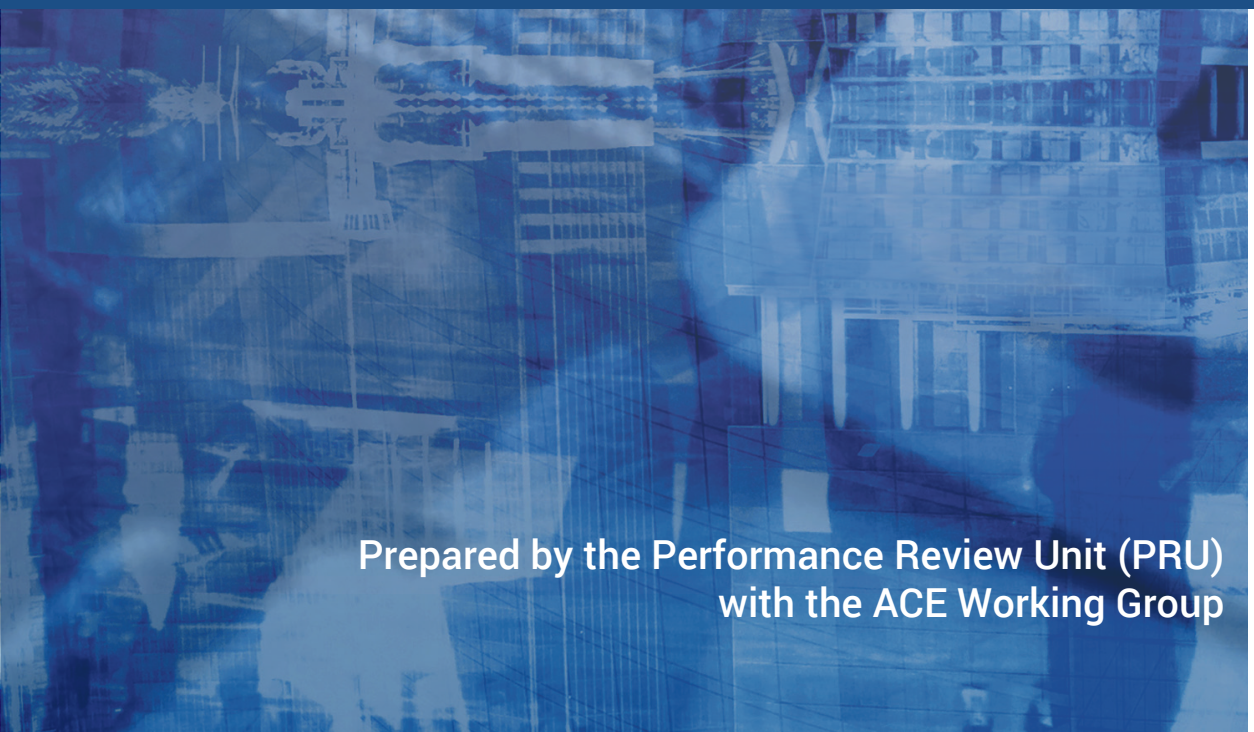
EUROCONTROL

ACE Benchmarking Report 2025 Edition

Report Commissioned by the Performance Review Commission



Prepared by the Performance Review Unit (PRU)
with the ACE Working Group

Background

This report has been commissioned by the Performance Review Commission (PRC).

The PRC was established in 1998 by the Permanent Commission of EUROCONTROL, in accordance with the ECAC Institutional Strategy (1997).

One objective in this Strategy is «*to introduce a strong, transparent and independent performance re-view and target setting system to facilitate more effective management of the European ATM system, encourage mutual accountability for system performance...*»

The PRC's website address is https://www.eurocontrol.int/air-navigation-services-performance-review

Notice

The Performance Review Unit (PRU) has made every effort to ensure that the information and analysis contained in this document are as accurate and complete as possible. Should you find any errors or inconsistencies we would be grateful if you could please bring them to the PRU's attention.

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ATM Cost-Effectiveness (ACE) Benchmarking Report

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Abstract

This report is the 23rd in a series of annual reports based on mandatory information disclosure provided by 38 Air Navigation Services Providers (ANSPs) to the independent Performance Review Commission (PRC). It comprises factual data and analysis on cost-effectiveness and productivity of these 38 ANSPs for the year 2023, including high level trend analysis spanning the years 2018-2023. Additionally, it examines how ANSPs' assets and liabilities evolved during and after the COVID-19 pandemic and provides a detailed analysis of economic cost-effectiveness focusing on ANSPs most contributing to capacity and staffing ATFM delays, looking at trends in traffic, ATCOs in OPS, recruitment of ab-initio trainees and capital expenditures over the 2012-2023 period.

The scope of the report is both en-route and terminal navigation services (i.e. gate-to-gate). The focus is on the ATM/CNS provision costs as these costs are under the direct control and responsibility of the ANSP. Costs borne by airspace users for less-than-optimal quality of service are also considered. The report describes a performance framework for the analysis of cost-effectiveness. The framework highlights three key performance drivers contributing to cost-effectiveness (productivity, employment costs and support costs). The report also analyses forward-looking information for the years 2024 to 2028.

Keywords

Performance Review Commission – Economic information disclosure – Benchmarking – Exogenous factors – ATM/CNS cost-effectiveness comparisons – European Air Navigation Services Providers (ANSPs) – Gate-to-gate – En-route and Terminal ANS – Inputs and outputs metrics – Performance framework – Quality of service – 2023 data – Factual analysis – Historic trend analysis – Costs drivers – Productivity – Employment costs – Support costs – ATCOs in OPS hours on duty – Area Control Centres (ACCs) productivity comparisons – Actual and historic capital expenditures (2018-2023) – Financial indicators.

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The ACE benchmarking report is prepared by the EUROCONTROL Performance Review Unit (PRU) in cooperation with the ACE working group and commissioned by the EUROCONTROL's independent Performance Review Commission (PRC). It presents a review and comparison of ATM cost-effectiveness for 38 Air Navigation Service Providers[1] (ANSPs) in Europe (see Figure 0.1 below) examining both individual ANSPs and the Pan-European ATM/CNS system.

This report analyses ANSPs' performance in a context marked by the traffic recovery following the shock caused by the COVID-19 pandemic. Compared to the previous year's report it provides a more detailed analysis of economic cost-effectiveness, which deteriorated in 2023 for several ANSPs. The ACE work is based on information provided by ANSPs in compliance with Decision No. 88 of the Permanent Commission of EUROCONTROL on economic information disclosure.

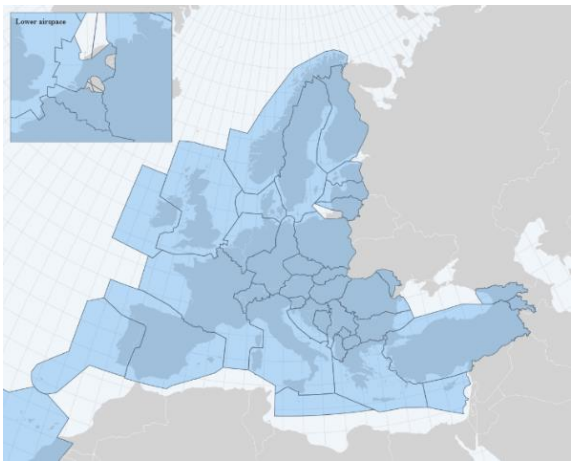

Figure 0.1: Geographic coverage of the ACE benchmarking analysis

The data processing, analysis and reporting were conducted with the assistance of the ACE Working Group, which comprises representatives from participating ANSPs, airspace users, regulatory authorities, and the Performance Review Unit. This enabled participants to share experiences and ensure a common understanding of underlying assumptions and data limitations.

From a methodological point of view, the analysis focusses on gate-to-gate ATM/CNS provision costs and does not address performance relating to oceanic ANS, services provided to military operational air traffic (OAT) or airport (landside) management operations. Similarly, the costs associated with other entities such as National Supervisory Authorities (NSAs), national MET providers and the EUROCONTROL Agency (although mentioned for completeness purposes in the introduction of the report) are not considered in the calculation of the cost-effectiveness indicators.

Table 0.1 presents key data at Pan-European system level in 2023. Changes compared to 2019[2] indicate a certain degree of recovery from the COVID-19 effects.

Composite flight-hours		Gate-to-gate revenues		ATM/CNS provision costs		Number of ATM/CNS staff (FTEs)	
21 M		**€10 790 M**		**€9 696 M**		**52 595**	
+11.1%	*(%) 2022 - 23*	*+12.9%*	*(%) 2022 - 23*	*+2.9%*	*(%) 2022 - 23*	*+1.1%*	*(%) 2022 - 23*
-3.7%	*(%) 2019 - 23*	*-3.7%*	*(%) 2019 - 23*	*-3.6%*	*(%) 2019 - 23*	*-0.8%*	*(%) 2019 - 23*
Number of ATCOs in OPS (FTEs)		Net Book Value (NBV) of gate-to-gate fixed assets		Gate-to-gate capital expenditures		ATFM delays (minutes)	
17 347		**€7 748 M**		**€1 186 M**		**25 M**	
+1.0%	*(%) 2022 - 23*	*-4.4%*	*(%) 2022 - 23*	*-1.6%*	*(%) 2022 - 23*	*+30.1%*	*(%) 2022 - 23*
+0.6%	*(%) 2019 - 23*	*-13.8%*	*(%) 2019 - 23*	*-25.0%*	*(%) 2019 - 23*	*+4.5%*	*(%) 2019 - 23*

Table 0.1: Key data at Pan-European system level, 2023

[1] Due to the ongoing war in Ukraine, UkSATSE has been excluded from the ACE analysis.
[2] Percentage changes vs. 2019 are calculated without BHANSA, which joined the ACE sample in 2020.

Traffic and revenues

Despite a significant increase (+11.1%) in 2023, composite flight-hours remained -3.7% below 2019 levels. At ANSP level, traffic patterns varied widely, with differences compared to 2019 ranging from -43% to +63%.

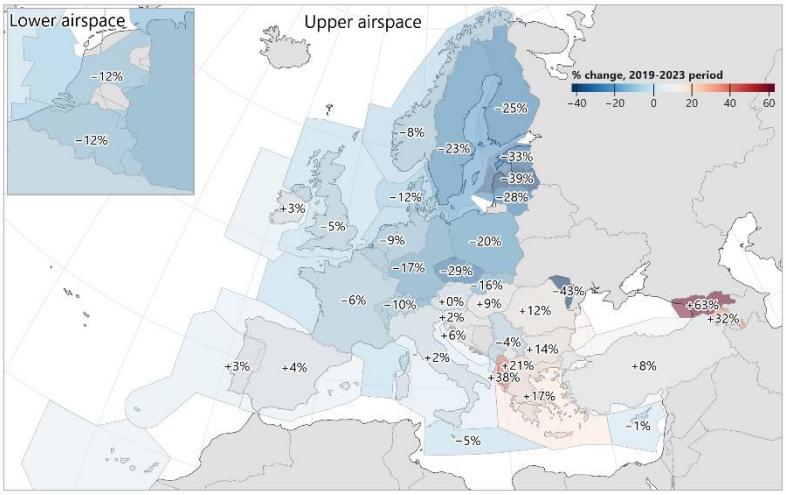

Figure 0.2: Changes in composite flight-hours between 2019 and 2023

The war in Ukraine led to airspace closures and reciprocal sanctions on air carriers which impacted traffic flows in Europe. This inevitably impacts the levels and trends of ACE indicators for the ANSPs being most affected by the changes in traffic patterns.

Gate-to-gate ANS revenues reached €10.8 billion in 2023 (+12.9% compared to 2022). Despite this significant increase, ANSP revenues in 2023 remained below their pre-pandemic levels (- 3.7%, or - 0.4 billion).

Balance sheet structure

There have been significant changes in ANSPs balance sheet structure as the COVID-19 pandemic resulted in an unprecedented drop in revenues. For ANSPs operating under the SES performance and charging schemes, exceptional measures have been adopted, allowing revenue under-recoveries during the pandemic to be spread equally over five-to-seven years, starting in 2023. These measures had a significant impact on long-term financial assets. As a result, their average value in 2023 was more than four times higher than the amounts recorded during the 2012-2019 period.

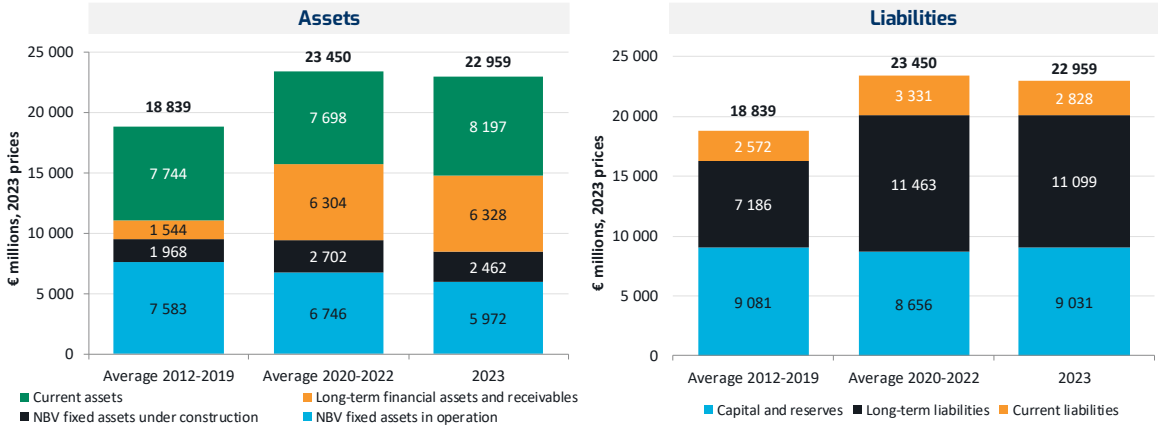

Figure 0.3: Changes in balance sheet by asset and liability type

In 2023, the share of long-term financial assets remained high (28%), while **as a result of large reductions in capital expenditures following the COVID-19 crisis, the proportion of fixed assets in operation (26% in 2023) was significantly lower than during the 2012-2019 period (40%)**.

On the liabilities side, the share of long-term liabilities increased (from 38% over 2012-2019 to 49% over 2020-2022) as ANSPs were facing liquidity issues to cover their operating costs and continued to finance their investments.

Liquidity & cash indicators

Following a positive shift in 2022, which marked the end of three years of continuous decline, **the current ratio measured for the pan-European system continued to improve in 2023**, reaching 3.21, the highest recorded over the 2018-2023 period. **This increase was primarily driven by a +19% rise in current assets** between 2022 and 2023, **largely attributed to components other than cash** (e.g., receivables or other short-term assets).

Following the unprecedented drop in traffic and resulting loss of revenues in 2020, the net cash flow from operating activities turned negative (- €2.4 billion, compared to + €2.4 billion in 2019). Since then, there has been a progressive recovery.

In 2023, the free cash flow from operations reached + €2.5 billion. After accounting for capital expenditures (- €1.2 billion), the resulting free cash flow of + €1.3 billion exceeded the values recorded in 2018 and 2019.

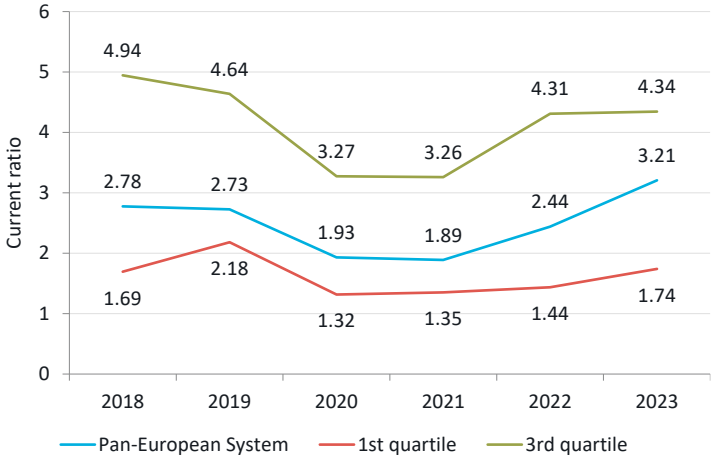

Figure 0.4: Trends in current ratio, 2018-2023

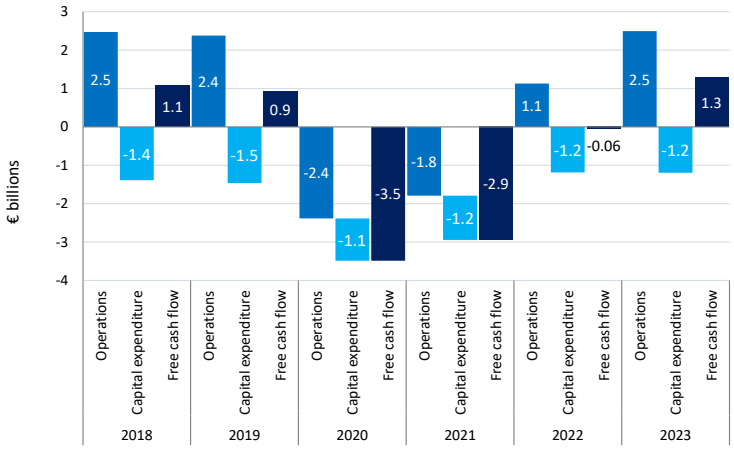

Figure 0.5: Cash flow, 2018-2023 (nominal terms)

Overall, the monitoring of ANSPs financial strength shows a progressive improvement at Pan-European system level, with the average current ratio and free cash flow back to their pre-crisis levels. However, these observations should be nuanced since a) the increase in the current ratio is affected by the large amounts of short-term receivables which are not yet converted into cash; and b) the free cash flow improvement compared to 2019 is partly due to lower capital expenditures. Finally, the analysis of the cash-on-hand days and free cash flow indicators shows that several ANSPs might still need several years to fully recover from the COVID-19 crisis.

Costs

Between 2022 and 2023, total ATM/CNS provision costs rose by + 2.9%. However, when considering the savings achieved in 2020 and 2021, ANSPs cost-bases were - 3.6% (- €361.0M) lower than in 2019.

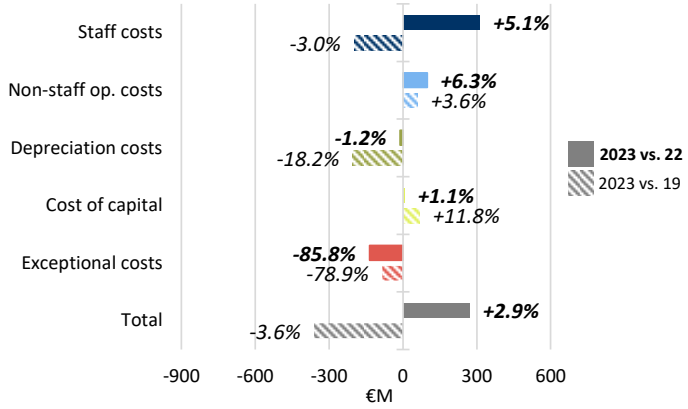

Figure 0.6: Breakdown of changes in ATM/CNS provision costs (real terms)

Figure 0.6 shows that between 2022 and 2023 (plain coloured bars) total ATM/CNS provision costs rose by +2.9%, mainly reflecting increases in staff costs (+5.1% or +€312.1M) and non-staff operating costs (+6.3% or +€98.5M). However, ANSPs cost-bases were still - €361.0M (-3.6%) lower than in 2019 (see striped bars in Figure 0.6) owing to the significant cost-savings achieved by ANSPs at system level in 2020 and 2021. These cost reductions compared to 2019 primarily concerned staff costs and depreciation costs.

Although the changes presented in Figure 0.6 are expressed in real terms, it is important to consider that inflationary pressures continued in 2023. According to EUROSTAT, the inflation rate for the European Union (EU-27) stood at 6.4% in 2023. This remains, after the peak of 9.2% recorded in 2022, significantly higher than in the previous years. This context of high inflation can affect the level of ANSPs costs in different ways since cost categories are not all impacted in the same proportion.

Financial cost-effectiveness

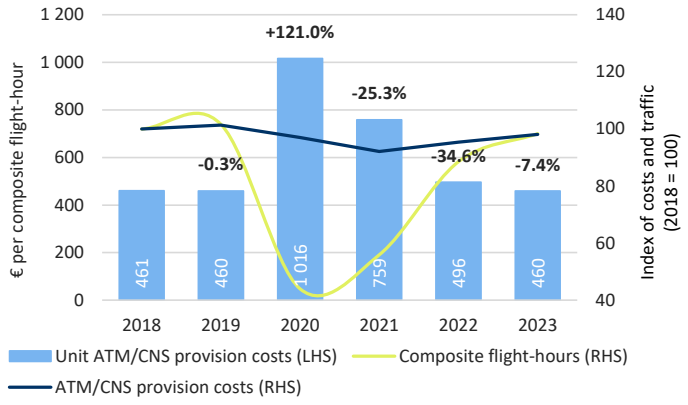

Figure 0.7: Changes in unit ATM/CNS provision costs, 2018-2023 (real terms)

At Pan-European system level, unit ATM/CNS provision costs fell by - 7.4% in 2023, and as a result were back to their 2019 level. This performance improvement reflects the fact that composite flight-hours rose much faster (+11.1%) than ATM/CNS provision costs (+2.9%).

As the values of the 2022 indicators were affected by the persistent consequences of the COVID-19 crisis, the analysis below focuses on the trends of the main components of the financial cost-effectiveness indicator using 2019 as a reference year.

Figure 0.8 shows that in 2023 traffic remained -3.7% below its 2019 level and, total support costs were -4.8% lower. As a result, unit support costs in 2023 were -1.2% lower than in 2019. **Both ATCO employment costs per ATCO-hour and ATCO-hour productivity remained below pre-pandemic levels (-1.6% and - 4.3% respectively).** As a result, unit ATM/CNS provision costs in 2023 were marginally above those recorded in 2019 (+0.1%).

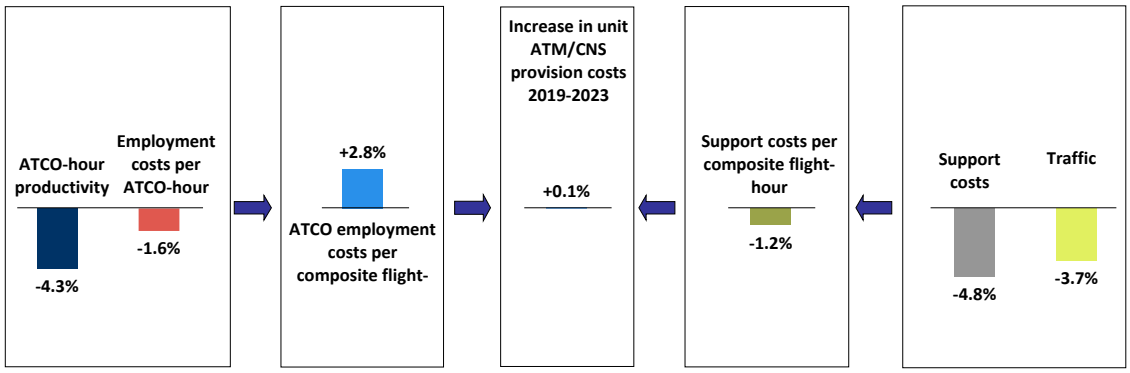

Figure 0.8: Changes in the financial cost-effectiveness indicator, 2019-2023 (real terms)

Number of staff

In 2023, the number of ATM/CNS staff rose by +1.1% (+550 FTEs) compared to 2022. It however remained -0.8% lower than in 2019.

The overall change in staff numbers observed between 2022 and 2023 mainly reflects changes in the following staff categories:

- ATCOs in OPS rose by +168 FTEs (or +1.0%). It is understood that this increase partly reflects a reallocation of staff previously reported as ATCOs on other duties (- 99FTEs, or - 4.1%).
- OPS support (non-ATCOs) (+120 FTEs, or +3.1%).
- Technical support staff for operational maintenance, monitoring and control (+99 FTEs, or +1.2%).

All other staff categories showed an increase in reported staff numbers. The highest proportional increase (+ 7.0% or + 59 FTEs) was in ab-initio trainees, suggesting that some ANSPs increased recruitment of trainees for ATCO positions in 2023.

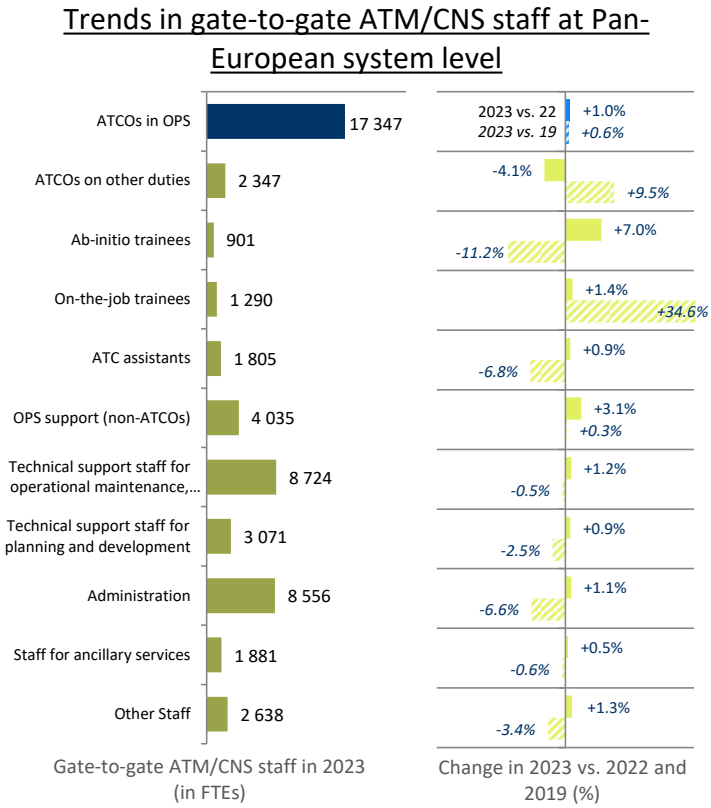

Figure 0.9: Total gate-to-gate ATM/CNS staff per staff category

Compared to 2019, the number of ATCOs in OPS was +0.6% higher in 2023, while the number of support staff was -1.5% lower. The overall reduction in support staff was mainly driven by a -6.6% decrease in administrative staff (-598 FTEs), partly compensated by an +34.6% increase in the number of on-the-job trainees (+331 FTEs).

Economic cost-effectiveness

In 2023, despite composite flight-hours being -3.7% lower than in 2019, ATFM delays reached 24.5M minutes, equivalent to levels observed in 2018 and 2019 when several ANSPs experienced significant capacity issues. As such the share of ATFM delays in the unit economic costs amounted to 24%.

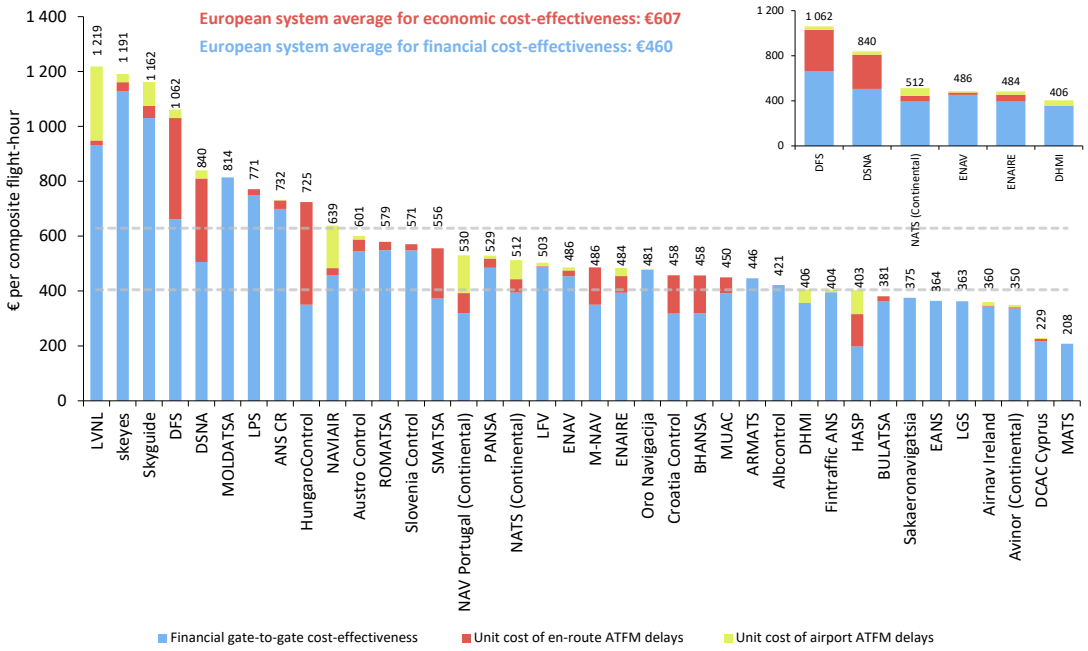

Figure 0.10: Economic gate-to-gate cost-effectiveness, 2023

While benchmarking cost-effectiveness is key, looking exclusively at costs without considering the quality of the service would present limitations. Thus, the PRC introduced in its ACE benchmarking reports the concept of economic cost-effectiveness to better capture the trade-offs between ATC capacity and costs. This indicator is defined as gate-to-gate ATM/CNS provision costs plus the costs of ATFM delays for both en-route and terminal ANS, all expressed per composite flight-hour.

In 2023, unit economic costs ranged from €1 219 for LVNL to €208 for MATS; a factor of almost six. The difference between the highest and lowest is quite striking but is driven by a large range of factors not all in the ANSPs control. Some of these factors include: a) substantial amounts of ATFM delays generated by some ANSPs; b) differences in ATCO-hour productivity, unit employment costs and unit support costs which could, all else equal, contribute to large differences in unit ATM/CNS provision costs; and, c) various factors, sometimes beyond the direct control of the ANSPs, such as the cost of living. The PRC is planning to undertake further analysis based on the ACE analytical framework in order to better understand the differences observed in terms of unit costs across ANSPs, and identify potential areas for improvement.

Compared to 2022, the pan-European system experienced a slight decline (-2.4%) in **unit economic costs**, which **amounted to €607**. **This is similar to the value recorded in 2018, a year marked by substantial capacity issues** for several ANSPs. **The reduction observed in 2023 is primarily due to a -7.4% decrease in unit ATM/CNS provision costs, which was almost entirely offset by a significant increase (+17.1%) in the unit costs of ATFM delays.**

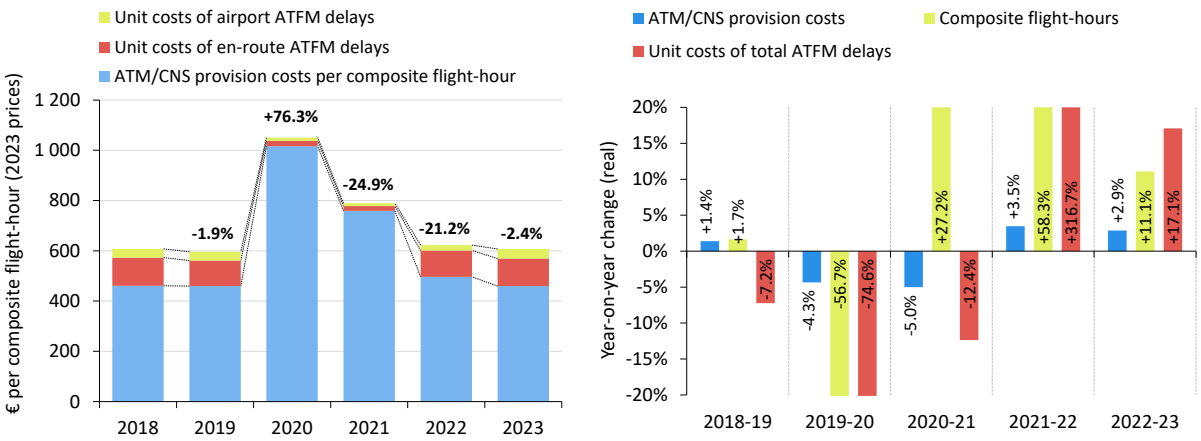

Figure 0.11: Changes in unit economic costs, 2018-2023 (real terms)

For this report, additional analysis was performed on a subset of nine ANSPs which experienced high levels of capacity and staffing delays in 2023. These ANSPs were: **Croatia Control, DFS, DSNA, ENAIRE, HASP, HungaroControl, NATS, NAV Portugal and NAVIAIR**.

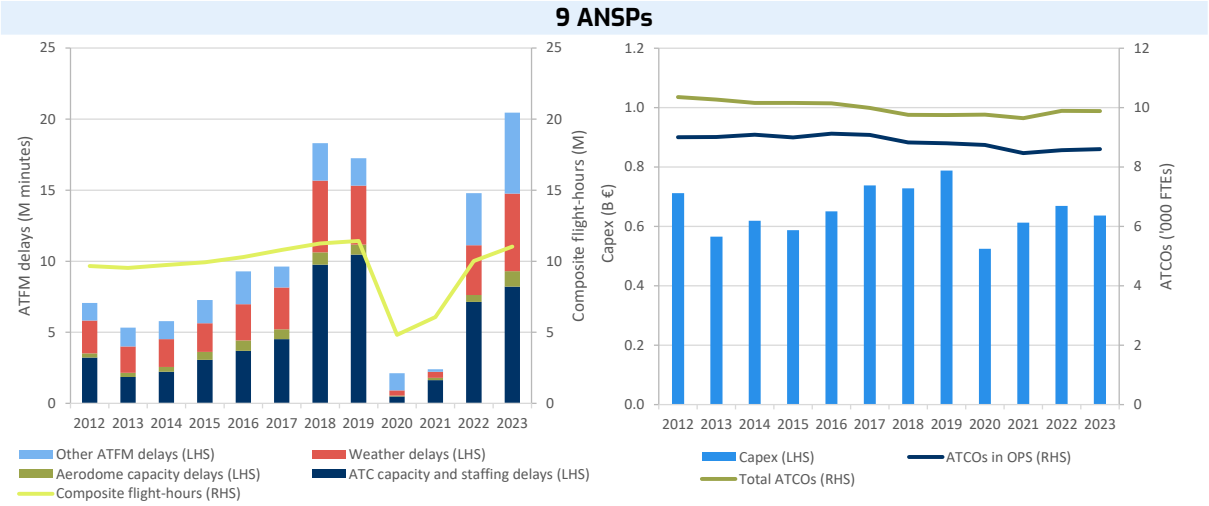

Figure 0.12: Trends in ATFM delays (capacity and staffing reasons), traffic and ATCOs for the sample of nine ANSPs, 2012-2023

The ATFM delays generated by these nine ANSPs significantly increased between 2012 and 2019, primarily due to ATC staffing and capacity issues. Following a period of very low delays during the pandemic, ATC capacity and staffing delays rose again in 2022 and 2023. Notably, the higher delays observed in 2018, 2019, 2022, and 2023 coincided with robust traffic increases.

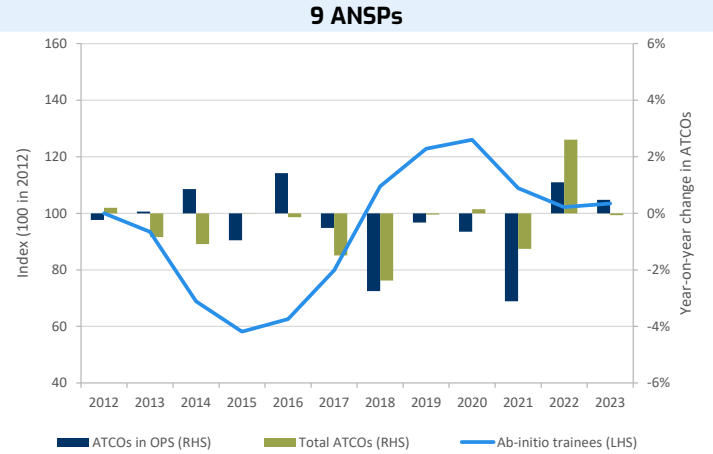

Figure 0.13: Ab-initio trainees and changes in ATCOs for the sample of nine ANSPs, 2012-2023

Based on the data recorded by these nine ANSPs, overall, ATCOs in OPS numbers decreased between 2012 and 2021 (-5.9%). For these ANSPs, the reduction in ab-initio trainees between 2012 and 2015 was followed by decreases in ATCOs in OPS, especially in 2017 and 2018. **These trends might illustrate the fact that the ATCOs outtake (e.g. departure in retirement) was consistently higher than the intake over this period**. The number of trainees rose between 2015 and 2020 but reduced again in 2021 and 2022 potentially reflecting challenges created by social distancing requirements, limited ATCO college capacity, and cost-containment measures implemented during the COVID-19 crisis.

Several external factors, such as the ongoing and uneven recovery in traffic from the COVID-19 pandemic and uncertainties related to the ongoing war in Ukraine, may have impacted the planning and deployment of ATC capacity for some ANSPs. However, the decrease in ATCOs in OPS observed during the last decade has undoubtedly constrained the flexibility of ANSPs to adequately adapt to sharp fluctuations in traffic demand, therefore increasing the likelihood of ATC capacity and staffing delays.

Summary

In 2023, despite composite flight-hours being -3.7% lower than in 2019, ATFM delays reached historical high levels, equivalent to those observed in 2018 and 2019 when several ANSPs experienced significant capacity issues. As a result, excluding the years affected by the COVID crisis, unit economic costs in 2023 (607€ per composite flight-hour) were the highest recorded in the last decade.

As indicated in the PRC's latest Performance Review Report (PRR), **there appears to be a shortfall in ATCO numbers for some ANSPs and there is an urgent need to recruit more and/or make sure that they are adequately and flexibly deployed in order to meet future traffic demand. Clearly, insufficient capacity levels lead to disproportionately higher costs for airspace users and passengers, which may far exceed the costs associated with deploying additional ATCOs.** In addition, considering the lead time necessary to recruit and train ATCOs, **even if remedial actions are taken now, high levels of ATC capacity and staffing delays may remain a feature of the network for some years to come.**

1. INTRODUCTION

1.1 About this report

The Air Traffic Management Cost-Effectiveness (ACE) benchmarking report prepared by the EUROCONTROL Performance Review Unit (PRU) in cooperation with the ACE working group and commissioned by the EUROCONTROL's independent Performance Review Commission (PRC) is the 23rd in a series of reports comparing the ATM cost-effectiveness of EUROCONTROL Member States' Air Navigation Service Providers (ANSPs)[3].

