020 were 60.2% lower than in April 2019. In Europe, the decrease in April 2020 was with 91.0% notably higher at the main 34 airports.

Compared to May to July 2019, departures at the main 34 U.S. airports decreased in 2020 by 60.0% and by 80.1% at the main 34 European airports. As observed before, the notably lower decrease in the U.S. is linked to the stronger domestic market in the U.S. which appears to be less affected than international flights. Hubs with stronger international traffic (e.g. Atlanta, Chicago, and San Francisco) were subject to a higher traffic reduction within the U.S.

A detailed list of the main airports in each region is included in Annex I of this report.

3.2 On-time performance

This section compares the on-time performance, i.e. arrivals delayed by less than or equal to 15 minutes versus the scheduled on block time, also known as arrival punctuality in the U.S. and in Europe. On-time performance is reported by the U.S. Department of Transportation (DOT) [17] and in Europe by the Central Office for Delay Analysis (CODA) [18]. Although the U.S. DOT definition for on-time performance counts the 15th minute as delayed in this report, the 15th minute is counted as on-time to stay consistent with the EUROCONTROL definition of on-time performance.

On-time performance is influenced by many factors including airline/local turnaround delays, extreme weather, late arriving aircraft, security, and ATM-related[5] delays.

Figure 3-2 shows the aggregated arrival punctuality at the 34 main airports in the U.S. and in Europe as of 2019. The results at airport level can be found in Annex II.

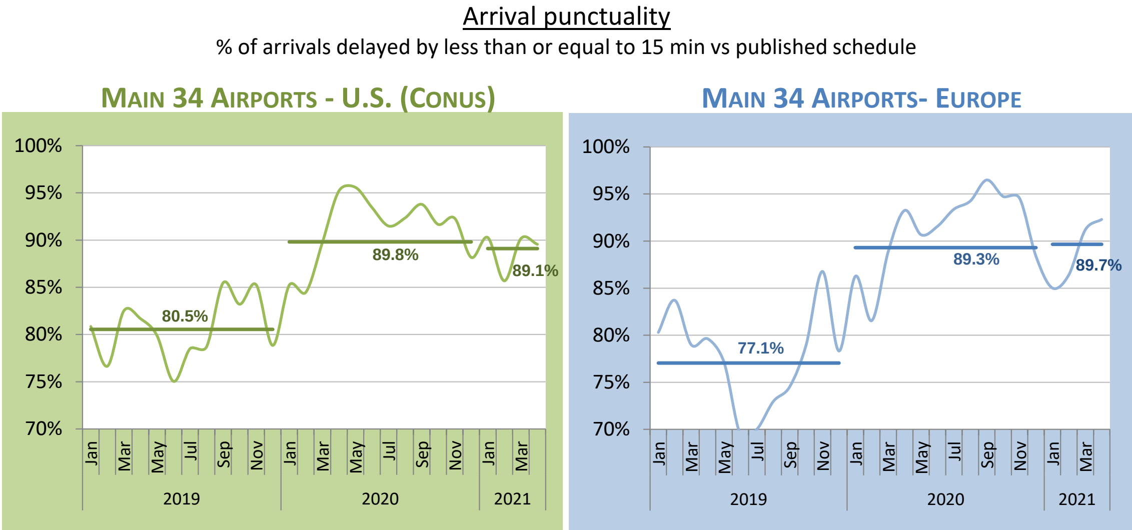


Figure 3-2: Arrival punctuality at the main 34 airports in the U.S. and in Europe

In 2019, overall arrival punctuality was better in the U.S. (80.5%) than in Europe (77.1%) - with seasonal patterns on both sides of the Atlantic. Whereas the winter performance is mostly affected by weather-related delays at airports, the summer is affected by higher demand and resulting congestion but also by convective weather in the en-route airspace. In Europe, the lack of en-route capacity contributed notably to the performance deterioration in summer 2019.

5 In this report, "ATM-related" means that ATM has a significant influence on the operations.

Following the dramatic traffic reduction because of the COVID-19 pandemic in March 2020, arrival punctuality at the main 34 airports in both systems improved notably to reach a similar level (89%) in the U.S. and in Europe in 2020 for the flights still operating. In Europe, on time performance continued to improve as of April 2020 while at the main 34 U.S. airports arrival punctually decreased in line with the continuously rising traffic level.

3.3 ATM-related operational performance

While on-time performance is a good passenger indicator for overall service quality, the analysis of ATM-related performance requires more specific indicators. As detailed in previous comparison reports [1], the FAA/ATO and EUROCONTROL have been sharing approaches to performance measurement over the past years. Both have developed similar sets of operational Key Performance Areas and indicators. The specific indicators used in this section were developed using common procedures on comparable data from both the FAA/ATO and EUROCONTROL. The indicators are aligned with the KPIs listed in the ICAO Global Air Navigation Plan (GANP) [19] which can be used to assess the benefits of the global implementation of Aviation System Block Upgrades (ASBUs).

3.3.1 ATM-related departure restrictions (ATM/TMI delays)

Both the U.S. and Europe report ATM-related delay imposed on departing flights through Traffic Management Initiatives (TMIs)[6] by ANSPs in order to achieve required levels of safety as well as to most effectively balance demand and capacity. Such delays are generally referred to as Air Traffic Flow Management (ATFM) delays.

To stay consistent with previous US/EU comparison reports, only ATFM delays equal or greater than 15 minutes were included in the analyses. Unlike airline schedule delay of Figure 3-2, ATFM delay is based on day of operation reference such as an estimated take-off time in the last submitted flight plan. For the US, this is an estimated take-off time based on the time an aircraft enters FAA control (calls ready) plus a nominal taxi-out time.

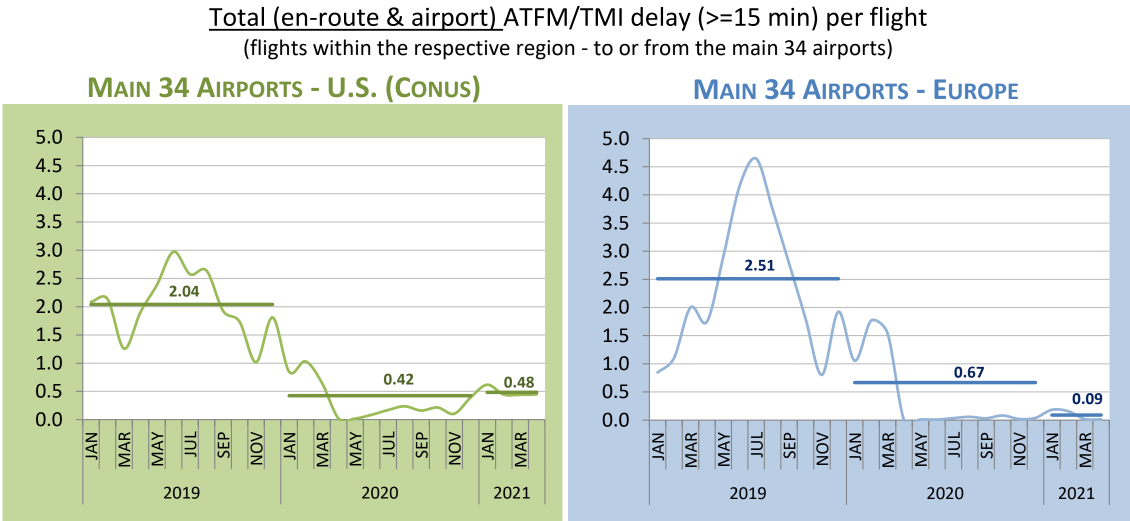


Figure 3-3: Total (en-route + airport) ATFM/TMI delays per flight (main 34 airports)

[6] The ATM/TMIs shown for the U.S. in this section include all TMI delays. The TMIs included are Ground Stops (GS), Ground Delay Program (GDP), Collaborative Trajectory Options Program (CTOP), Airspace Flow Programs (AFP), Severe Weather Avoidance Plan (SWAP), Miles in Trail (MIT), Minutes in Trail (MINIT), Departure Stops, Metering, Departure/En-Route/Arrival Spacing Programs (DSP/ESP/ASP).

Figure 3-3 shows the average ATM/TMI delay (en-route and airport) per flight at the main 34 airports in Europe between 2019 and 2021. In Europe, the high level of ATFM delay due to the lack of en-route capacity in summer 2019 is clearly visible. Following the dramatic drop in traffic because of the COVID-19 pandemic, ATFM delays virtually disappeared in Europe as of April 2020 and the focus changed entirely from managing the capacity crisis in 2019 to downscaling of operations to ensure business continuity.

The overall situation in the U.S. reflects the higher level of traffic with ATM-related delays and associated TMIs. Although traffic as of April 30, 2021 had returned to 80% of pre-COVID levels, ATFM delay remained low at 24% of pre-COVID levels (2.04 in 2019 vs 0.48 minutes per flight in 2021). US traffic has not returned evenly. For 2021, facilities with historically high ATFM delay impact (LGA, EWR, SFO) have relatively much lower traffic compared to DFW which now contributes most to this indicator during COVID and the recovery.