The report is based on information provided by ANSPs in compliance with Decision No. 88 of the Permanent Commission of EUROCONTROL, which makes annual disclosure of ANS information mandatory in all EUROCONTROL Member States, according to the Specification for Economic Information Disclosure (SEID).

The analysis developed in the ACE reports is particularly relevant to identify best practices and areas for improvement. It is also useful to understand how cost-effectiveness performance has evolved over time, both for the Pan-European system as a whole and for individual ANSPs. The factual analysis provided in the ACE reports could be used by the Performance Review Commission, together with other information, to support recommendations published in the Performance Review Reports regarding cost-efficiency.

The ACE benchmarking report provides an independent analysis of ANSPs cost-effectiveness performance. The preparation of this report has been supported by the ACE Working Group, which comprises ANSPs experts, airspace users, and regulatory authorities.

1.2 Scope of the analysis

In total, 38 ANSPs provided 2023 data in the SEID and are therefore included in the ACE analysis. The range of services provided differs across ANSPs, as do their organisational and corporate arrangements. A majority of the participating ANSPs (29 out of 38) are bound by the Single European Sky (SES) regulations. To enhance the cost-effectiveness comparison across ANSPs, costs relating to oceanic ANS, military operational air traffic (OAT), airport management operations and payment for delegation of ATM services were excluded to the maximum extent possible from the analysis.

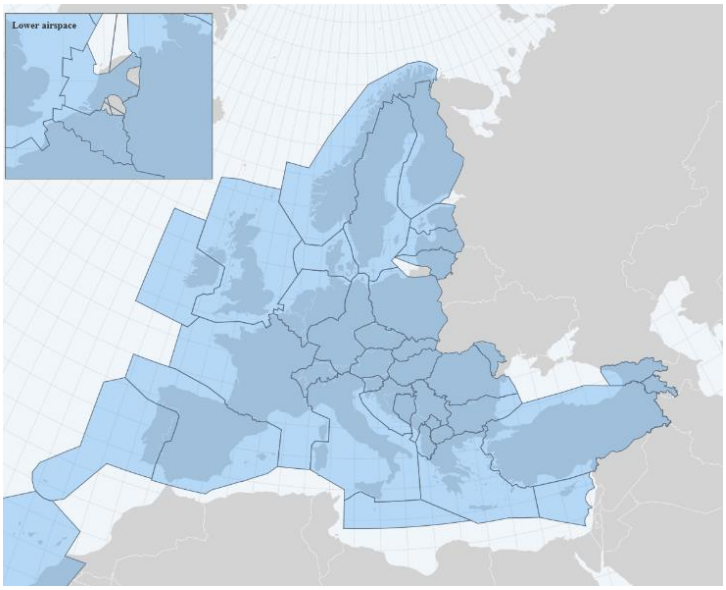

Figure 1.1: Geographic coverage of the ACE benchmarking analysis

Table 1.1 describes the States and ANSPs participating in the ACE 2023 data analysis. More detailed information on those aspects is provided in the ACE handbook[4]. Due to the ongoing war in Ukraine, UkSATSE is excluded from the analysis.

[3] Previous reports can be found at https://ansperformance.eu/publications/prc/ace/
[4] The ACE handbook is available at https://ansperformance.eu/economics/ace/ace-handbook/

	ANSP	Code	Country	Organisational & Corporate Arrangements	OAT Services	Oceanic	MUAC	Delegated ATM	Internal MET	Ownership and management of airports
1	AirNav Ireland	IE	Ireland	Joint-stock company (State-owned)		x				
2	Albcontrol	AL	Albania	Joint-stock company (State-owned)	x				x	
3	ANS CR	CZ	Czech Republic	State-owned enterprise						
4	ARMATS	AM	Armenia	Joint-stock company (State-owned)						
5	Austro Control	AT	Austria	Limited liability company (State-owned)					x	
6	Avinor	NO	Norway	Joint-stock company (State-owned)	x	x				
7	BHANSA	BA	Bosnia and Herzegovina	State-owned enterprise	x			x	x	
8	BULATSA	BG	Bulgaria	State-owned enterprise					x	
9	Croatia Control	HR	Croatia	Limited liability company (State-owned)	X			x	x	
10	DCAC Cyprus	CY	Cyprus	State body						
11	DFS	DE	Germany	Limited liability company (State-owned)	x		x			
12	DHMİ	TR	Türkiye	Autonomous State enterprise						x
13	DSNA	FR	France	State body (autonomous budget)				x		
14	EANS	EE	Estonia	Joint-stock company (State-owned)						
15	ENAIRE	ES	Spain	State-owned enterprise						
16	ENAV	IT	Italy	Listed company, Italian state is the majority shareholder					x	
17	Fintraffic ANS	FI	Finland	State-owned enterprise	x			x	x	
18	HASP	GR	Greece	State body						
19	HungaroControl	HU	Hungary	State-owned enterprise						
20	LFV	SE	Sweden	State-owned enterprise	x			x	x	
21	LGS	LV	Latvia	Joint-stock company (State-owned)				x	x	
22	LPS	SK	Slovak Republic	State-owned enterprise						
23	LVNL	NL	Netherlands	Independent administrative body			x			
24	MATS	MT	Malta	Joint-stock company (State-owned)						
25	M-NAV	MK	North Macedonia	Joint-stock company (State-owned)	x				x	
26	MOLDATSA	MD	Moldova	State-owned enterprise					x	
27	MUAC			International organisation	x					
28	NATS	UK	United Kingdom	Joint-stock company (part-private)		x		x		
29	NAV Portugal	PT	Portugal	State-owned enterprise		x				
30	NAVIAIR	DK	Denmark	State-owned enterprise	x					
31	Oro Navigacija	LT	Lithuania	Limited liability company (State-owned)				x		
32	PANSA	PL	Poland	State body (acting as a legal entity with an autonomous budget)						
33	ROMATSA	RO	Romania	State-owned enterprise					x	
34	Sakaeronavigatsia	GE	Georgia	Limited liability company (State-owned)					x	
35	skeyes	BE	Belgium	Autonomous State enterprise			x		x	
36	Skyguide	CH	Switzerland	Joint-stock company (part-private)	x			x		
37	Slovenia Control	SI	Slovenia	State-owned enterprise	x					
38	SMATSA	RS	Serbia	Limited liability company	x			x	x	
		ME	Montenegro							

States covered by the SES Regulations
States part of the ECAA
States that signed a CAA agreement with the EU
States not covered by the SES Regulations

Table 1.1: States and ANSPs participating in the ACE 2023 data analysis

1.3 Data collection, analysis and processing

The SEID requires participating ANSPs to submit their information to the PRC/PRU by 1st July in the year following the year to which it relates. The submission of this information is significantly constrained by the publication of ANSPs' Annual Reports and Financial Statements, which can be a lengthy process. Indeed, after the finalisation of their financial accounts, ANSPs have to follow official procedures which include, inter alia, the preparation of an independent audit report and the formal approval for publication which is granted by the relevant authorities (sometimes at Ministry level). Typically, ANSPs' Annual Reports for year N are published in the second quarter of year N+1.

For this ACE report, 29 ANSPs out of 38 provided data within a month after the deadline. Conversely, nine ANSPs (ARMATS, Avinor, BULATSA, DCAC Cyprus, DSNA, HASP, MATS, Oro Navigacija, and ROMATSA) sent their ACE data submissions more than one month after the deadline.

Robust ACE benchmarking analysis should be made available in a timely manner since stakeholders, notably ANSPs' management, regulatory authorities (e.g. NSAs) and airspace users, have a keen interest in receiving the information in the ACE reports as early as possible. Delays in data submission inevitably result in delays in producing the ACE benchmarking report.

The process leading to the production of the ACE report, which comprises data analysis and consultation, as well as a description of validation issues, status of Annual Reports and methodological comparison between ACE and the Single European Sky Monitoring indicators are presented in the ACE handbook.

1.4 Communication of ACE benchmarking results

The ACE benchmarking results are communicated through several channels:

1. **The ACE benchmarking report** provides an analysis of the economic and financial cost-effectiveness performance in a given year at Pan-European system and ANSP levels. It also analyses changes in ATM/CNS cost-effectiveness over the past five years and presents forward-looking information for the next 5 years. A particular focus is put on the three main economic drivers of cost-effectiveness (productivity, employment costs and support costs).
2. **The ACE handbook** provides general information on the scope of the analysis, outlines the processes involved in the production of the report, and includes explanations on the factors affecting performance and the indicators used in the ACE benchmarking analysis.
3. **ANSP factsheets and individual summary reports** are published on the ACE website.
4. **The ACE Dashboard** provides interactive functionalities that allow users to design and customise original analyses and presentations based on ACE data (starting with 2002 data and updated annually).

Digital versions of all the documents listed above as well as the ACE dashboard are available at the following link:

https://ansperformance.eu/economics/ace-overview/

1.5 Organisation of the ACE report

The present report consists of six chapters:

- Chapter 1 introduces the report.
- Chapter 2 provides an overview of key ANS data at Pan-European system level and introduces the main factors affecting performance.
- Chapter 3 provides an analysis of financial cost-effectiveness performance in 2023 at both Pan-European system and ANSP level. It also analyses changes in ATM/CNS cost-effectiveness performance between 2018 and 2023, paying particular attention to the three main economic drivers of cost-effectiveness (productivity, employment costs and support costs).
- Chapter 4 provides an analysis of economic cost-effectiveness at Pan-European and ANSP level, with a special focus on ANSPs most contributing to capacity and staffing ATFM delays, and looking at trends in traffic, ATCOs in OPS, ab-initio trainees and capital expenditures.
- Chapter 5 presents a forward-looking analysis of cost-effectiveness performance covering the period 2024 to 2028.
- Chapter 6 provides complementary information to the ACE indicators, focusing on monitoring ANSPs' liquidity situation. It presents a set of financial indicators calculated from ANSPs' Financial Statements. More detailed information at ANSP level is available on the ANSPs Financial Dashboard.

Finally, tables comprising key data used in the ACE analysis are available in the Annex to this report.

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2. OVERVIEW OF THE PAN-EUROPEAN ANS SYSTEM

In 2023, composite flight-hours rose by +11.1% at Pan-European system level but remained -3.7% lower than in 2019 (ranging from -43% to +63% at ANSP level). The war in Ukraine resulted in airspace closures and reciprocal bans on air carriers which impacted traffic flows in Europe. This inevitably affects the levels and trends of ACE indicators for the ANSPs most impacted by the changes in traffic patterns.

2.1 Key information at Pan-European ANS system level

The Pan-European ANS system analysed in this report comprises 38 ANSPs, excluding where relevant the services provided to military operational air traffic (OAT), oceanic ANS, and landside airport management operations. Twenty-nine of these ANSPs are bound by SES rules (see Table 1.1). The Pan-European ANS system also includes National Supervisory Authorities (NSAs) and other regulatory and governmental authorities, national MET providers, and EUROCONTROL.

In 2023, traffic (measured in composite flight-hours) was +11.1% higher than in 2022 but remained -3.7% lower than in 2019. In the meantime, total gate-to-gate revenues increased slightly more than traffic (+12.9%, or +€1 236M) and remained -3.7% lower than in 2019.

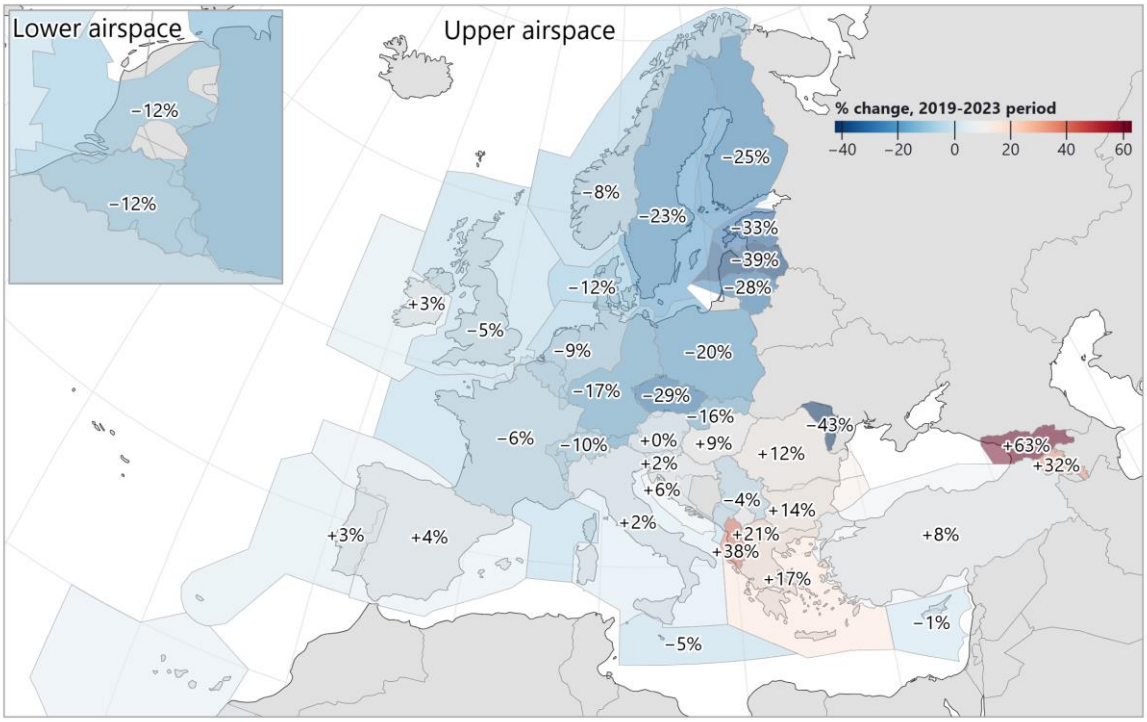

Figure 2.1: Changes in composite flight-hours between 2019 and 2023

At ANSP level, traffic in 2023 recovered to varying degrees from the crisis caused by the COVID-19 pandemic (see Figure 2.1). At the higher end, composite flight-hours were +63% and +38% above 2019 levels for Sakaeronavigatsia and Albcontrol respectively. While at the lower end, traffic remained -43% and -39% below 2019 levels for MOLDATSA and LGS respectively. The war in Ukraine continued to cause airspace closures and reciprocal sanctions on air carriers, which impacted traffic flows in Europe. This inevitably impacted the levels and trends of ACE indicators for the most affected ANSPs.

Looking forward, the recent EUROCONTROL Seven-Year Forecast shows that traffic may remain below pre-pandemic levels until at least 2025.

Table 2.1 below presents key data at Pan-European system level for 2022 and 2023. Gate-to-gate ANS revenues reached €10.8 billion in 2023, marking a significant increase compared to 2022 (+12.9%).

	2022	2023	23/22
Gate-to-gate ANS revenues (not adjusted by over/under recoveries) (in € M):	**9 554**	**10 790**	**12.9%**
En-route ANS revenues	7 658	8 616	12.5%
Terminal ANS revenues	1 896	2 174	14.6%
Gate-to-gate ATM/CNS provision costs (in € M):	**9 426**	**9 696**	**2.9%**
En-route ATM/CNS costs	7 371	7 592	3.0%
Terminal ATM/CNS costs	2 055	2 104	2.4%
Institutional costs (in € M):	**1 226**	**1 252**	**2.1%**
MET costs (including internal MET costs)	454	456	0.5%
EUROCONTROL Agency costs	507	518	2.1%
Payment to national authorities and irrecoverable VAT	265	278	4.7%
Gate-to-gate ANS costs (in € M)	**10 652**	**10 948**	**2.8%**
Gate-to-gate ATM/CNS staff:	**52 045**	**52 595**	**1.1%**
ATCOs in OPS	17 179	17 347	1.0%
ACC ATCOs	9 374	9 561	2.0%
APPs + TWRs ATCOs	7 805	7 786	-0.2%
NBV of gate-to-gate fixed assets (in € M)	**8 106**	**7 748**	**-4.4%**
Gate-to-gate capex (in € M)	**1 205**	**1 186**	**-1.6%**
Outputs (in M)			
Distance controlled (km)	10 997	12 300	11.8%
Total IFR flight-hours controlled	15.2	16.9	11.1%
ACC flight-hours controlled	13.6	15.1	11.6%
IFR airport movements controlled	13.7	15.2	11.1%
IFR flights controlled	9.1	9.9	9.7%
Gate-to-gate ATFM delays ('000 min.)	**18 874**	**24 548**	**30.1%**

Table 2.1: Key ANS data for 2022 and 2023 (real terms)

The costs associated to aeronautical MET services, EUROCONTROL Agency costs, and other costs related to regulatory and governmental authorities fall outside the control of individual ANSPs. Therefore, the ACE benchmarking analysis focuses specifically on the costs linked to providing gate-to-gate ATM/CNS services, totalling €9 696M in 2023. This represents a +2.9% increase compared to the amount recorded in 2022. Both en-route and terminal ATM/CNS costs rose in 2023 (+3.0% and +2.4%, respectively).

In 2023, the Pan-European ANSPs employed a total of 53 435 staff (comprising 52 595 staff providing ATM/CNS services and 840 internal MET staff). Some 17 347 staff (33%) were ATCOs working on operational duties, split between ACCs (55%) and APP/TWR facilities (45%). On average, 2.0 support staff are required for every ATCO in OPS in Europe.

ACE also analyses indicators derived from ANSP balance-sheets and capital expenditures. The total Net Book Value (NBV) of fixed assets employed by the Pan-European ANSPs to provide ATM/CNS services is valued at some €7 748M. Fixed assets mainly relate to ATM/CNS systems and equipment in operation or under construction. In 2023, the gate-to-gate ANSP capex at Pan-European system level amounted to some €1 186M (-1.6% less than in 2022).

Additionally, Figure 2.2 shows that gate-to-gate ATM/CNS provision costs can be split into en-route (78.3%) and terminal (21.7%) costs. Despite the existence of common general principles, there are some differences in cost-allocation between en-route and terminal ANS across European ANSPs. This heterogeneous situation might distort comparisons carried out separately for en-route and terminal services provision.

Hence, this report puts the focus on overall gate-to-gate cost-effectiveness. For the sake of completeness, Annex 2 of this report provides the breakdown of the gate-to-gate cost-effectiveness indicator into en-route and terminal.

Staff costs amounted to €6.5 billion in 2023 and remain the largest cost category (66.7% of the total). These are followed by non-staff operating costs (17.5%, including exceptional costs), depreciation costs (9.4%) and the cost of capital (6.4%).

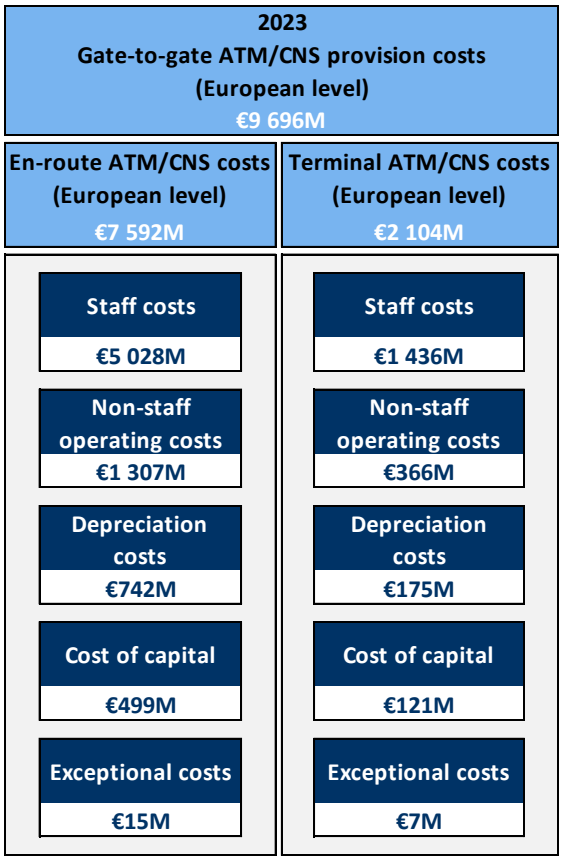

Figure 2.2: Breakdown of ATM/CNS provision costs, 2023

ANSPs' ATM/CNS provision costs are then divided by an output metric to obtain a measure of performance – the **financial cost-effectiveness indicator**. The output metric is the composite flight-hours, a "gate-to-gate" measure which combines both en-route flight-hours controlled and IFR airport movements controlled. The ACE handbook provides more information on the calculation of this output metric.

2.2 Factors affecting performance

Many factors contribute to observed differences in ANSPs' performance. Over the years, the Performance Review Unit has developed a framework showing which exogenous factors (i.e. those outside the control of an ANSP) and endogenous factors (those entirely under the ANSP's control) can influence ANSPs' cost-effectiveness performance. A comprehensive description of this framework can also be found in the ACE handbook.

Employment costs constitute a major portion of ANS provision costs. Staff members are typically recruited from local labour markets, where prevailing wage rates are often applied. The different grades and types of staff hired can significantly impact overall employment costs.

There are various ways of measuring differences in prevailing wage levels across countries. In the ACE benchmarking reports, unit employment costs are also compared when adjusted for Purchasing Power Parities (PPPs). To demonstrate the differences of PPP across the 38 ANSPs participating in

the ACE benchmarking analysis, an index has been calculated by comparing GDP adjusted at current prices with GDP adjusted for PPPs.[5,6]

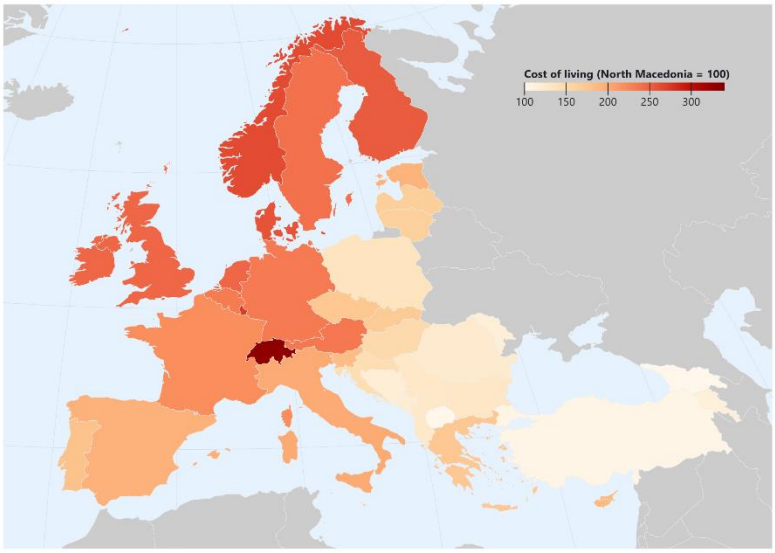

Figure 2.3: Cost of living indexes based on PPPs, 2023

The interpretation of this index suggests that to achieve an equivalent standard of living, earnings in, for instance, Switzerland (using market exchange rates) would need to be approximately four times higher than those in Türkiye (see Figure 2.3).

The impact of size on ANSPs' performance is an important policy element due to the infrastructure characteristics of the ANS sector and the expectation that fixed costs can be more efficiently exploited with higher traffic volumes.

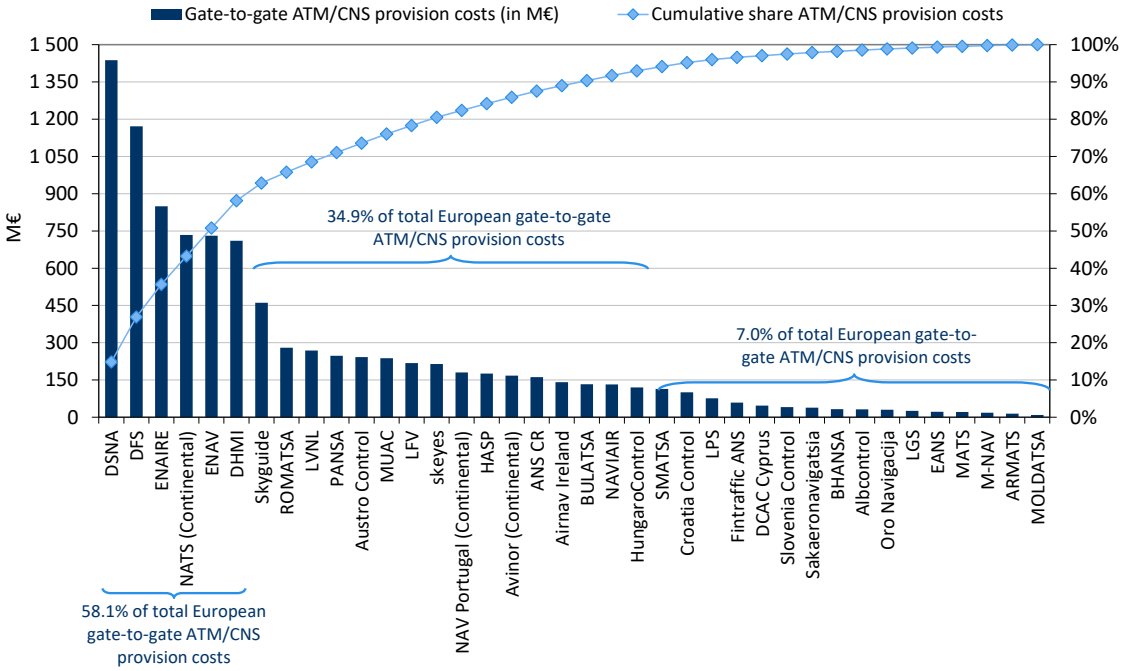

Figure 2.4: Distribution of ATM/CNS provision costs in 2023

Figure 2.4 shows that, in 2023, the six largest ANSPs (DSNA, DFS, ENAIRE, NATS, ENAV and DHMI) bore 58.1% of the total Pan-European gate-to-gate ATM/CNS provision costs and controlled 58.0% of the total composite flight-hours. Compared to previous years' report, DHMI is now part of this

[5] The cost of living indexes are based on the data published by the IMF in the World Economic Outlook database in April 2025, see Annex 4 for more details.

[6] The designations employed do not imply the expression of any opinion whatsoever on the part of EUROCONTROL concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

group since its share in the total Pan-European system costs is reaching 7%, which is close to ENAV and NATS shares.

Ideally, since the 38 ANSPs operate in very diverse environments across Europe, all the factors affecting performance should be considered to make fair performance comparisons, especially since many of these factors are outside the direct control of an ANSP. However, many of the factors affecting ANSPs performance are not quantifiable or measurable. For this reason, the analysis undertaken in ACE reports is purely factual (measuring what the indicators are) and not normative (inferring what the indicator should be).

2.3 Developments in ANSPs' balance sheet structure at Pan-European system level

2.3.1 Introduction

At the Pan-European system level, outturn performance in terms of unit ATM/CNS provision costs and level of ATFM delay in 2023 seems very similar to 2018. However, several key developments since 2019 mean that the ANS industry has not simply returned to the same position, notably:

- The **COVID-19 pandemic** led to significant reductions in air traffic and corresponding revenues, particularly in 2020 and 2021, with a gradual recovery to pre-pandemic levels still ongoing in 2023. During this period of high uncertainty that made planning for the short- and medium-term difficult, ANSPs took a range of actions, including exceptional measures to reduce costs; postponement/cancellation of some investments; and increased borrowing to mitigate the reduction in revenues which could not be offset by cost savings.
- **Russia's war of aggression against Ukraine**, and the ensuing airspace restrictions for European and Russian airlines respectively, caused changes in traffic flows within European airspace. Flights towards Asia are now more commonly flying to the south of Russia and avoiding Ukrainian airspace, with countries in Southeastern Europe experiencing significantly higher traffic in 2023 compared to 2019 (see Figure 2.1).
- **High inflation** in 2022 (9.2%) and 2023 (6.4%) also reflects changes in the overall economic environment compared to the low inflationary period between 2018-2021 (less than 2% per annum).

As a result of these developments, compared to 2018 the ANS industry in 2023 is characterised by:

- **Higher levels of debt**, due to significant increases in borrowing in response to the reduction in traffic (and hence revenues) during the pandemic;
- **Lower levels of capital expenditure**, due to cost reductions, postponements, and cancellations of some investments made during the pandemic; and
- **Larger variations in financial cost-effectiveness across ANSPs**, due to the changed balance of traffic across the network.

The remainder of this section reviews the capital structure of ANSPs and their level of capital expenditure. Key differences are highlighted which demonstrate how the ANS industry has changed between 2018 and 2023, despite the high-level similarities in outturn performance between the two years. The analysis considers the pre-pandemic period (2012-2019), the pandemic period and early recovery (2020-2022), and 2023.

2.3.2 Balance sheet structure of ANSPs

Figure 2.5 shows the composition of ANSPs' balance sheets in aggregate at the Pan-European level and how this has changed since 2012[7].

[7] Sakaeronavigatsia joined the ACE benchmarking project in 2014, and BHANSA in 2020. These two ANSPs are therefore excluded from the Pan-European total shown in this section.

Between 2012 and 2019, the total asset base gradually increased at a compound annual growth rate (CAGR) of +2.6%. The relative proportions of each asset type changed within the period, with gradual increases in current assets (31% in 2012 to 43% in 2019, CAGR of +7.3%) and decreases in fixed assets in operation (47% in 2012 to 37% in 2019, CAGR of -1.1%). In the meantime, both capital and reserves and long-term liabilities increased (CAGR of +2.1% and +4.5%, respectively) driving the overall increase in liabilities.

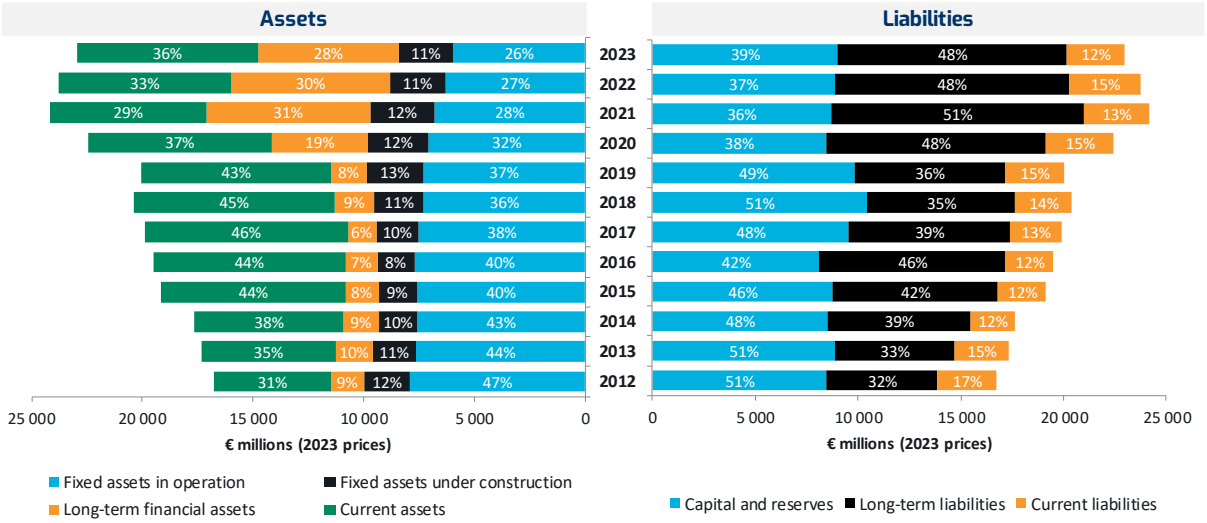

Figure 2.5: Composition of balance sheet, Pan-European level, 2012-2023 (real terms)

Since 2020, there have been more significant changes as the COVID-19 pandemic resulted in an unprecedented drop in revenues. For ANSPs operating under the SES performance and charging schemes, exceptional measures have been adopted, allowing revenue under-recoveries during the pandemic to be spread equally over five-to-seven years, starting in 2023. The impact of these measures is clearly visible in the increase in long-term financial assets (from 8% in 2019 to 19% in 2020 and 31% in 2021). On the liabilities side, the share of capital and reserves decreased (from 49% in 2019 to 38% in 2020) and long-term liabilities increased (from 36% in 2019 to 48% in 2020) as ANSPs faced liquidity issues to cover their operating costs and continue financing their investments.

In 2023, some of the changes observed during the pandemic appeared to be reversing. The proportion of long-term financial assets decreased (from 30% in 2022 to 28% in 2023) as under-recoveries began being paid through unit rate adjustments, while the proportion of current assets increased. However, the composition of the balance sheet remains substantially different from the pre-pandemic situation, as ANSPs are still repaying the long-term borrowing taken during the pandemic. Also, the proportion of fixed assets in operation (26% in 2023) is significantly lower than in 2019 (37%) and is at its lowest proportion of the total asset base for the entire period considered (2012-2023).

Figure 2.6 compares the absolute changes in the balance sheet at a Pan-European system level. Specifically considered are the average of the 2012-2019 period, the average of the 2020-2022 period, and the latest situation in 2023.

For assets, the 2020-2022 average (i.e. during the pandemic and early recovery) was €4.6 billion higher (+24.5%) versus the 2012-2019 average, mainly driven by a substantial increase in long-term financial assets (+308.3%). Similarly in 2023, when expressed in real-terms, the Pan-European asset base was €4.1 billion (+21.9%) higher than the 2012-2019 average, again due to a larger amount of long-term financial assets. As indicated above, for ANSPs operating under the SES performance and charging schemes, financial assets comprise amounts relating to revenue under-recoveries during the pandemic to be recovered from airspace users in line with the exceptional measures implemented by the European Commission.

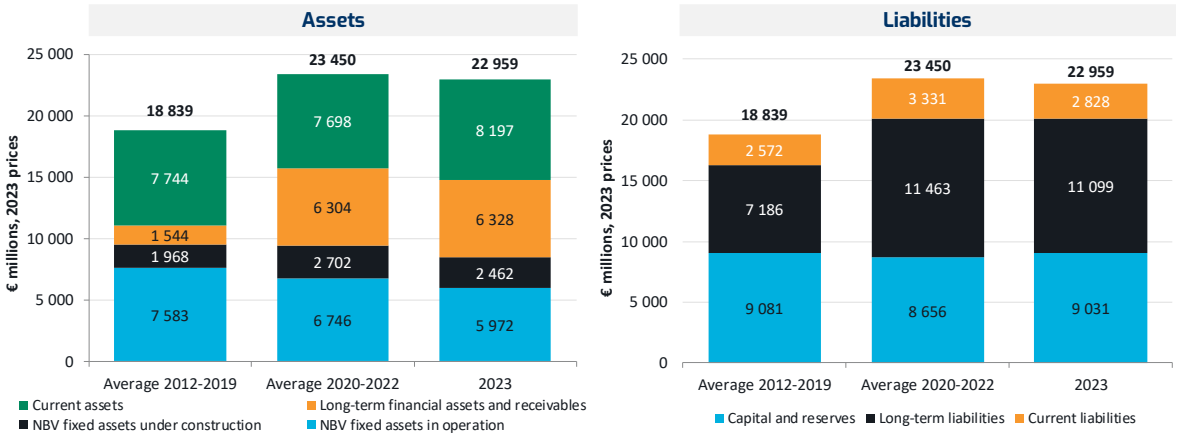

Figure 2.6: Changes in balance sheet by asset and liability type (total ANS)

For liabilities, the observed increase between the 2012-2019 average and the 2020-2022 average was mainly driven by an increase in long-term liabilities (+€4.3 billion or +59.5%). In 2023, total liabilities remained €4.1 billion (+21.9%) higher than the 2012-2019 average, with long-term liabilities continuing to be the main contributor to this difference. The other notable difference is that average current liabilities in the 2020-2022 period were €759M (+29.5%) higher than the 2012-2019 average. However, this difference fell in 2023, so that current liabilities were €256 million (+10.0%) higher than the 2012-2019 average.

2.3.3 Fixed assets and capital expenditures

Figure 2.7 shows that the amount of ANSPs' fixed assets reduced in 2022 and 2023, mainly due to significant reductions in capital expenditures in the previous years. As a result, in 2023 the net book value of fixed assets both in operation and under construction was some -13.7% lower than in 2012.

On the other hand, Figure 2.7 indicates that the composition of ANSPs gate-to-gate fixed assets, namely land and buildings, intangible asset, systems and equipment, and common projects remained relatively stable over the 2012-2023 period[8].

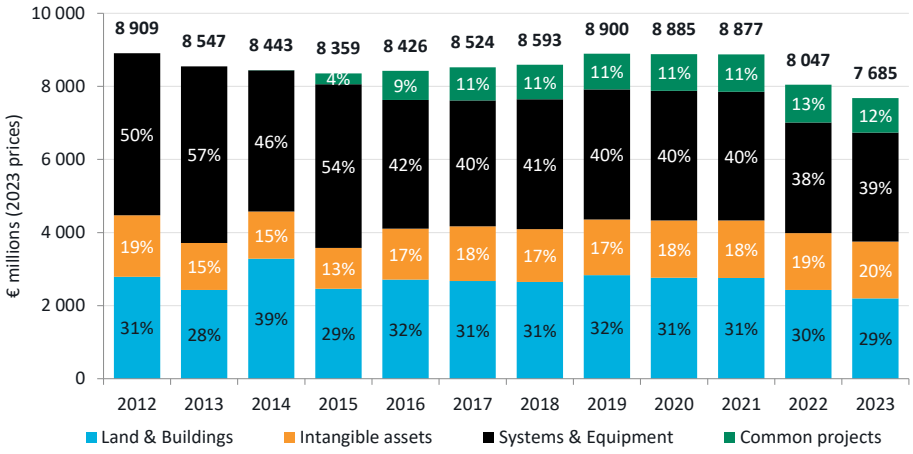

Figure 2.7: Composition of ANSPs fixed assets at gate-to-gate level, 2012-2023 (real terms)

[8] Common projects may in some cases be classified as systems & equipment and in others intangible assets. Common projects are implementing instruments defined in the Single Sky's service provision Regulation and should support the achievement of the SES performance objectives defined in Commission Regulation (EC) 691/2010, by facilitating and accelerating the deployment of ATM operational changes.