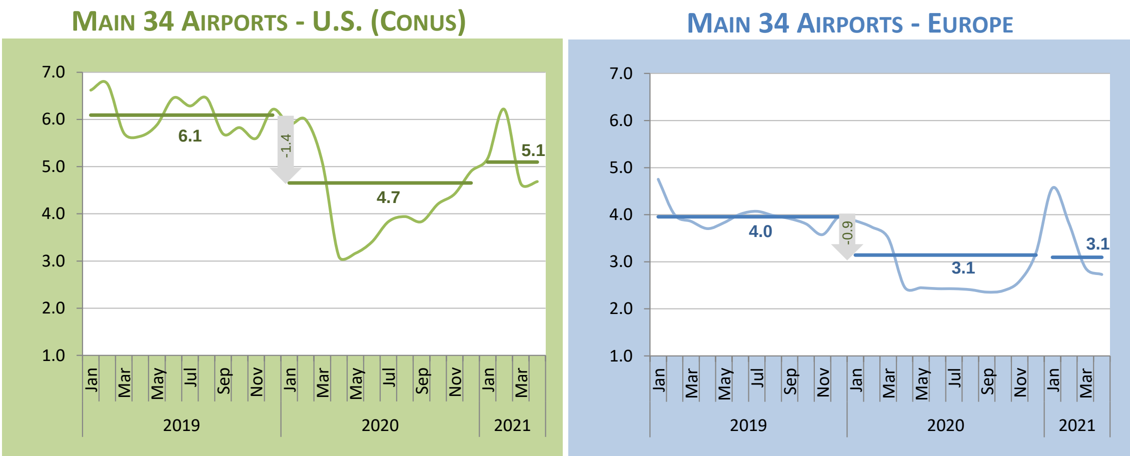
3.3.2 ATM-related taxi-out efficiency

The analysis of taxi-out efficiency refers to the period between the time when the aircraft leaves the stand (actual off-block time) and the take-off time. The additional time is measured as the average additional time beyond an unimpeded reference time.

In the U.S., the additional time observed in the taxi-out phase also includes some delays due to ATM/TMI and departure delays taken after pushback from the gate due to constraints at the departure airport and en-route (at local TRACON and ARTCC). The TMIs associated to local en-route constraints are SWAP, MIT, MINIT, DSP/ESP/ASP, etc. In Europe, the additional time might also include a small share of ATFM delay which is not taken at the departure gate, or some delays imposed by local restriction, such as Minimum Departure Interval (MDI).

The taxi-out phase and hence the performance indicator is influenced by a number of factors such as take-off queue size (waiting time at the runway), distance to runway (runway configuration, stand location), downstream departure flow restrictions, aircraft type, and remote de-icing, to name a few. Of these aforementioned causal factors, the take-off queue size[7] is considered to be the most important one for taxi-out efficiency [20].

Additional time in the taxi out phase
(minutes per departure)



(based on 20th percentile for each service (same operator, same airport, monthly))

Figure 3-4: Additional times in the taxi-out phase (20th percentile)

7 The queue size that an aircraft experienced was measured as the number of take-offs that took place between its pushback and take-off time.

The method in Figure 3-4 uses the 20th percentile of each service (same airport, operating carrier, departure season and calendar year) as a reference for the "unimpeded" time and compares it to the actual times to compute the additional time in the taxi-out phase.

On average, additional times in the taxi-out phase were some 2.1 minutes higher in the U.S. than in Europe in 2019. As a result of the COVID-19 pandemic and the drop in traffic as of March 2020, additional taxi out time in the U.S. and in Europe decreased substantially. Following the reduction in additional taxi out time in April 2020, it is interesting to note that in the U.S. additional taxi-out time increased again in line with growing traffic levels whereas in Europe the additional taxi-out time remained low even during summer 2020 when traffic levels increased. This suggests that the level of recovery stayed below a level that could result in surface congestion. Also, even with reduced traffic, some airports continued to have peaked schedules, reducing the benefits of low daily traffic levels on on-time performance.

3.3.3 Horizontal en-route efficiency

Horizontal en-route flight efficiency (HFE) compares the actual flown trajectory with the shortest distance between flight origin and destination using the Great Circle Distance (GCD). "En-route" is defined as the portion between a 40 NM radius around the departure airport and a 100 NM radius around the arrival airport.

It is acknowledged that this distance-based approach does not necessarily correspond to the "optimum" trajectory when meteorological conditions or economic preferences of airspace users are considered for specific flights. However when used at the strategic level, the indicator will point to areas where track distance is increasing or decreasing over time.

For the interpretation of the results it is important to stress that the indicator, per design, cannot and should not be zero. This is because, in addition to route network design and route availability related inefficiencies, the indicator also captures necessary (separation, danger areas, etc.) or even desirable deviations from the GCD (trade-offs, etc.).

Figure 3-5 shows the average horizontal en-route flight efficiency of flights to or from the main 34 airports in Europe. Only flights taking off and landing within the respective region were considered in the analysis (i.e. transatlantic flights are excluded). An "inefficiency" of 5% means for instance that the extra distance over 1 000 NM was 50 NM.

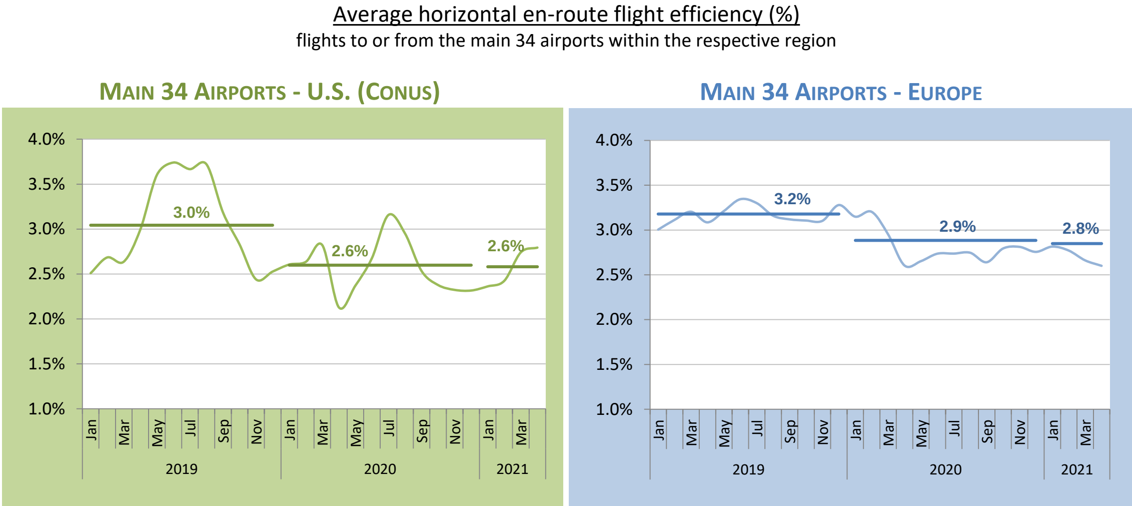


Figure 3-5: Horizontal en-route flight efficiency

The dramatic drop in traffic following the COVID-19 outbreak in March 2020 resulted in an improvement of horizontal en-route flight efficiency in Europe and in the U.S.

The "inefficiency" in Europe decreased from 3.2% in 2019 to 2.9% in 2020. Virtually from one day to the next, the flow measures implemented to manage the en-route capacity crisis in Europe (re-routing, level-capping) in 2019 were no longer necessary and therefore removed. Since the beginning of the pandemic in early 2020, ANSPs - in collaboration with the Network Manager- removed around 1,200 Route Availability Document (RAD) measures in the ATM network, enabling more efficient flights. This resulted in an overall reduction of constraints based on airspace design and operational requirements, and culminated in the observed higher levels of en-route flight efficiency.

Flight inefficiency in the U.S. increased notably in summer of 2019. Following the drop in traffic in 2020, flight efficiency in the horizontal phase in the U.S. improved but started to decrease again in summer 2020 with traffic recovering. The positive trend associated between lower traffic levels and operational procedures will be complemented for the next edition of this special COVID report. The observed trend in terms of horizontal flight efficiency in the U.S. is characterised by the significantly higher level of traffic recovery in 2020 and early 2021.

3.3.4 Flight efficiency within the last 100NM

This section analyses the level of inefficiencies that occur during the arrival/descent phase. Hence, in order to capture tactical arrival control measures (sequencing, flow integration, speed control, spacing, stretching, etc.) irrespective of local ATM strategies, a standard Arrival Sequencing and Metering Area (ASMA) of a 100 NM ring around the respective airport was used.

The actual transit times within the 100 NM ASMA ring are affected by a number of ATM and non-ATM-related parameters including, but not limited to, flow management measures (holdings, etc.), airspace design, airports configuration, aircraft type environmental restrictions, and in Europe, to some extent, the objectives agreed by the airport scheduling committee when declaring the airport capacity.

The "additional" time is used as a proxy for the level of inefficiency within the last 100 NM. It is defined as the average additional time beyond the unimpeded transit time. The unimpeded times[8] are developed for each arrival fix, runway configuration and aircraft type combination.