Figure 2.8 below shows the trends in investments over the 2012-2023 period. Between 2012 and 2019, capital expenditures grew at a compound annual growth rate of +3.3%. In proportional terms, the largest increase was observed for land & buildings expenditures (CAGR of +8.7%).

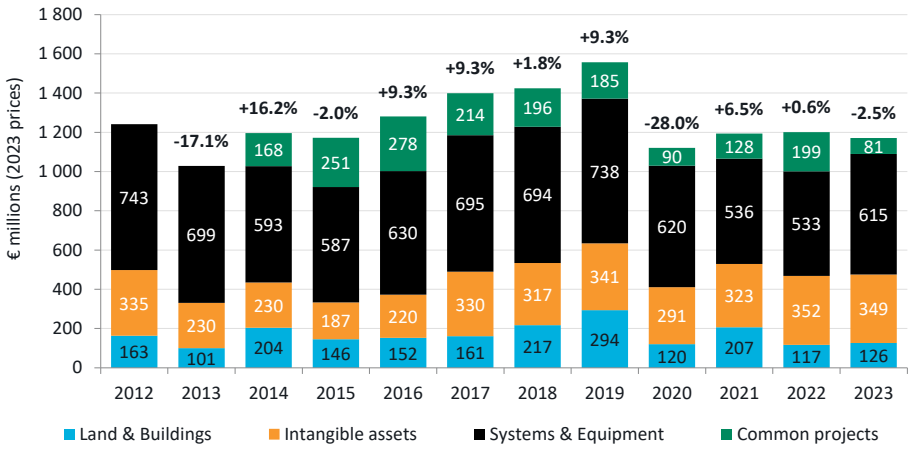

Figure 2.8: Capital expenditures, 2012-2023 (real terms)

Over the 2012-2023 period, the highest capital expenditures were seen in 2019, when they peaked at €1 557M.

In 2020, the COVID-19 pandemic led to a sharp reduction in capex of -€436M (-28.0%), with reductions made across all capex categories. Capex for land & buildings decreased by -€174M (- 59.2%), systems & equipment by -€118M (-16.0%), common projects by -€95M (-51.2%), and intangible assets by -€50M (-14.6%) in 2020 vs. 2019.

Over the 2020-2023 period, total capital expenditures have remained at lower levels than the 2012-2019 period. While capex grew between 2020 and 2023 (CAGR of +1.5%) this was mostly due to the +6.5% growth in 2021 relative to 2020.

Figure 2.9 below shows the change in capex by asset type between the different periods considered. The 2020-2022 average for total capex shows a -€116.0M (-9.0%) decrease versus the 2012-2019 average, mainly driven by decreases in systems & equipment of -€109.6M (- 16.3%) and capex for land & buildings of -€32.2M (-17.9%) but offset by an increase in capital expenditures for intangible assets of +48.4M (+17.7%).

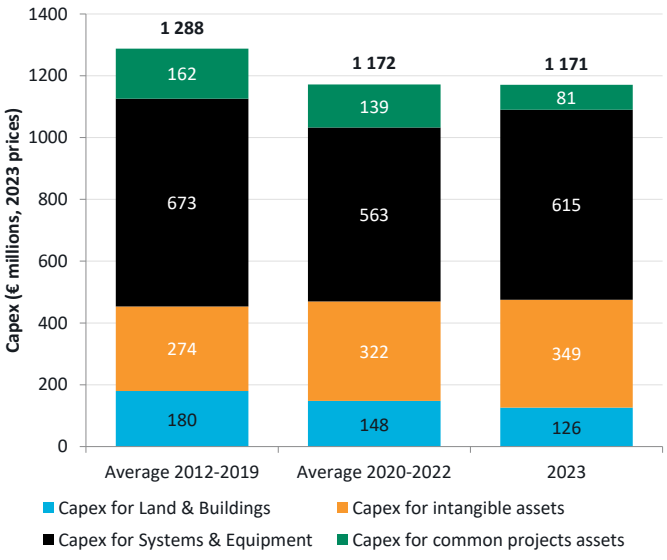

Figure 2.9: Changes in capital expenditure by asset type

Total capex remained -€116.6M (- 9.1%) lower in 2023 compared to the 2012-2019 average, with capex for land & buildings and common projects at lower levels than the 2020-2022 average, but capex for systems & equipment and intangible assets higher than the 2020-2022 average.

Of the 36 ANSPs considered, 24 reduced their capex in real terms in 2023 relative to their 2012-2019 average capex. Among the six largest ANSPs, the situation is contrasted, with substantial reductions recorded for NATS (-€92.6M), DFS (- €42.0M), and ENAV (-€31.1M) while relatively large increases were observed for ENAIRE (+€71.6M), DHMI (+€54.7 M) and DSNA (+€28.3M).

2.3.4 Comparison of short- and long-term borrowing with capital and reserves

Figure 2.10 below shows the evolution of capital and reserves (blue bars) and total borrowings (black bars) at Pan-European system level between 2012 and 2023. The height of the bars indicates the absolute values of these two main components of ANSPs' balance sheets while the relative size of borrowings compared to capital and reserves is shown as a percentage inside the black bars.

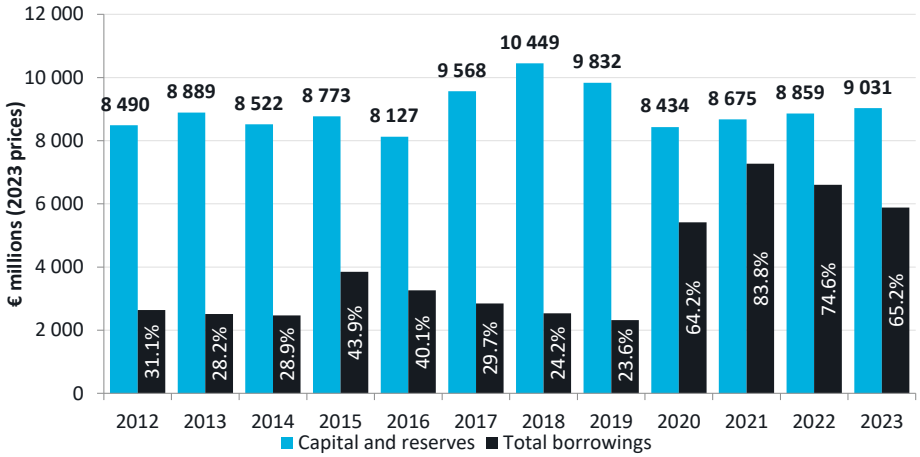

Figure 2.10: Capital and reserves and total borrowings, 2012-2023 (real terms)

The level of debt significantly increased during the COVID-19 pandemic. Since 2020, it has remained higher than at any point over the 2012-2019 period, representing €5 887M in 2023.

In 2019, around half of the ANSPs had no debt, while in 2023 25 ANSPs (69% of the sample) recorded borrowings in their balance sheet. The five largest contributors to this total in 2023 were DSNA (€2.2 billion), NATS (€1.0 billion), ENAV (€0.5 billion), DFS (€0.5 billion), and LVNL (€0.5 billion).

The European ANSPs have substantially increased the proportion of financing through debt since 2020 (between 64% and 84% for the 2020-2023 period, compared to 24%-44% over 2012-2019). However, despite this relatively high proportion of debt financing compared to previous years, it seems that the average ratio for ANSPs in 2023 remained relatively low or comparable with other aviation stakeholders (e.g. EasyJet 68% or Schiphol 142%).

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3. FINANCIAL COST-EFFECTIVENESS PERFORMANCE

3.1 Financial cost-effectiveness

At Pan-European system level, unit ATM/CNS provision costs fell by -7.4% in 2023, reflecting the fact that composite flight-hours rose much faster (+11.1%) than ATM/CNS provision costs (+2.9%). As a result, unit ATM/CNS provision costs in 2023 (€460) were only slightly above (+0.1%) pre-pandemic level.

Figure 3.1 shows the comparison of ANSPs gate-to-gate ATM/CNS provision costs per composite flight-hour in 2023. The two dotted lines represent the bottom and top quartiles (€352 and €536, respectively) and provide an indication of the dispersion across ANSPs. At Pan-European level, unit ATM/CNS provision costs amounted to €460 per composite flight-hour.

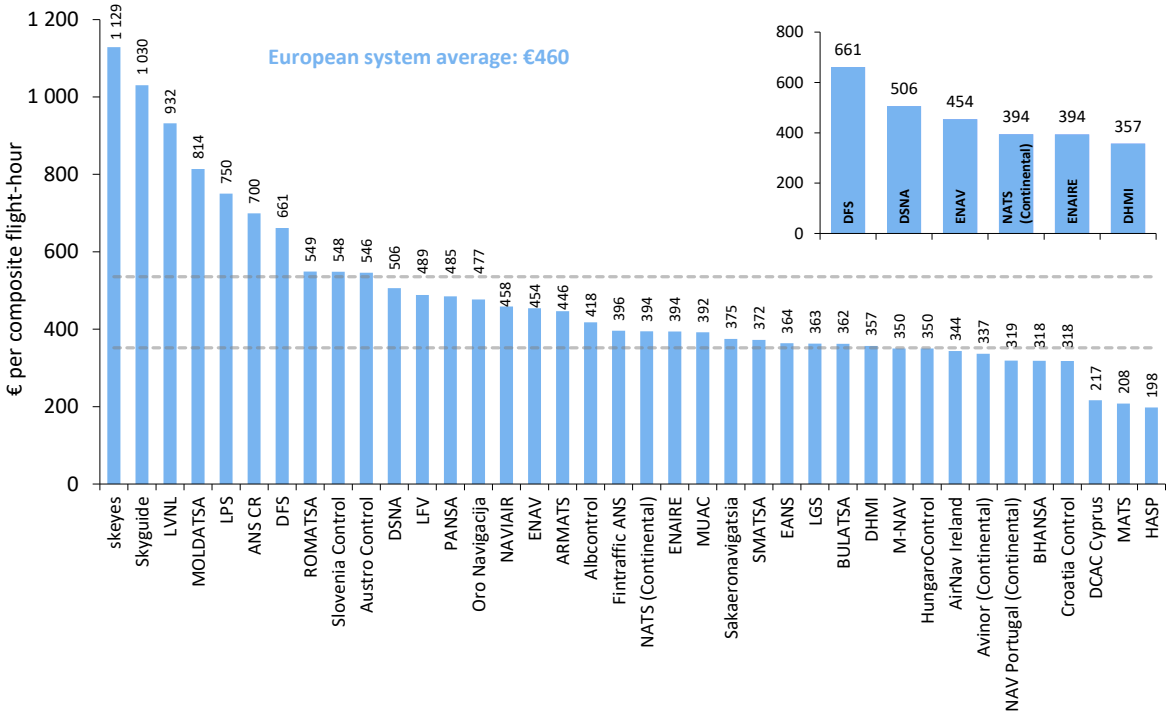


Figure 3.1: ATM/CNS provision costs per composite flight-hour, 2023

For ANSPs operating outside the Euro area, substantial changes in the national currency against the Euro may significantly affect the level of unit ATM/CNS provision costs when expressed in Euros. Between 2022 and 2023, significant variations in exchange rates compared to the Euro include the appreciation of the Albanian Lek (+9%), Armenian Dram (+9%) and Georgian Lari (+8%), as well as depreciations of the Turkish Lira (-33%), the Norwegian Krona (-12%) and the Swedish Krona (-7%). Detailed information on ANSPs exchange rates is available in Annex 4 of this report.

Figure 3.1 indicates that in 2023 the unit ATM/CNS provision costs of some ANSPs operating in Central and Eastern European countries (e.g. MOLDATSA, LPS, ANS CR, ROMATSA and Slovenia Control) are higher than the Pan-European system average, and close to the unit costs of ANSPs operating in Western European countries where the cost of living is much higher (see Figure 2.3). In fact, for most of these ANSPs, unit ATM/CNS provision costs were consistently higher than the Pan-European system average over the last 10 years.

Figure 3.1 also shows that there is a substantial difference (85%) in unit ATM/CNS provision costs among the six largest ANSPs ranging from DFS (€661) to DHMI (€357). This should also be seen in the context of the cost of living in Türkiye which is significantly lower than in the rest of the group.

In 2023, the unit ATM/CNS provision costs of skeyes and LVNL were first and third highest, respectively, among all the ANSPs. It is noteworthy that, although these two ANSPs operate in relatively similar economic and operational conditions (i.e. both exclusively provide ATC services in lower airspace), skeyes has consistently maintained higher unit ATM/CNS provision costs compared to LVNL (+18% on average over 2013-2023). It should also be noted that these ANSPs own infrastructure made available to MUAC. To better assess the cost-effectiveness of ATM/CNS services provided in each of the four MUAC States' (Belgium, Germany, the Netherlands, and Luxembourg) national airspaces, the costs and outputs of MUAC are consolidated with the costs and outputs of the respective national providers.

The top of Figure 3.2 shows the figures used for this adjustment. The cost figures are based on the cost allocation keys used to establish the cost-base of the four States, while the flight-hours are based on those controlled by MUAC in the three Flight Information Regions (FIRs of Belgium, the Netherlands, and Germany).

MUAC	Belgium	Germany	The Netherlands
Flight-hours allocated to:	173 185	250 604	181 844
Costs allocated to:	€80.5M	€111.2M	€45.7M

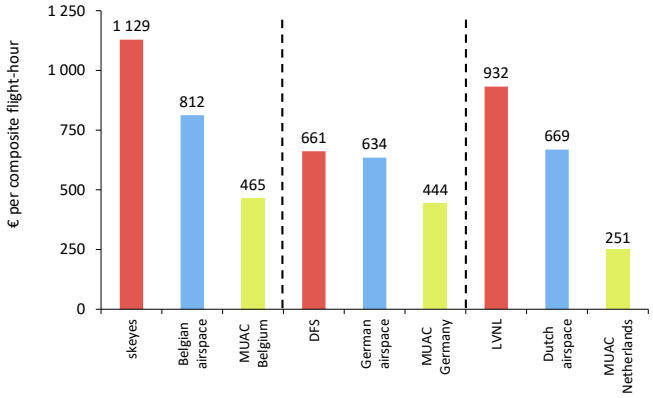


Figure 3.2: Adjustment of the financial cost-effectiveness indicator for ANSPs operating in the four States' airspace, 2023

The bottom section of Figure 3.2 presents a consolidated view of ATM/CNS provision costs per composite flight-hour in the airspace of Belgium, the Netherlands, and Germany (see blue bars). However, these costs still include the costs relating to infrastructure owned by DFS, LVNL and skeyes, which are accessible to MUAC.

Following this adjustment, the unit costs in Belgian airspace (€812) remain higher (+21%) than in Dutch airspace (€669).

It should also be noted that the MUAC costs allocated to Belgium (€80.5M) are significantly higher than those allocated to the Netherlands (€45.7M)[9].

Figure 3.3 below provides a long-term trend analysis showing the changes in traffic, ATM/CNS provision costs and unit costs between 2012 and 2023. This analysis is based on a consistent sample of ANSPs providing ACE data since 2012, comprising a total of 36 ANSPs. This excludes Sakaeronavigatsia and BHANSA, which joined in 2014 and 2020, respectively.

Between 2012 and 2019, ATM/CNS provision costs rose by +0.6% p.a., which was less than the +2.8% annual growth in traffic. As a result, unit ATM/CNS provision costs decreased by -2.1% p.a. (or - 13.8% in total over the period).

Between 2019 and 2023, traffic initially decreased due to the COVID-19 pandemic (-56.9% in 2020) before rebounding in 2021 (+27.1%). Despite consecutive increases that followed in 2022 (+58.2%)

[9] The cost-sharing arrangements between the four MUAC States are not based on traffic. Instead, they are based on the number of ATCOs allocated to the sectors. This approach considers an additional cost-sharing arrangement for further distribution of the costs of the Brussels sectors group, which is based on the kilometres controlled. Similarly, there is a comparable arrangement for sharing DECO sectors between Germany and the Netherlands, which is based on sector-hours.

and in 2023 (+10.9%), the composite flight-hours in 2023 were still below those in 2019, although being +16.5% higher than in 2012.

Meanwhile, cost containment measures implemented by the ANSPs in 2020 and 2021, resulted in a cumulative reduction of -9.4% (or - 940.3M) in ATM/CNS provision costs between 2019 and 2021. The trend of reducing ATM/CNS provision costs was then followed by two years of increases. Despite these increases, ATM/CNS costs remained -3.6% below pre-pandemic levels (compared to 2019) and were only +0.7% higher than in 2012.

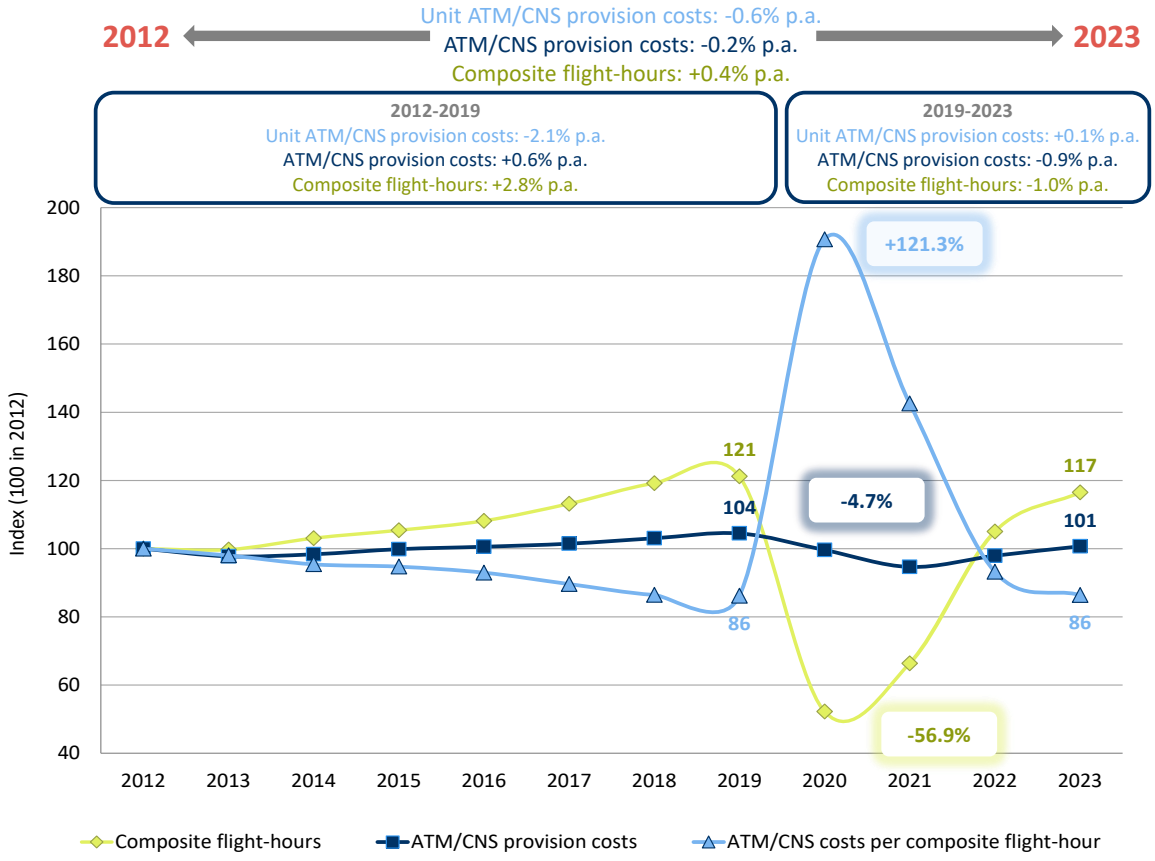


Figure 3.3: Long-term trends in traffic, ATM/CNS provision costs and unit costs

Figure 3.4 below shows that between 2022 and 2023 (plain coloured bars) total ATM/CNS provision costs rose by +2.9%, mainly reflecting increases in staff costs (+5.1% or +€312.1M) and non-staff operating costs (+6.3% or +€98.5M). However, ANSPs cost-bases were still -€361.0M (-3.6%) lower than in 2019 (see striped bars in Figure 3.4) owing to the significant cost savings achieved by the ANSPs at system level in 2020 and 2021.

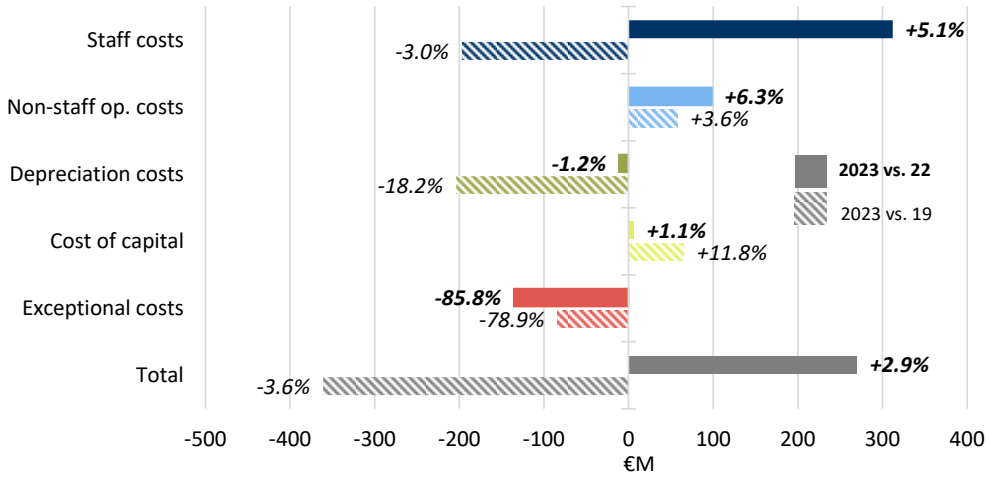


Figure 3.4: Breakdown of changes in ATM/CNS provision costs, 2022-2023 and 2019-2023 (real terms)

Although the changes presented in Figure 3.4 are expressed in real terms, it is important to consider that inflationary pressures continued in 2023. According to EUROSTAT, the inflation rate for the European Union (EU-27) stood at 6.4% in 2023. Although lower than in 2022 (9.2%) it is significantly higher than in the previous years. This context of high inflation can affect the level of ANSPs costs in different ways, since cost categories are not all impacted in the same proportion and the relationship might also differ across States.

Figure 3.5 shows the 2023 annual inflation rates[10], ranging from 2.0% in Armenia to 54.0% in Türkiye with rates exceeding 10% for seven of the 38 countries analysed.

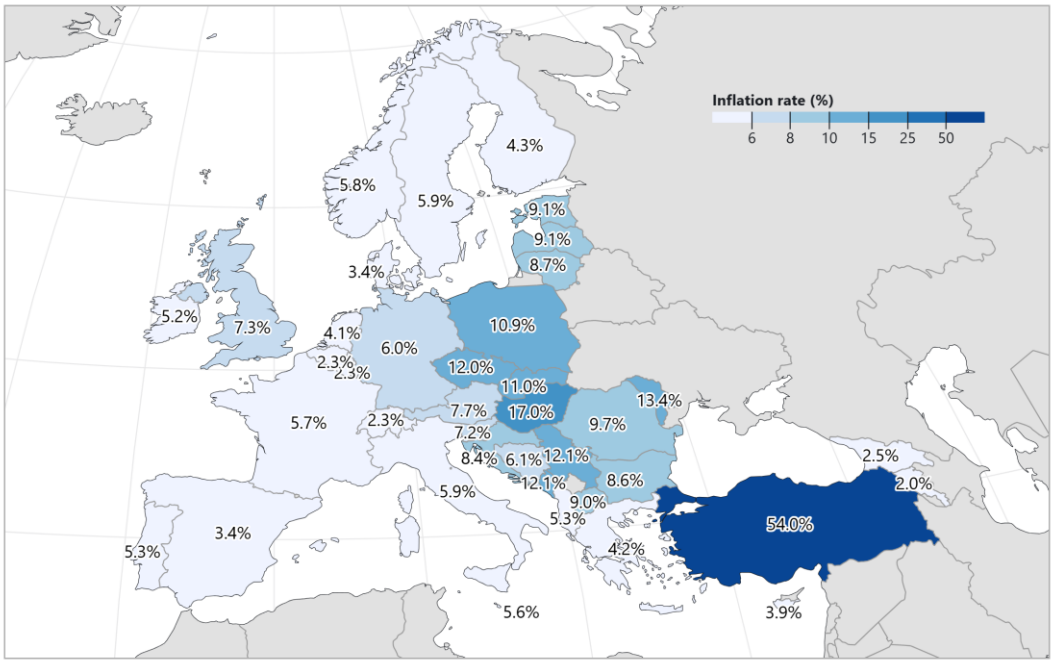


Figure 3.5: Annual inflation rates in 2023

[10] The historical inflation figures used in ACE are obtained from EUROSTAT, or from the International Monetary Fund World Economic Outlook database when the information is not available on the EUROSTAT website. For Luxembourg, the inflation rate reported for the Belgium-Luxembourg charging zone is shown, while, in the case of Montenegro, inflation for the Serbia and Montenegro charging zone is displayed.

Presenting and comparing historical series of financial data from different countries poses challenges, especially when involving different currencies and varying inflation rates. When analysing ANSPs cost-effectiveness over time, it is important to use data expressed in real terms. Working in nominal values may create a bias in the interpretation of performance trends, as it would not accurately reflect genuine changes in cost-effectiveness levels.

For this reason, the following method is applied to calculate real-term series expressed in Euros:

- Financial data is collected each year in national currency, at the price level of the reporting year (i.e. nominal terms).
- These nominal term series are then converted into real terms using national inflation rates.
- Finally, for comparison purposes, the real-term series in national currencies are converted to Euros using the exchange rate of the year of analysis (2023).

This approach ensures that ANSPs' performance trends are not distorted by transient changes in exchange rates over time. However, it implies that the financial data shown in a given ACE report for years preceding the reference year (e.g. 2018 data shown in the current report) differ from the values published in previous ACE reports. Therefore, cross-sectional comparisons are only suitable when using the data within a given ACE report and should not mix data published in different years' reports.

Although the trend analysis presented in this report is conducted in real terms, the context of high inflation can nevertheless affect the level of ANSPs' costs in 2023:

- Over long time periods, inflation inevitably affects employment costs. However, depending on the prevailing rules in each country and the characteristics of the collective agreements, inflation recorded during the year of analysis will not necessarily result in a simultaneous and proportional change in the average employment costs for that year.
- Non-staff operating costs are expected to rise along with inflation, but certain cost categories (e.g. power consumption) might rise faster than the average inflation rate. Furthermore, the prices of imported products or services might be affected by the inflation rate of the exporting country and exchange rate fluctuations.
- Depreciation costs are generally calculated based on the historical cost of the asset. However, some ANSPs can perform revaluations of their fixed assets, indexing the residual value of the asset to inflation.
- A higher inflation rate generally results in higher nominal interest rates, which contribute to increasing the required return on equity. Although working in real terms may largely offset this effect, there might be factors – similar to other cost categories – creating a lag or a non-proportional relationship (e.g. when loans are contracted at a fixed interest rate).

Figure 3.6 provides a detailed analysis of changes in cost-effectiveness, where unit ATM/CNS provision costs are broken down into a cost effect and a traffic effect for each ANSP. Changes in total ATM/CNS costs are presented in percentage and absolute values between 2022 and 2023. In addition, the small lines in the fifth column indicate the trends between 2019 and 2023. These trends are illustrative and the minimum and maximum values account for each ANSP's individual situation; therefore, they cannot be compared across the different ANSPs.

	Change in unit costs % 2022-2023	Change in traffic % 2022-2023	Change in costs % 2022-2023	In €M	2019 2020 2021 2022 2023	Cumulative change (€M)
EANS	-10.9%	+3.2%	-8.1%	-1.9		-13.5
ENAIRE	-15.7%	+10.2%	-7.1%	-65.0		-33.0
M-NAV	-18.5%	+14.8%	-6.4%	-1.3		-2.8
MATS	-28.4%	+32.4%	-5.2%	-1.1		-3.8
ARMATS	-17.3%	+15.5%	-4.5%	-0.7		-1.1
Avinor (Continental)	-5.5%	+1.6%	-4.0%	-7.1		-32.8
Austro Control	-14.8%	+12.9%	-3.9%	-9.7		-40.5
ENAV	-11.6%	+9.1%	-3.6%	-27.2		-83.5
HungaroControl	-13.2%	+12.2%	-2.6%	-3.3		-11.4
NATS (Continental)	-14.5%	+15.6%	-1.2%	-8.7		-205.0
DSNA	-7.6%	+8.0%	-0.3%	-3.6		-107.1
Fintraffic ANS	-7.3%	+8.7%	+0.9%	+0.5		-12.8
DFS	-4.4%	+6.0%	+1.2%	+14.4		-166.0
Croatia Control	-7.4%	+12.3%	+4.0%	+3.9		-11.2
MUAC	-5.9%	+11.0%	+4.5%	+10.2		+31.3
DCAC Cyprus	-9.2%	+15.1%	+4.5%	+2.0		+5.4
SMATSA	-8.4%	+14.5%	+4.8%	+5.2		-2.2
LGS	+0.5%	+4.4%	+4.9%	+1.2		-8.8
Oro Navigacija	+2.5%	+2.4%	+4.9%	+1.4		-5.7
HASP	-6.5%	+12.4%	+5.1%	+8.5		+5.5
NAVIAIR	-3.7%	+9.8%	+5.8%	+7.2		-2.8
BULATSA	-9.4%	+17.5%	+6.5%	+8.1		-11.1
skeyes	+3.5%	+2.9%	+6.5%	+13.1		+2.7
Airnav Ireland	-7.0%	+14.6%	+6.6%	+8.7		+4.4
BHANSA	-4.5%	+11.8%	+6.7%	+2.1		+32.5
PANSA	-2.2%	+9.4%	+7.0%	+16.3		-19.0
Albcontrol	-11.3%	+22.0%	+8.2%	+2.4		-6.6
ANS CR	-1.4%	+10.2%	+8.6%	+12.8		-48.7
Slovenia Control	-0.7%	+9.4%	+8.6%	+3.2		-0.1
Skyguide	+5.1%	+4.5%	+9.9%	+41.4		+63.5
ROMATSA	-5.6%	+16.5%	+10.0%	+25.5		+40.5
Sakaeronavigatsia	-26.9%	+53.7%	+12.3%	+4.2		+1.4
LVNL	+5.8%	+7.3%	+13.4%	+31.9		+0.8
DHMI	-4.2%	+20.0%	+14.9%	+92.1		+295.4
LPS	+6.4%	+8.5%	+15.5%	+10.2		-7.0
MOLDATSA	-1.9%	+18.1%	+15.9%	+1.3		-5.3
LFV	+14.9%	+6.2%	+22.0%	+39.4		+28.6
NAV Portugal (Continental)	+11.2%	+9.7%	+22.0%	+32.5		+1.3

Figure 3.6: Changes in unit ATM/CNS provision costs, traffic and costs at ANSP level

Figure 3.6 shows that, between 2022 and 2023, unit ATM/CNS provision costs reduced for 30 ANSPs with the largest reductions recorded for MATS (-28.4%), Sakaeronavigatsia (-26.9%) and M-NAV (-18.5%). For most of these ANSPs the reduction in unit costs reflects a combination of decrease in costs in the context of growth in composite flight-hours. On the other hand, eight ANSPs recorded increases in unit costs with most significant growth for LFV (+14.9%), NAV Portugal (+11.2%) and LPS (+6.4%). For most of these ANSPs, increases reflect significant additions in provision costs which exceeded traffic gains.

Figure 3.6 also shows that traffic grew for all ANSPs in 2023 with increases ranging from +53.7% for Sakaeronavigatsia to +1.6% Avinor (Continental). At the same time, the ATM/CNS costs also grew for a majority of the ANSPs (27 out of 38). On the other hand, the increases in ATM/CNS provision costs should be seen in the context of substantial cost reductions achieved by most ANSPs over 2019-2022 period. As a result, despite significant cost increases in 2023, the costs for 14 of these 27 ANSPs still remained below pre-crisis levels.

As shown in Figure 3.6, ATM/CNS provision costs rose by more than +10% for eight ANSPs between 2022 and 2023:

- The increase for NAV Portugal (+22.0%, or +€32.5M) primarily reflects significant increase in staff costs (+21.2%, or +€25.0M) stemming from developments for the defined benefit pension plan for ATCOs recruited before 2007. Specifically, this increase reflects actuarial

losses driven by higher salaries and pensions, combined with a downward revision of the discount rate. This apparent rise should also be viewed in the context of exceptional gains recorded for this pension scheme in 2022, which led to unusually low pension costs.

- For LFV (+22.0%, or +€39.4M) the main driver for the increase is a substantial growth in staff costs (+33.5%, or +€41.3M) reflecting extraordinary contributions to the pension fund following indexation of pension liabilities.
- In the case of MOLDATSA, costs increased by +15.9% (+€1.3M), primarily due to a significant rise in non-staff operating expenses (+66.5%, or +€1.0M), which mainly reflects the establishment of a provision for bad debts from airlines. The increase in total costs should however be seen in the context of substantial cost reductions implemented by MOLDATSA between 2019 and 2022. Indeed, over this period, total ATM/CNS provision costs fell by some -45% (-€6.6M).
- For LVNL (+13.4%, or +€31.9M), the growth in ATM/CNS costs results from a combination of increases across all cost categories. Staff costs rose by +7.8% (+€12.7M) due to a rebound from 2022 levels, which were lowered by the release of provisions. Non-staff operating costs rose by +15.4% (+€8.4M) due to higher energy costs, outsourcing expenses and externalisation of ATCO training. Finally, the cost of capital (+€8.2M), rose due to higher interest rates in the Netherlands, particularly affecting LVNL which is entirely debt-financed.
- The cost increase for Sakeronavigatsia (+12.3%, or +€4.2M) mainly reflects an increase in staff costs (+17.5%, or +€3.2M) linked to the payment of bonuses as well as a general increase in the level of remuneration. This should also be seen in the light of the substantial traffic growth in Georgia in the past two years (+68% in 2022 and +54% in 2023).
- In the case of LPS (+15.5%, or +€10.2M), this reflects significant growth in staff costs (+20.8%, or +€9.4M) which follows an increase in the basic wage rates as agreed in the collective bargaining agreement.
- Finally, ROMATSA recorded a +10.0% (+€25.5M) increase in ATM/CNS provision costs resulting primarily from growth in staff costs (+12.6%, or +€26.2M) which reflects a combination of higher pension costs and salaries aimed at compensating personnel for high inflation (9.7% in 2023) as well as payment of bonuses for the achievement of capacity targets.

On the other hand, M-NAV, EANS and MATS were able to reduce ATM/CNS provision costs by more than -5%. In the cases of M-NAV (-6.4%, or -€1.3M) and MATS (-5.2%, or -€1.1M), the apparent reductions result from the inflation effect since, when expressed in nominal terms, the ATM/CNS provision costs for these ANSPs grew by +2.3% and by +0.1% respectively in 2023. For EANS (-8.1%, or -€1.9M) the decrease in costs is mainly due to substantially lower depreciation (-35.4%, or -€1.5M) reflecting delayed and postponed investments.

Among the six largest ANSPs, ATM/CNS provision costs grew for DHMI and DFS, but reduced for DSNA, NATS, ENAV and ENAIRE:

- DHMI (+14.9% or +€92.1M) recorded increases across all cost categories, notably in staff costs (+27.8%, or +€54.3M) and non-staff operating costs (+13.2%, or +€25.3M). Staff costs were affected by government measures to address the falling purchasing power of public civil servants, including inflation adjustments and one-off flat-rate increases in salaries. These changes occurred amid extraordinary high inflation in Türkiye (54.0% in 2023 and 72.3% in 2022). At the same time, increases in energy prices, repair and maintenance expenses as well rises in insurance premiums, following devastating earthquakes in Southern-East part of Türkiye, resulted in a substantial increase in non-staff operating costs.
- For DFS, the ATM/CNS provision costs grew by +1.2% (+€14.4M) in real terms, reflecting mainly a substantial increase in non-staff operating costs (+20.8%, or +€27.8M) steaming from a combination of higher energy costs, intensified recruitment efforts and transfer of

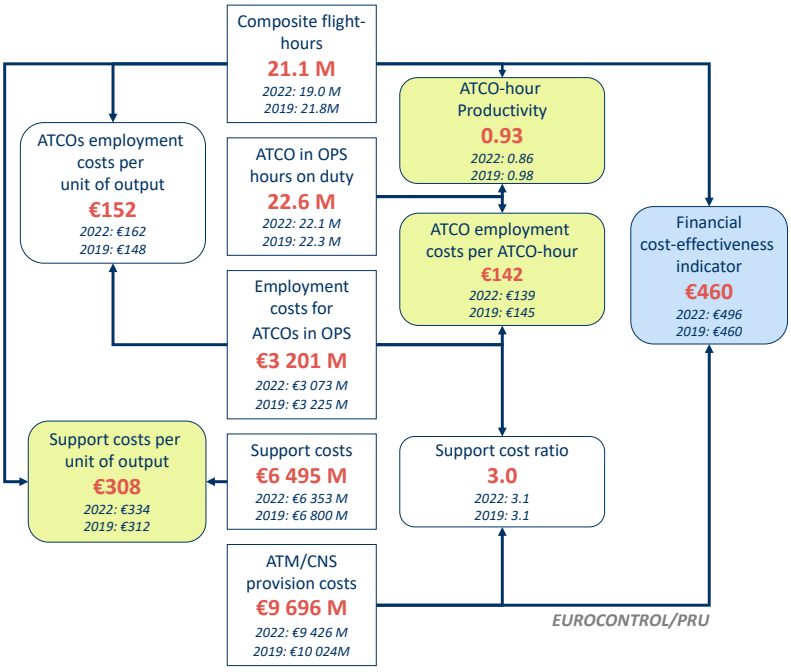
costs from depreciation to operating costs following a change in the iCAS maintenance contract. It should also be mentioned that, in nominal terms, DFS recorded a substantial increase in staff costs (+€45.6M) reflecting an adjustment of salaries to compensate for inflation. This increase, however, appears as a slight reduction (-0.6%) when expressed in real terms. The overall increase in ATM/CNS provision costs for DFS in 2023 should also be seen in the context of -13.5% (-€180.4M) reduction achieved over 2019-2022 period.