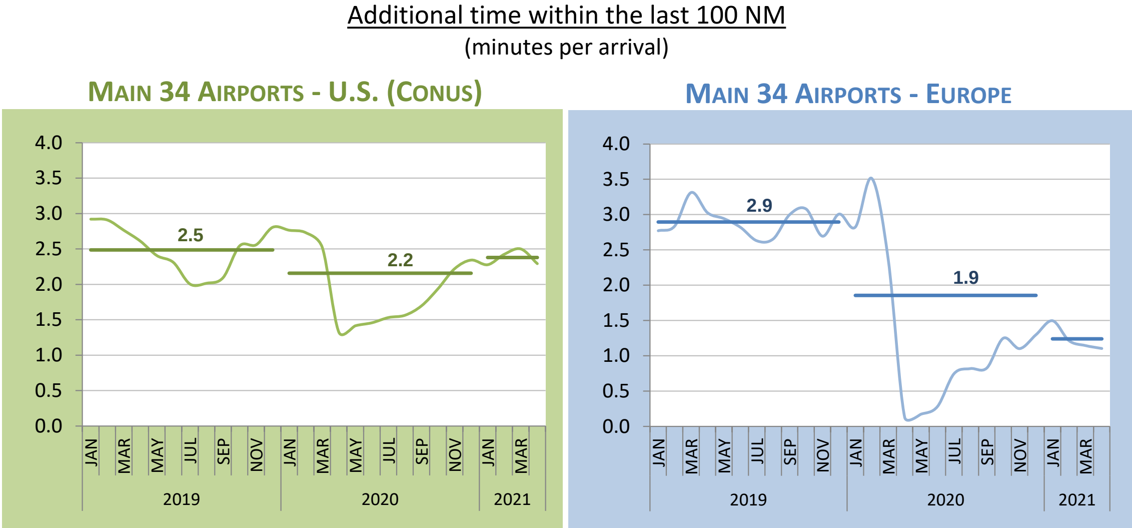


Figure 3-6: Additional time within the last 100 NM (main 34 airports)

8 Although the methodologies are expected to produce rather similar results, due to data issues, the calculation of the unimpeded times in Europe and the US is based on the respective "standard" methodologies and the results should be interpreted with a note of caution.

Figure 3-6 shows the evolution of average additional time within the last 100 NM for the U.S. and Europe at the main 34 airports as of January 2019.

At the main 34 airports, the average additional time within the last 100 NM was in Europe almost 30 seconds higher than in the U.S. before the COVID-19 pandemic in 2019.

When traffic dropped, following the COVID-19 related travel restrictions in March 2020, the additional time within the last 100 NM decreased on both sides of the Atlantic, but with a notably higher improvement at the 34 main European airports (-1 minute compared to 2019). Additional time increased again in the U.S. and in Europe in line with rising traffic levels after the tipping point in April 2020.

3.3.5 Vertical flight efficiency in descent

In recent years, the analysis of fuel-efficient continuous descent operations has gained increasing interest as they are seen by ICAO as one of the key improvement steps to further efficiency gains (fuel, emissions and noise).

Complementary to the analysis of additional time within the last 100 NM in the previous section, this section evaluates vertical flight efficiency in the arrival phase at the main 34 European airports (no comparable data is presently available for the U.S.) to get a more complete picture on ANS-related constraints ranging from airspace and procedure design through tactical interventions by air traffic controllers, including arrangements between adjacent air traffic units.

The analysis focuses on the vertical profile of the arrivals at the main 34 European within a 200 NM radius around the airports.

Figure 3-7 shows the average time flown level in descent at the main 34 airports in Europe as of January 2019.

Vertical efficiency at the top 30 airports during approach in 2020, measured as average time flown level, decreased by 47 seconds compared to 2019.

Despite the low traffic numbers since March 2020, quite some vertical inefficiency was always present. This suggests that procedural and airspace related constraints play a factor in the vertical efficiency (e.g. hand-over between different ATC units, airspace borders).

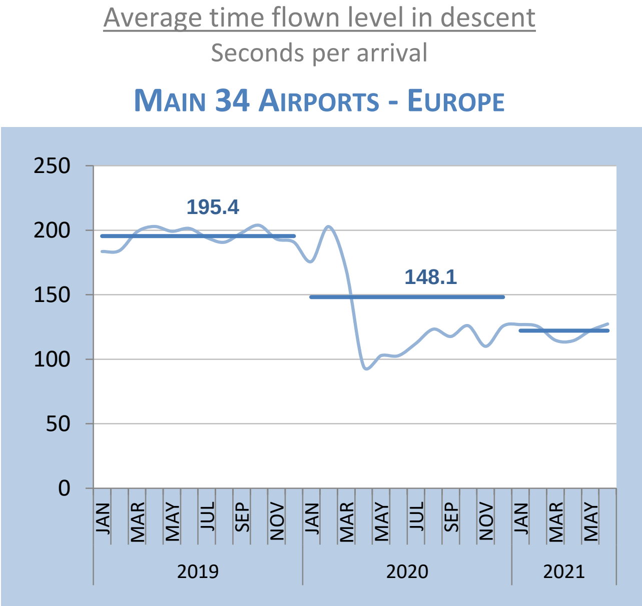


Figure 3-7: Average time flown level in descent at the main 34 airports in Europe

4 Economic impact of COVID-19 on ANS

The response by National Governments to curb the spread of COVID-19 resulted in an unprecedented loss of air transport demand. The aviation industry was hit harder than many other industries due to the reduced demand and continuing travel constraints on air travel in both Europe and the U.S.

The extraordinary impact of the COVID-19 pandemic on ANS is shown in Figure 4-1, depicting the long-term trends in IFR flight-hours controlled between 2006 and 2020 for FAA/ATO, European and the SES ANSPs.

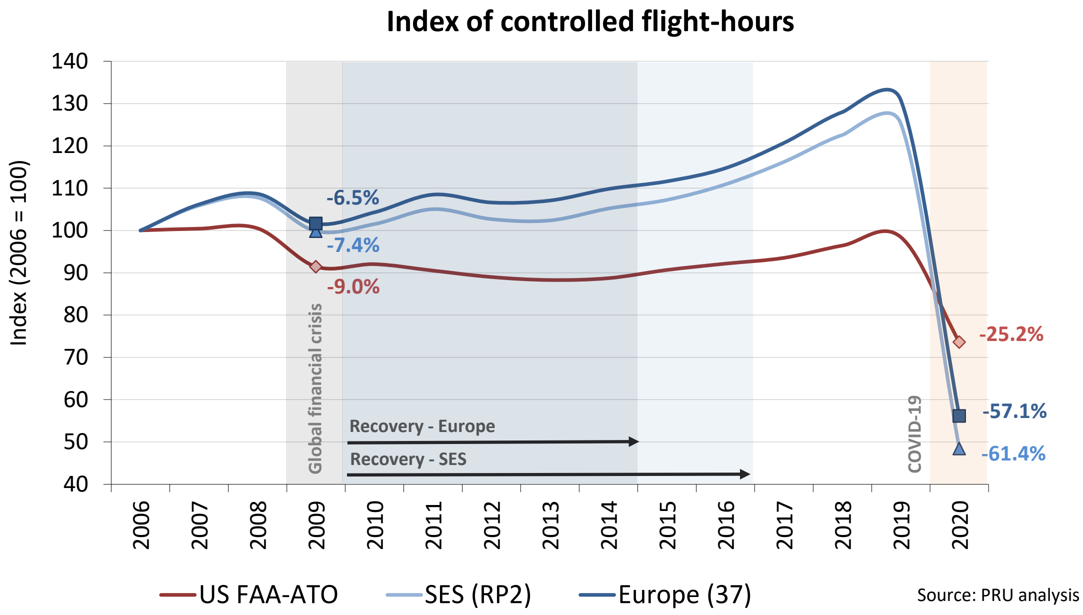


Figure 4-1: Trends in IFR flight-hours controlled (2006-2020)

Figure 4-1 shows that the effects of the global financial crisis on the aviation industry in 2009 for Europe resulted in a -6.5% drop in flight-hours controlled (-7.4% for ANSPs operating in the SES States), while it took five years for the traffic levels to recover to pre-crisis levels (seven years for SES ANSPs). On the other hand, for FAA/ATO, the traffic levels had not yet recovered to pre-crisis levels after a -9.0% reduction in 2009.

This impact, however, is not even comparable to the disastrous effects of the COVID-19 crisis in 2020. Figure 4-1 shows that in 2020, the FAA/ATO controlled -25.2% less IFR flight-hours, while the reduction for the European ANSPs has been much more severe with a decrease of -57.1% at a European level, and -61.4% for the SES ANSPs.

4.1 Financing of ANS in the U.S. and Europe

Whereas the U.S. system is operated by one single ANSP, in Europe ANSPs are still largely organised by State boundaries with different working arrangements, systems and cost structures. It is also important to highlight that the majority of European ANSPs are established as state-owned limited liability or joint-stock companies, which, by nature of the enterprise, enables them to collect revenues and manage their budgets independently from the State budget[9]. In a December 2000 executive order, the U.S. president directed the Federal Aviation Administration (FAA) to create a performance-based

[9] The organisational set-up is different for DCAC Cyprus and HCAA, the Greek ANSP, both of which are State bodies without an autonomous budget. More details of organisational and corporate arrangements of European ANSPs are provided on p. 3 of ACE 2019 Benchmarking report [31] .

organization focused on the efficient operation of the ATC, and in February 2004, the Air Traffic Organization (ATO) officially began operations.

There is a fundamental difference in how ANS provision is funded in Europe and in the U.S. The European ANSPs are primarily funded through specific en-route and terminal ANS charges imposed on flights in controlled airspace, based on aircraft weight and distance flown (service units[10]). Two distinct systems for setting ANS charges exist in Europe.

The revenue of European ANSPs operating in States subject to Single European Sky legislation (SES States) is set out by regulators ahead in form of a multiannual performance plan[11]. This plan includes targets and specific risk-sharing arrangements, aiming at incentivising economic performance. Revenue gains/losses due to traffic variations (i.e. over-recovery or under-recovery) compared to the plan are returned to airspace users or recovered by ANSPs in future years[12] (usually in year n+2 based on Commission Implementing Regulation (EU) 2019/317).

Given the sizable drop in traffic in 2020 and despite the measures implemented by SES ANSPs to respond to this crisis, the regulatory scheme was expected to result in a massive increase of ANS charges from 2022. To address this, the Commission put in place exceptional measures[13] which required the performance plans to be revised and ANSPs' revenue loss of the years 2020 and 2021 to be recovered over a period of 5 to 7 years. These measures were designed to make sure both, that ANSPs adjust their operations to the new realities and that airspace users are shielded from a sudden increase of ANS charges during recovery from the COVID-19 pandemic.

The ANSPs in the eight European States which are part of the EUROCONTROL Multilateral Route Charges System and which are not bound by SES regulations, apply various national cost recovery schemes, which, for the majority of these States, is based on a "full cost recovery" regime.

In contrast, in the U.S. the Airport and Airway Trust Fund (AATF) provides the primary source of funding for FAA and receives revenues principally from a variety of excise taxes paid by users of the National Airspace System (NAS). The excise taxes are imposed on domestic passenger tickets, domestic flight segments, and international passenger arrivals and departures, and on purchases of air travel miles for frequent flyer and similar programs. However, the taxes are not applied to ancillary fees. In addition, taxes are imposed on air cargo waybills and aviation fuel purchases. The largest source of excise tax revenues are related to transportation of passengers. Expenditures from the Trust Fund are subject to congressional appropriations and included in the federal budget [21].

The analysis in the previous U.S. - Europe continental comparison reports were not affected by these differences in funding as they focused on comparing the costs rather than the underlying funding mechanisms to finance the system. These differences are, however, important in the context of the current COVID-19 crisis since the collapse in traffic in 2020 had a direct impact on the ability of both systems to finance their operations in short and medium terms.

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10 $Service\ unit = distance\ flown \times \sqrt{\frac{MTOW}{50}}$

11 The performance plans have to be consistent with EU-wide targets set out by the Commission. The plans cover a 5 years period called reference period. The current (3rd) reference period covers the years 2020 to 2024.

12 The recovery scheme provides that up to 4.4% of ANSPs' revenues are at risk in the event that actual traffic is substantially (±10% or more) different from what was set out in the plan

13 Commission Implementing Regulation (EU) 2020/1627 of 3 November 2020 on exceptional measures for the third reference period (2020-2024)

4.2 COVID-19 impact on ANS income/revenues

While detailed European ANS cost figures for 2020 were not available at the time of writing of this report, it is nevertheless possible to provide an overview of the estimated impact of the COVID-19 crisis on the revenues for European ANSPs in 2020[14].

It is important to keep in mind that the revenues of European ANSPs primarily comprise en-route and terminal charges (some 74% and 16% respectively of the gate-to-gate ANS revenues collected in the scope of the ACE analysis). Other ANS revenues include income from airport operators (around 4%) which correspond to situations where terminal charges are charged to airspace users by the airports before transferring revenues to the ANSP. The remaining 6% of gate-to-gate ANS revenues comprise financial income and other revenues (mostly from National Governments). Even when ANSPs earn revenues from other activities, these will mainly relate to revenues from Oceanic ANS, airport management and commercial activities which will also be largely impacted by the drop in traffic.

While the actual amount of revenue reduction for European ANSPs (i.e. including terminal ANS revenues) is not yet available, it can be estimated that the impact on en-route and terminal revenues between 2019 and 2020 will be in the same order of magnitude as the reduction in the number of en-route service units for the year 2020 (i.e. -58%)[15].

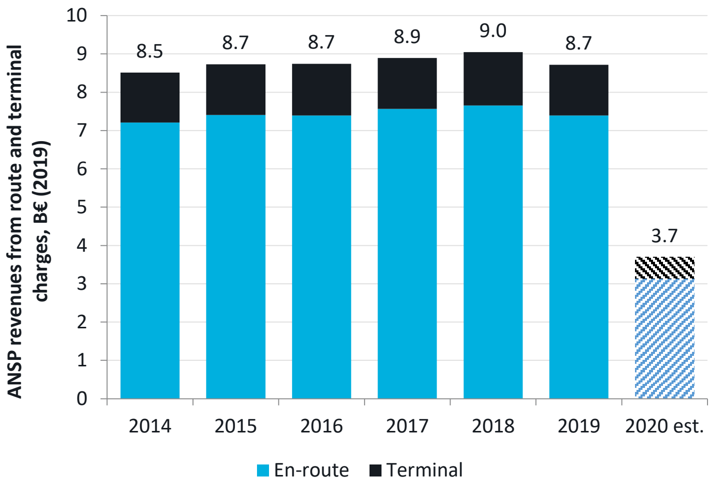

Figure 4-2: Revenues from route and terminal charges of European ANSPs (2014-2020 est.)

Applying this assumption, Figure 4-2 shows the estimated level of European ANSPs gate-to-gate revenues from charges in 2020 (€3.7B) and compares it to the annual revenues from en-route and terminal charges earned over the 2014-2019 period (between €8.5B and €9.0B).

The cash and reserves reported by the European ANSPs at the end of 2019 stood at an estimated €2.9 Billion[16], which, compared to the amount of estimated losses of gate-to-gate revenues of €3.7B, suggests that in the short and medium-terms, these ANSPs might face significant liquidity issues (shortage of cash to finance operations). This might be particularly the case if airlines are not in a position to pay for ANS charges (i.e. bankruptcies, defaults on payments).

For the U.S., in March 2020, as part of the CARES Act [4], the United States Congress imposed an excise tax holiday period, effective March 27, 2020 through December 31, 2020, on certain excise taxes that

14 It is important to recognise that the analysis for European ANSPs does not refer to actual collection or disbursement of cash and only provides indicative information on the estimated revenues under the charging schemes currently in place. It should be highlighted that the financial amounts calculated here only constitute an initial estimate and should be interpreted with caution due to the preliminary nature of the data used, and a number of simplifying assumptions taken.

15 Based on the actual TSU figures for 2020 reported in the EUROCONTROL Forecast Update 2021-2024 published in May 2021, https://www.eurocontrol.int/publication/eurocontrol-forecast-update-2021-2024

16 This figure reflects the cash and cash equivalents held by the 38 European ANSPs at the end of 2019 based on the information reported in ACE 2019 data submissions.

fund the AATF. During this period, collection of federal excise taxes that apply to commercial operations were suspended, including:

- Taxes on transportation of persons and property by air
- Aviation fuel for commercial use.

On October 1, 2020, following the drop in aviation taxes and surcharges that support the AATF, the U.S. Congress appropriated a $14 billion (€12B) transfer from the Treasury's General Fund to the AATF through the FY 2021 Continuing Appropriations Act (Public Law 116-159) [22]. Note that this $14 billion (€12B) transfer is used to support the entire FAA budget, of which ATO is only one part.

4.3 COVID-19 impact on cost management and ANSPs financial situation

In the view of these short and medium term pressures, a number of European ANSPs already undertook a range of measures to mitigate the impact of the traffic reduction on their activity but also to address potential cash shortages. Broadly, they can be grouped into three categories:

- Aid from National Governments;
- Loans; and
- Cost-containment measures.

Figure 4-3 provides an overview of the cost containment measures reported by the European ANSPs as well as classifies those enacted within the FAA/ATO organisation. For European ANSPs this information is not yet available in detailed, quantified terms, and, at this point, only contains a general list of high-level measures planned or already undertaken.

<table>
<tr><th rowspan="2">Aid from National Government</th><th rowspan="2">Loans</th><th colspan="3">Cost-containment measures</th></tr>
<tr><th>Staff</th><th>Non-staff</th><th>Capital expenditure</th></tr>
<tr><td colspan="5">ANS CR, ANS Finland, Austro Control, DFS[b], LGS[a,b], LPS[b], NATS[a], NAVIAIR, skeyes[a], Slovenia Control</td></tr>
<tr><td colspan="2"></td><td colspan="3">Albcontrol, ARMATS, Avinor, BULATSA, Croatia Control, DCAC Cyprus, DSNA, EANS, ENAIRE, HungaroControl, IAA, LFV, LVNL, M-NAV, MUAC, NAV Portugal, PANSA, ROMATSA, Skyguide, SMATSA, UkSATSE</td></tr>
<tr><td>Skyguide [b]

Avinor[b]

FAA-ATO</td><td>Albcontrol[a], ARMATS, Croatia Control, DHMI[a], DSNA, EANS[a], HungaroControl, IAA, LVNL[c], MATS[a], NAV Portugal, Oro Navigacija[a], PANSA, ROMATSA, Sakaeronavigatsia, SMATSA, UkSATSE</td><td>ENAV

HCAA

MATS

MOLDATSA</td><td>DHMI

ENAV

MOLDATSA

FAA-ATO</td><td>DHMI

HCAA

MATS

Sakaeronavigatsia</td></tr>
</table>

(a) EUROCONTROL Loan. (b) Increase in equity. In the case of Avinor from the parent company, which is a State-owned enterprise.
(c) LVNL operates in a specific environment where the balance in its current accounts is ensured by Treasury banking.

Figure 4-3: Mitigation measures implemented by ANSPs in 2020 or planned in 2021[17]

[17] More details on the measures implemented by the European ANSPs in response to COVID-19 crisis are available in the PRC Performance Insight #2 on the economic impact of COVID-19 on the ANS system and the ACE 2019 Benchmarking Report [31].