- The significant reduction for ENAIRE (-7.1%, or -€65.0M) results from the fact that the 2022 costs included an exceptional one-off expense (some €137M in 2022) to cover retroactive adjustments related to future liabilities for ATCOs placed under a specific regime – "Special Active Reserve" (RAE). This change, mandated by law 26/2022 and aimed at addressing financing requirements stemming from difference in retirement age of ATCOs (65 years) and national legal retirement age (67 years) also has a bearing on ENAIRE staff costs which now include RAE provisions (some €18M in 2023). At the same time, substantial increases were recorded in staff costs (+9.6%, or +€55.3M), reflecting an inclusion of the aforementioned RAE provision as well as a salary increase due to changes in law, depreciation costs (+11.9%, or +€11.3M) and the cost of capital (+46.3%, or +€12.1M).

While DSNA (-0.3%), NATS (-1.2%) and ENAV (-3.6%) all reported reductions in ATM/CNS provision costs, it should be noted that these reductions reflect solely the inflation impact since nominal costs for these three ANSP grew by +5.4%, +6.0% and +2.1%, respectively. In the cases of DSNA and NATS, the nominal ATM/CNS provision costs grew across all cost categories. For ENAV the nominal increase reflects higher staff costs (+4.1%) and a slight increase in the cost of capital (+0.5%) partly compensated by reductions in non-staff operating costs (-1.3%) and depreciation costs (-0.3%).

More detailed information on the changes in cost-effectiveness and its components at ANSP level are provided in the ANSPs individual summary reports.

Figure 3.7 shows the analytical framework used in the ACE analysis to break down the financial cost-effectiveness indicator into basic economic drivers.



Key drivers for the financial cost-effectiveness performance include:

a) ATCO-hour productivity (0.93 composite flight-hours per ATCO-hour);
b) ATCO employment costs per ATCO-hour (€142); and,
c) support costs per unit of output (€308).

These three economic drivers are analysed in detail in the next sections of this chapter.

Figure 3.7: ACE performance framework, 2023 (real terms)

Some 33% of ATM/CNS provision costs directly relate to ATCOs in OPS employment costs, while the remaining 68% relate to "support" functions. This includes non-ATCOs in OPS employment costs, non-staff operating costs and capital-related costs such as depreciation and the cost of capital.

Figure 3.8 shows that in 2023, ATCO employment costs per ATCO-hour rose by +2.1% while ATCO-hour productivity rose by +8.9%. As a result, ATCO employment costs per composite flight-hour decreased (-6.2%) compared to 2022. In the meantime, unit support costs fell by -8.0% due to an increase in composite flight-hours (+11.1%) being partly offset by an increase in support costs (+2.2%). Consequently, in 2023, unit ATM/CNS provision costs fell by -7.4% at the Pan-European system level compared to 2022, taking into account the relative weighting of ATCO employment and support costs based on their shares of total ATM/CNS provision costs.

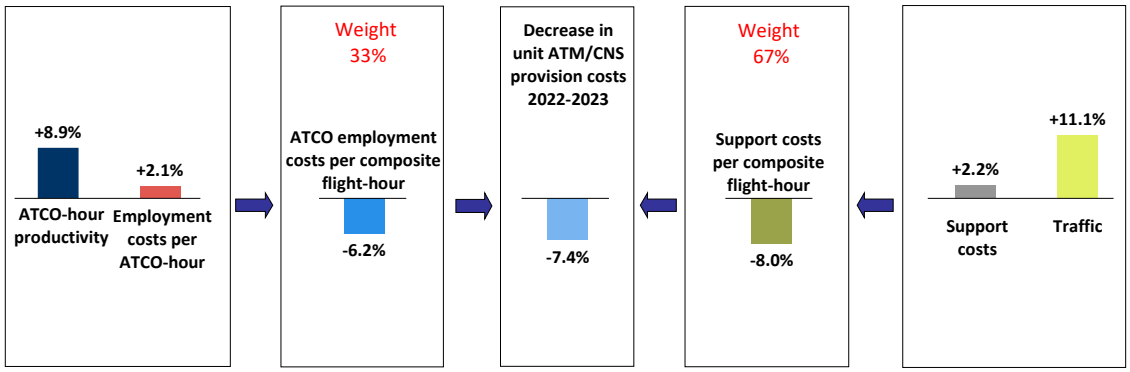


Figure 3.8: Changes in the financial cost-effectiveness indicator, 2022-2023 (real terms)

As the values of the 2022 indicators were affected by the persistent consequences of the COVID-19 crisis, Figure 3.9 below presents an additional analysis using 2019 as a reference year. It shows that in 2023 traffic was still -3.7% below its 2019 level. However, since total support costs also reduced by -4.8%, the resulting unit support costs in 2023 were lower than those in 2019 (-1.2%). ATCO employment costs per composite flight-hour were above their 2019 value (+2.8%) as ATCO-hour productivity in 2023 was significantly below pre-pandemic levels (-4.3%) while employment costs per ATCO-hour were also lower than in 2019 (-1.6%). As a result, unit ATM/CNS provision costs in 2023 were only marginally above those in 2019 (+0.1%).

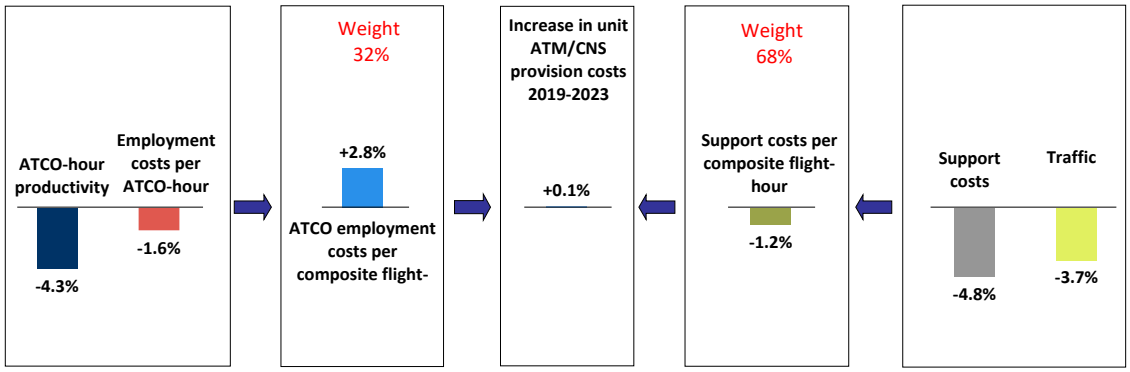


Figure 3.9: Changes in the financial cost-effectiveness indicator, 2019-2023 (real terms)

3.2 ATCO-hour productivity

In 2023 composite flight-hours rose by +11.1%, much faster than ATCO-hours on duty (+2.0%). Consequently, ATCO-hour productivity increased by +8.9%, reaching 0.93 composite flight-hours per ATCO-hour on duty. This productivity level is higher than in 2022 (0.86), but still lower than that recorded in 2019 (0.98), when traffic volumes controlled were +3.8% higher at Pan-European system level.

Figure 3.10 and Figure 3.11 indicate that, despite a noticeable decrease in the number of ATCO-hours on duty in 2020 (by -13.0% vs. 2019), ATCO-hour productivity declined by some -50%, mainly due to an extraordinary drop in traffic (-56.9%).

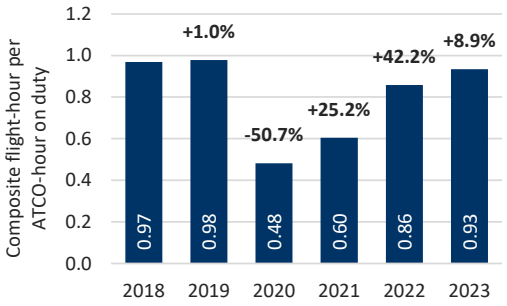


Figure 3.10: ATCO-hour productivity (2018-2023)

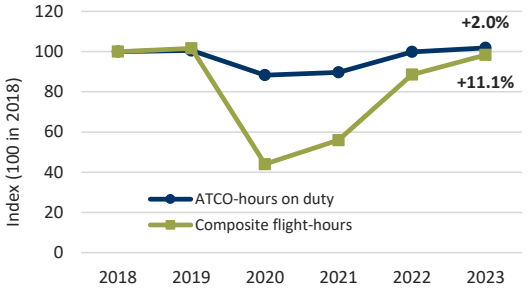


Figure 3.11: ATCO in OPS hours on duty and traffic (2018-2023)

After a significant rebound in composite flight-hours in 2021 and 2022 (+27.2% and +58.3% respectively), traffic growth continued in 2023 (+11.1%). In the meantime, ATCO-hours on duty rose by +2.0% in 2023, resulting in a significantly higher ATCO-hour productivity indicator at system level (+8.9%).

At Pan-European system level, ATCO-hour productivity measured in 2023 (0.93) is still slightly lower to that recorded in 2019 (0.98), when traffic volumes controlled were +3.8% higher. It is also important to note that the metric of ATCO-hour productivity[11] used in this report reflects the average productivity throughout the year for a given ANSP and does not give an indication of the productivity at peak times, which can be substantially higher. A more detailed discussion of the factors to consider when interpreting this indicator is provided in the ACE handbook.

Figure 3.12 shows that the +2.0% increase in total ATCO-hours on duty results from the combination of an increase in the number of ATCOs in OPS (+1.0%) and slightly higher average hours on duty per ATCO in OPS (+1.1%). In addition, it indicates that the number of ATCOs on other duties fell by -4.1%, reflecting that, in 2023, some ATCOs allocated to non-operational duties during the years of low traffic levels continued to return to operational tasks.

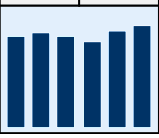
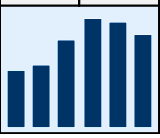
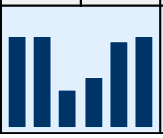
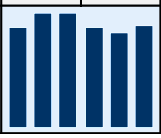
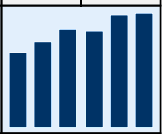
	ATCOs in OPS		ATCOs on other duties		Avg. hours on duty per ATCO in OPS		Ab-initio trainees		On-the-job trainees	
2022-2023 changes	+168 FTEs	***+1.0%***	-99 FTEs	***-4.1%***	+14 hours	***+1.1%***	+59 FTEs	***+7.0%***	+18 FTEs	***+1.4%***
2018-2023 trend										

Figure 3.12: Changes in the number of ATCOs and average hours on duty

Figure 3.13 presents the changes in ATCO in OPS hours on duty and its main drivers (number of ATCOs in OPS and average hours on duty) between 2022 and 2023. The small lines in the second, fourth and sixth columns display the trends between 2019 and 2023. These trends illustrate the minimum and maximum values for each ANSP's individual situation. Therefore, they should not be used to compare the magnitude of the variations across the different ANSPs.

[11] It should be noted that the ACE benchmarking analysis focuses on IFR traffic and that it does not reflect the activity associated with the provision of ANS to VFR flights. For some ANSPs (e.g. skeyes) the amount of VFR activity at regional airports can be very high and might affect ATCOs in OPS' workloads, hence also impacting ATCO-hour productivity.

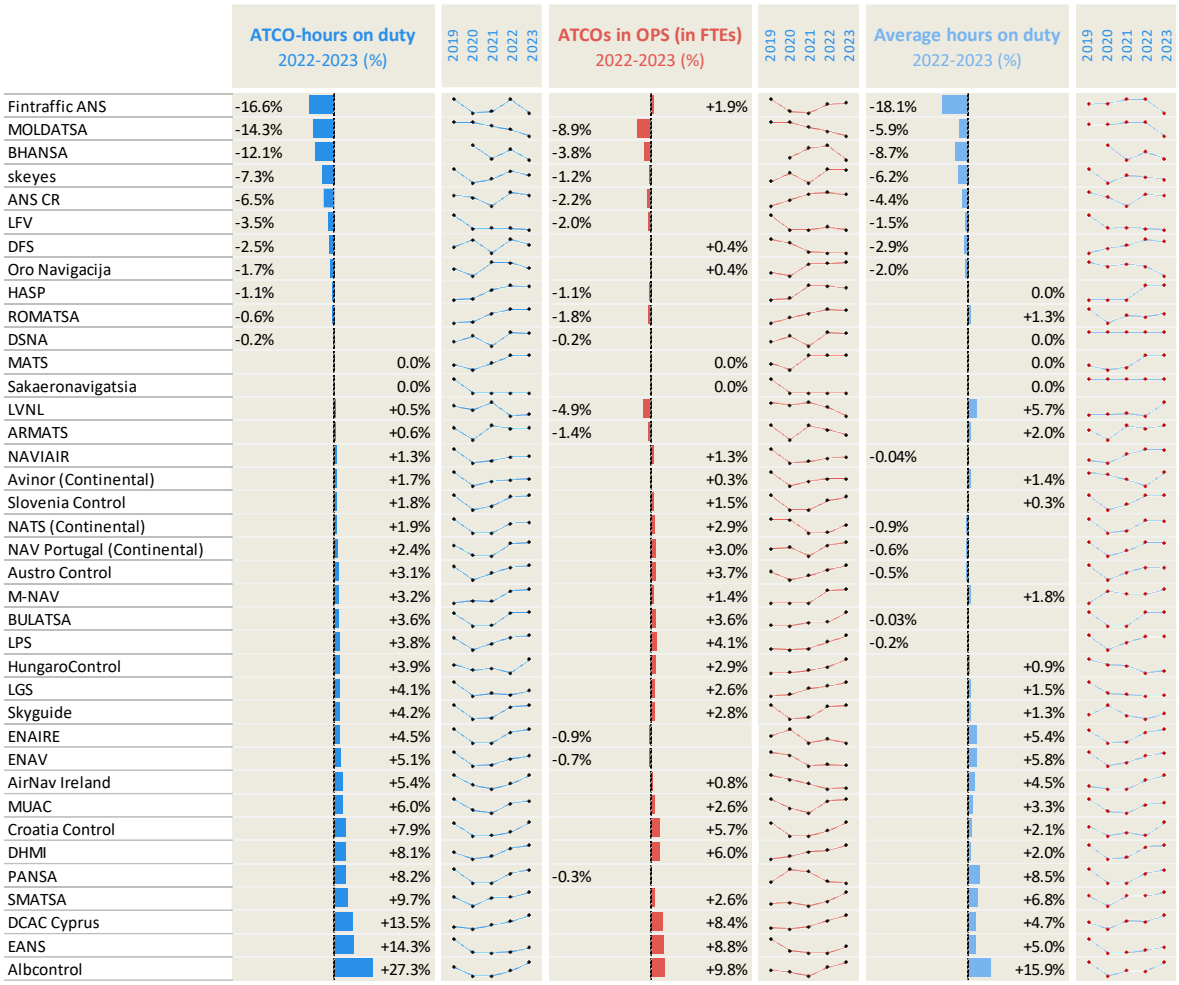


Figure 3.13: Changes in ATCO-hours on duty, number of ATCOs in OPS and average hours on duty at ANSP level (2022-2023)

Fintraffic ANS (-16.6%), MOLDATSA (-14.3%) and BHANSA (-12.1%) show the largest reduction in total ATCO-hours on duty. For Fintraffic ANS, this results from a -18.1% decrease in the average hours on duty, partly offset by a +1.9% increase in the number of ATCOs in OPS, while for MOLDATSA and BHANSA both the number of ATCOs in OPS (-8.9% and -3.8% respectively) and the average hours on duty (-5.9% and -8.7% respectively) decreased.

In 2023, total ATCO-hours on duty rose for 25 out of 38 ANSPs, with increases greater than +10% for three of them (i.e. DCAC Cyprus, EANS and Albcontrol). For these three ANSPs, this reflects higher average hours on duty (see light blue bars on the right-hand side) combined with a greater number of ATCOs in OPS (see red bars in the middle).

Figure 3.14 illustrates the ATCO-hour productivity for each ANSP in 2023. The vertical bars represent the value of the indicator in 2023, while the lime diamonds represent the levels attained in 2019. Since traffic is an important factor influencing the level of productivity, the bars coloured in red highlight ANSPs for which traffic in 2023 was higher than in 2019.

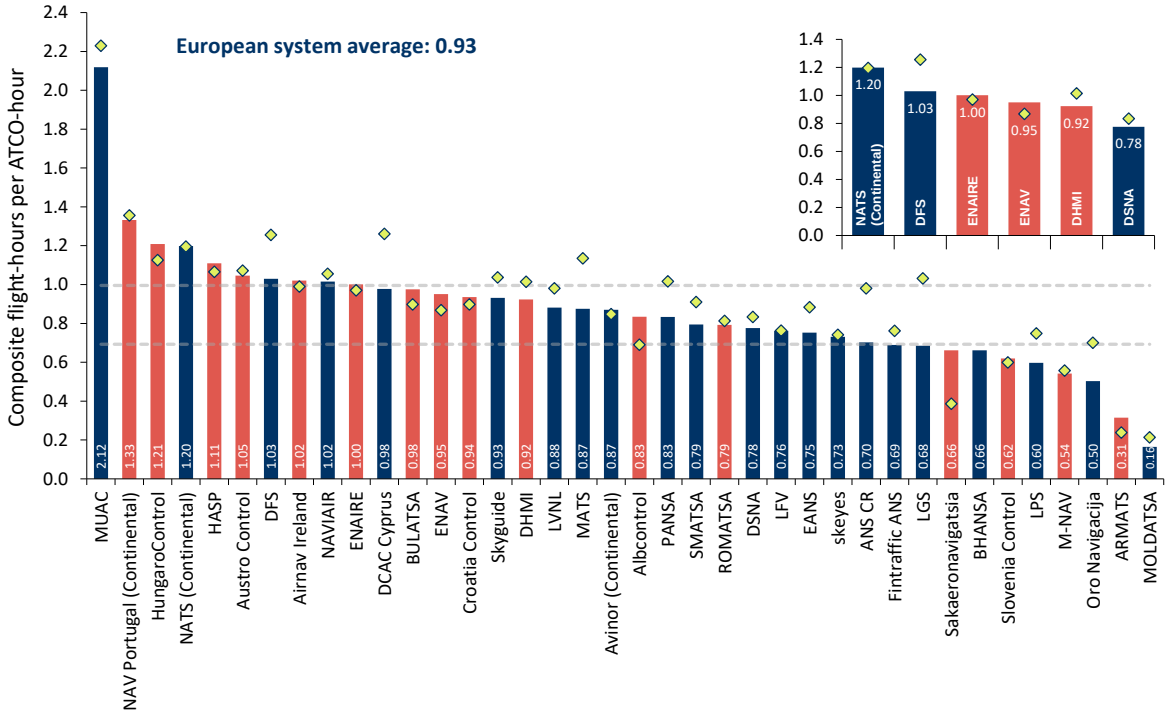


Figure 3.14: ATCO-hour productivity (gate-to-gate), 2023

The ATCO-hour productivity differs significantly across ANSPs. As in previous years, MUAC (2.12) is the ANSP with the highest ATCO-hour productivity. This is well above NAV Portugal (1.33) and HungaroControl (1.21), which rank second and third, respectively. When considering the position of these ANSPs, it is important to note that MUAC exclusively provides ATC services in upper airspace. Conversely, the ANSPs with the lowest ATCO-hour productivity are Oro Navigacija (0.50), ARMATS (0.31) and MOLDATSA (0.16). Their low productivity may stem from their small size, and the challenges of adapting their available ATC capacity and infrastructure to low traffic volumes.

Figure 3.14 highlights that for 13 ANSPs, ATCO-hour productivity in 2023 was at or above the level in 2019. Among those, Avinor and NATS achieved this with less composite flight-hours than in 2019.

In 2023, some ANSPs were significantly affected by the war in Ukraine and the resulting changes in traffic flows (e.g. MOLDATSA, EANS, LGS and Oro Navigacija). Caution is therefore needed when interpreting the level of productivity observed for these ANSPs.

ATCO-hour productivity measured at ANSP level reflects an average performance, which can hide large differences across ACCs, even for those belonging to the same ANSP. It is therefore important to also analyse the productivity at ACC level, which is presented in Figure 3.15. The 60 ACCs included in the ACE benchmarking analysis are grouped into five clusters based on two characteristics: (1) structural operational characteristics of the ACC; and (2) the number of area control sectors open at maximum configuration.

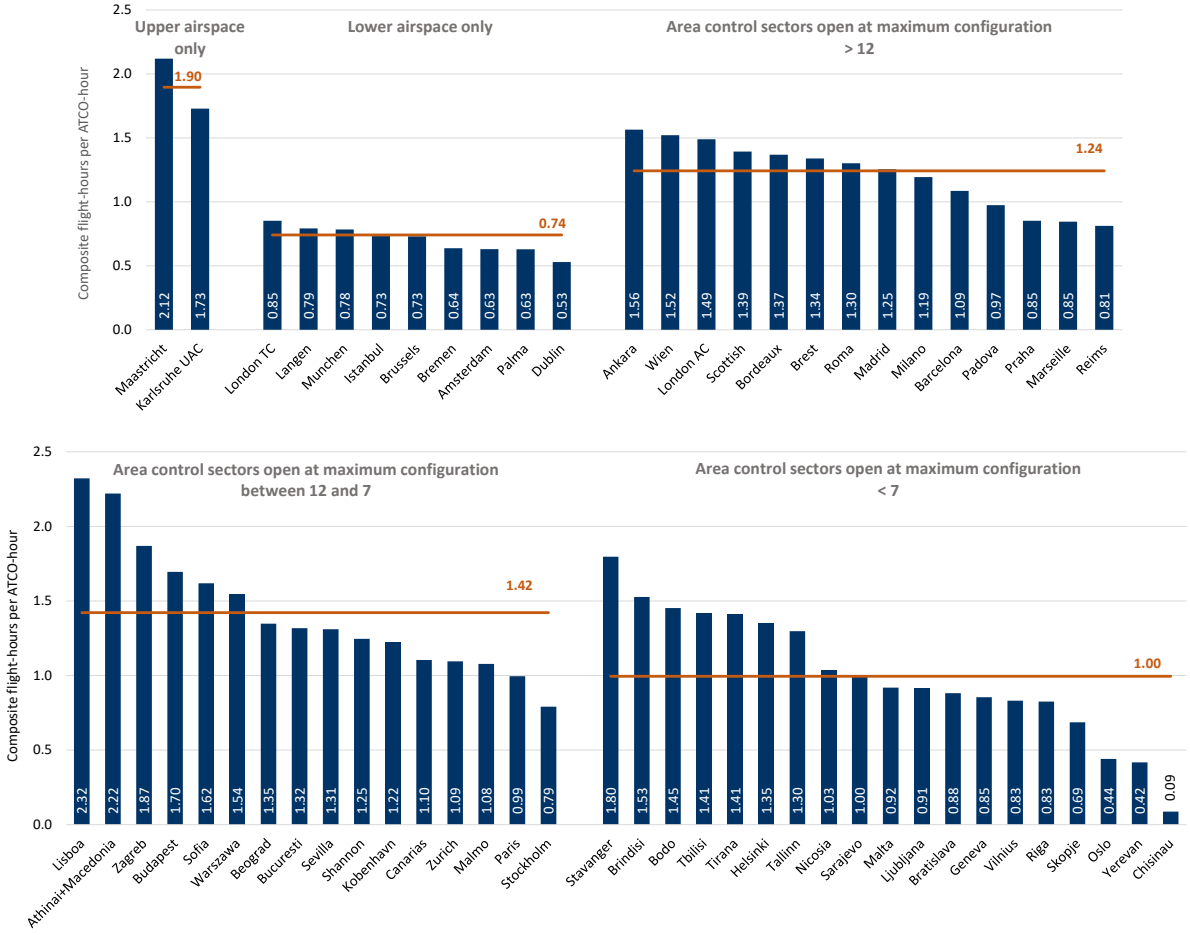


Figure 3.15: Summary of productivity results at ACC level, 2023

Each cluster is briefly described below:

- **Cluster 1 (two ACCs serving upper airspace only)** has the highest average productivity of the five (1.90 IFR flight-hours per ATCO-hour). However, these two ACCs generated 19% of the Pan-European en-route ATFM delays in 2023. This result is driven mostly by Karlsruhe UAC, which generated the highest number of ATFM delays among all the Pan-European ACCs in 2023 (around 2.9 million minutes of en-route ATFM delays).
- **Cluster 2 (nine ACCs serving predominantly lower airspace)** has the lowest average ATCO-hour productivity of the five clusters (0.74 flight-hours per ATCO-hour). The ACCs included in this cluster generated some 11% of en-route ATFM delays at Pan-European level. Munchen ACC accounted for 60% of all en-route ATFM delays generated in this cluster (around 1.1 million minutes).
- **Cluster 3 (14 ACCs with more than 12 sectors at maximum configuration)** has an average productivity of 1.24 flight-hours per ATCO-hour. These ACCs controlled approximately 43% of the traffic at Pan-European level in terms of IFR flight-hours, with Ankara ACC recording the highest number of IFR flight-hours controlled among all Pan-European ACCs. Some 38% of the Pan-European system's en-route ATFM delays were generated by these ACCs. In 2023, Reims and Marseille ACCs recorded 57% of all en-route ATFM delays generated in this cluster (around 3.7 million minutes).
- **Cluster 4 (16 ACCs with 7 to 12 sectors at maximum configuration)** has an average productivity of 1.42 flight-hours per ATCO-hour. This cluster includes Lisboa, Athinai and Macedonia, and Zagreb ACCs, which are among the five ACCs with the highest productivity in 2023 (2.32, 2.22, and 1.87 flight-hours per ATCO-hour, respectively). Overall, 31% of ATFM

delays at system level were generated by ACCs in this cluster, 49% of which was recorded by Paris and Budapest ACCs (around 2.6 million minutes).

- **Cluster 5 (19 ACCs with less than 7 sectors at maximum configuration)** has an average productivity of 1.00 flight-hours per ATCO-hour, which ranks as the second lowest among the five clusters. However, it includes Stavanger ACC, which has the fifth highest ACC productivity (1.80) among the ACE sample in 2023. These ACCs represent approximately 1.0% of total en-route ATFM delays at the system level. It is noteworthy that low productivity in some of these ACCs may be a consequence of their small size and the challenges in adapting their available ATC capacity and existing infrastructure to low traffic volumes.

The analysis of ATCO-hour productivity at ACC level presented in Figure 3.15 suggests that, while their operational characteristics are helpful in categorising ACCs into broadly consistent groups, large differences in productivity performance persist among individual ACCs within these clusters.

3.3 ATCOs in OPS employment costs

In 2023, ATCO employment costs per ATCO-hour rose by +2.1% compared to 2022 but remained - 1.6% lower than in 2019. Except for 2020, when ANSPs had to adapt working hours in OPS to very low traffic levels without having the possibility to reduce employment costs in a similar proportion, the average employment cost per ATCO-hour remained relatively stable in real terms between 2018 and 2023. At Pan-European system level, the increase in ATCO-employment costs per ATCO-hour in 2023 reflects the fact that ATCO in OPS employment costs (+4.2%) rose faster than ATCO-hours on duty (+2.0%).

Figure 3.16 presents the changes in ATCO in OPS employment costs and employment costs per ATCO-hour between 2022 and 2023 (both in percentage and absolute value) at ANSP level. The small lines in the third and fifth columns show the trends between 2019 and 2023. These trends are illustrative and represent the minimum and maximum values set to each ANSP individual situation. Hence, they should not be used to directly compare the magnitude of the variations across ANSPs.

The fourth column of Figure 3.16 highlights that in 2023, ATCO employment costs per ATCO-hour rose for 23 out of 38 ANSPs as in many cases total ATCO in OPS employment costs rose faster than ATCO hours on duty.

Four ANSPs showed increases in ATCO in OPS employment costs greater than +20%: DHMI (+29.4%), LFV (+23.2%), Sakaeronavigatsia (+21.6%) and NAV Portugal (+21.5%). In absolute terms, the most significant increases were observed for DFS (+€36.2M), DHMI (+€30.1M), LFV (+€19.4M) and NAV Portugal (+€14.1M).

- For DHMI, this increase reflects a higher number of ATCOs in OPS (+6.0%, +104 FTEs) combined with higher employment costs per ATCO-hour (+19.7%). The increase in unit employment costs mainly results from government decisions applied to all public employees.
- For LFV, a slight decrease in the number of ATCOs in OPS (-2.0%, -8 FTEs) was outweighed by an increase in employment costs per ATCO-hour (+27.6%). This increase was due to extraordinary contributions to the pension fund resulting from the inflation indexation of the pension debt.
- In the case of Sakaeronavigatsia, the increase is entirely due to higher employment costs per ATCO-hour (+21.6%), while the number of ATCOs in OPS remained unchanged. Higher unit employment costs resulted from an increase in salaries and bonuses to incentivise staff to accommodate increases in the level of traffic (+53.7%).
- For NAV Portugal, the increase primarily results from higher employment costs per ATCO-hour (+18.7%), coupled with +3.0% (+6 FTEs) increase in the number of ATCOs in OPS. This increase is driven changes to pension plans.

- For DFS, the increase in employment costs for ATCOs in OPS (+8.0%) mainly results from the payment of incentives for ATCOs to work additional shifts on a voluntary basis in case of staff shortages.

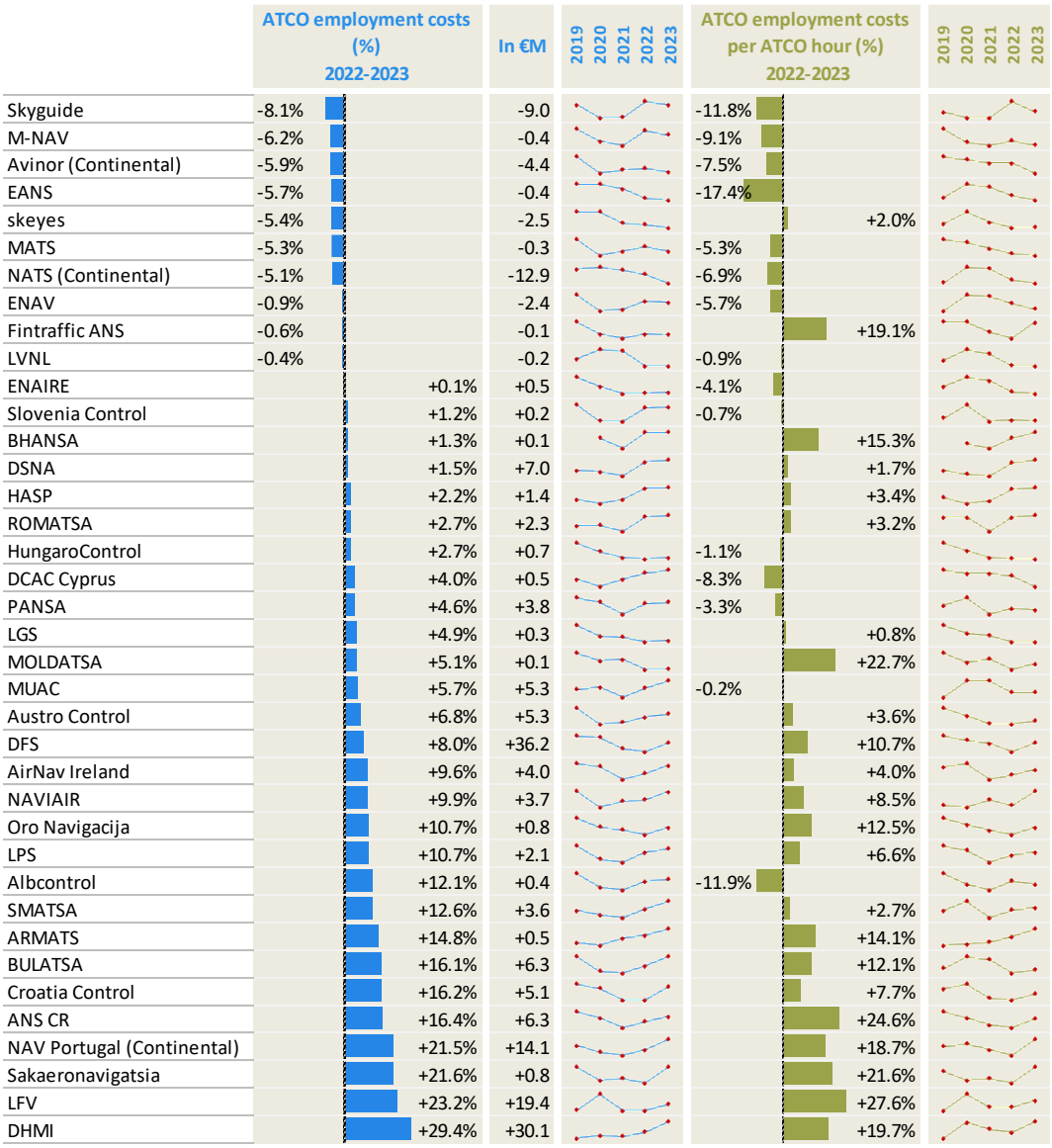


Figure 3.16: Changes in ANSPs ATCO in OPS employment costs (real terms)

On the other hand, 10 ANSPs reported lower ATCO in OPS employment costs in 2023. For seven of them the decrease was greater than -5%, with Skyguide (-8.1%, or -€9.0M) and M-NAV (-6.2%, or -€0.4M) showing the greatest relative reductions. In absolute terms, the most significant reductions were observed for NATS (-€12.9M) and Skyguide (-€9.0M) in real terms.

The ATCO employment costs per ATCO-hour at Pan-European system level amounted to €142 in 2023. Figure 3.17 shows the values for this indicator for all the ANSPs.

As in previous years, MUAC (€341) shows the highest ATCO employment costs per ATCO-hour, standing well above DFS (€285) and Skyguide (€214), which rank second and third, respectively. Conversely, the ANSPs with the lowest ATCO employment costs per ATCO-hour in 2023 were Albcontrol (€36), Sakaeronavigatsia (€30) and MOLDATSA (€27).

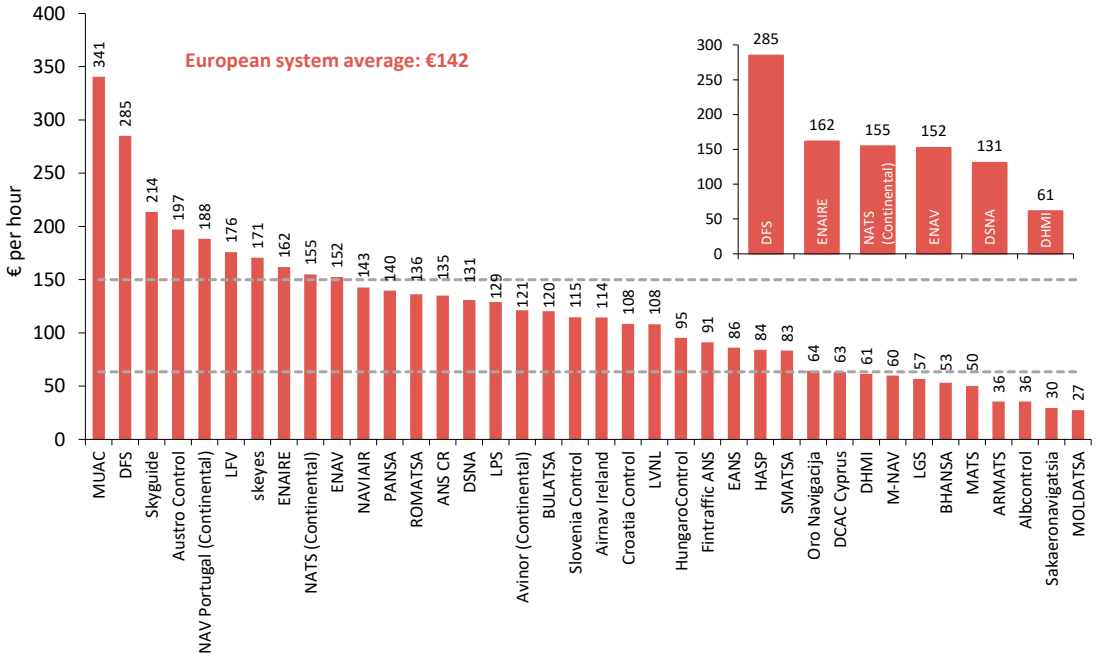


Figure 3.17: ATCO employment costs per ATCO-hour (gate-to-gate), 2023

A major exogenous factor contributing to differences in unit employment costs is the difference in prevailing market wage rates within the national economies. This discrepancy is also associated with differences in the cost of living. Although there are inherent limitations to the use of Purchasing Power Parity (PPP),[12] Figure 3.18 shows the ATCO employment costs per ATCO-hour both before and after adjustment for PPPs. For further details, Annex 4 of this report provides the PPPs for each State/ANSP in 2023, as available from EUROSTAT and IMF databases.

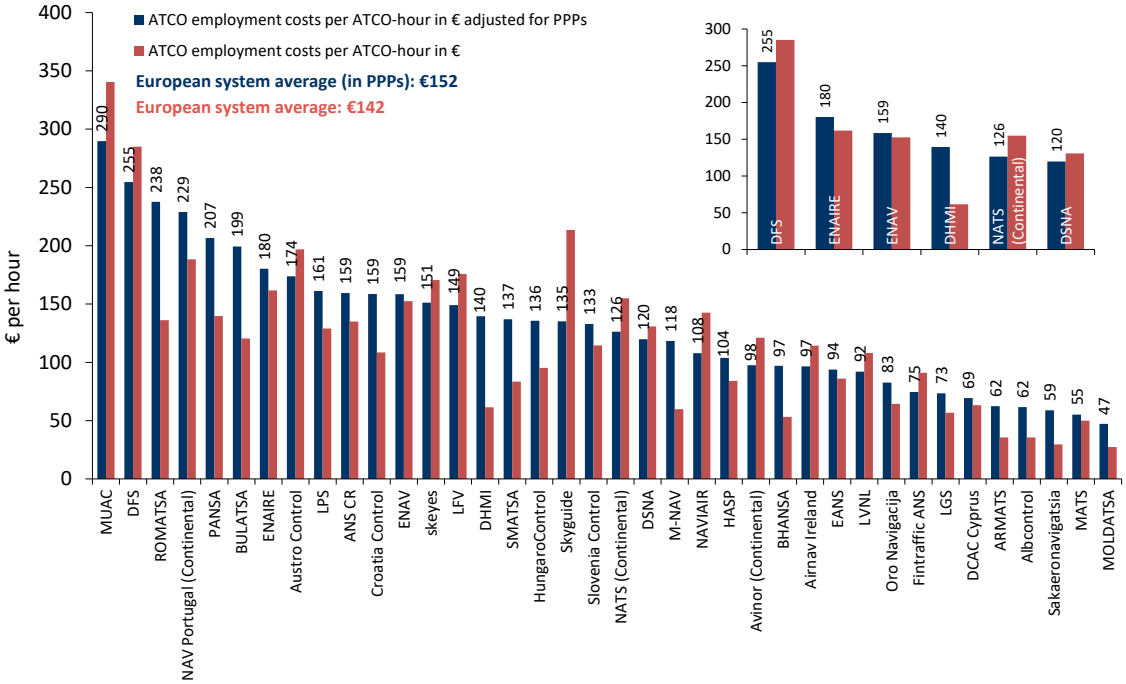


Figure 3.18: ATCO employment costs per ATCO-hour with and without PPPs, 2023

[12] For instance, it is possible that for a given country, the cost of living in regions where the ANSP headquarters and other main buildings (e.g. ACCs) are located is higher than the average value computed at national level.

After PPP adjustment, the average unit employment costs per ATCO-hour amounts to €152 (compared to €142 without adjustment). For ANS CR, BULATSA, Croatia Control, LPS, PANSA and ROMATSA, this adjustment brings their employment costs per ATCO-hour from below to above the European system average. Similarly, among the six largest ANSPs, DHMI employment cost per ATCO-hours on duty (€61) is considerably lower compared to the other five ASNPs. However, after PPP adjustment, the employment cost per ATCO-hours of DHMI rises to €140, standing between NATS (€126) and ENAV (€159).

The ACE data analysis does not put a significant weight on the results obtained from PPP adjustments. Nevertheless, PPPs are a valuable analytical tool for international benchmarking.

Figure 3.19 shows the ATCO employment costs per composite flight-hour in 2023.

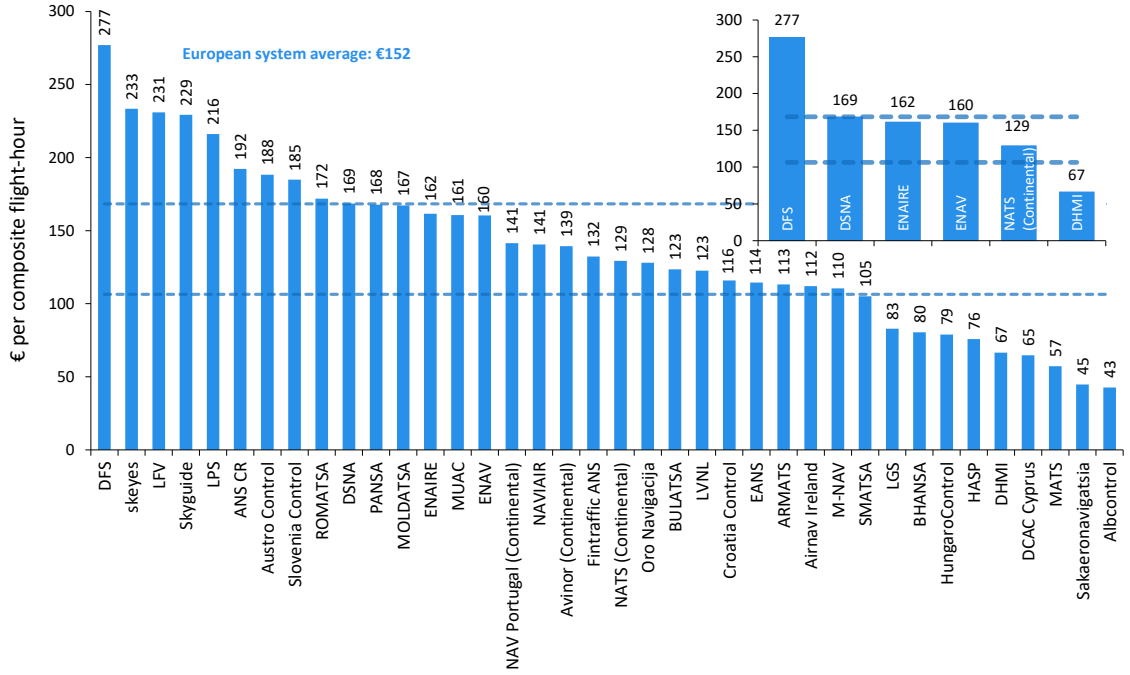


Figure 3.19: ATCO employment costs per composite flight-hour, 2023

This indicator results from combining two of the main components of the financial cost-effectiveness indicator: ATCO-hour productivity (Figure 3.14) and employment costs per ATCO-hour (Figure 3.17). All else being equal, lower ATCO employment costs per unit of output contribute to greater financial cost-effectiveness. As an illustration, an ANSP may have high ATCO employment costs per ATCO-hour, but if their ATCOs are highly productive, it will result in relatively lower employment costs per composite flight-hour.

Employment costs are typically subject to complex bargaining agreements between ANSPs management and staff representatives. They are usually embedded within collective agreements for a specific period. In some cases, salary conditions are negotiated every year. As indicated above, high ATCO employment costs may be offset by high productivity. Therefore, in the context of staff planning and contract renegotiation, it is important for ANSPs to effectively manage ATCO employment costs and set quantitative objectives for ATCO productivity, while ensuring sufficient capacity to minimise ATFM delays. The link between ATCOs and ATFM delays is analysed in more detail in section 4.3.

3.4 Support costs

In 2023, unit ATM/CNS support costs fell by -8.0% compared to 2022, reaching €308. This decrease mainly reflects the fact that total support costs rose at a slower pace (+2.2%) than composite flight-hours (+11.1%).

Figure 3.20 illustrates the changes in support costs (expressed in real terms) per composite flight-hour. In 2023, unit ATM/CNS support costs fell by -8.0% compared to 2022 (down from €334 to €308). This mainly reflects the fact that traffic rose much faster (+11.1%) than total support costs (+2.2%).

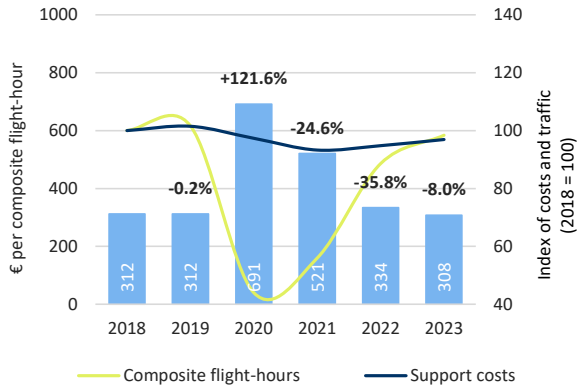


Figure 3.20: Changes in support costs (real terms) per composite flight-hour, 2018-2023

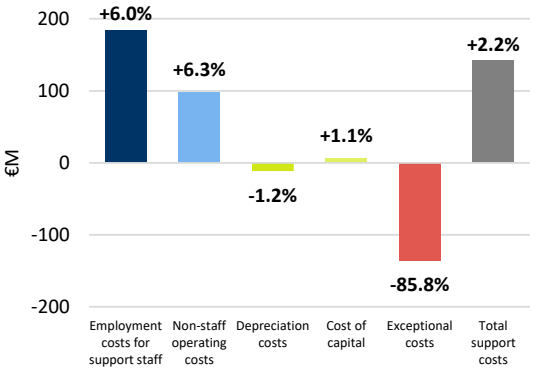


Figure 3.21: Breakdown of changes in support costs, 2022-2023 (real terms)

The year 2023 therefore marks a second consecutive year of increase in total support costs, after two years of reductions. This reflects the fact that a few ANSPs recorded relatively large staff cost increases relating to salary adjustments or extraordinary pension contributions. For some ANSPs, it also reflects the release of temporary cost saving measures implemented during the COVID-19 crisis.

As shown in Figure 3.21 total support costs increased by +€141.9M (or +2.2%) in 2023, primarily driven by higher employment costs for support staff (+€183.9M or +6.0%) and non-staff operating costs (+€98.5M or +6.3%).

Exceptional costs fell in 2023 (-€135.7M, or -85.8%), mainly due to the fact that in 2022, these costs comprised a very large amount (€141.7M) associated with ENAIRE, to cover retroactive adjustments of future liabilities to ATCOs being placed under a specific regime called "Special Active Reserve", following the application of Law 26/2022.

Meanwhile, the depreciation costs (-€11.4M, or -1.2%) and the cost of capital (+€6.7M, or +1.1%) remained relatively stable.

At Pan-European system level, when considering the savings achieved in 2020 and 2021, ANSPs' support costs in 2023 were still -€329.0M (-4.8%) lower than in 2019.

Since employment costs for support staff represent half (50%) of the total support costs, the remainder of this section focuses on the changes observed in the number of support staff. It first looks at long-term trends (see Figure 3.22 and Figure 3.23) and then puts the focus on the 2022-2023 period (see Figure 3.24).

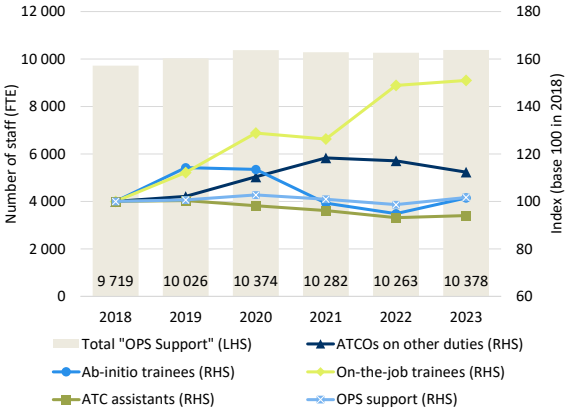


Figure 3.22: Changes in support staff relating to OPS activities (2018-2023)

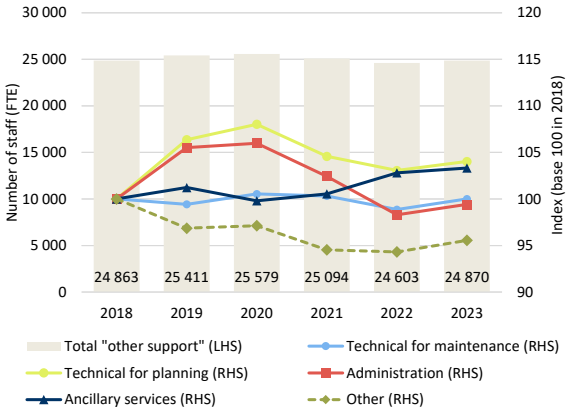


Figure 3.23: Changes in other support staff categories (2018-2023)

Figure 3.22 shows that, between 2018 and 2023, the number of support staff working on activities closely associated with ATC operations (including ATCOs on other duties, ab-initio and on-the-job trainees, ATC assistants and OPS support) increased by some +6.3% (+609 FTEs). This growth was mainly driven by substantial increases in the number of on-the-job trainees (+435 FTEs), partially offset by a reduction in the number of ATC assistants (-123 FTEs).

When considering the total number of support staff dedicated to "other" activities (those less directly connected to ATC operations, as shown in Figure 3.23), a slight decrease is observed in 2023 compared to 2018 (-1.1% or -274 FTEs). There were significant reductions in administration staff (- 124 FTEs) and staff allocated to other activities (i.e. security staff, drivers, etc.), which decreased by -177 FTEs during this period.

In 2020, some ANSPs implemented a range of cost-cutting measures affecting staff numbers, such as redundancies, or early retirement schemes. The impact of these measures became apparent in 2021 and 2022, resulting in a significant decrease in the total number of support staff.

Support staff categories	Changes over 2022-2023	in FTEs
ATCOs on other duties	-4.1%	-99
Ab-initio trainees	+7.0%	+59
On-the-job trainees	+1.4%	+18
ATC assistants	+0.9%	+17
OPS support (non-ATCOs)	+3.1%	+120
Technical support staff for operational maintenance, monitoring and control	+1.2%	+99
Technical support staff for planning and development	+0.9%	+29
Administration	+1.1%	+96
Staff for ancillary services	+0.5%	+9
Other Staff	+1.3%	+34
Total number of support staff	**+1.1%**	**+382**

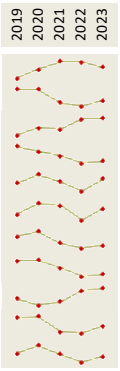


Figure 3.24: Changes in the number of support staff by category, 2022-2023

In 2023, while traffic volumes converged towards pre-crisis levels, the total number of support staff increased by +1.1% (+382 FTEs). This was mainly due to an increase in the number of OPS support staff (+120 FTEs), technical support staff engaged in operational maintenance, monitoring, and control activities (+99 FTEs) and administration staff (+96 FTEs). The only staff category decreasing within the support staff group was ATCOs on other duties (-99 FTEs) reflecting the fact that ATCOs allocated to other activities in 2020-21 continued to go back into operations in 2023 as traffic was bouncing back.

It is noteworthy that both ab-initio trainees (+7.0%) and on-the-job trainees (+1.4%) increased in 2023. It will be interesting to closely monitor these trends, as the availability (or lack thereof) of ATCOs could potentially impact the level of capacity provided by ANSPs as traffic continues to grow.

Figure 3.25 shows the changes for ANSPs between 2022 and 2023 in total support costs (in percentage and absolute values) and in the different categories of support costs (in percentage). In 2023, support costs rose for 26 out of 38 ANSPs, with substantial increases (i.e. above +€20M) observed for DHMI (+€61.9M, or +12.0%), Skyguide (+€50.3M or +16.3%), LVNL (+€32.0M or +15.9%) and ROMATSA (+€23.2M or +13.7%).

Support costs increases were also significant in relative terms for NAV Portugal (+22.4%, or +€18.4M), LFV (+20.9% or +€19.9M), MOLDATSA (+19.1%, or +€1.2M), LPS (+17.5%, or +€8.1M), Slovenia Control (+12.8%, or +€3.1M), Sakaeronavigatsia (+11.2%, or +€3.4M) and skeyes (+10.1%, or +€15.6M).

- DHMI recorded increases across all support cost categories, notably in support staff costs (+26.0%, or +€24.2M) and non-staff operating costs (+13.2%, or +€25.3M). Staff costs were affected by government measures to address the falling purchasing power of public civil servants, including inflation adjustments and one-off flat rate increases in salaries. These changes occurred amid extraordinarily high inflation in Türkiye (54.0% in 2023 and 72.3% in 2022). At the same time, increases in energy prices, repair and maintenance expenses as well rise in insurance premiums, following devastating earthquakes in southern-east Türkiye, resulted in a substantial increase in non-staff operating costs.
- For Skyguide, the observed increase reflects higher support staff costs (+28.0%, or +€43.3M) mainly due to the refinancing of the pension fund. Non-staff operating costs also showed a relatively large increase (+15.7%, or +€11.8M) primarily due to rising administrative expenses and costs associated with resilience projects as some systems and equipment were becoming obsolete and requiring additional maintenance. With some of these assets becoming fully depreciated, depreciation costs and the cost of capital reduced (-14.4% and -19.7%, respectively).
- In the case of LVNL, increases were observed across all support cost categories, notably in the support staff costs (+10.0%, or +€12.9M), non-staff operating costs (+15.4%, or +€8.4M) and cost of capital (+521.6%, or +€8.2M). The observed increase in support staff costs was partially due to the release of provisions linked with an update of actuarial assumptions reducing overall 2022 staff costs. Higher non-staff operating costs resulted from higher energy prices, outsourcing and externalisation of ATCO training, while the cost of capital was affected by an increase in the Dutch interest rate from 1.9% to 3.9%.
- ROMATSA's increase mainly came from higher support staff costs (+19.6% or +€23.9M). This increase resulted from higher pensions costs, compensation for high inflation and bonuses paid to en-route staff for achieving their performance targets and handling a higher traffic in 2023.

At the same time, three ANSPs recorded significant decreases in total support costs (i.e. greater than -5% and -€5M), namely ENAIRE (-11.6%, or -€65.4M), Austro Control (-8.6%, or -€15.0M), and ENAV (-5.0%, or -€24.8M).

- In the case of ENAIRE this is mainly due to the fact that exceptional costs in 2022 included a very large amount (€141.7M) to cover retroactive adjustments of future liabilities to ATCOs being placed under a specific regime called "Special Active Reserve", following the application of Law 26/2022. The decrease in exceptional costs was partially offset by increases in support staff costs (+23.8%, or +€54.8M), depreciation (+11.9%, or +€11.3M) and cost of capital (+46.3%, or +€12.1M).
- For Austro Control the decrease resulted from reductions in real terms in all categories of support costs, mainly support staff costs (-10.1%, or -€10.9M) following the significant increases recorded in 2021 (+26.5%) and 2022 (+19.0%).
- Similarly, for ENAV, decreases in real terms were observed across all support cost categories, mainly reflecting milder changes in costs in nominal terms in the context of a +5.9% rate of inflation.

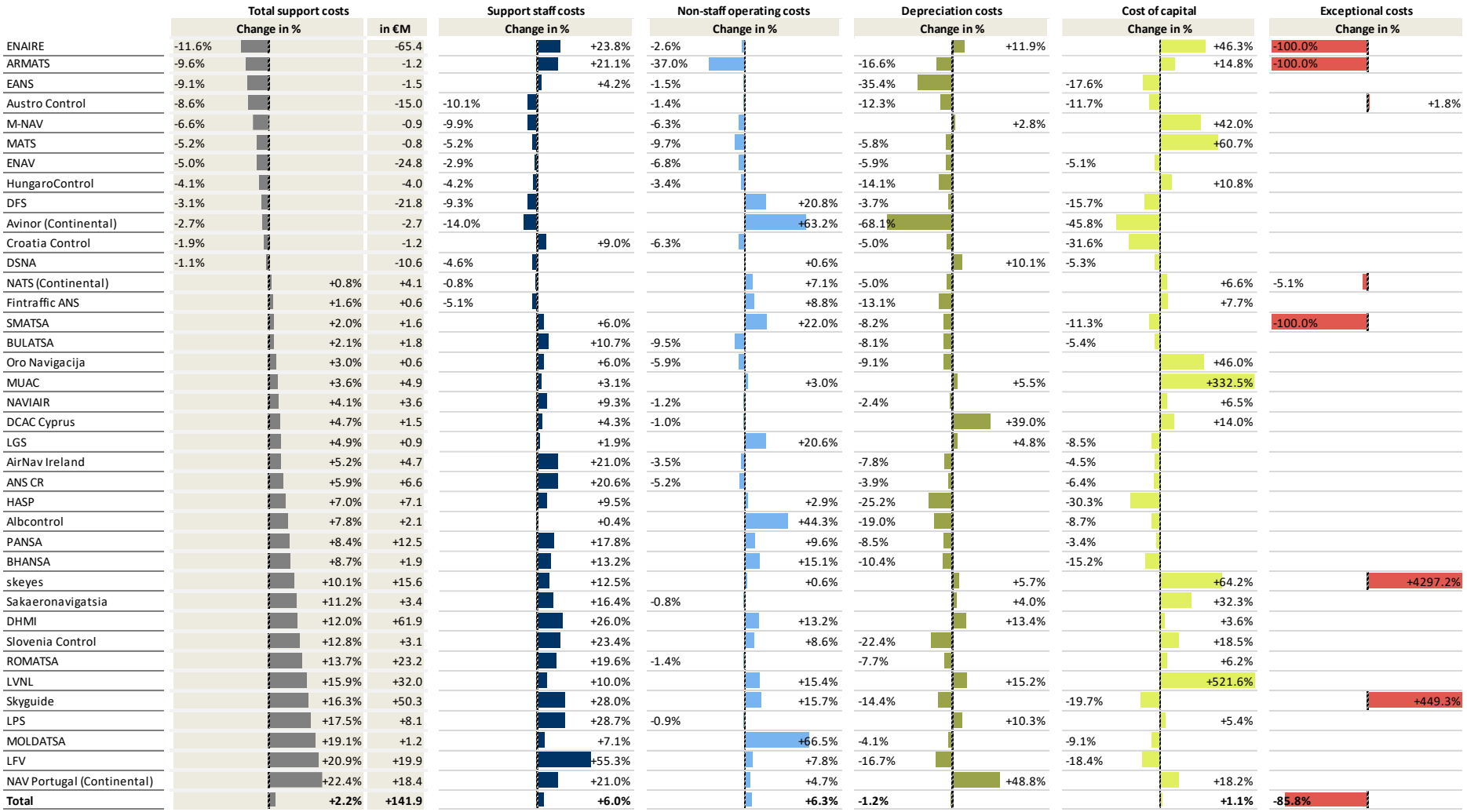


Figure 3.25: Changes in the components of support costs, 2022-2023 (real terms)

In 2023, at Pan-European system level, the average support costs per composite flight-hour stood at €308. Nevertheless, Figure 3.26 shows significant differences in the levels of unit support costs across ANSPs. The two dotted lines represent the bottom and the top quartiles (€238 and €362, respectively) and provide an indication of the dispersion across ANSPs, which reaches a factor of 7.3 between skeyes (€895) and HASP (€122). LVNL (€809) and Skyguide (€801) come second and third, respectively, in terms of unit support costs. Conversely, DCAC Cyprus (€152) and MATS (€150) are the ANSPs with the second and third lowest unit support costs, respectively.

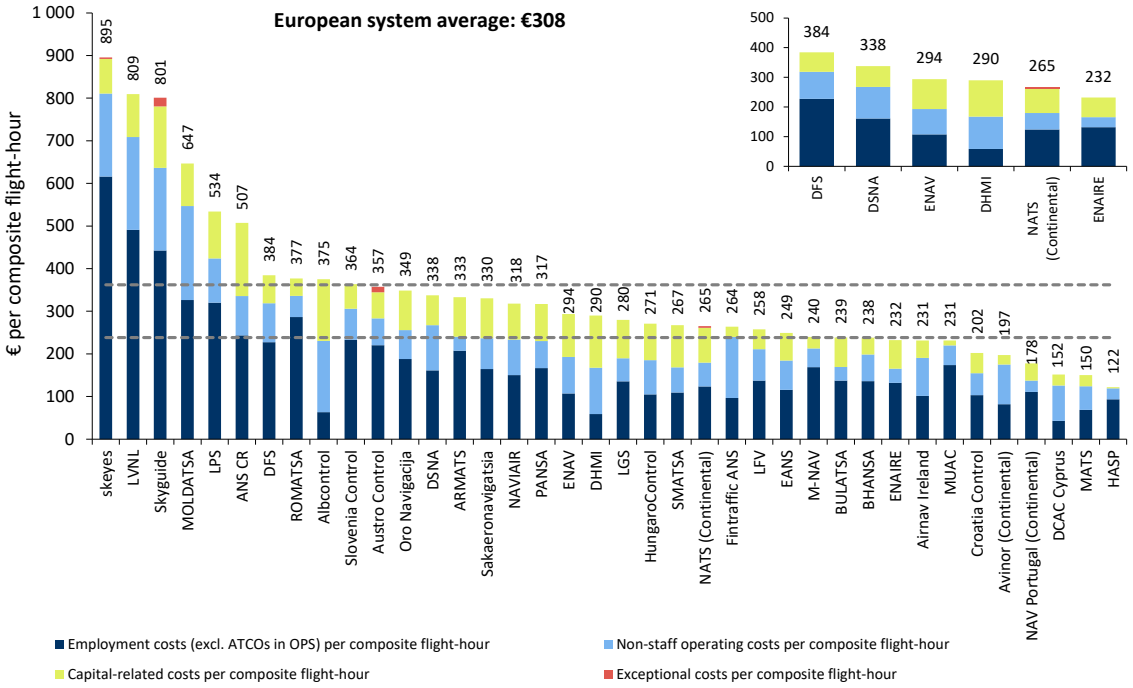


Figure 3.26: Support costs per composite flight-hour at ANSP level, 2023

In 2023, the unit support costs of various ANSPs operating in Central and Eastern European countries (e.g. MOLDATSA, LPS, ANS CR, ROMATSA, Albcontrol and Slovenia Control) were higher than the Pan-European system average and above the unit support costs of ANSPs operating in some Western European countries (such as DSNA, ENAV and NATS) where the living standards are higher. This partly explains why for some of these ANSPs, unit ATM/CNS provision costs were higher than the Pan-European system average (see also Figure 3.1).

Figure 3.27 shows the employment costs (excluding ATCOs in OPS) per composite flight-hour both before and after adjusting for PPP. While the adjustment reduces the dispersion of this indicator, there are still significant differences in unit employment costs for support staff across ANSPs.

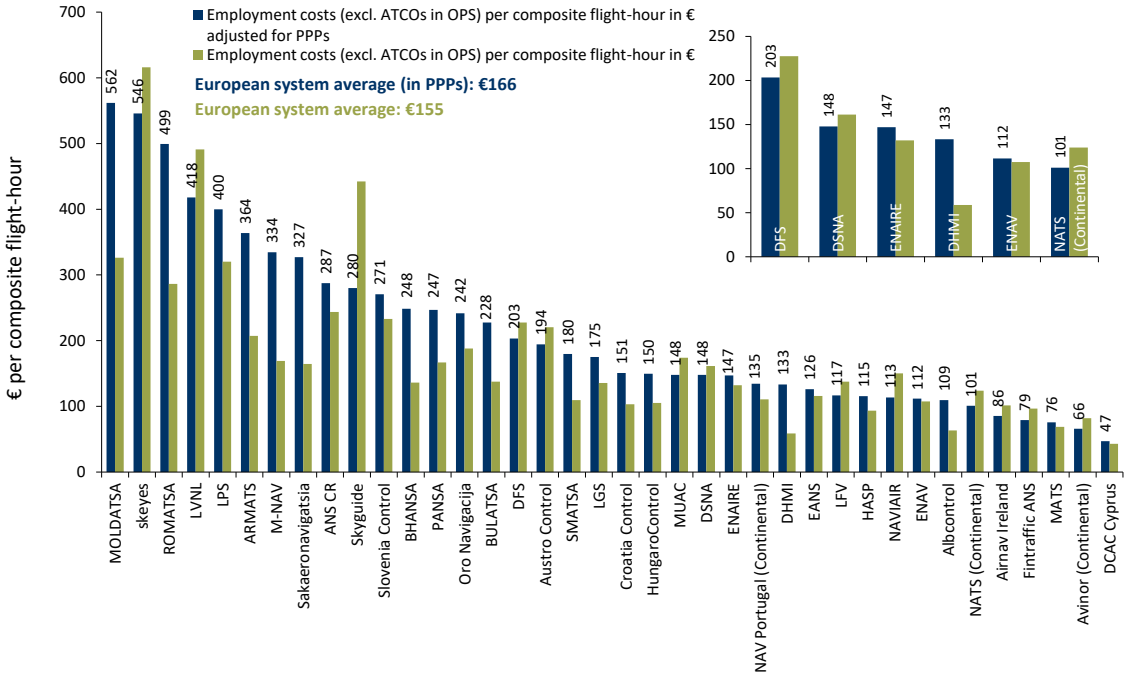


Figure 3.27: Employment costs (excl. ATCOs in OPS) with and without adjustment for PPPs, 2023

Similarly to overall unit support costs, the unit employment costs adjusted for PPP in many Central and Eastern European ANSPs (such as MOLDATSA, ROMATSA, LPS, ARMATS, M-NAV, Sakaeronavigatsia, ANS CR, BHANSA, PANSA and BULATSA) are higher than those operating in Western Europe. While there are exceptions to this trend, such as DHMI and Albcontrol, these differences highlight some challenges worth monitoring as there seems to be increasing upward pressure on employment costs for these ANSPs. Effectively managing non-ATCO in OPS employment costs is crucial to sustaining the current staffing levels and associated employment costs.

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4. ECONOMIC COST-EFFECTIVENESS ANALYSIS

In 2023, ATFM delays reached 24.5M minutes, equivalent to levels observed in 2018 and 2019 which were years marked by significant capacity issues. As a result, the share of ATFM delays in the unit economic costs amounted to 24%, an increase from 20% in 2022.

An assessment of ANS performance should consider not only the direct costs associated with ATM/CNS provision, but also the indirect costs incurred by airspace users, such as delays, additional flight time, or fuel burn, while ensuring compliance with ANS safety standards. The PRC introduced the concept of economic cost-effectiveness in its ACE benchmarking reports. This indicator is defined as the gate-to-gate ATM/CNS provision costs (detailed in Chapter 3) plus the costs of ground ATFM delays[13,14] for both en-route and airport operations, all expressed per composite flight-hour.

This chapter first sets out the situation and trends at a Pan-European level as of 2023, analysis at the ANSP level is then set out. This is followed by more focused analysis on specific ANSPs that were the main contributors to the delays experienced in 2023.

4.1 Trends at Pan-European level

In 2023, ATFM delays across the Pan-European system reached 24.5M minutes, equivalent to levels observed in 2018 and 2019 when several ANSPs experienced significant capacity issues. As shown in Figure 4.1, this growth has happened alongside the continued rebound in traffic following the COVID-19 pandemic, however 2023 delays per composite flight-hour slightly exceeded the level in 2018. As such the share of ATFM delays in the unit economic costs amounted to 24.3%, an increase from 20.3% in 2022.

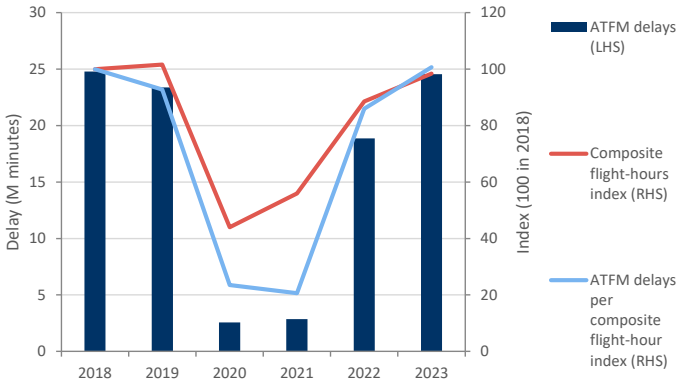


Figure 4.1: ATFM delays and traffic, 2018-2023

In this context, Figure 4.2 analyses the changes in economic cost-effectiveness between 2018 and 2023 at Pan-European system level. The left-hand side chart illustrates the changes in unit economic costs, while the right-hand side graph provides complementary information on the year-on-year changes in ATM/CNS provision costs, composite flight-hours, and unit costs of total ATFM delays.

[13] The cost of ATFM delays (€127 per minute in 2023) is based on the findings of the study "European airline delay cost reference values" conducted by the University of Westminster in March 2011 and updated in December 2015 (the value is adjusted annually based on EU-27 average inflation rate). Further details on the computation of the economic costs per composite flight-hour at ANSP and Pan-European system level are available in Annex 2 of this report and in the ACE handbook.

[14] ATFM delays analysed in this report take into account the changes due to the post operations and eNM measures adjustment processes. All delay causes are considered. See Annex 2 – Performance indicators used for the comparison of ANSPs for more information.

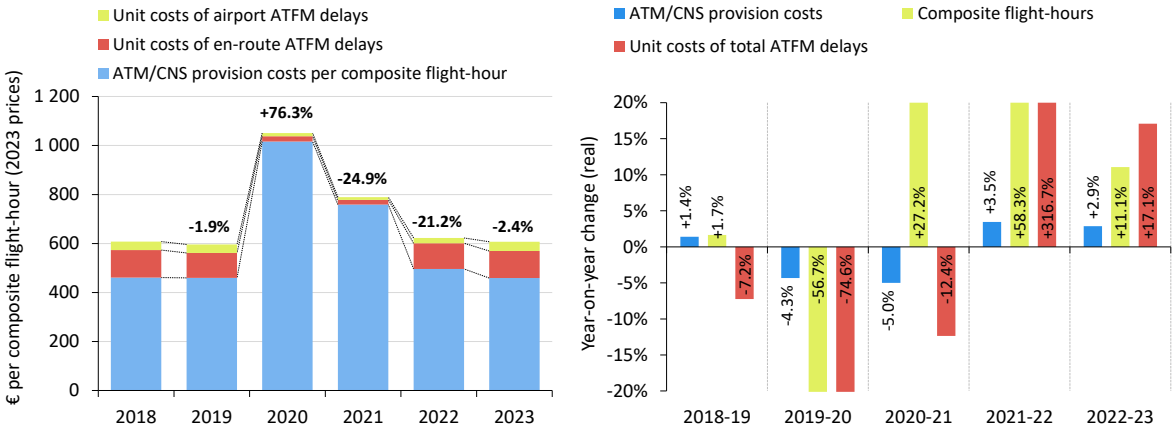


Figure 4.2: Changes in unit economic costs (2018-2023, real terms)

Figure 4.2 shows that in 2023, unit economic costs fell by -2.4% compared to 2022 on the basis that traffic rose faster (+11.1%) than ATM/CNS provision costs (+2.9%), while the unit costs of ATFM delays also increased (+17.1%). The growth rate of composite flight-hours represents a marked slowdown from the change observed in 2022 (which was +58.3%), as the system came closer to reaching pre-pandemic levels. The increase in delays, however, signifies a swift return to the exceptional levels experienced pre-pandemic in 2018 and 2019. As a result, the economic costs per composite flight-hour reached in 2023 a level in line with that observed in 2018.

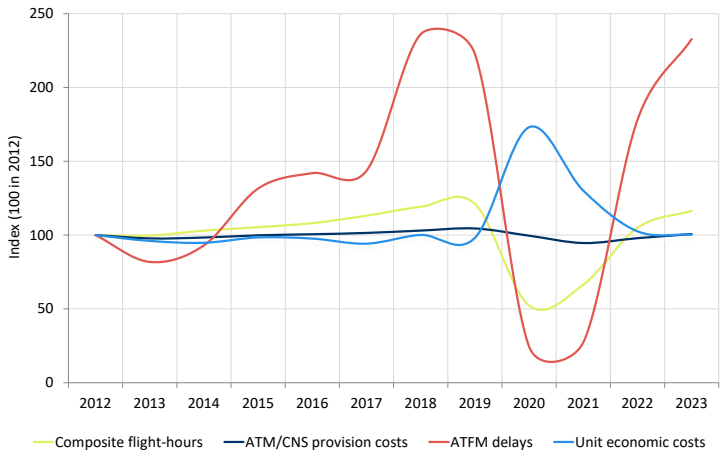


Figure 4.3: Long-term trends in traffic, ATM/CNS provision costs and ATFM delays (2012-2023)

Figure 4.3 illustrates the long-term trends in ATM/CNS provision costs, composite flight-hours, ATFM delays[15] and unit economic costs. ATM/CNS provision costs remained relatively stable between 2012 and 2023, with the largest amount recorded in 2019 (+4.5% above 2012) and the lowest in 2021 (-5.4% below 2012). The level of costs in 2023 was close to the values observed in 2012.

2012-2019 was a period of sustained traffic growth, during which ATFM delays rose significantly, reaching a peak in 2018 (+136.2% above 2012). Consequently, the rising unit costs of ATFM delays outweighed the reductions in unit ATM/CNS provision costs.

[15] ANSPs observed that using the Ready Message (REA) to improve flight punctuality could artificially alter ATFM delay calculations for individual flights and the requesting ANSP. They raised this issue with the Network Management Board (NMB). In collaboration with airspace users and the NM, a more accurate process was developed to prevent such distortions. This new process was approved by the NMB in March 2015 and implemented in April 2016. The unit costs of ATFM delays in the ACE report were affected by this change in the EUROCONTROL Network Manager's delay calculation methodology in April 2016, resulting in notably less delays compared to earlier years. While this impacts trends from 2013-2018, it does not affect changes from 2017 onwards. More information on this adjustment is available at: https://ansperformance.eu/methodology/atfm-delay-calculation/.

After the sudden drop in traffic caused by the COVID-19 crisis, ATFM delays fell to historically low levels in 2020 and 2021 but rebounded quickly in 2022 and subsequently in 2023.

Figure 4.4 illustrates the breakdown of ATFM delays by segment and reason for the delay (after post-operations and eNM adjustments),[16] using data recorded in the Network Manager database. The majority of ATFM delays generated at the Pan-European system level in 2023 were associated with en-route ATFM delays (74.3%), primarily related to en-route ATC capacity and staffing issues (42.1%), followed by en-route weather-related events (29.4%) and other en-route constraints (28.5%).

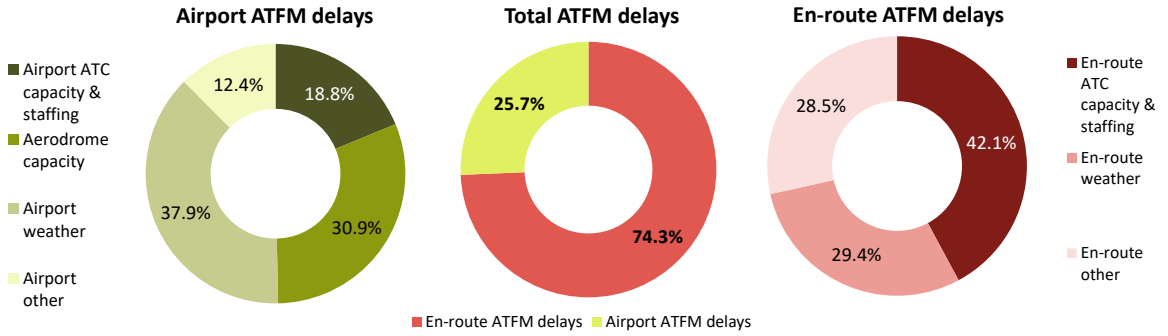


Figure 4.4: Causes of en-route and airport ATFM delays at system level (2023)

The Performance Scheme regulation[17] identifies the delays categories that are considered in the context of setting the en-route capacity incentives scheme for ANSPs operating under SES regulations. These delays exclude those relating to weather (W), industrial actions (I) and other issues (O). For the purposes of the analysis developed in this report, delays attributed to industrial actions and other reasons are included in the en-route "Other" category (see the pink portion of the right-hand side ring in Figure 4.4).