Figure 4-3 shows that the 38 European ANSPs participating to the ACE benchmarking project have reported the implementation of exceptional measures targeting, in almost all cases, a combination of operating and capital-related costs. The impact of these measures on ANSPs cost-bases in not in the same order of magnitude as the traffic reduction and resulting revenue loss. Initial actual cost figures available for the SES ANSPs[18] as published in the PRB annual monitoring report for 2020 shows that, the en-route costs of ANSPs operating in SES States decreased by some -3% in real terms between 2019 and 2020, while traffic measured in terms of service units was -58% lower[19]. Ten ANSPs listed in the first row reported implementing all types of measures (affecting staff, non-staff operating costs, capital expenditures, loans and aid from National Government).

Measures targeting non-staff operating costs have been reported by almost all ANSPs. These measures generally consisted in completing only essential maintenance and reducing external (e.g. consultancy) support and utilities costs as well as non-essential training activities. Some restructuring of operational units and actions to streamline administration, purchase and overhead costs were also reported.

The staff-oriented typically cover reductions in staff numbers. These could take various forms, such as permanent or temporary layoffs, furloughing schemes, accelerated retirements or voluntary redundancies. Additional actions to reduce staff costs included the suspension of bonuses and overtime, reduced working hours, postponement of promotions and associated salary increases, and freezing of recruitment as well as temporary salary reductions.

Most European ANSPs also reported canceling or deferring non-essential investments, which primarily mitigates cash constraints but will also reduce capital-related costs in the longer term. On the other hand, some large scale projects considered as essential have been maintained.

Figure 4-3 also shows that 27 European ANSPs contracted loans and 12 received some form of aid from national governments. These aids took various forms such as direct or indirect contributions to equity, payment of EUROCONTROL costs, and financing of furloughing schemes or other temporary measures reducing staff.

While this aspect is not shown in Figure 4-3, it is also important to note that several ANSPs incurred additional costs because of COVID-19. These additional costs mainly relate to new internal procedures in order to ensure physical distancing and to comply with more stringent sanitary measures. Increases in allowances for bad debts have also been reported.

Although the FAA/ATO experienced minor increases in the costs of custodial services and cleaning supplies to keep the workforce safe during the public health emergency, the organization was able to reduce spending on training, travel, supplies and overtime over the same period. To further enhance the health and safety of its workforce and maintain the resiliency of the ATC system, the organization temporarily adjusted the operating hours of approximately 100 air traffic control towers nationwide and created segregated teams of controllers to curtail the possibility of cross-exposure to COVID-19 caused by normal shift rotations.

Currently, the FAA/ATO is working with managers and employees to strategically manage leave requests in order to minimize future cost in terms of reduced productivity (for office/support staff) and/or overtime (for operational staff) when employees begin using leave accrued during the pandemic.

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18 These figures are based on the data provided by the SES States in their June 2021 submission of en-route reporting tables. Caution is recommended when interpreting these figures since, it is understood that for some of these States the reported actual 2020 cost figures are still provisional and subject to change.

19 It should be noted that these ANSP cost figures for Europe are not comparable to those published in the previous U.S. - Europe continental comparison reports since i) they only comprise data of 29 ANSPs operating in the SES States, and ii) they only comprise en-route costs.

All of these strategies, along with existing FAA/ATO contingency plans, have allowed the FAA/ATO to continue to provide the world's safest and most efficient air traffic services during the COVID-19 public health emergency.

While it remains to be seen how the European ANSPs will be able to adjust their costs in view of the many uncertainties, detailed analysis on the impacts of these measures should be analysed in the coming years when more detailed cost figures become available.

5 Conclusions

The outbreak of COVID-19 pandemic in 2020 had a devastating impact on the global aviation affecting the entire value chain from aircraft manufacturers to the ANS providers.

This special report is the seventh in a series of joint comparisons between the U.S. and Europe. It aims at understanding the operational and economic impact of the COVID-19 pandemic unfolding in early 2020 on the ATM systems in the U.S. and in Europe.

Without a doubt, the aviation industry has been hit harder than many other industries as a result of the protective travel restrictions implemented by many States to contain the COVID-19 pandemic and the subsequent unprecedented drop in demand for air travel.

For 2020, the International Civil Aviation Organisation (ICAO) estimates a 60% reduction in passengers globally with grave effects on the entire industry. In the U.S. (CONUS area), traffic decreased by 33.5% compared to 2019 which corresponds to 5.3 million fewer flights in 2020. In Europe (ECAC area) the number of flights decreased by 55.2% in 2020 which corresponds to some 6.1 million fewer flights compared to 2019.

The notably higher traffic reduction in Europe appears to be linked to the differences between the U.S. and Europe in terms of market composition and the measures implemented by the individual countries to fight the COVID-19 pandemic. The analysis shows that domestic traffic was less affected than international traffic on both sides of the Atlantic. However, the share of the domestic traffic in the U.S. CONUS area is with 85.6% much higher than in Europe (28.4%) which significantly contributed to lower overall traffic reduction observed in the U.S.

The high share of international or cross-border traffic in Europe (71.6% in 2019) seems to have contributed to the traffic reduction in 2020 but also adds to the difficulty on the way to recovery because of the large number of different rules in terms of quarantine and testing requirements implemented by the European States which proved to be a major obstacle for passengers to fly.

On both sides of the Atlantic, the lowest traffic point was observed in April 2020 when traffic in the U.S. CONUS area and in Europe was 65% and 90% below 2019 levels respectively. After passing the turning point in April 2020, traffic in the U.S. and in Europe grew continuously during the summer, despite a second COVID-19 wave in the U.S. between July and September 2020.

For Europe, the increase during the summer period in 2020 was partly driven by flights to holiday destinations (Spain, Italy, Greece and Turkey) as well as overall relaxation of travel and lockdown restrictions by some European States following a decline in in COVID-19 cases during this period. Following the resurgence of COVID-19 cases in October 2020 and the subsequent tightening of travel restrictions by European States, traffic began to decrease again in Europe with only a small increase during the holiday period at the end of 2020 and then stagnating at around 65% below 2019 levels in the first quarter of 2021.

Despite two further COVID-19 waves in summer 2020 and in winter 2020/21, traffic in the U.S. recovered continuously after April 2020 to reach around 80% of the 2019 level at the end of April 2021.

The earlier start of the vaccination campaign and the large domestic market in the U.S. contributed to the continuous recovery path which is notably different from that observed for Europe. Under the most optimistic scenario currently available, the European traffic is expected to rebound back to 2019 levels by 2024.

With the start of the COVID-19 pandemic and the resulting dramatic drop in traffic, on-time performance and all operational ATM-related indicators improved on both sides of the Atlantic for the flights still operating. To ensure better comparability, the analysis of operational performance was limited to flights to or from the main 34 airports in each region.

In 2019, overall arrival punctuality was better in the U.S. (80.5%) than in Europe (77.1%) which, at that time, was suffering from a lack of en-route capacity which contributed to the lower punctuality level. In 2020 however, the dramatic drop in demand as of March 2020 led to a substantial improvement of arrival punctuality, with both systems reaching similar levels in the U.S. and in Europe in 2020 (89%).

Flight efficiency with subsequent environmental (CO_2 emissions) and economic (fuel) benefits was already high on the agenda before the COVID-19 crisis and will remain so during the recovery and beyond. Here, the lower traffic levels as a result of the crisis offer an opportunity to review and evaluate operational constraints imposed by ANS on both sides of the Atlantic and to further improve existing ATM operations, where possible, with a view to maintain the better service levels also when traffic returns.

In addition to the operational impact, the dramatic traffic reduction as a result of the pandemic also had significant economic implications for ANS on both sides of the Atlantic.

Since both, the U.S. and European ANS funding systems are directly linked to the output, the collapse in traffic in 2020 had a significant impact on revenues and on the ability of both systems to finance their operations in short and medium terms. Controlled flight hours in the U.S. decreased by more than a quarter (-25.2%) as a result of the pandemic, while in Europe, the impact was even more severe with a recorded decrease of -61.4% compared to 2019.

While the analyses in previous comparison reports focused on cost comparisons and were therefore not affected by the differences in funding, in the context of the COVID-19 crisis it is important to also consider the underlying funding mechanisms used to finance these systems.

While detailed European ANSP cost figures for 2020 are not yet available at the time of the release of this report, it is already possible to estimate the impact of this crisis on the ANSP revenues from charges in 2020. Based on latest available figures, it is estimated that these revenues decreased by -58% to around €3.7B (compared to some €8.5B in 2019). Based on the charging systems currently in place in Europe, the majority of these lost revenues are expected to be recovered from the airspace users in the coming years. However, the timing of these recoveries suggests, that in the short and medium term European ANSPs might face significant liquidity issues to finance their operations.

At the same time, the U.S. Federal Aviation Administration (and the Air Traffic Organization (ATO) as the FAA’s operations arm), which derives the majority of its funding from the U.S. Airport and Airway Trust Fund (AATF), was impacted by the decision of the U.S. Congress to impose an excise tax holiday period, effective March 27, 2020 through December 31, 2020. Due to the resulting drop in aviation taxes and surcharges that support the AATF, the U.S. Congress appropriated a $14 billion (€12B) transfer from the Treasury's General Fund to the AATF (note that the transfer is used to support the entire FAA budget, of which the ATO is only one part).