In 2023, airport ATFM delays represented 25.7% of the total ATFM delays, with 37.9% of these attributed to weather-related events at airports, followed by 30.9% being capacity problems at aerodromes. While they also deserve attention, airport ATC capacity and staffing issues (18.8%) are to a lesser extent directly attributable to ANSPs.

Figure 4.5 shows the breakdown of ATFM delays into a) airport and en-route ATC capacity and staffing related delays, b) aerodrome capacity delays, c) weather delays, and d) all other delay reasons, for the 2012-2023 period. It shows that between 2013 and 2019, the increase in ATFM delays was mainly associated with ATC capacity and staffing issues (see dark blue portion of the bars). In 2023, the overall amount of ATC capacity and staffing related delays increased by +7.2% from 2022, reaching 8.9M minutes although their share in the total fell by -7.7 percentage points. In 2023, weather-related delays grew

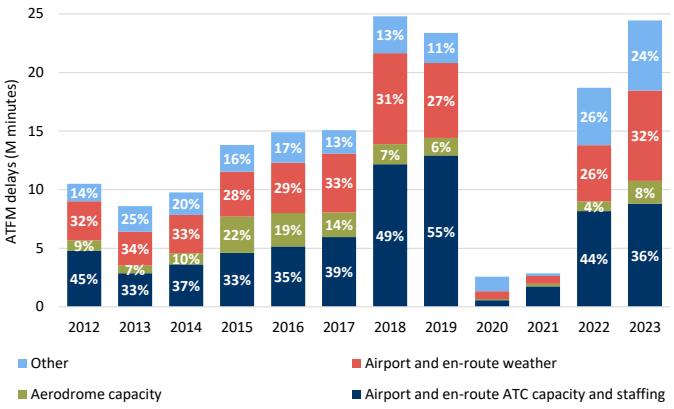


Figure 4.5: Changes in main reasons for ATFM delays (2012-2023)

[16] See Annex 2 – Performance indicators used for the comparison of ANSPs for more information.

[17] Commission Implementing Regulation (EU) 2019/317 laying down a performance and charging scheme in the single European sky available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019R0317.

by +58.6%. Analysis presented in the latest Performance Review Report[18] indicates that the situation continued to worsen in 2024, with further increases in en-route ATC capacity as well as in weather delays.

4.2 ANSPs' economic cost-effectiveness in 2023

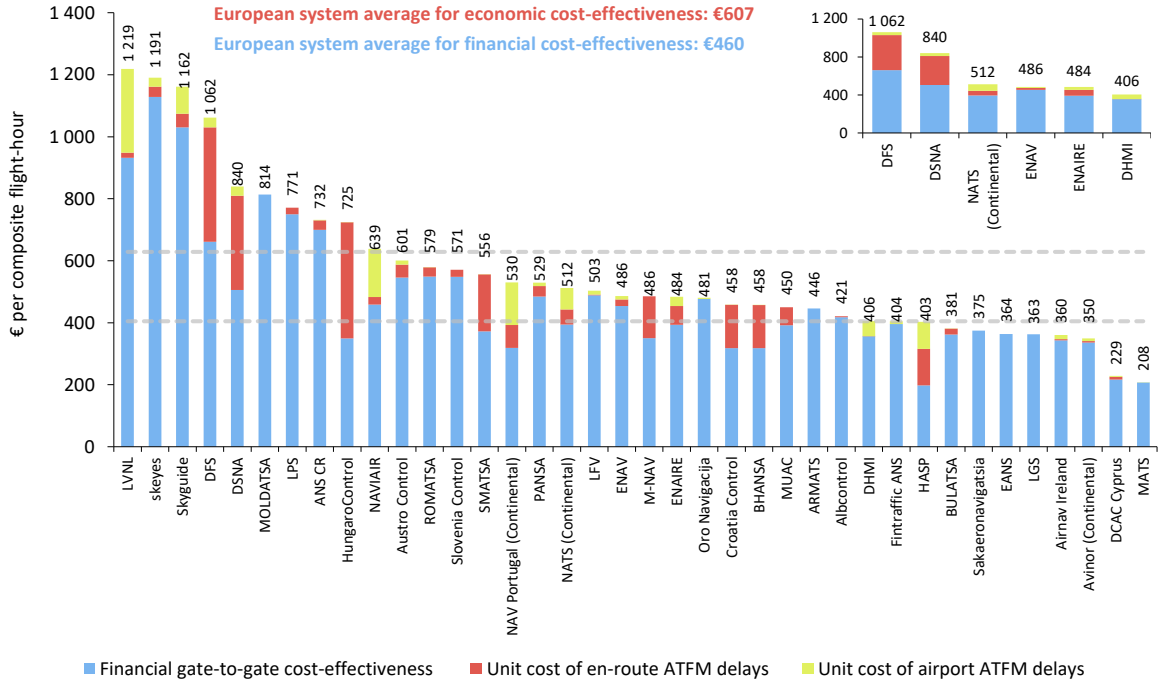


Figure 4.6: Economic gate-to-gate cost-effectiveness indicator by ANSP, 2023

Figure 4.6 compares the gate-to-gate economic costs per composite flight-hour of all ANSPs in 2023. It shows that unit economic costs ranged from €1 219 for LVNL to €208 for MATS; nearly a six-fold difference. The two dotted lines in the figure represent the bottom (€405) and top (€629) quartiles, indicating the dispersion across ANSPs. In 2023, there was a €224 difference between these two quartiles, some +8.3% higher compared to 2022, which indicates a higher dispersion in the sample.

It is important to note that the impact of individual ANSPs on the Pan-European system does not only depend on the value of their unit economic costs, but also on their size in terms of cost-base and traffic controlled. For example, although DSNA and MOLDATSA return similar unit economic costs above €800 per composite flight-hour, the impact of DSNA (controlling over 200 times more traffic in 2023) on the Pan-European system is much higher. Further information on the size of ANSPs in terms of costs and traffic is available in Chapter 2.

As a consequence, due to their weight in the Pan-European system, the ACE benchmarking reports place particular emphasis on the results of the six largest ANSPs (DFS, DHMI, DSNA, ENAIRE, ENAV and NATS). As discussed in Chapter 2 these ANSPs bore 58.1% of the total Pan-European gate-to-gate ATM/CNS provision costs and controlled for 58.0% of the total traffic. Compared to previous years' report, DHMI is now part of this group since its share in the total Pan-European system costs is now reaching 7.3%, which is close to ENAV and NATS shares.

Figure 4.6 shows that DFS (€1 062) had the highest unit economic costs among this group, followed by DSNA (€840), NATS (€512), ENAV (€486) and ENAIRE (€484). DHMI records the lowest unit economic costs among the six (€406), although compared to the other large ANSPs DHMI is operating in distinct economic conditions whereby the cost of living in Türkiye is much lower than

[18] See Chapter 5. The report can be found at: https://www.eurocontrol.int/publication/performance-review-report-prr-2024

in western European Member States. Section 2.2 discusses cost of living and other important factors affecting performance in more detail.

It is important to note that, for ANSPs operating outside of the Euro area (such as Skyguide and NATS), changes in the national currency against the Euro could significantly impact their unit economic costs in 2023 when expressed in Euro. Annex 4 to this report provides detailed information on ANSPs exchange rates.

Figure 4.6 indicates that the share of unit economic costs represented by ATFM delays, which was 24.3% across the Pan-European system as a whole, varied between ANSPs. For instance, five ANSPs recorded no delays in 2023 (ARMATS, EANS, LGS, MOLDATSA and Sakaeronavigatsia). In contrast, for HASP and HungaroControl ATFM delays represented more than half of their unit economic costs (51.0% and 51.7% respectively). Other ANSPs with large shares of ATFM delays in their unit economic cost included DFS (37.7%), DSNA (39.7%) and NAV Portugal (39.8%).

In 2023 as in 2022, some ANSPs had to control high traffic levels due to significant shifts in traffic flows caused by the war in Ukraine. These changes may have created difficulties in adjusting available capacity to meet the increased demand. It should however be noted that ATFM delays directly related to the war in Ukraine are not considered in the post-operations adjustment process dataset and therefore not included in this report.

Figure 4.7 below shows that, between 2022 and 2023, gate-to-gate economic costs per composite flight-hour fell for 23 ANSPs. In most cases, this resulted from decreases in unit ATM/CNS provision costs combined with marginal variations in the unit costs of ATFM delay. However, for ANS CR, BHANSA, PANSA and SMATSA, representing four of the five largest falls in unit economic cost, the change was driven overwhelmingly by reductions in delays. The high ATFM delays recorded in Praha ACC in 2022 were primarily due to the simultaneous deployment of the new ATM system and the Russian aggression against Ukraine. This combination led to significant challenges in the operational deployment of the TopSky ATM system because of new restrictions, and altered flight trajectories. Consequently, ANS CR decided to reduce the capacity in Prague ACC as a precautionary measure.

On the other hand, Figure 4.7 also shows that unit economic costs rose for 15 ANSPs. For some of these ANSPs the increase was driven by a varying combination of increases in unit ATM/CNS provision costs and ATFM delays. However, the largest increases experienced by HASP, LVNL and NAVIAIR were driven predominantly by changes in ATFM delay costs.

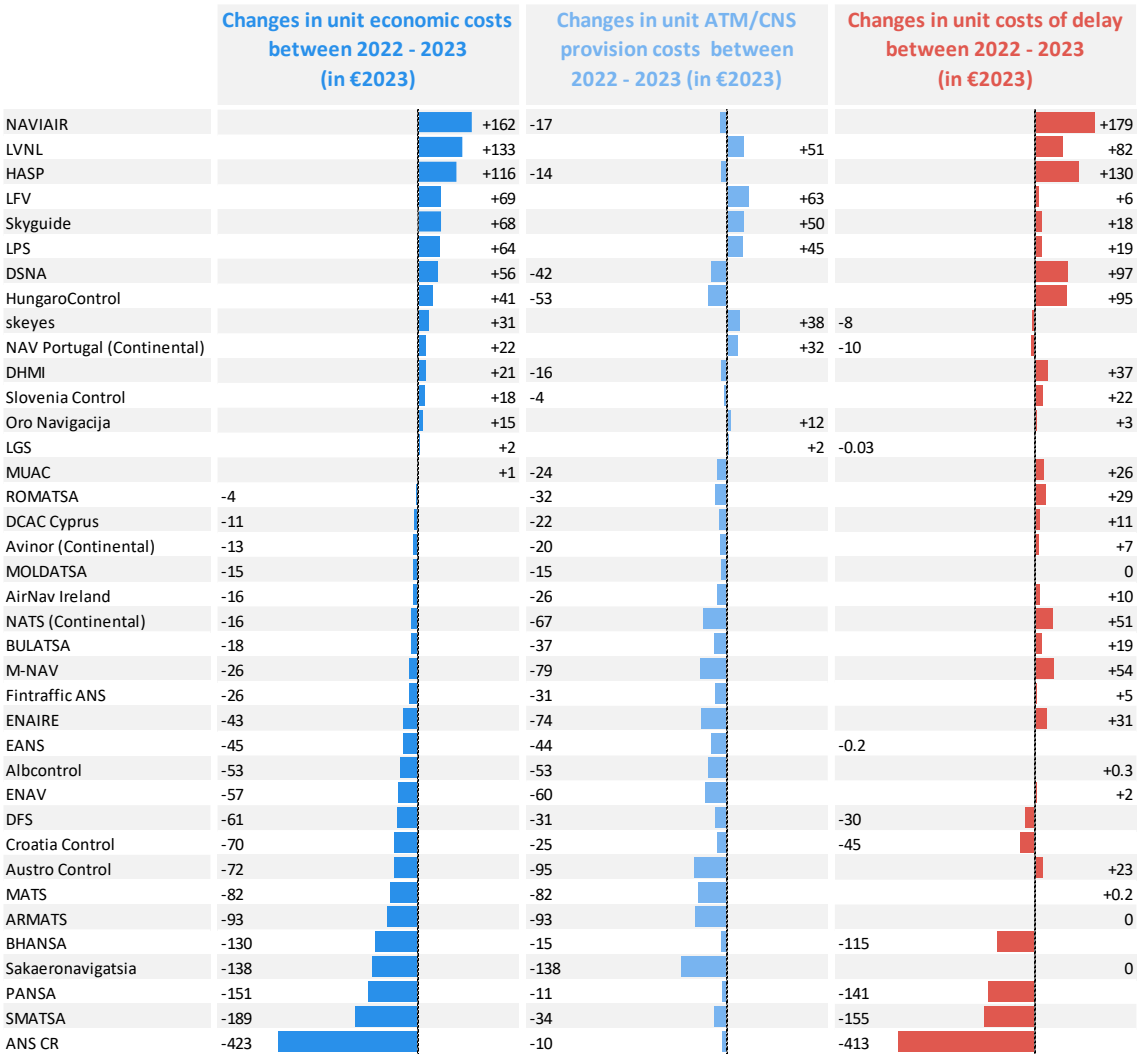


Figure 4.7: Changes in economic cost-effectiveness by ANSP, 2022-2023 (real terms)

Figure 4.8 shows the ANSPs most contributing[19] to the net increase in ATFM delays observed in 2023 at Pan-European system level, for both en-route and terminal. It consists of two charts:

- The left-hand side chart displays the net changes in ATFM delays generated by individual ANSPs between 2022 and 2023, with values expressed in thousands of minutes.
- The right-hand side chart represents the share of ATFM delays in each ANSP's economic costs for 2023. This indicator helps understanding whether an ANSP is affected by capacity issues by comparing its individual share with the proportion of ATFM delays in the Pan-European system economic costs (24.3% in 2023).

[19] ANSPs with ATFM delays increasing by more than 50 000 minutes between 2022 and 2023 are shown in Figure 4.8.

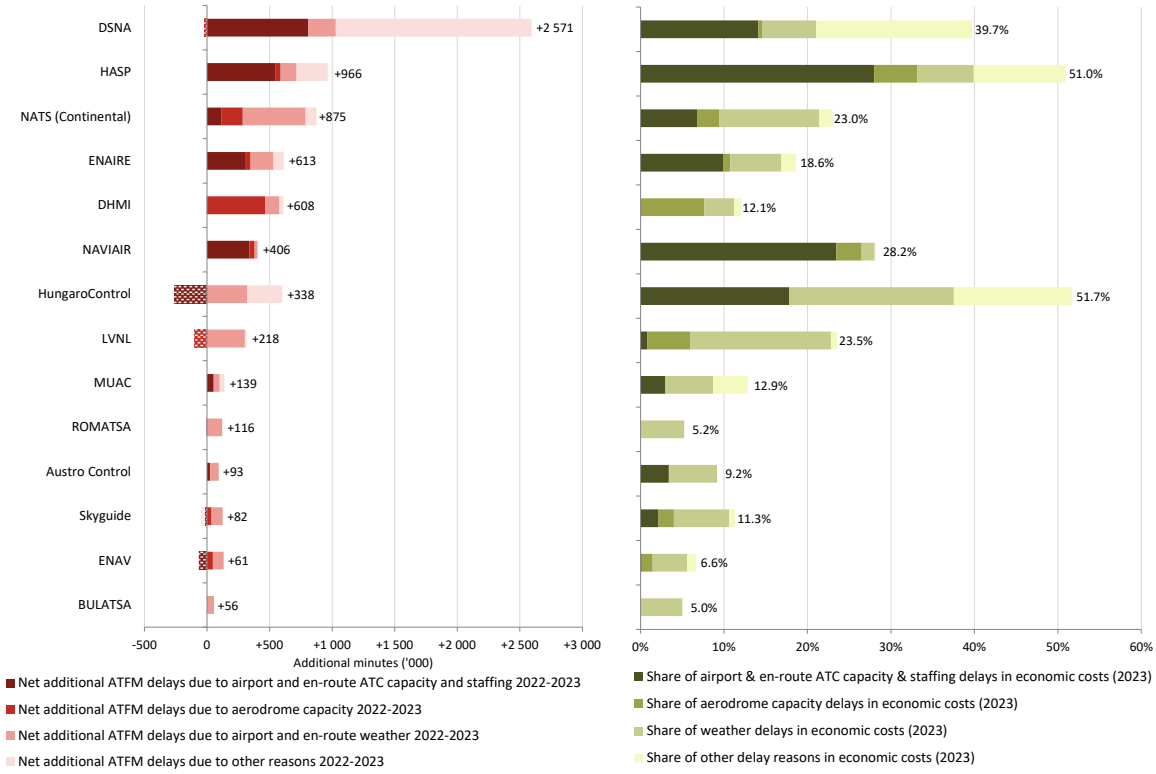


Figure 4.8: ANSPs contribution to ATFM delays increase at Pan-European system level in 2023

Another element that should be considered is the share of ATFM delays generated by each ANSP in the total Pan-European system. In this case, it is important to consider the "size effect" when interpreting the data. Arguably, in a situation of under-capacity, all else being equal, an ANSP handling a relatively large amount of traffic in Pan-European terms is likely to generate more delays than an ANSP with much lower traffic volumes.

For instance, for Croatia Control, whose ATFM delays represented 1.4% of the Pan-European system, the share of ATFM delays in their economic costs was 30.6%. This value is significantly higher than for ENAIRE (18.6% share of ATFM delays in economic costs), which accounted for 6.2% of the total ATFM delays generated at Pan-European system level. This comparison may highlight certain capacity issues for Croatia Control, even though the ATFM delays generated in Croatian airspace only represent a small proportion of the Pan-European system ATFM delays.

Overall, the ANSPs contributing most to ATFM delays in 2023 were DSNA (30.4% of total delays in the Pan-European system), DFS (22.7%), NATS (7.0%), ENAIRE (6.2%), HASP (5.9%) and HungaroControl (4.1%). These six ANSPs accounted for 76.4% of total ATFM delays across the Pan-European system in 2023.

Figure 4.8 shows that most of these ANSPs also contributed to the increase in ATFM delays observed in 2023 (see left-hand side chart), and/or showed a relatively high proportion of ATFM delays in their unit economic costs (see right-hand side chart).

Annex 2 provides a comprehensive analysis of the ATFM delays generated by each ANSP in the total Pan-European system for the year 2023. Furthermore, ANSPs individual summary reports published on the ACE landing page provide more details on the changes in ATFM delays at ANSP level. Delay causes are further analysed in the PRR reports as well as in the Network Operations Report 2023. Additional information on ATFM delays can also be found on the Performance Review Unit data portal (http://ansperformance.eu/).

4.3 Deep-dive: ATC capacity and staffing delays

The return to high levels of delays in 2023 (with subsequent increase in 2024) has prompted greater discussion and analysis of the acute capacity issues encountered across the Pan-European network. For example, in its Performance Review Reports (PRR)[20], the PRC analyses the reasons underlying the high levels of delays.

In this context, this section presents a more detailed analysis of ATC capacity and staffing delays alongside related indicators that have a bearing on ATC capacity, tracked as part of the ACE report series. The analysis first covers the Pan-European system as a whole and then considers a subset of ANSPs that experienced high delays due to ATC capacity and staffing issues. This analysis focuses on trends in traffic and delays, as well as ATCO numbers and levels of capex, over the medium (2016-2023) and long-term (2012-2023).

4.3.1 Pan-European system

A summary of the trends in delays and associated indicators at the Pan-European system level is provided in Figure 4.9.

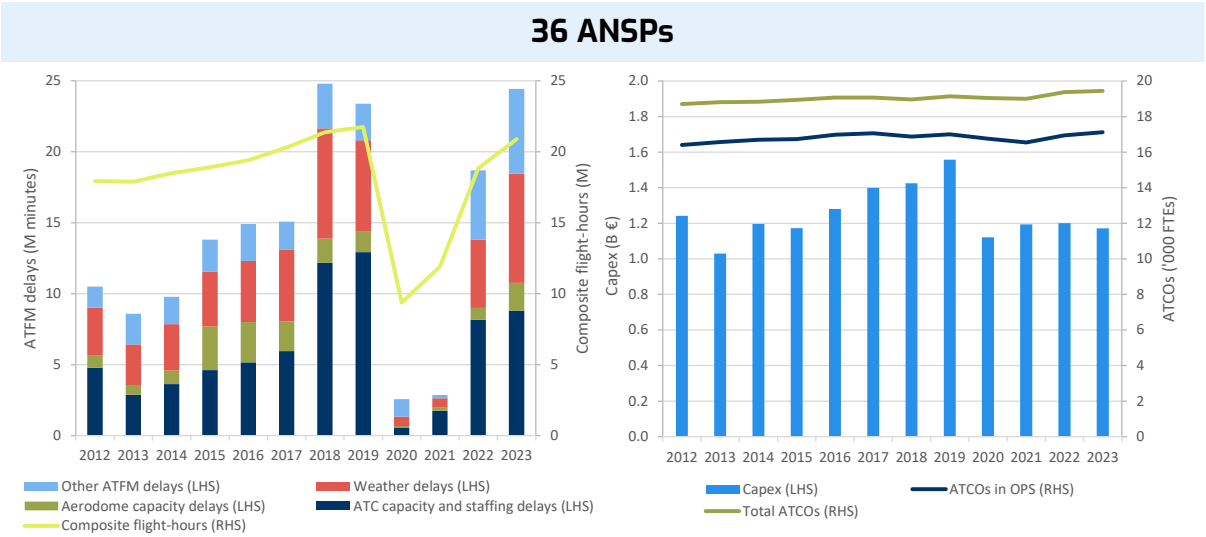


Figure 4.9: Pan-European system trends in ATFM delays, traffic, capex and ATCOs, 2012-2023

The left-hand chart shows that over the period prior to the COVID-19 pandemic ATC capacity and staffing delays were increasing gradually in line with composite flight-hours prior to 2018, at which point they more than doubled despite an increase in traffic of only +5.3%. This points to the non-linear relationship between traffic and capacity and staffing delays, whereby small increases in traffic beyond a threshold can produce large impacts on network delays. ATC capacity and staffing delays further increased in 2019 by +6.1% (traffic increased by +1.7%) and then reduced sharply in line with traffic during the COVID-19 pandemic. In 2022 and 2023, both composite flight-hours and delays bounced back, however ATC capacity and staffing delays remained lower than in 2018 and 2019 relative to traffic. Figure 4.9 also shows that the decrease in ATC capacity and staffing delays was offset by increases in other and weather delays.

The right-hand chart shows the corresponding trends in ATCOs and capex. ATCOs in OPS remained largely stable over the period, increasing between 2012 and 2019 by +3.7% (or +605 FTEs), and after a drop during the COVID-19 pandemic reaching a high for the period of 17 118 FTEs in 2023. Total ATCOs similarly increased over the period, rising +4.0% (or +749 FTEs) between 2012 and 2023, with

[20] The 2024 report can be found at: https://www.eurocontrol.int/publication/performance-review-report-prr-2024

the ATCO 'headroom' (i.e. difference between ATCOs in OPS and total ATCOs) fluctuating between 10% and 13%.

Capital expenditures for the Pan-European system fluctuated over the period and should be understood in the context of investment cycles associated with the upgrade and commissioning of ATM systems. From a low in 2013 of €1.0 billion, capex increased by +51.3% to €1.6 billion in 2019. However, with the onset of the COVID-19 pandemic in 2020, capex fell by -28.0% and subsequently remained at or below €1.2 billion through to 2023.

4.3.2 ANSPs with high ATC capacity and staffing delays in 2023

Within the Pan-European system, delays are not spread uniformly, and it is therefore important to focus on ANSPs where delay issues are concentrated.

As such the remainder of this section considers a subset of ANSPs that met at least one of the following criteria in 2023:

- ATC capacity and staffing delays generated by the ANSP represented at least 5% of the total capacity and staffing delays across the network; or
- ATC capacity and staffing delays contributed at least 10% of the ANSP's unit economic costs.

These criteria allow for both ANSPs that represent a large portion of ATC capacity and staffing delays relative to the Pan-European network and also ANSPs that generate a large amount of ATC capacity and staffing delays relative to their size. However, in order to facilitate the analysis ANSPs that generated less than 50 000 minutes of ATC capacity and staffing delays in 2023 are excluded, as are ANSPs of Member States that joined after 2012.

This produces a sub-set of nine ANSPs: **Croatia Control, DFS, DSNA, ENAIRE, HASP, HungaroControl, NATS, NAV Portugal and NAVIAIR**. These nine ANSPs represented 93% of ATC capacity and staffing delays and 83% of total delays across the network in 2023, despite accounting for 52% of composite flight-hours.

Although the remainder of the section focuses on the nine ANSPs listed above, it is also important to highlight that 29 ANSPs, representing 48% of the Pan-European system composite flight-hours, cumulatively contributed to only 7% of ATC capacity and staffing delays in 2023. Among these:

- ARMATS and Sakaeronavigatsia recorded no ATFM delays in 2023 despite experiencing extraordinarily high traffic increases compared to 2019 (+32% and +63%, respectively);
- Austro Control and DCAC Cyprus achieved significant reductions in ATFM delays while controlling approximately the same level of traffic as in 2019; and
- skeyes, which was among the main ATFM delay producers in 2019, significantly reduced ATFM delays, possibly partly enabled by lower traffic (-12% compared to 2019).

As in the previous sub-section, trends in delays for the sample of nine ANSPs are presented alongside traffic, ATCOs and capex indicators to understand the situation in this group of ANSPs and their development pre- and post-COVID-19.

However, when analysing a more select group of ANSPs it is important to acknowledge the greater sensitivity of the analysis to changes in ANSPs' data reporting over time. Undoubtedly, over the years the data provided by ANSPs in their ACE submissions has improved since some have implemented more accurate data collection processes. In addition, some ANSPs have undertaken significant structural changes that may have impacted the total number of ATCOs they employ, for example the tower liberalization process in Spain. As such, it should be recognised that these factors might affect the trends in ATCOs FTEs especially when analysed over a long time period.

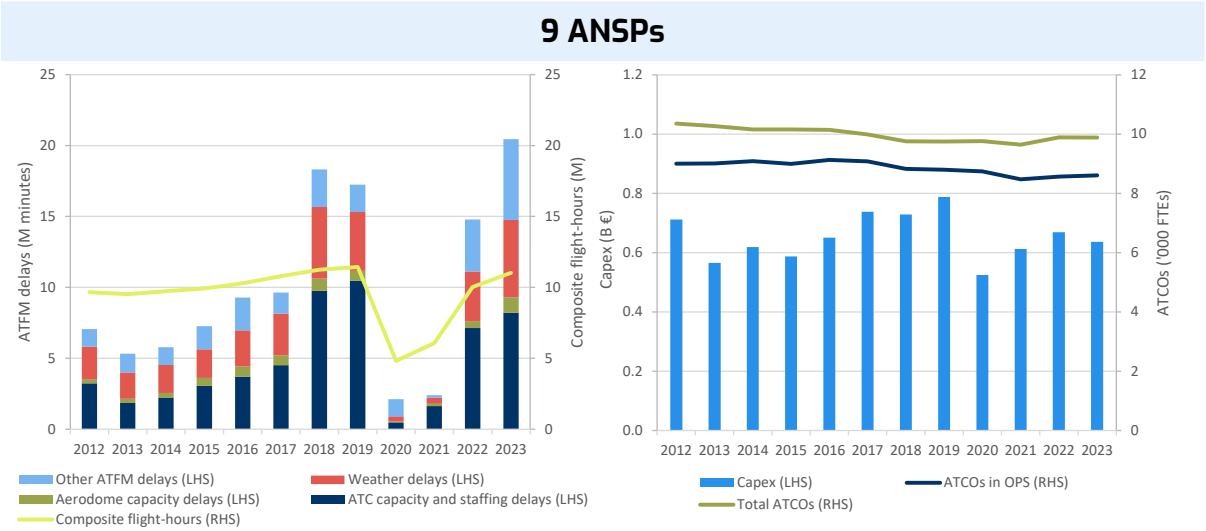


Figure 4.10: Trends in ATFM delays, traffic, capex and ATCOs for the sample of nine ANSPs, 2012-2023

Figure 4.10 shows the trends in delays since 2012 alongside traffic, capex and ATCOs for the sample of nine ANSPs. As for the Pan-European system as a whole, ATC capacity and staffing delays rapidly increased in 2018 (+116.0%) and again in 2019 (+7.4%) in a context of traffic growth (+4.3% and +1.6%, respectively). Following the COVID-19 pandemic, ATC capacity and staffing delays returned but at lower levels (-21.5% in 2023 relative to 2019), although being more than offset by increases in weather and other delays, the latter mainly due to industrial action impacting DSNA.

Between 2012 and 2023, the number of ATCOs in OPS in the sample of nine ANSPs reduced by - 4.4% (or -397 FTEs), with the largest year-on-year reductions recorded in 2018 (-2.7%, or -250 FTEs) and 2021 (-3.1%, or -272 FTEs). The latter should be viewed in the context of a significant reallocation of ATCOs from OPS to other duties during the COVID-19 pandemic and resulting drop in traffic. The number of ATCOs in OPS rose in 2022 and 2023 by +1.1% (or +93 FTEs) and +0.5% (or +41 FTEs) respectively, but remained lower than pre-crisis levels.

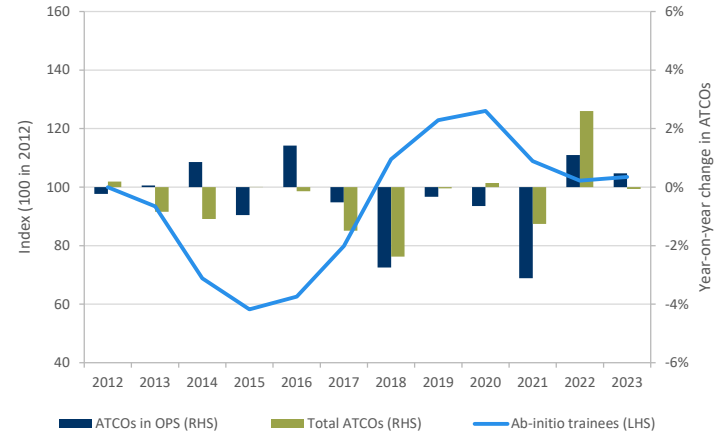


Figure 4.11: Ab-initio trainees and change in ATCOs for the sample of nine ANSPs, 2012-2023

In order to complement this analysis, the remainder of this sub-section focuses on the recruitment and training of additional ATCOs and the magnitude of ANSPs capex between 2012 and 2023.

Figure 4.11 shows the trends in ab-initio trainees[21], plotted with the changes in ATCOs in OPS and total ATCOs. For the nine ANSPs as a whole, the reduction in ab-initio trainees between 2012 and 2015 (- 41.8%) was followed by decreases in total ATCOs, especially in 2017 (- 1.5%) and 2018 (- 2.4%). These

[21] As with ATCO numbers, a detailed analysis of ab-initio trainee numbers must be undertaken with an understanding of factors impacting the data. In this case, several ANSPs within the sample do not report ab-initio trainees as they are not part of their payroll. It is therefore better to limit the analysis of ab-initio trainee trends to the sample as a whole and not consider the changes at individual ANSP level.

trends might illustrate the fact that the ATCOs outtake (e.g. departure in retirement) was consistently higher than the intake over this period.

Figure 4.11 also indicates that while the number of trainees increased substantially between 2015 and 2020 (+116.6%), the number of ATCOs in OPS declined during the 2017-2021 period, highlighting the lead time required for ATCO recruitment and training. Ab-initio trainees then reduced between 2020 and 2022 (-9.9% p.a.) potentially reflecting challenges created by social distancing requirements, limited ATCO college capacity, and cost-containment measures implemented during the COVID-19 crisis. The number of ATCOs in OPS rose in 2022 (+1.1%) and 2023 (+0.5%). These increases partly reflect the fact that some ATCOs, previously allocated to "on other duties" following the traffic decrease in 2020, were progressively re-allocated to OPS duties.

Several external factors, such as the ongoing and uneven recovery in traffic from the COVID-19 pandemic and uncertainties related to the ongoing war in Ukraine, may have impacted the planning and deployment of ATC capacity for some ANSPs. However, the decrease in ATCOs in OPS observed during the last decade has undoubtedly constrained the flexibility of ANSPs to adequately adapt to sharp fluctuations in traffic demand, therefore increasing the likelihood of ATC capacity and staffing delays. As indicated in the PRC's latest PRR[22], a major challenge for ANSPs is to maintain an adequate number of qualified ATCOs to meet both current and future traffic demands. Clearly, insufficient capacity levels lead to disproportionately higher costs for airspace users and passengers, which may far exceed the costs associated with deploying additional ATCOs. In addition, considering the lead time necessary to recruit and train ATCOs, even if remedial actions are taken now, high levels of ATC capacity and staffing delays may remain a feature of the network for the years to come.

Figure 4.12 shows the changes in terms of capex for the sample of nine ANSPs from 2012 to 2023, including a breakdown into several categories such as land and buildings, intangible assets, systems and equipment, and common projects. It also includes the annual averages for the periods 2012-2019 and 2020-2023, representing pre- and post-COVID-19 time periods.

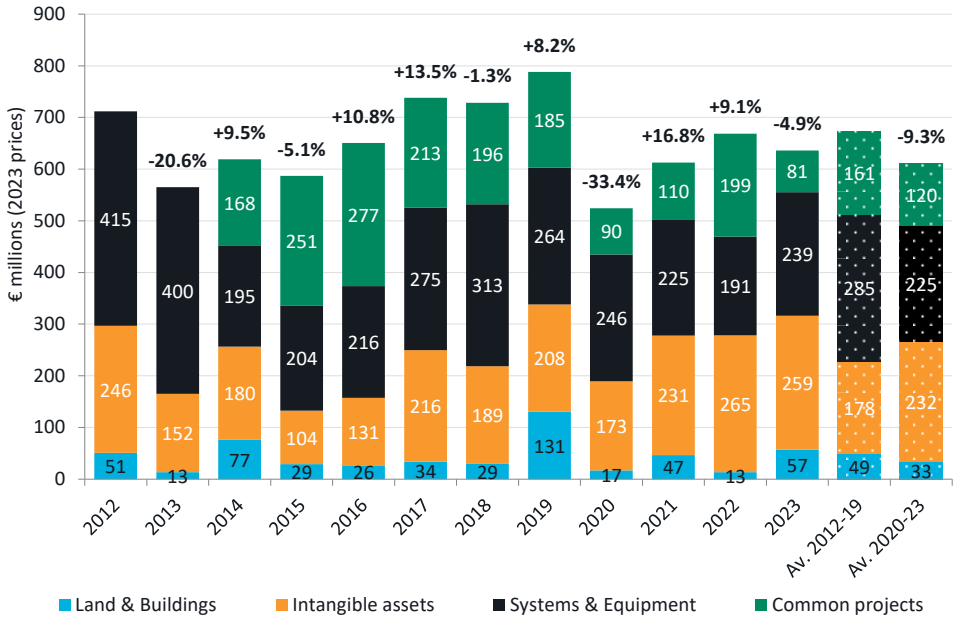


Figure 4.12: Capital expenditures by category for the sample of nine ANSPs, 2012-2023 (real terms)

As for the Pan-European system level, capex for the sample of nine ANSPs fluctuates year-on-year and should be understood in the context of investment and budget cycles. Figure 4.12 shows how

[22] The report can be found at: https://www.eurocontrol.int/sites/default/files/2025-03/eurocontrol-performance-review-report-2024.pdf

capex rose from €565M in 2013 to a peak of €788M in 2019, marking a +39.4% increase. Capex then sharply dropped by -33.4% in 2020, coinciding with the onset of the COVID-19 pandemic. Despite a recovery in 2021 and 2022, the average annual capex for the period 2020-2023 was -9.3% below the average for the period 2012-2019.

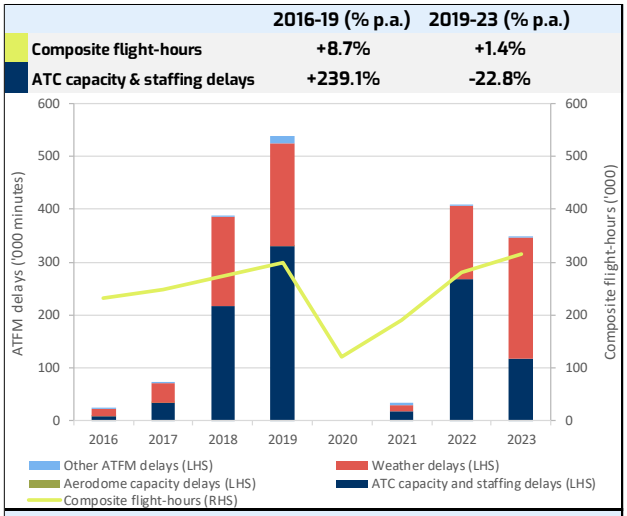
Figure 4.12 shows that the lower average capex recorded over the 2020-2023 period was driven by falls in all categories apart from intangible assets, which saw a +30.3% rise on average. Also, the spike in 2019 was largely associated with a relatively large amount of land and buildings capex mainly driven by NATS and DFS.