In response to these short and medium term challenges, a number of European ANSPs already undertook a range of measures to mitigate the impact of the dramatic traffic reduction on their activity but also to address potential cash shortages. These include the implementation of cost-containment initiatives, taking up loans to alleviate liquidity risk as well as, in some cases, receiving support from

National Governments. High level results from the PRB 2020 monitoring analysis shows that while traffic has dramatically decreased, European ANSPs have not been able to respond with cost savings of comparable magnitude (SES ANSP's 2020 en-route costs were down by some -3% when compared with 2019). The FAA/ATO also reported cost savings, primarily related to travel and overtime, it is notable that some costs also grew - especially in the areas of cleaning and custodial services, a trend, which is also expected to be observed for some European ANSPs.

While it remains to be seen how the European ANSPs and the FAA/ATO will be able to adjust their costs in view of the many uncertainties, detailed analysis on the impacts of these measures should be carried out in the coming years when more detailed cost figures become available.

6 Annexes

6.1 Annex I – Operations at the main 34 airports

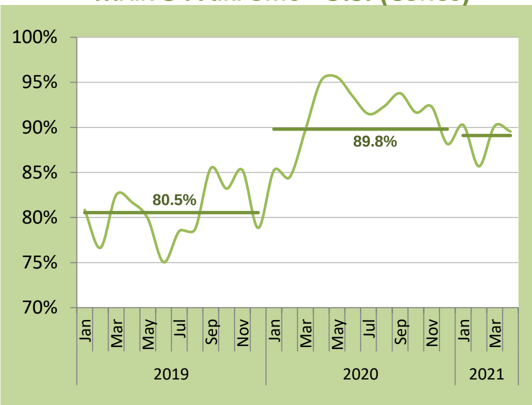
USA	ICAO	IATA	COUNTRY	Avg. daily IFR departures in 2020 (May-Jul)	2020 vs. 2019 (May-Jul)
Atlanta (ATL)	KATL	ATL	United States	448	-65.1%
Chicago (ORD)	KORD	ORD	United States	458	-65.1%
Dallas (DFW)	KDFW	DFW	United States	549	-46.2%
Los Angeles (LAX)	KLAX	LAX	United States	335	-65.4%
Denver (DEN)	KDEN	DEN	United States	428	-53.4%
Charlotte (CLT)	KCLT	CLT	United States	393	-50.3%
Houston (IAH)	KIAH	IAH	United States	207	-68.4%
New York (JFK)	KJFK	JFK	United States	141	-78.0%
Phoenix (PHX)	KPHX	PHX	United States	282	-50.0%
San Francisco (SFO)	KSFO	SFO	United States	193	-70.2%
Las Vegas (LAS)	KLAS	LAS	United States	267	-56.9%
Miami (MIA)	KMIA	MIA	United States	221	-59.7%
Philadelphia (PHL)	KPHL	PHL	United States	211	-62.3%
Newark (EWR)	KEWR	EWR	United States	136	-77.6%
Minneapolis (MSP)	KMSP	MSP	United States	201	-65.3%
Detroit (DTW)	KDTW	DTW	United States	201	-64.2%
Seattle (SEA)	KSEA	SEA	United States	287	-56.1%
Boston (BOS)	KBOS	BOS	United States	183	-70.4%
New York (LGA)	KLGA	LGA	United States	77	-84.9%
Orlando (MCO)	KMCO	MCO	United States	200	-59.7%
Washington (IAD)	KIAD	IAD	United States	156	-64.7%
Washington (DCA)	KDCA	DCA	United States	111	-72.4%
Salt Lake City (SLC)	KSLC	SLC	United States	241	-43.7%
Ft. Lauderdale (FLL)	KFLL	FLL	United States	148	-64.6%
Chicago (MDW)	KMDW	MDW	United States	179	-46.0%
Baltimore (BWI)	KBWI	BWI	United States	206	-44.5%
Memphis (MEM)	KMEM	MEM	United States	258	-16.8%
Dallas Love (DAL)	KDAL	DAL	United States	187	-37.3%
Portland (PDX)	KPDX	PDX	United States	137	-59.0%
San Diego (SAN)	KSAN	SAN	United States	122	-62.4%
Houston (HOU)	IHOU	HOU	United States	137	-46.4%
Tampa (TPA)	KTPA	TPA	United States	135	-50.6%
St. Louis (STL)	KSTL	STL	United States	133	-50.4%
Nashville (BNA)	KBNA	BNA	United States	157	-49.2%
Average (M34)				227	-60.0%

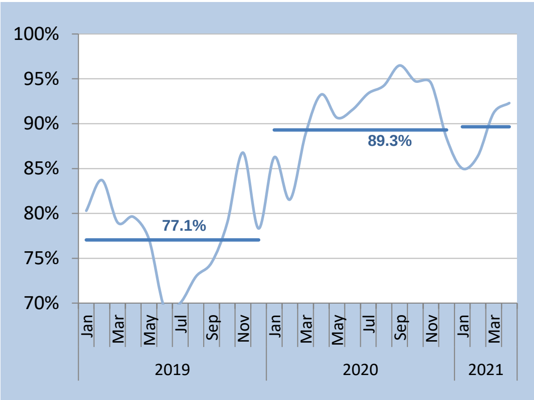
EUROPE	ICAO	IATA	COUNTRY	Avg. daily IFR departures in 2020 (May-Jul)	2020 vs. 2019 (May-Jul)
Frankfurt (FRA)	EDDF	FRA	Germany	177	-76.6%
Amsterdam (AMS)	EHAM	AMS	Netherlands	173	-76.6%
Paris (CDG)	LFPG	CDG	France	189	-74.2%
London (LHR)	EGLL	LHR	United Kingdom	145	-78.7%
Madrid (MAD)	LEMD	MAD	Spain Continental	95	-84.7%
Munich (MUC)	EDDM	MUC	Germany	90	-85.1%
Barcelona (BCN)	LEBL	BCN	Spain Continental	81	-84.6%
Rome (FCO)	LIRF	FCO	Italy	76	-83.6%
London (LGW)	EGKK	LGW	United Kingdom	22	-95.1%
Vienna (VIE)	LOWW	VIE	Austria	79	-81.5%
Zurich (ZRH)	LSZH	ZRH	Switzerland	86	-78.3%
Copenhagen (CPH)	EKCH	CPH	Denmark	65	-83.0%
Oslo (OSL)	ENGM	OSL	Norway	110	-69.2%
Dublin (DUB)	EIDW	DUB	Ireland	61	-83.2%
Milan (MXP)	LIMC	MXP	Italy	91	-71.5%
Stockholm (ARN)	ESSA	ARN	Sweden	53	-84.0%
Brussels (BRU)	EBBR	BRU	Belgium	76	-78.0%
Dusseldorf (DUS)	EDDL	DUS	Germany	57	-82.9%
Paris (ORY)	LFPO	ORY	France	33	-90.3%
Lisbon (LIS)	LPPT	LIS	Portugal	50	-84.7%
Athens (ATH)	LGAV	ATH	Greece	120	-67.4%
Palma (PMI)	LEPA	PMI	Spain Continental	85	-80.0%
Manchester (MAN)	EGCC	MAN	United Kingdom	33	-89.5%
London (STN)	EGSS	STN	United Kingdom	60	-79.9%
Helsinki (HEL)	EFHK	HEL	Finland	49	-82.0%
Warsaw (WAW)	EPWA	WAW	Poland	53	-81.1%
Geneva (GVA)	LSGG	GVA	Switzerland	60	-76.3%
Prague (PRG)	LKPR	PRG	Czech Republic	39	-83.3%
Hamburg (HAM)	EDDH	HAM	Germany	49	-77.8%
Nice (NCE)	LFMN	NCE	France	66	-74.0%
London (LTN)	EGGW	LTN	United Kingdom	50	-76.6%
Cologne (CGN)	EDDK	CGN	Germany	82	-61.3%
Malaga (AGP)	LEMG	AGP	Spain Continental	46	-80.3%
Stuttgart (STR)	EDDS	STR	Germany	38	-81.4%
Average (M34)				78	-80.1%

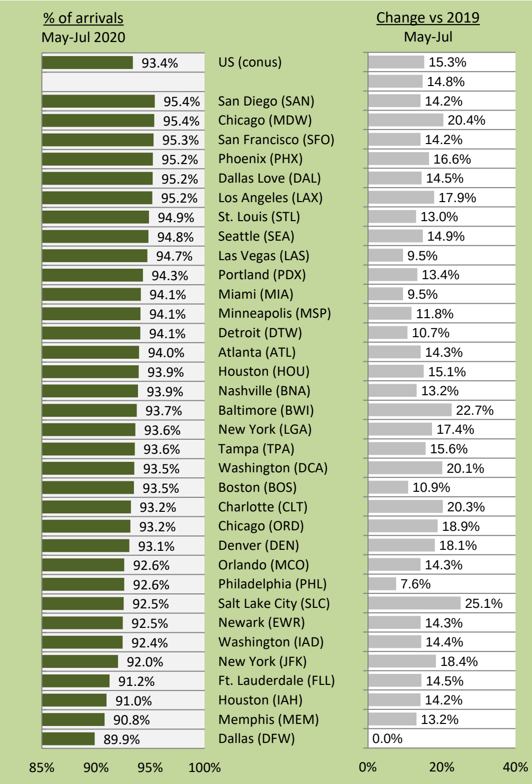
6.2 Annex II – On time performance at the main 34 airports