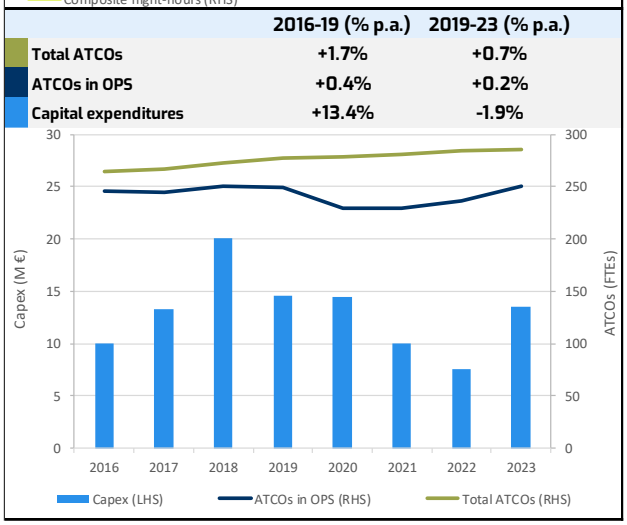
The lower levels of capex following the COVID-19 pandemic reflect challenges faced by ANSPs, both related to the pandemic and otherwise. During the pandemic many ANSPs within and outside the sample scaled down, postponed or cancelled many projects for a variety of reasons including cost containment and supply chain difficulties. The information presented in Figure 4.12 indicates that some of these challenges may have persisted in 2022 and 2023 since the level of capex recorded for these years remain below that observed in the years preceding the pandemic.

4.3.3 Individual ANSPs analysis

As context for the analysis presented above the highlighted indicators are presented for each of the nine ANSPs in turn, complemented with a high-level discussion on important context and underlying factors. In contrast to the aggregated charts above the figures show only data from 2016 to 2023, in acknowledgement of some of the limitations mentioned earlier in this section while preserving a sufficient time series for analysis. In addition, the relative scaling of the respective charts' axes is kept consistent to enable quick comparison of relative indicator levels. For example, where the ATC capacity and staffing delay datapoint is at the same level in a chart as composite flight-hours, this indicates one minute of ATC capacity and staffing delay per composite flight-hour.

Croatia Control





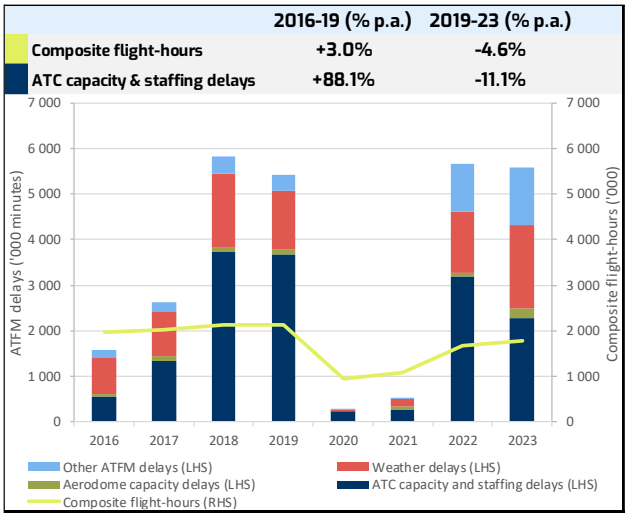
In 2023 Croatia Control represented 1.5% of the system composite flight-hours and **1.3% of total ATC capacity and staffing delays**, which **accounted for 10.3% of its unit economic costs**.

Between 2016 and 2019, ATC capacity and staffing delays rose substantially (+239.1% p.a.) **in a context of robust traffic growth** (+8.7% p.a.). Across the period, ATC capacity and staffing delays were highest in 2019. In the meantime, **total ATCOs** (+1.7% p.a.) and **ATCOs in OPS rose** (+0.4% p.a.), albeit at a slower pace for the latter. Capital expenditures peaked in 2018 at €20M, corresponding to upgrades in existing ATM systems.

During the COVID-19 pandemic, delays were almost non-existent while **the total number of ATCOs continued to grow**. The decrease in ATCOs in OPS observed in 2020 reflects the fact that some of them were assigned to other duties.

In 2023, traffic was above 2019 levels while ATC capacity and staffing delays decreased (-22.8% p.a. compared to 2019). Both total ATCOs and ATCOs in OPS were above 2019 levels. During this period, additional operational shifts were introduced in the ATCO rostering to increase flexibility in managing traffic. **After decreases in 2021 and 2022** following the pandemic, **capital expenditures rose in 2023** (+79.6%).

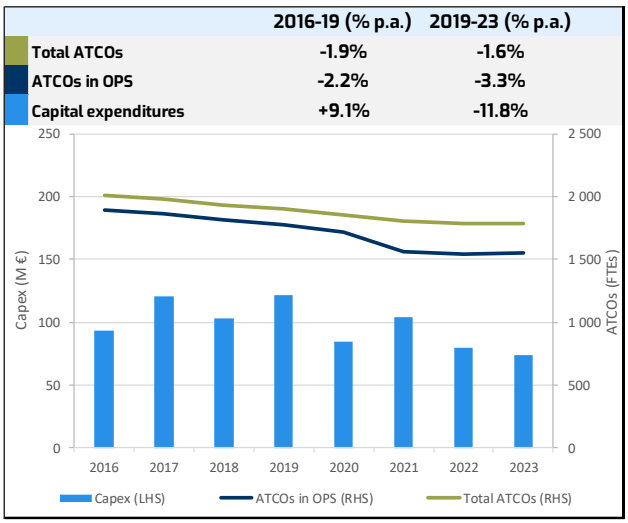
DFS



In 2023 DFS represented 8.4% of the system composite flight-hours and **25.8% of total ATC capacity and staffing delays**, which **accounted for 15.4% of its unit economic costs**.

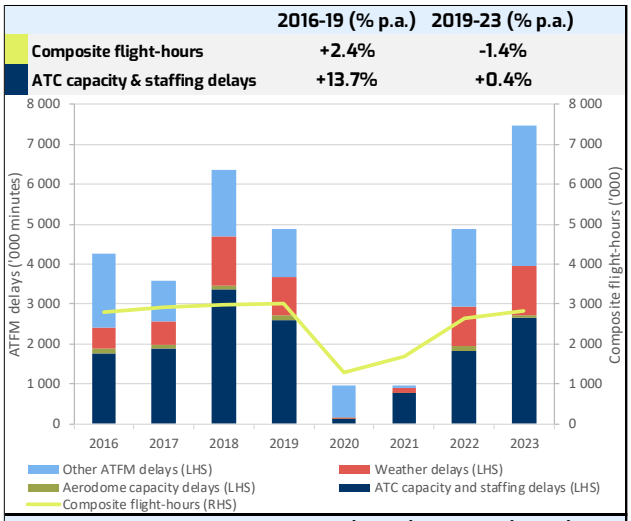
ATC capacity and staffing delays rose substantially between 2016 and 2018 (+160.7% p.a.) while **traffic grew** (+4.0% p.a.). **Total ATCOs and ATCOs in OPS declined** across the pre-COVID-19 period by -1.9% p.a. and -2.2% p.a. respectively. Capital expenditures fluctuated around the €100M mark, peaking in 2019 at €121M.

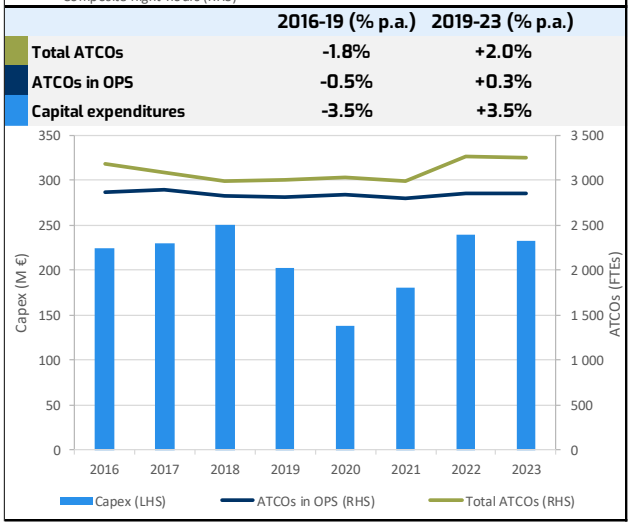
During the COVID-19 pandemic, the decrease in ATCOs in OPS accelerated (-8.9% in 2021) and **then their numbers remained relatively flat in 2022 and 2023**. Capex also fell markedly in 2020 (-30.1%), increased in 2021 (+23.2%) but reduced in 2022 and 2023 (-16.2% p.a.).



With the recovery of traffic, **ATC capacity and staffing delays sharply rose in 2022** from the low levels recorded during the pandemic but then fell in 2023 (-28.4%). However, **out of the sample of nine ANSPs DFS had the highest ATC capacity and staffing delays in 2023 when expressed in terms of composite flight-hour** (1.3 minutes). These delays were in part attributed to disproportionately high traffic growth affecting Karlsruhe ACC as a result of changes in traffic flows following the start of the war in Ukraine.

DSNA





In 2023 DSNA represented 13.5% of the system composite flight-hours and **29.9% of total ATC capacity and staffing delays**, which **accounted for 14.1% of its unit economic costs**.

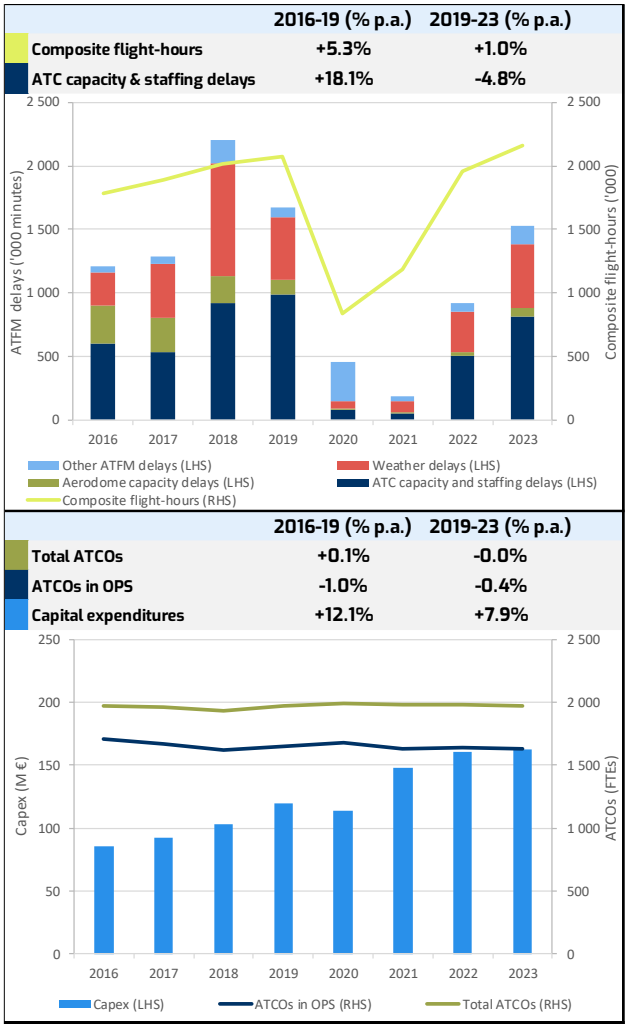
ATC capacity and staffing delays remained high throughout the 2016-2019 period and reached a peak in 2018. This occurred in a context of traffic growth (+2.4% p.a.) and slight reduction in the number of ATCOs in OPS (-0.5% p.a.).

Following the sharp traffic reduction in 2020, ATC capacity and staffing delays significantly reduced in 2020. Although they both increased in 2021, they remained at relatively low levels while the COVID-19 pandemic was ongoing. **During the pandemic ATCO levels remained stable and capex was reduced** due to a combination of normal project completion and disruption due to the pandemic.

In 2022 and 2023, traffic continued to grow, but remained -5.7% below 2019 levels, while ATCOs in OPS increased, surpassing their 2019 level (+1.3%). Capital expenditures, after a 2020 low, rebounded to pre-COVID-19 levels by 2022. In 2023, **DSNA's ATC capacity and staffing delays per composite flight-hour** (0.9 mins) **exceeded their 2019 level**. These delays were partly associated with the industrial actions impacting DSNA in 2022/23[23] and implementation of 4-Flight in several ACCs, which affected the utilisation of ATCOs during the test and transition periods.

[23] ATFM delays as a direct result of industrial action are recorded in the other delay category, however these will most likely have had knock-on impacts on the level of ATC capacity and staffing delays.

ENAIRE



In 2023 ENAIRE represented 10.2% of the system composite flight-hours and **9.2% of total ATC capacity and staffing delays**, which **accounted for 9.9% of its unit economic costs**.

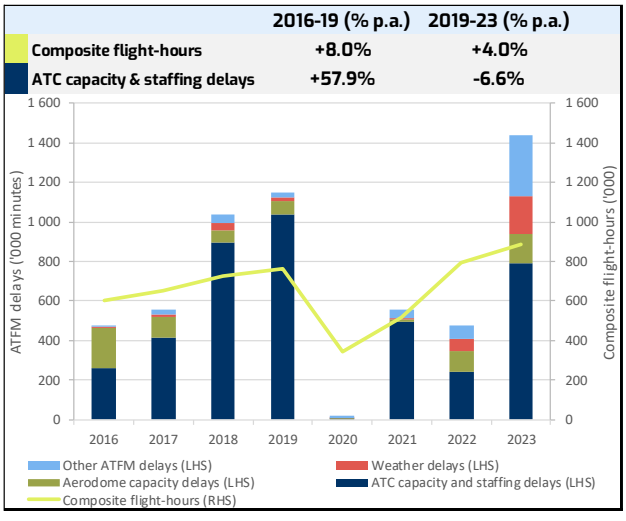
Between 2016 and 2019, ATC capacity and staffing delays generally rose (+18.1% p.a.) as **composite flight-hours increased consistently** (+5.3% p.a.), with both reaching peaks in 2019. In the meantime, **total ATCOs remained stable** and **ATCOs in OPS decreased marginally** (-1.0% p.a.).

During the COVID-19 pandemic, ATC capacity and staffing delays fell to near-zero. Between 2019 and 2023, **total ATCOs remained stable** relative to previous years and ATCOs in OPS exhibited a marginal decline (-0.4% p.a.).

In 2023, although traffic was +3.9% above its 2019 level (+1.0% p.a.) **ATC capacity and staffing delays were -17.9% lower** (-4.8% p.a.).

Unlike most other ANSPs, capital expenditures steadily increased over the 2016-2023 period (+9.7% p.a.) reflecting continuous growth in ATM systems and technology investments. Even the impact of COVID-19 on capex in 2020 was limited (-4.9%) compared to other ANSPs.

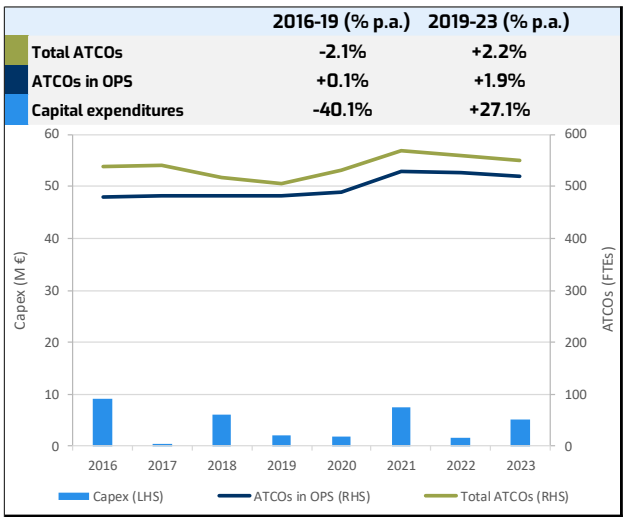
HASP



In 2023 HASP represented 4.2% of the system composite flight-hours and **8.9% of total ATC capacity and staffing delays**, which **accounted for 28.0% of its unit economic costs**.

Between 2016 and 2019, ATC capacity and staffing delays rose substantially (+57.9% p.a.) **in a context of robust traffic growth** (+8.0% p.a.). In the meantime, **ATCOs in OPS marginally rose**, while total ATCOs fell (-2.1% p.a.) and capital expenditures fluctuated at low levels in the context of austerity measures implemented by the Greek government.

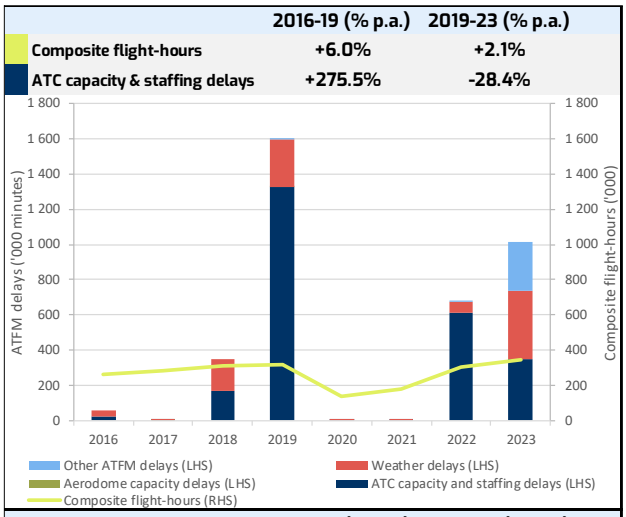
During the COVID-19 pandemic, while almost no delays occurred in 2020, **ATC capacity and staffing delays returned in 2021, surpassing 2016 and 2017 values despite traffic being lower and the number of ATCOs in OPS reaching their highest** (+10.0% above 2016). This illustrates the complex relationship between these variables. In the case of HASP, **other factors should be**

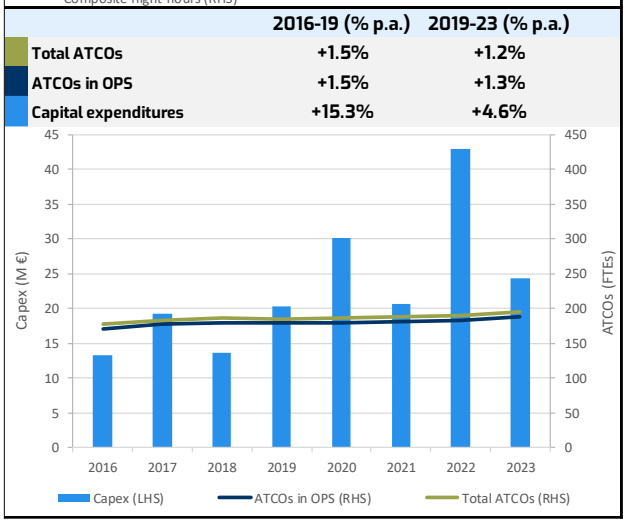


considered, such as the speed of traffic recovery, which could be relatively difficult to forecast, and a high seasonal variability. In this respect, among the nine ANSPs analysed in this section, HASP showed the highest traffic growth over 2019-2023 (+16.9%).

In 2022, ATC capacity and staffing delays decreased by -51.3% despite traffic growth of +52.9%, partly enabled by the implementation of a more flexible ATCO rostering system. **However, in 2023** while traffic further increased by +12.4% and ATCOs in OPS slightly reduced (-1.1%) **ATC capacity and staffing delays sharply increased**, and total ATFM delays reached their highest level of the 2016-2023 period.

HungaroControl





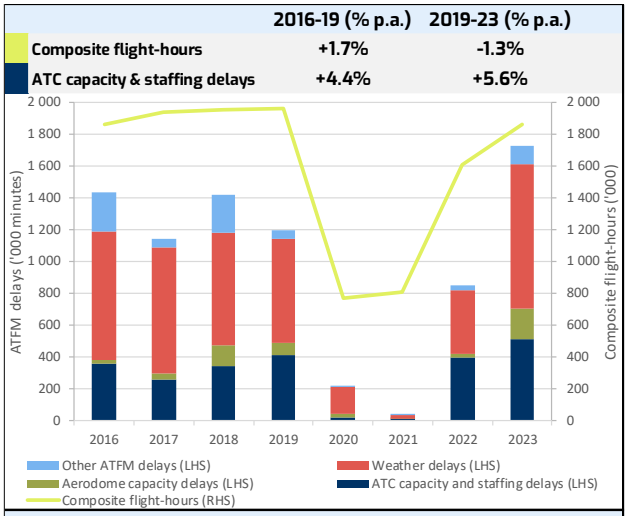
In 2023 HungaroControl represented 1.6% of the system composite flight-hours and **3.9% of total ATC capacity and staffing delays**, which **accounted for 17.8% of its unit economic costs**.

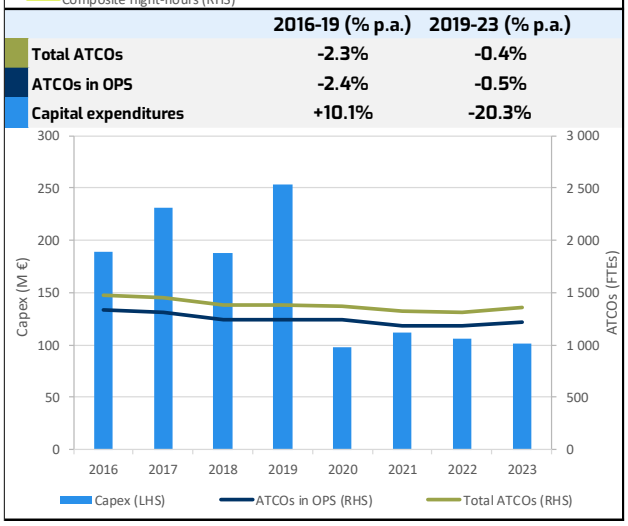
Between 2016 and 2018, ATC capacity and staffing delays were marginal or relatively low despite a sustained traffic growth during these years. **In 2019, traffic growth was modest (+0.7%) but ATC capacity and staffing delays increased dramatically, possibly indicating that HungaroControl reached capacity limits**. It is understood that traffic growth over the previous years led to high workload triggering the adoption of a new collective agreement limiting additional shifts and monthly hours to ensure safety.

During the COVID-19 pandemic, while delays were reduced to a minimum, **ATCOs in OPS slightly increased** and **capital expenditures remained high** due to ATM system upgrades.

In 2022, ATC capacity and staffing delays returned in the context of robust traffic growth (+73.4%), resulting in part from changes in traffic flows following from the war in Ukraine. New measures were then implemented to increase capacity such as **airspace restructuring, enhanced civil-military cooperation, new rostering options, and accelerated recruitment to mitigate the lack of ATCOs**. Capital expenditures increased substantially in 2022 (+107.9%), due to ATM systems investments, including remote tower systems for Budapest airport.

NATS (Continental)





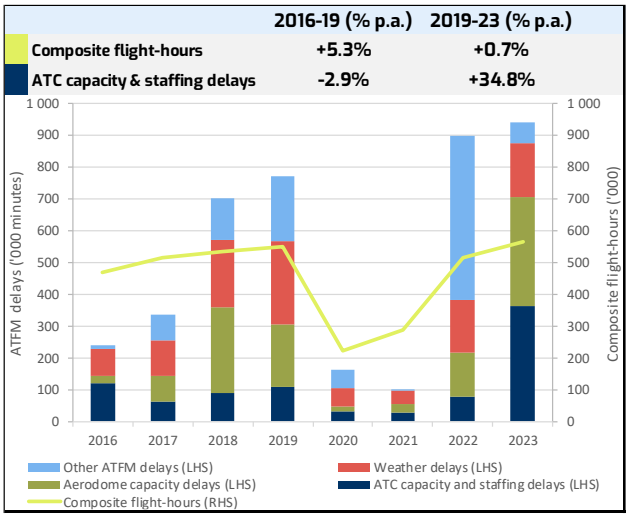
In 2023 NATS represented 8.8% of the system composite flight-hours and **5.7% of total ATC capacity and staffing delays**, which **accounted for 6.8% of its unit economic costs**.

Between 2016 and 2019, ATC capacity and staffing delays fluctuated, reaching a peak in 2019 while **traffic steadily rose** (+1.7% p.a.) and **ATCOs in OPS fell** (- 2.4% p.a.). In this respect, it is noteworthy that NATS introduced a voluntary redundancy plan before RP2 and that pension changes during RP2 resulted in higher-than-expected retirements.

During the COVID-19 pandemic, ATC capacity and staffing delays were near zero while **the total ATCOs and ATCOs in OPS continued to decline**. **Capex also decreased dramatically** in 2020 (- 61.3%) as projects were paused or scaled down in response to the pandemic. There was little change in the following years, with capex remaining well below pre-pandemic levels.

In 2022 and 2023, ATC capacity and staffing delays returned (+5.6% p.a.) and exceeded 2019 levels despite lower, albeit rapidly increasing, traffic. This was in part due to NATS' reappointment in 2022 as ATS provider for Gatwick airport, which was experiencing staff shortages. Indeed in 2023, en-route capacity and staffing delays were lower than in 2016, 2018 and 2019. **Total ATCOs increased in 2023** (+2.9%) partially due to the transfer of Gatwick staff but **remained slightly below 2019 levels**.

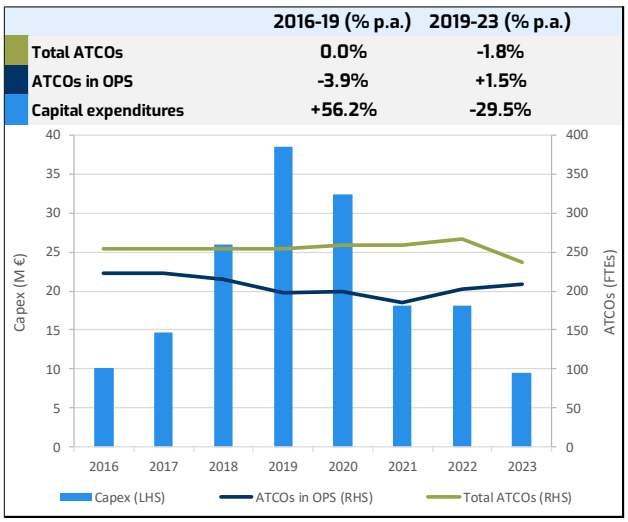
NAV Portugal (Continental)



In 2023 NAV Portugal represented 2.7% of the system composite flight-hours and **4.1% of total ATC capacity and staffing delays**, which **accounted for 15.4% of its unit economic costs**.

Between 2016 and 2019, total ATFM delays increased rapidly, in a context of strong traffic growth (+5.3% p.a.). However, **only a relatively small proportion of total ATFM delays were reported as ATC capacity and staffing**. Total ATCOs remained flat but ATCOs in OPS fell (-3.9% p.a.) as **some ATCOs were allocated to training activities and to the preparation for upgrades to the ATM system**. This system upgrade is also visible in the capex trend (+56.2% p.a.).

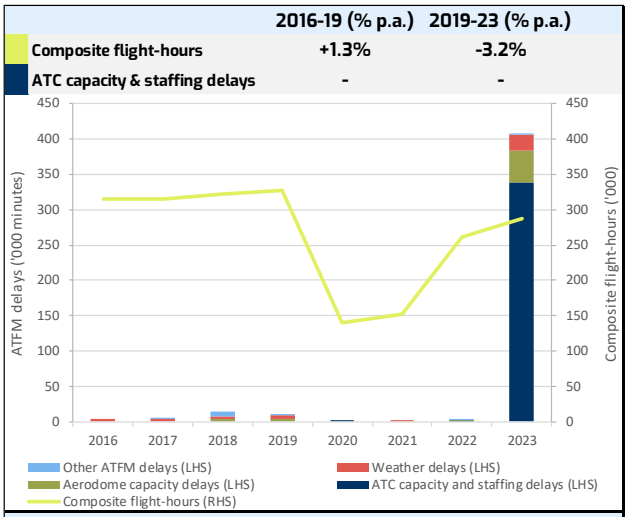
During the COVID-19 pandemic, delays dropped to low levels in line with the reduction in traffic. At the same time, total ATCOs slightly increased

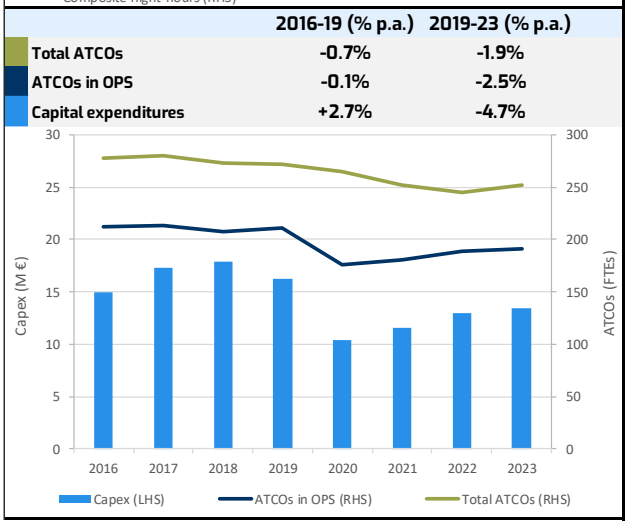


(+0.8% p.a.) and capex fell by -31.3% p.a. between 2019 and 2021, due to projects being paused or scaled down in response to the pandemic.

Delays and traffic rapidly returned to pre-pandemic levels in 2022, and, in 2023, ATC capacity and staffing delays increased dramatically (+373.6%) alongside a further **increase in traffic** (+9.7%). Despite increasing by +3.0% in 2023, ATCOs in OPS remained -5.9% lower than in 2016. Important factors to consider are **higher-than-expected traffic growth and ATCO departures that could have created significant challenges despite an ambitious recruitment plan**. Capex fell to its lowest for the whole period in 2023 due to projects being subject to delays and reassessment.

NAVIAIR





In 2023 NAVIAIR represented 1.4% of the system composite flight-hours and **3.8% of total ATC capacity and staffing delays**, which **accounted for 23.5% of its unit economic costs**.

Over the period under review, NAVIAIR experienced high levels of ATC capacity and staffing delays only in 2023, averaging 1.2 minutes per composite flight-hour, the second highest among the nine ANSPs.

This exceptional situation happened while renovation works at Copenhagen airport necessitated the closure of one runway for three months (May to July 2023). Although the closure itself caused some aerodrome capacity delays (indicated by the green portion of the bar), a shortage of tower and approach ATCOs hindered NAVIAIR from fully exploiting the remaining operational runway. As a result, a very large amount of ATFM delays were recorded as staffing delays.

This occurred amidst a notable reduction in both total ATCOs (-1.4% p.a.) and ATCOs in OPS (-1.5% p.a.) over 2016-2023 and a subsequent dispute with ATCO unions. An agreement was finally reached in June 2023, leading to stabilised operations at Copenhagen airport.

5. FORWARD-LOOKING COST-EFFECTIVENESS (2024-2028)

Considering those ANSPs for which information is available, the gate-to-gate unit ATM/CNS provision costs are planned to decrease by -0.5% p.a. between 2023 and 2028 at Pan-European system level. This mainly reflects the fact that traffic is expected to rise faster (+3.3% p.a.) than ATM/CNS provision costs (+2.8% p.a.) over this period.

According to the SEID V3.0, ANSPs are expected to submit forward-looking information covering the 2024-2028 period.

As shown in Figure 5.1, 36 out of 38 ANSPs provided a complete set of planned costs and traffic data in their ACE data submission.

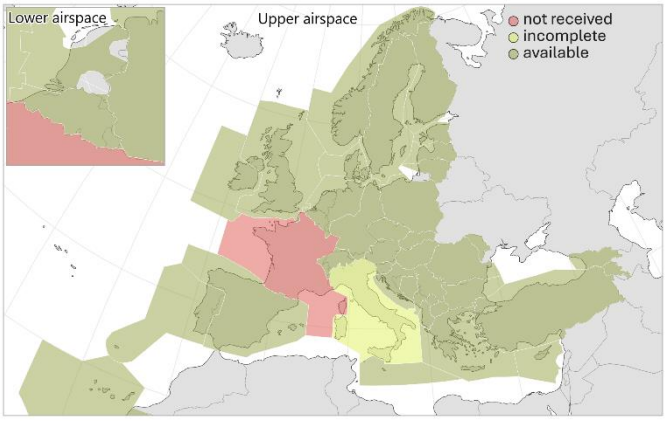


Figure 5.1: Status of forward-looking data availability (traffic and costs)

Two ANSPs (DSNA and ENAV) were unable to provide a complete or meaningful set of forecast traffic and cost data for the 2024-2028 period. Additionally, NATS is excluded from the analysis due to the lack of direct comparability between forward-looking data (based on regulatory accounting rules) and historical data (based on IFRS). Consequently, the planned cost-effectiveness analysis provided in this section is based on 35 ANSPs, while the data for the 2018-2023 period covers 38 ANSPs, where relevant.

It is important to note that for ANSPs operating in SES States, the European Commission and its Performance Review Body (PRB) are, at the time of writing this report, assessing performance plans for the fourth reference period (2025-2029). Caution is therefore required when interpreting the trends in cost-effectiveness performance presented in this chapter since they might be affected by the outcome of the performance plans assessment process.

Figure 5.2 illustrates the evolution of gate-to-gate unit ATM/CNS provision costs between 2023 and 2028. For the ANSPs included in the analysis, unit costs per composite flight-hour are expected to decrease by -2.5% between 2023 and 2028 (-0.5% p.a.). This trend primarily reflects the expectation that traffic will grow faster (by +17.8%, or +3.3% p.a. between 2023 and 2028) than total ATM/CNS provision costs (+14.9%, or +2.8% p.a.).

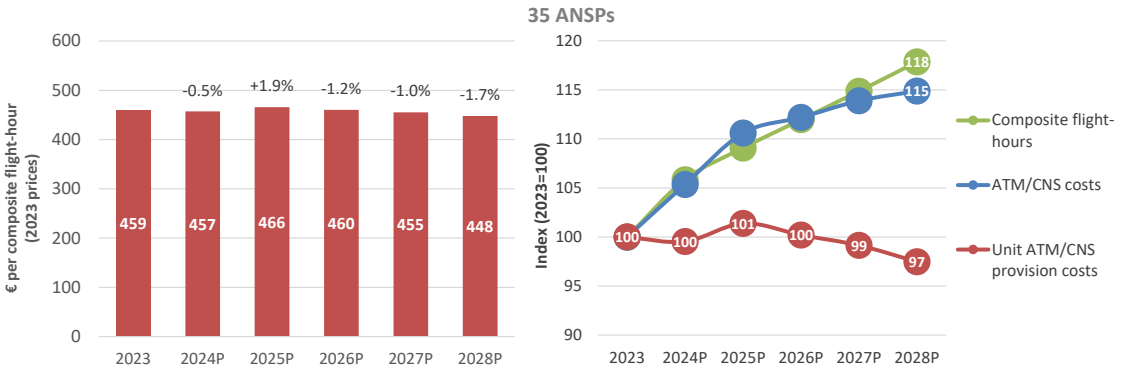


Figure 5.2: Forward-looking cost-effectiveness at Pan-European system level, trends in costs, traffic and unit costs, 2023-2028 (real terms)

Figure 5.3 indicates that all ANSPs, with the exception of DCAC Cyprus (decrease of -1.1% p.a.) and NAVIAIR (decrease of -0.2% p.a.), are forecasting increases in traffic over the 2023-2028 period. The highest increases are planned for MOLDATSA (+11.2% p.a.), Albcontrol (+8.1% p.a.) and ANS CR (+6.2% p.a.). In the meantime, all ANSPs but three (LFV, -6.0% p.a., SMATSA, -0.3% p.a. and ARMATS, -0.3% p.a.) are planning for cost increases in real terms.

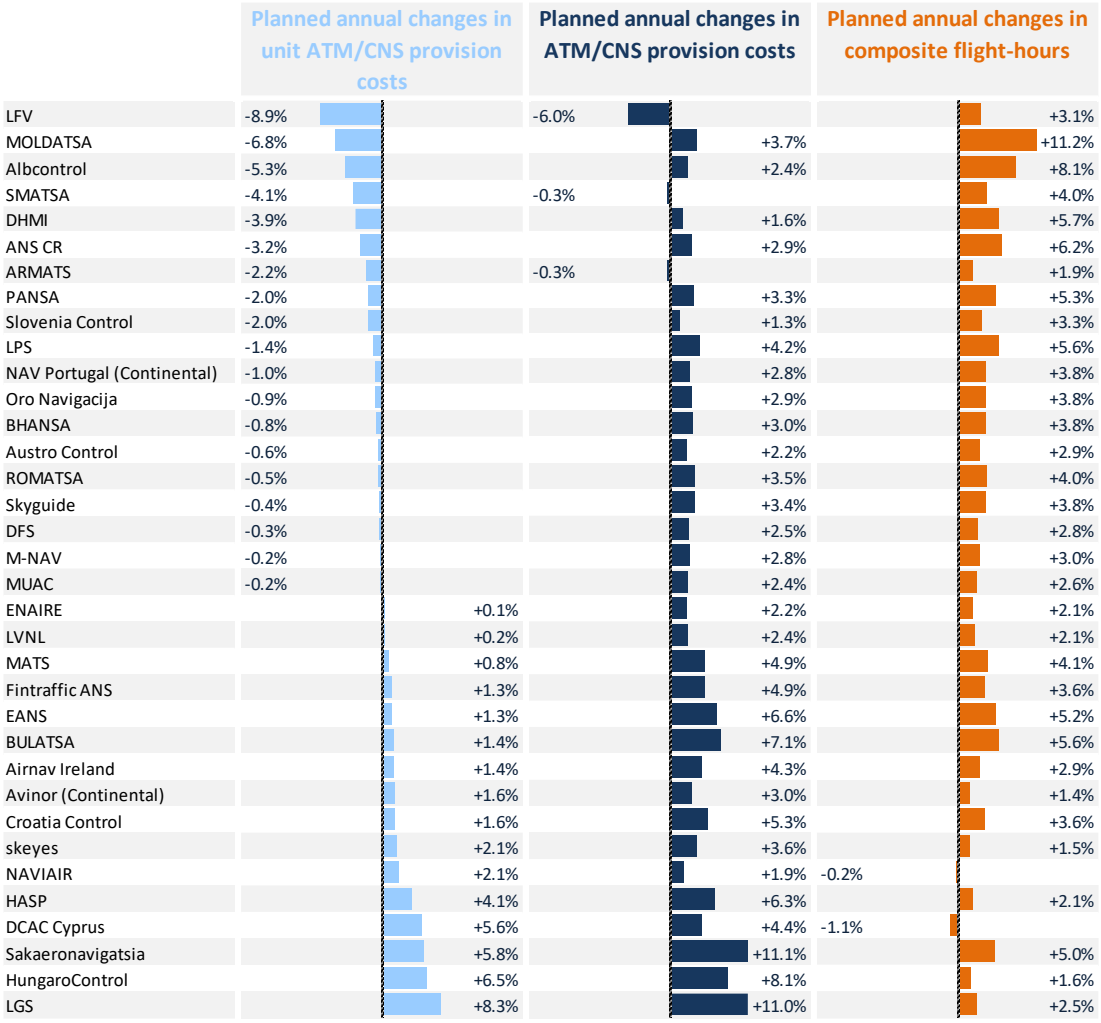


Figure 5.3: Planned annual changes in unit costs over the 2023-2028 period (in % p.a., real terms)

Overall, unit ATM/CNS provision costs are expected to fall for 19 ANSPs and to increase for 16 ANSPs.