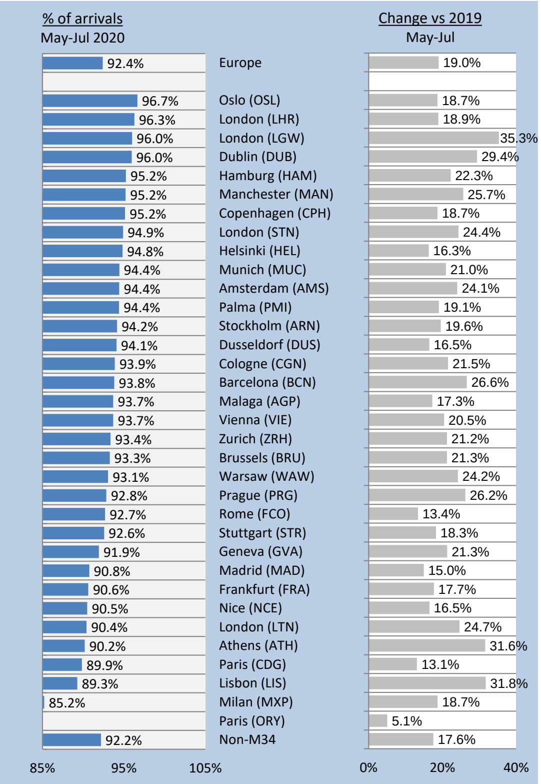
Arrival punctuality

% of arrivals delayed by less than or equal to 15 min vs published schedule









Arrival punctuality at the main 34 airports (2020)

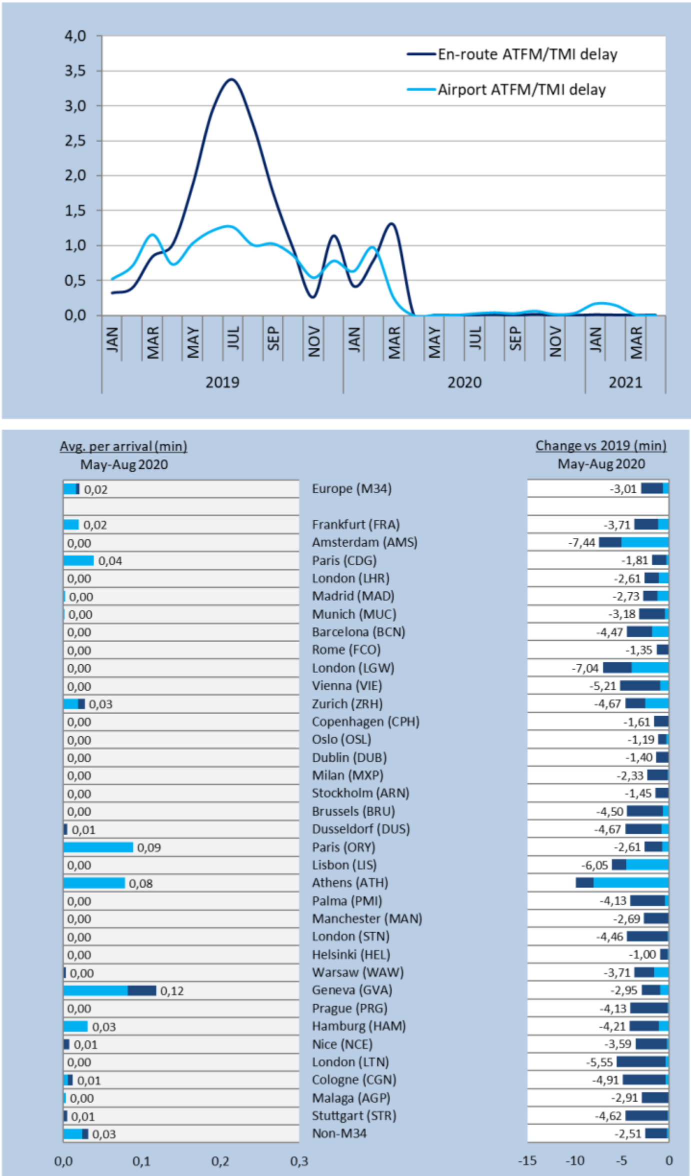
6.3 Annex III – ATFM/TMI delays per flight

This section will be complemented with US data for the update of this special report in 2022.

<u>En-route and airport</u> ATFM/TMI delay (>=15 min) per flight

(flights within the respective region - to or from the main 34 airports)

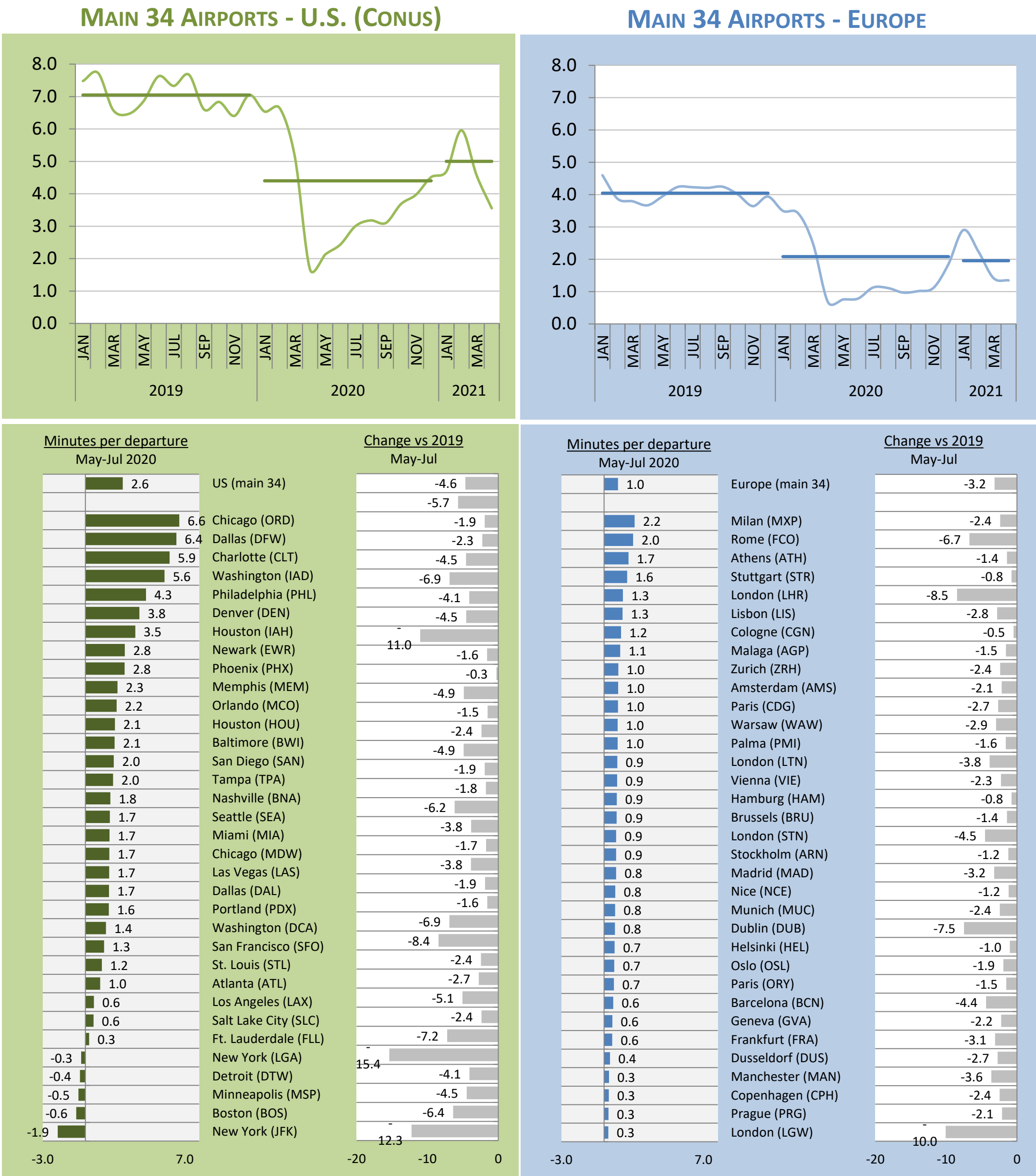
MAIN 34 AIRPORTS - EUROPE



Evolution of total ATFM/TMI delay (Main 34 airports)

6.4 Annex IV – Additional time in the taxi-out phase

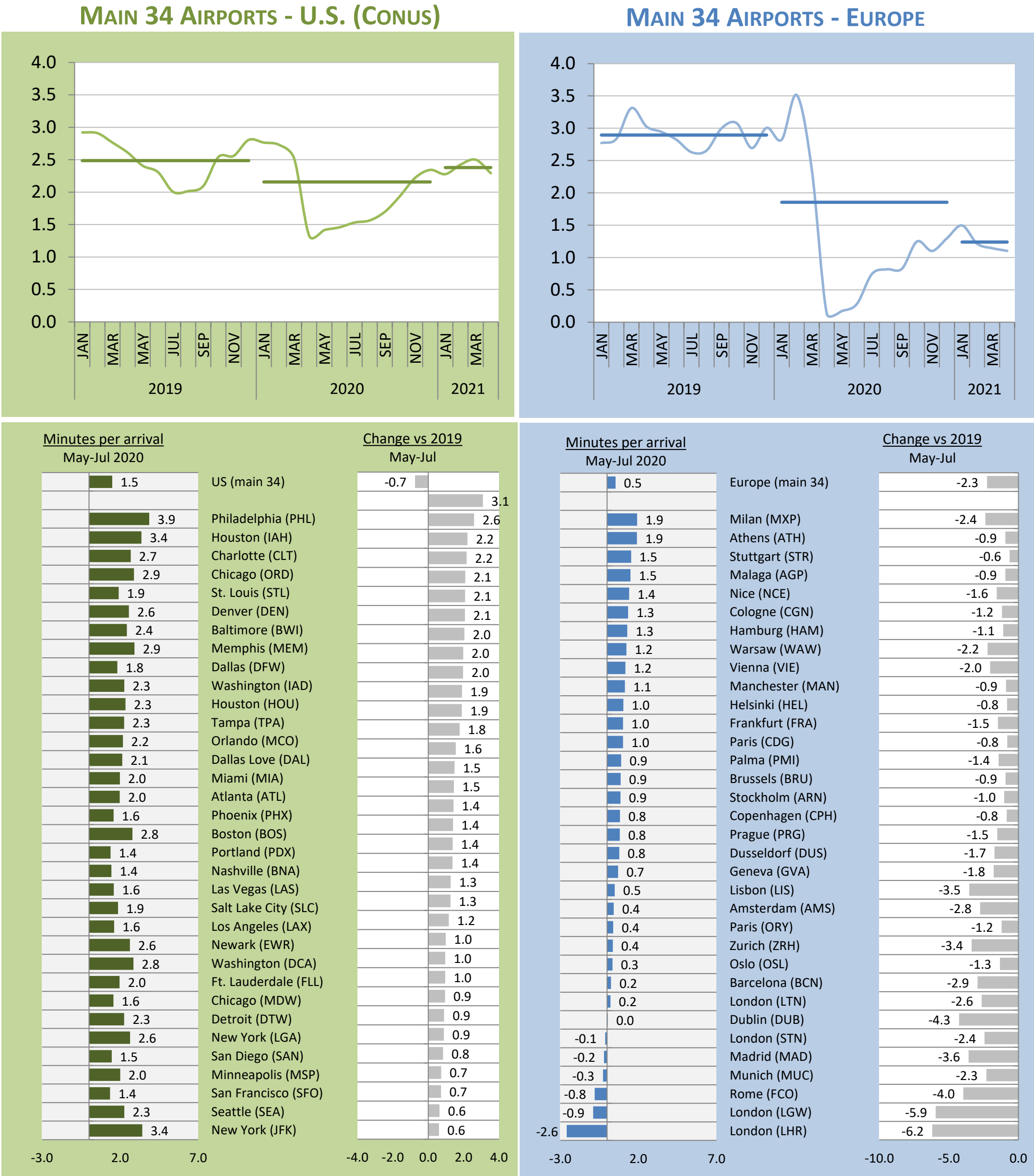
<u>Additional time in the taxi out phase</u>
(minutes per departure)



Additional time in the taxi-out phase by airport

6.5 Annex V – Additional time within the last 100NM

Additional time within the last 100 NM
(minutes per arrival)



Estimated average additional time within the last 100 NM

7 Bibliography

[1] EUROCONTROL Performance Review Unit and FAA-ATO, "U.S./Europe - Comparison of ATM-Related Operational Performance 2017," April 2019.

[2] EUROCONTROL Performance Review Unit, "U.S./Europe comparison of air navigation services (ANS) cost-efficiency trends between 2006-2016," April 2019.

[3] ICAO, "Effects of Novel Coronavirus (COVID-19) on Civil Aviation: Economic Impact Analysis," 24 February 2021. [Online]. Available: https://www.icao.int/sustainability/Documents/COVID-19/ICAO_Coronavirus_Econ_Impact.pdf. [Accessed 02 2021].

[4] 116th U.S. Congress, *Coronavirus Aid, Relief, and Economic Security Act (CARES Act), PUBLIC LAW 116–136,* March 27, 2020, [Online]: Available: https://www.congress.gov/116/plaws/publ136/PLAW-116publ136.pdf.

[5] https://www.npr.org/, "What's Inside The Senate's $2 Trillion Coronavirus Aid Package," 26 March 2020. [Online]. Available: https://www.npr.org/2020/03/26/821457551/whats-inside-the-senate-s-2-trillion-coronavirus-aid-package?.

[6] U.S. Department of Transportation, "U.S. Department of Transportation Issues Final Order on Service Obligations for Air Carriers Receiving Financial Relief Through CARES Act," 07 April 2020. [Online]. Available: https://www.transportation.gov/briefing-room/us-department-transportation-issues-final-order-service-obligations-air-carriers.

[7] https://www.npr.org/, "Thousands Of Airline Workers Facing Unemployment As Aid Package Stalls In Congress," 25 September 2020. [Online]. Available: https://www.npr.org/2020/09/25/916664046/thousands-of-airline-workers-facing-unemployment-as-aid-package-stalls-in-congre.

[8] U.S. Department of Transportation, "CARES Act Air Service Exemptions for Spirit Airlines and JetBlue Airlines," 05 May 2020. [Online]. Available: https://www.transportation.gov/briefing-room/cares-act-air-service-exemptions-spirit-airlines-and-jetblue-airlines.

[9] Airports Council International (ACI), *"The impact of COVID-19 on the airport business and the path to recovery",* March 25, 2021, [Online]. Available: https://aci.aero/news/2021/03/25/the-impact-of-covid-19-on-the-airport-business-and-the-path-to-recovery/.

[10] Federal Aviation Administration (FAA), *Passenger Boarding (Enplanement) and All-Cargo Data for U.S. Airports,* Retrieved in June 2021, [Online]. Available: https://www.faa.gov/airports/planning_capacity/passenger_allcargo_stats/passenger/.

[11] IATA, *"Outlook for the global airline industry",* April 2021, [Online]. Available: https://www.iata.org/en/iata-repository/publications/economic-reports/airline-industry-economic-performance---april-2021---report/.

[12] Airlines for America, *Tracking the Impacts of COVID-19,* 12 April 2021, [Presentation].

[13] Airbus, *Airbus 2020 deliveries demonstrate resilience,* 8 January 2021, [Online]. Available: https://www.airbus.com/newsroom/press-releases/en/2021/01/airbus-2020-deliveries-demonstrate-resilience.html.

[14] Boeing, *Airplane orders and deliveries,* Retrieved in May 2021, [Online]. Available: http://www.boeing.com/commercial/#/orders-deliveries.

[15] EUROCONTROL, "Data Snapshot on the market share of cargo flights," February 2021. [Online]. Available: https://www.eurocontrol.int/publication/eurocontrol-data-snapshot-all-cargo-flights-market-share. [Accessed 2021].

[16] STATFOR, "EUROCONTROL Five-Year Forecast 2020-2024," https://www.eurocontrol.int/publication/eurocontrol-five-year-forecast-2020-2024, May 2021.

[17] U.S. DOT Bureau of Transportation Statistics, "Airline On-Time Performance and Causes of Flight Delays," [Online]. Available: https://www.bts.gov/explore-topics-and-geography/topics/airline-time-performance-and-causes-flight-delays.

[18] EUROCONTROL CODA Publications, "Air transport delay publications," 2017. [Online]. Available: https://www.eurocontrol.int/articles/coda-publications.

[19] ICAO, "GANP Portal - KPI Overview," 2020. [Online]. Available: https://www.icao.int/SAM/Documents/2021-RLA06901-TallerVOLIII-1/KPI%20GANP%206.pdf.

[20] Idris, H., Clarke, J.P., Bhuva, R., and Kang, L. Massachusetts Institute of Technology, "Queuing Model for Taxi-Out Time Estimation," *ATC Quarterly,* 2001.

[21] Federal Aviation Administration (FAA), *Airport and Airway Trust Fund (AATF), Fact Sheet,* April 2020, [Online]. Available: https://www.faa.gov/about/budget/aatf/media/AATF_Fact_Sheet.pdf.

[22] 116th U.S. Congress, *Continuing Appropriations Act, 2021 and Other Extensions Act, PUBLIC LAW 116–159,* October 1, 2020, [Online]: Available: https://www.congress.gov/116/plaws/publ159/PLAW-116publ159.pdf.

[23] EUROCONTROL, Performance Review Unit, "Specification for Economic Information Disclosure, v3.0.".

[24] CANSO, "Global Air Navigation Services Performance Report 2016, 2011 – 2015 ANSP Performance Results," December, 2016.

[25] Y. H. M. &. Z. B. Liu, "Aircraft gauge differences between the US and Europe and their operational implications," *Journal of Air Transport Management, 29, 1-10,* 2013.

[26] Performance Review Commission (PRC), "PRC Performance Insight on the economic impact of COVID-19 on the ANS system," 23 March 2021. [Online]. Available: https://www.eurocontrol.int/publication/new-prc-performance-insight-economic-impact-covid-19-ans-system. [Accessed 2021].

[27] EUROCONTROL Performance Review Unit and FAA-ATO, "U.S./Europe - Comparison of ATM-Related Operational Performance 2008," October 2009.

[28] EUROCONTROL Performance Review Unit and FAA-ATO, "U.S./Europe - Comparison of ATM-Related Operational Performance 2013," June 2014.

[29] EUROCONTROL Performance Review Unit and FAA-ATO, "U.S./Europe - Comparison of ATM-Related Operational Performance 2015," August 2016.

[30] ACI Europe, "Europe’s airport 2020 passenger traffic back to 1995 levels," 12 February 2021. [Online]. Available: https://www.aci-europe.org/media-room/303-europe-s-airport-2020-passenger-traffic-back-to-1995-levels.html. [Accessed 03 2021].

[31] EUROCONTROL Performance Review Commission, "ATM Cost-effectiveness (ACE) 2019 Benchmarking Report. Report commissioned by the Performance Review Commission," May 2021, Available online at http://www.eurocontrol.int/prc/publications.

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