ANSPs planning for the five largest reductions in unit costs are: LFV (-8.9% p.a.), MOLDATSA (-6.8% p.a.), Albcontrol (-5.3% p.a.), SMATSA (-4.1% p.a.) and DHMI (-3.9% p.a.).

- For LFV, this reduction is primarily due to a significant decrease in ATM/CNS provision costs in real terms (-6.0% p.a.), which is partly attributed to the planning of lower pension costs.
- For MOLDATSA, Albcontrol and DHMI the main drivers for the expected reductions in unit costs are relatively large increases in traffic (+11.2% p.a., +8.1% p.a. and +5.7% p.a., respectively) while ATM/CNS provision costs are planned to increase by +3.7% p.a., +2.4% p.a. and +1.6% p.a., respectively.

Conversely, LGS (+8.3% p.a.), HungaroControl (+6.5% p.a.), Sakaeronavigatsia (+5.8% p.a.) and DCAC Cyprus (+5.6%) are planning for significant increases in unit ATM/CNS provision costs.

- In the case of LGS, HungaroControl and Sakaeronavigatsia traffic growth is expected to be outweighed by substantial increases across all categories of ATM/CNS provision costs.

- For DCAC Cyprus, the planned increase in unit costs results from a combination of higher ATM/CNS provision costs and lower traffic (-1.1% p.a.).

The left-hand side of Figure 5.4 illustrates the total capital expenditure and depreciation costs at Pan-European system level between 2018 and 2023. This includes 37 ANSPs that consistently reported ACE data over this period. The right-hand side of the figure shows the planned capex and depreciation costs for the period 2024 to 2028 for the 35 ANSPs that consistently reported this information in their ACE 2023 data submission.

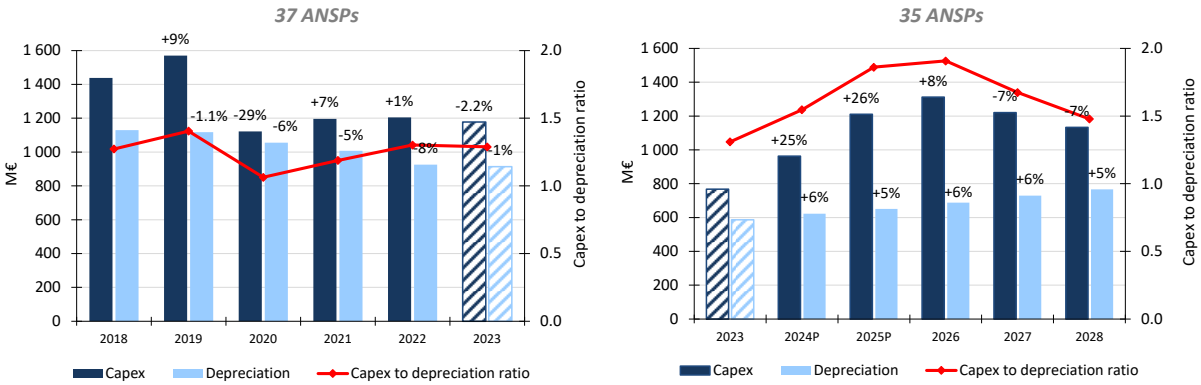


Figure 5.4: Capital expenditures and depreciation costs (2018-2028, real terms)

The total capital expenditures planned for 2024-2028 amount to €5 838M, averaging €1 168M per year. Meanwhile, the planned depreciation costs are €3 455M, or €691M per year on average. As a result, the average capex to depreciation ratio planned for 2024-2028 is 1.69, significantly higher than the 1.25 ratio observed during 2018-2023. This indicates that, overall, ANSPs asset bases are expected to grow faster than in the past six years, which can be partially explained by the reductions or postponements of capital expenditures in 2020-2021 due to the COVID-19 crisis.

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6. FINANCIAL INDICATORS CALCULATED FROM ANSPs' FINANCIAL STATEMENTS

6.1 Introduction

The decline in demand for air travel resulting from the outbreak of COVID-19 pandemic led to an unprecedented reduction in ANSP revenues since 2020. To assess and monitor the impact of this crisis on ANSPs financial strength, selected financial indicators have been introduced in previous ACE reports with the aim of providing deeper insights into financial resilience across the sector.

It should be recognised that examining financial indicators on an annual basis does not capture short-term fluctuations in ANSPs cash position during the year, or whether they are able, for example, to honour any bi-weekly interest commitments. Despite having limitations, these indicators help monitoring ANSPs' financial positions at year-end and therefore provide contextual information for the benchmarking analysis presented in this report.

This chapter provides an overview of ANSPs' financial situation over the 2018-2023 period, by focusing on three indicators: **the current ratio, cash-on-hand days and the free cash flow**. These indicators have been calculated at Pan-European system level, using the data published in ANSPs' financial statements. They are therefore consistent with the information published at individual ANSP level in the EUROCONTROL Aviation Intelligence Unit ANSPs Financial Dashboard[24]. This dashboard provides detailed financial information for 36 individual ANSPs[25] and an aggregated Pan-European view. Due to their specific financial setups, DCAC Cyprus, HASP and MUAC are not part of the dashboard and are therefore not included in this chapter. UkSATSE, excluded from the ACE analysis due to the war in Ukraine and absence of traffic, is still included in the dashboard and in this chapter, since it continued publishing financial statements.

Note on the ANSPs included in this chapter

As of the publication of this report, 2023 financial data is available and verified for 35 out of the 36 participating ANSPs. The 2023 Annual Report of MATS has not yet been published and, as a result, MATS is excluded from calculations at pan-European system level. Additionally, while NAV Portugal's 2023 financial data is available, it has not yet been published and is therefore not displayed in the individual ANSP's charts, though it is included in the pan-European aggregated indicators.

Due to specific circumstances, additional adjustments to the sample composition have been made, as outlined below:

Current ratio and cash-on-hand days:
LVNL is excluded from the sample due to missing information required for the calculation of these indicators.

Free cash flow:
skeyes does not publish cash flow statements. It is therefore excluded for the calculation of this indicator.

Depending on the organisational setup of different ANSPs, the information reported in their financial statements may cover a different scope of activities (e.g. it may include airport management

[24] The ANSP Financial Dashboard produced by the EUROCONTROL Aviation Intelligence Unit collects the data from ANSPs' most recent financial statements and validates them with the ANSPs. For more details, see: https://ansperformance.eu/economics/finance/.

[25] AirNav Ireland, Albcontrol, ANS CR, ARMATS, Austro Control, Avinor Flysikring, BULATSA, BHANSA, Croatia Control, DFS, DHMI, DSNA, EANS, ENAIRE, ENAV, Fintraffic ANS, HungaroControl, LFV, LGS, LPS, LVNL, MATS, M NAV, MOLDATSA, NATS, NAV Portugal, NAVIAIR, Oro Navigacija, PANSA, ROMATSA, Sakaeronavigatsia, skeyes, Skyguide, Slovenia Control, SMATSA and UkSATSE.

operations, commercial activities, etc.) which does not always correspond with the ACE gate-to-gate scope.

6.2 Current ratio and cash-on-hand days

Table 6.1 presents the definitions of two financial indicators which have been introduced in previous ACE reports to monitor ANSPs' liquidity.

Indicator	Formula	Description
Current Ratio	$\frac{Current\ assets}{Current\ liabilities}$	Measures the ability of a company to pay its short-term debt obligations with its current assets. A value greater than 1 suggests it can settle its short-term debt obligations without major difficulties. Conversely, a ratio below 1 may suggest potential liquidity issues.
Cash-on-hand Days	$\frac{Cash\ in\ hand\ or\ at\ bank}{Operating\ costs} \times 365$	Cash-on-hand days measures the length of time a company can pay its operating costs from its cash reserves. A higher number of cash-on-hand days implies greater financial stability and resilience to unforeseen financial shocks.

Table 6.1: Financial indicators definitions

Figure 6.1 presents the evolution of the average current ratio at Pan-European system level[26] between 2018 and 2023 as well as the first and third quartiles. Following a positive shift in 2022, which marked the end of three years of continuous decline, the average current ratio continued to improve in 2023, reaching 3.21, the highest recorded over the 2018-2023 period. This increase was primarily driven by a +19% rise in current assets between 2022 and 2023, largely attributed to components other than cash (e.g., receivables or other short-term assets) as explained in more detail in Figure 6.2 below, while current liabilities fell by -9% over the same period. However, 25% of the ANSPs reported a current ratio of 1.74 or lower in 2023 (see first quartile), indicating that despite the system-wide recovery, some providers continued to operate with short-term liquidity significantly lower than the average.

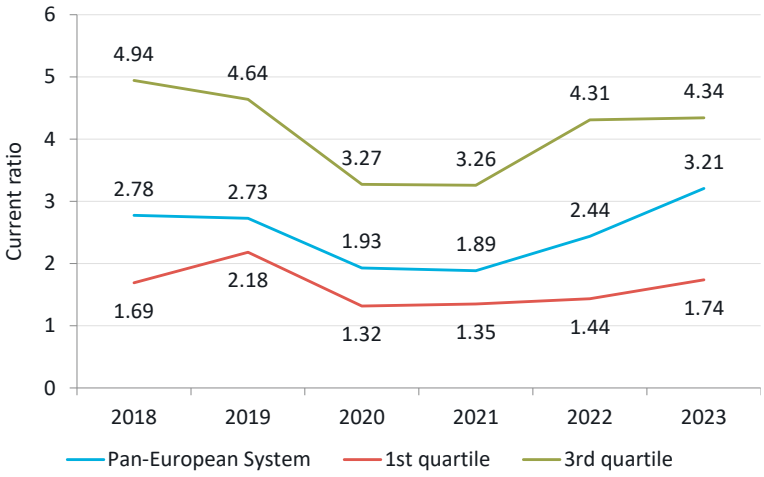


Figure 6.1: Trends in ANSPs current ratio, 2018-2023

[26] The Pan-European system (blue line in Figures 6.1 and 6.2) is calculated by first aggregating the financial data of individual ANSPs. The current ratio and cash-on-hand days are then computed from this combined dataset, producing a weighted average that more accurately represents the overall financial position of the system. This approach minimizes distortions that could arise from the disproportionate influence of individual ANSPs in a simple average calculation.

Figure 6.2 illustrates the changes in cash-on-hand days at Pan-European system over the 2018 - 2023 period, as well as trends in the first and third quartiles. In 2023, the Pan-European system cash-on-hand fell to 102 days, down from 116 days in 2022, and is still well below pre-pandemic level (173 days in 2018 and 157 days in 2019). This decline was driven by a combination of reduced cash balances (-7.2%) and a rise in operating expenses (+5.5%) between 2022 and 2023.

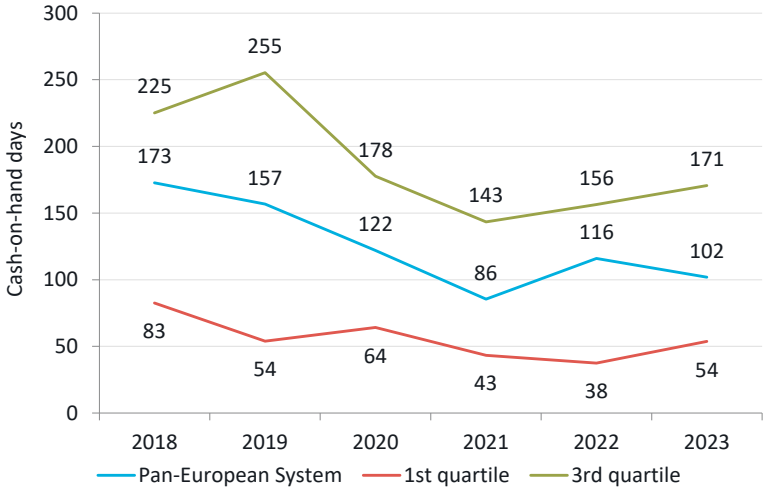


Figure 6.2: Trends in cash-on-hand days,2018-2023

Over the past four years several ANSPs have exhibited a notable divergence between growing current ratios and decreasing cash-on-hand days. At system level, this trend is heavily influenced by large ANSPs such as DFS and DSNA, which have maintained current ratios well above two, while their cash-on-hand days have steadily declined.

Several factors can explain why some ANSPs record increases in their current ratio but reductions or stagnation in cash-on-hand days.

1. Deferred revenue recovery (carry-overs) – Under the Single European Sky performance and charging scheme, ANSPs operate on a regulated cost-recovery basis, meaning that revenue shortfalls due to traffic downturns are recovered through future charges. During the COVID-19 crisis, the European Commission implemented exceptional measures to mitigate financial distress among airspace users. As part of these measures, the revenue shortfalls incurred by ANSPs in 2020-2021 are to be recovered from airspace users over a period of five to seven years starting in 2023 to prevent disproportionate increases in unit rates. As a result, part of these large future receivables are recorded as current assets, contributing to a significant increase in total current assets in 2022 and 2023. This trend is visible in Figure 6.3, where current assets rose from €5.5 billion in 2021 to €9.8 billion in 2023. Over the 2018-2023 period, the share of cash and equivalents in the current assets dropped from 54% to 26%.

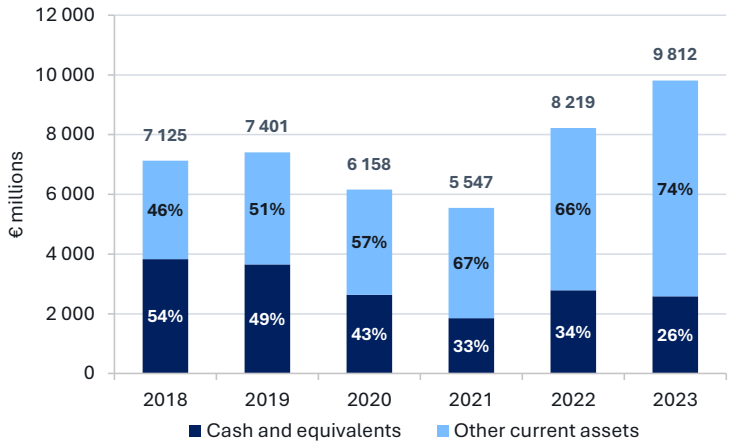


Figure 6.3: Evolution of cash and equivalents as a proportion of current assets, 2018-2023 (nominal terms)

2. Corporate setup and cash management – ANSPs embedded within larger state-owned enterprises often maintain low cash balances. ENAIRE (Spain) and Fintraffic ANS (Finland) hold very little cash as their liquidity is centrally managed at the group level.

6.3 Free cash flow

The Free cash flow is a widely used indicator reflecting the liquidity available to a company after covering its operating expenses and funding its capital expenditures. This metric complements the current ratio and cash-on-hand days indicators. While these are calculated based on accrual accounting, the free cash flow reflects the actual cash movements recorded during the year.

Figure 6.4 shows the free cash flow and its components (*net cash flow from operating activities* and *cash flow from capital expenditures)* for 34 ANSPs for which cash flow data is available from 2018 to 2023.

The COVID-19 pandemic had a major impact on ANSP cash flows. When air traffic collapsed in 2020, net operating cash flow dropped from +€2.4 billion in 2019 to -€2.4 billion in 2020, as revenue streams dried up. This cash shortfall continued into 2021, with a loss of about -€1.8 billion from operations, as traffic only partially recovered.

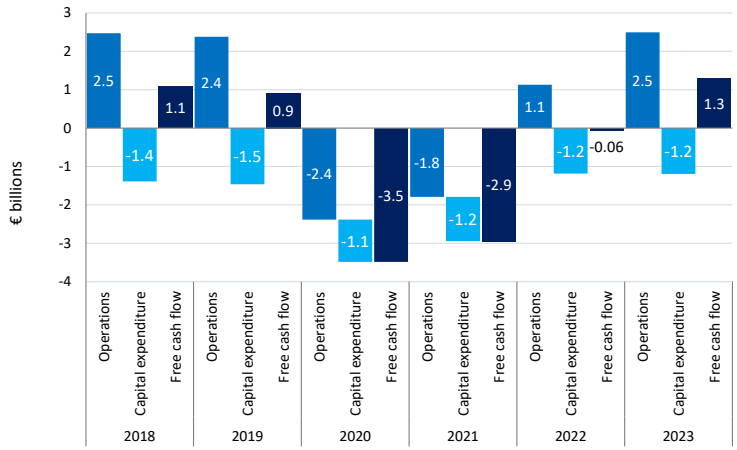


Figure 6.4: Cash flow, 2019-2023 (nominal terms)

At the same time, ANSPs still had to cover capital expenditures, although at lower levels than before the pandemic. As a result, the free cash flow (operating cash minus capital expenditures) fell to - €3.5 billion in 2020 and remained negative in 2021 (-€2.9 billion). As shown in Section 2.3.2 these losses forced many ANSPs to use their financial reserves and seek external funding.

By 2022, the situation started to improve. As traffic recovered and cost-cutting measures took effect, net operating cash flow turned positive again (+€1.1 billion) and almost covered capital expenditures, leading to a free cash flow close to zero.

In 2023, the situation continued to improve, with net cash from operations (+€2.5 billion) being much higher than capital outflows (-€1.2 billion). This resulted in a +€1.3 billion free cash flow at system level (a higher value than in 2018 and 2019).

To compare ANSPs irrespective of their size, the free cash flow to revenues ratio is used as a normalized indicator. Table 6.2 below describes how this indicator is calculated.

Indicator	Formula	Description
Free Cash Flow to Revenues ratio	$\frac{Net\ cash\ flow\ from\ operating\ activities - Capex}{Revenues}$	This indicator provides a representation of the cash generated by operations (after accounting for capital investments) which is available to repay creditors or pay dividends and interests to investors. Dividing free cash flow by revenues allows an easier interpretation of the indicator when looking at organisations of different size.

Table 6.2: Free cash flow to revenue ratio definition

Figure 6.5 below shows, at ANSP level, the 2023 free cash flow to revenue ratio, along with the annual cash flow changes from 2018 to 2023 and the cumulative free cash flow over 2018-2023.

ANSP	Free cash flow to revenue ratio, 2023	Free cash flow, €m						Cumulative free cash flow, 2018-2023
		2018	2019	2020	2021	2022	2023	
Sakaeronavigatsia	+30.5%	2	-3	-3	1	13	17	26
ENAIRE	+27.6%	632	600	-200	-195	-141	245	940
DHMI	+27.4%	246	95	-98	-278	152	487	604
HungaroControl	+25.4%	18	14	-48	-24	34	40	33
Oro Navigacija	+22.1%	2	2	-8	-3	-1	7	-1
NAV Portugal	2023 data not published	22	-58	-108	-30	51		
BULATSA	+18.1%	11	13	-40	-18	18	31	14
ARMATS	+17.7%	3	3	-4	2	4	3	12
Croatia Control	+17.1%	12	18	-44	-9	39	21	37
LFV	+14.2%	30	15	114	17	27	43	246
M-NAV	+13.5%	2	-1	-6	2	-2	3	-0
Slovenia Control	+12.2%	5	1	-13	-4	5	6	-0
Austro Control	+11.5%	35	16	-55	-37	36	40	37
ANS CR	+11.3%	-9	-4	-56	-32	10	20	-71
ENAV	+10.8%	186	224	-266	-239	147	107	159
UkSATSE	+10.7%	4	-36	-26	2	-10	3	-63
LPS	+8.3%	4	-1	-22	-14	3	7	-22
NATS	+7.4%	156	70	-387	-332	76	88	-328
DSNA	+6.9%	15	6	-960	-777	-104	127	-1 693
AirNav Ireland	+6.9%	20	32	-55	-35	7	13	-18
SMATSA	+6.6%	-8	-6	-34	-21	14	8	-47
ROMATSA	+5.5%	5	-24	-92	-47	9	17	-132
BHANSA	+3.4%	2	-2	-8	-0	15	1	8
Skyguide	+2.6%	-28	55	-150	-79	-22	14	-211
DFS	+0.2%	-278	-43	-498	-531	-297	3	-1 644
MATS	2023 data not published	1	1	1	1	8		
Avinor Flysikring	-1.1%	-1	2	-74	-2	-19	-2	-96
NAVIAIR	-2.5%	5	4	-50	-50	-13	-3	-108
LGS	-5.0%	2	-2	-4	-7	-3	-1	-15
LVNL	-8.8%	-27	-82	-204	-150	-64	-26	-552
PANSA	-11.3%	2	-3	-81	-33	-20	-32	-166
Fintraffic ANS	-16.5%	12	5	0	-14	-5	-12	-14
MOLDATSA	-20.1%	-1	5	-2	-1	-1	-2	-3
EANS	-32.8%	3	5	-5	-1	-5	-6	-8
Albcontrol	-63.1%	3	-3	2	-4	-11	-19	-33

Figure 6.5: Free cash flow indicators at ANSP level, 2018-2023 (nominal terms)

Despite the overall positive picture in 2023, not all ANSPs have recovered equally, and nine ANSPs still recorded negative free cash-flow in 2023. Furthermore, while 24 ANSPs recorded positive free cash flow in 2023, it was not always sufficient to offset the net losses recorded over 2018-2022. This

was indeed the case for 13 ANSPs, among which DSNA (-€1.7 billion), DFS (-€1.6 billion) and NATS (-€0.3 billion) recorded the largest cumulative losses.

Figure 6.6 below provides a detailed comparison of free cash flow components in 2023 and in 2019 (pre-COVID) for each ANSP. It shows that among the nine ANSPs with negative free cash flow in 2023:

- Five ANSPs reported **negative cash from operations**: Albcontrol[27] (-55.0%), Fintraffic ANS (- 8.3%), EANS (-2.6%), PANSA (-0.6%) and MOLDATSA (-0.5%). For EANS and MOLDATSA, this was combined with relatively large capital expenditures (relative to their revenues).
- Four ANSPs generated **positive cash flow from operations**: Avinor Flysikring (+1.5%), NAVIAIR (+8.0%), LGS (8.9%), and LVNL (+5.7%). However, this was not sufficient to cover their capital expenditures.

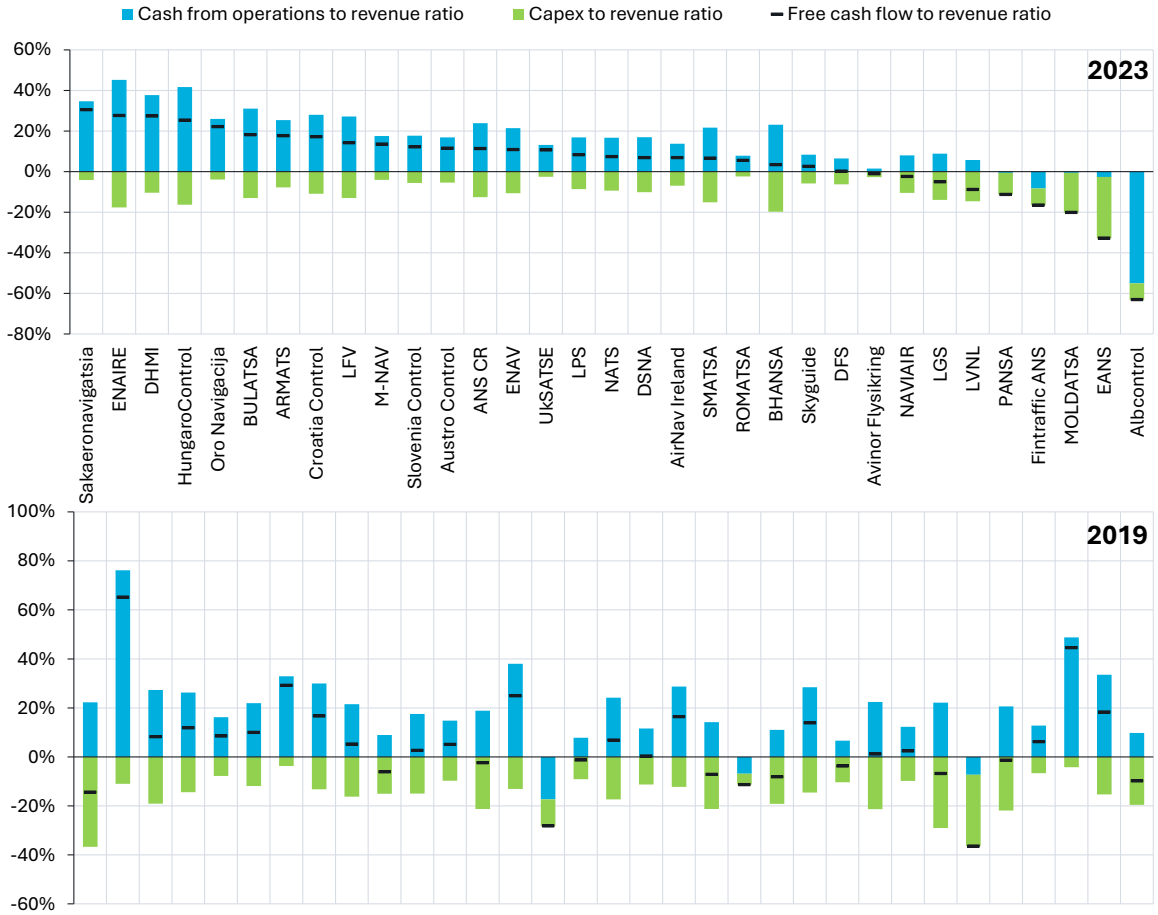


Figure 6.6: Free cash flow to revenues ratio and its components at ANSP level, 2019 compared to 2023

Considering capital expenditures, ANSPs generally spent less relative to their revenues in 2023 compared to 2019. For instance, only six ANSPs had a capex to revenue ratio above 15% in 2023 while they were 14 in 2019. Sakaeronavigatsia, Avinor Flysikring, LGS and LVNL were among the ANSPs showing the largest reductions in capex to revenue ratios between 2019 and 2023.

Only nine ANSPs increased their capex to revenue ratio, with the most significant increases recorded by MOLDATSA, EANS and ENAIRE.

[27] Albcontrol's revenues from en-route and terminal charges have been blocked since December 2020 due to a Belgian court's decision related to an ongoing case against the Republic of Albania. As a result, Albcontrol did not receive any revenue for the provision of these services during 2021, 2022, and 2023.

Overall, the monitoring of ANSPs financial strength shows a progressive improvement at Pan-European system level, with the average current ratio and free cash flow back to their pre-crisis levels. However, these observations should be nuanced since a) the increase in the current ratio is affected by the large amounts of short-term receivables which are not yet converted into cash; and b) the free cash flow improvement compared to 2019 is partly due to lower capital expenditures. Finally, the analysis of the cash-on-hand days and free cash flow indicators shows that several ANSPs might still need several years to fully recover from the COVID-19 crisis.

ANNEX 1 – STATUS OF ANSPs' 2023 ANNUAL REPORTS

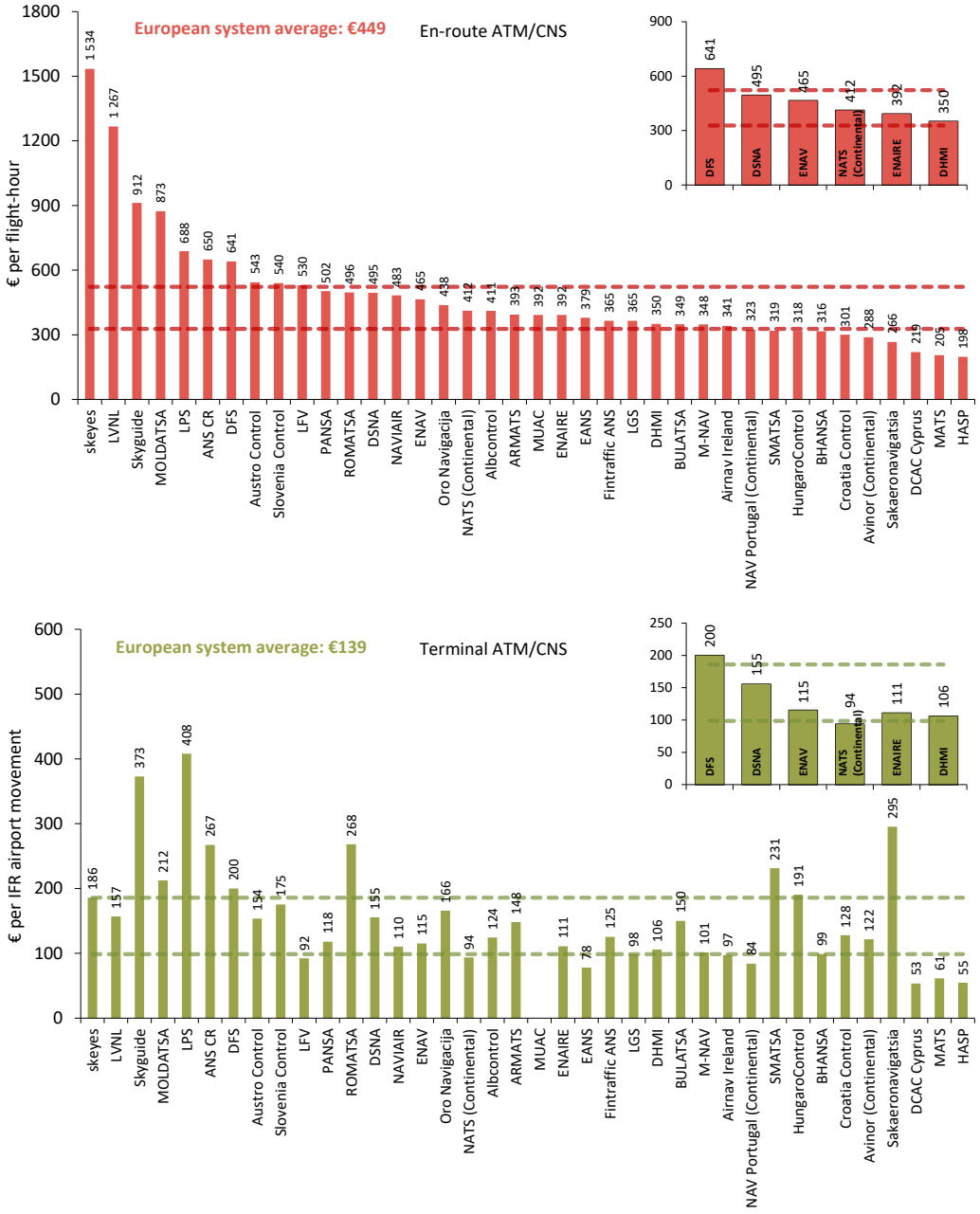
	Availability of a public Annual Report (AR)	Availability of Management Report	Availability of Annual Accounts	Independently audited accounts	Separate disclosure of en-route and terminal ANS costs	Information provided in English	Accounts fully or partially prepared according to IFRS	PRU comments
AirNav Ireland	✓	✓	✓	✓	No	✓	✓	The financial statements are prepared in accordance with Financial Reporting Standard 102 ('FRS102') which is IFRS for medium sized entities.
Albcontrol	✓	No	✓	✓	No	✓	✓	
ANS CR	✓	✓	✓	✓	No	✓	✓	
ARMATS	No	No	✓	✓	No	No	✓	An extract of the Financial Statements comprising an Income and a Balance Sheet statement in English has been provided.
Austro Control	✓	✓	✓	✓	No	✓	✓	
Avinor	✓	✓	✓	✓	✓	✓	✓	Separate disclosure of aggregated figures for en-route and terminal ANS.
BHANSA	No	No	✓	✓	No	✓	✓	
BULATSA	✓	✓	✓	✓	No	No	✓	
Croatia Control	✓	✓	✓	✓	No	✓	✓	
DCAC Cyprus	No	No	No	No	No	No	No	DCAC annually discloses a report which includes some financial information from Route Charges Document but not Financial Statements.
DFS	✓	✓	✓	✓	No	✓	✓	Separate accounts are used for internal reporting purposes and charges calculation.
DHMİ	✓	✓	✓	✓	No	✓	No	Includes airport activities.
DSNA	✓	✓	✓	✓	No	No	No	
EANS	✓	✓	✓	✓	✓	✓	✓	Separate disclosure of aggregated figures for en-route and terminal ANS.
ENAIRE	✓	✓	✓	✓	No	✓	✓	
ENAV	✓	✓	✓	✓	No	✓	✓	
Fintraffic ANS	✓	✓	✓	✓	No	✓	No	
HASP	No	No	No	No	No	No	No	
HungaroControl	✓	✓	✓	✓	No	✓	✓	
LFV	✓	✓	✓	✓	No	✓	No	
LGS	✓	✓	✓	✓	No	No	✓	
LPS	✓	✓	✓	✓	No	✓	✓	
LVNL	✓	✓	✓	✓	✓	No	✓	Separate disclosure of aggregated figures for en-route and terminal ANS.
MATS								Annual Report not yet published.
M-NAV	✓	✓	✓	✓	No	No	✓	
MOLDATSA	✓	✓	✓	✓	No	No	No	
MUAC	✓	✓	✓	✓	n/appl	✓	✓	
NATS	✓	✓	✓	✓	✓	✓	✓	Several Annual Reports for individual group companies.
NAV Portugal	✓	✓	✓	✓	✓	No	✓	Annual Report not yet published.
NAVIAIR	✓	✓	✓	✓	✓	✓	✓	Separate disclosure of aggregated figures for en-route and terminal ANS. Based on Danish Financial Statements Act which is broadly similar to IFRS.
Oro Navigacija	✓	✓	✓	✓	No	✓	✓	
PANSA	✓	No	✓	✓	✓	✓	✓	Only part of the information is provided in English.
ROMATSA	No	No	✓	✓	No	✓	✓	Annual Report not yet published.
Sakaeronavigatsia	✓	No	✓	✓	No	✓	✓	
skeyes	✓	✓	✓	✓	No	✓	✓	Annual Accounts are prepared according to the Belgian GAAP, which are close to IFRS.
Skyguide	✓	✓	✓	✓	No	✓	✓	Annual Accounts are prepared according to the Swiss GAAP, which are close to IFRS.
Slovenia Control	✓	✓	✓	✓	No	✓	✓	
SMATSA	✓	✓	✓	✓	No	✓	✓	

Annex 1 - Table 0.1: Status of ANSPs 2023 Annual Reports

ANNEX 2 – PERFORMANCE INDICATORS USED FOR THE COMPARISON OF ANSPs

For the sake of completeness, the gate-to-gate financial cost-effectiveness indicator is broken down into en-route and terminal components. The Figure below shows that there are cases where a high en-route cost per flight-hour (top graph) corresponds to a low terminal cost per IFR airport movement (bottom graph) and vice versa.

It is difficult to determine whether these differences are driven by economic and operational factors (for example, size of operations, economies of scale, or traffic complexity), or purely cost-allocation differences, which are known to exist across States/ANSPs. For this reason, the focus of the cost-effectiveness benchmarking analysis in this report is “gate-to-gate”.



Annex 2 - Figure 0.1: Breakdown of financial cost-effectiveness into en-route and terminal, 2023

The quality of service provided by ANSPs has an impact on the efficiency of aircraft operations, which carry with them additional costs that need to be taken into consideration for a full economic

assessment of ANSP performance. In this ACE benchmarking report, an indicator of "economic" cost-effectiveness is computed at ANSP and Pan-European system levels by adding the ATM/CNS provision costs and the costs of ATFM ground delay, all expressed per composite flight-hour. This computation is shown in the Table below (see column 10). More information on the cost of ATFM delays can be found in the ACE handbook.

ATFM delays used in the ACE analysis

- ATFM delays are extracted from the Network Manager database. All delay causes (e.g. capacity, weather, etc.) are considered.
- Only airports where the ANSPs are responsible to provide ATC services are taken into account when aggregating airport delays at ANSP level. This is verified each year during the ACE data validation process. Airport ATFM delays also include departure delay.
- ATFM delays are calculated after post-ops and eNM adjustments, which entails a re-allocation of ATFM delays across ACCs in order to account for the initiatives taken to improve performance at network level. This process was initially launched in 2016 but the magnitude of ATFM delay reallocation became really significant in 2018 and 2019 due to the large extent of the measures implemented by the NM. In order to have consistent time series within this ACE report, the adjusted ATFM delays are used retroactively starting from 2016.
- Delays are taken into account independently of their duration. There is no distinction between delays lower or higher than 15 minutes.

ANSPs	(1) Gate-to-gate ATM/CNS provision costs (in €'000)	(2) En-route ATFM delays ('000 minutes)	(3) Airport ATFM delays ('000 minutes)	(4)=(2)+(3) Total ATFM delays ('000 minutes)	(5) % share in European system ATFM delays	(6)=(4)x€127 Costs of ATFM delays (in €'000)	(7) Composite flight-hours (in '000)	(8)=(1)/(7) Financial gate-to-gate cost-effectiveness	(9)=(6)/(7) Costs of delay per composite flight-hour	(10)=(8)+(9) Economic costs per composite flight-hour
Airnav Ireland	140 904	11	43	54	0.2%	6 849	410	344	17	360
Albcontrol	31 916	2	0	2	0.0%	233	76	418	3	421
ANS CR	161 752	56	4	60	0.2%	7 585	231	700	33	732
ARMATS	14 697	0	0	0	0.0%	0	33	446	0	446
Austro Control	242 093	147	46	192	0.8%	24 421	444	546	55	601
Avinor (Continental)	167 773	17	34	51	0.2%	6 519	498	337	13	350
BHANSA	32 544	111	1	112	0.5%	14 242	102	318	139	458
BULATSA	132 821	55	0	56	0.2%	7 059	367	362	19	381
Croatia Control	100 174	347	0	347	1.4%	44 068	315	318	140	458
DCAC Cyprus	46 729	15	6	21	0.1%	2 680	216	217	12	229
DFS	1 171 220	5 148	431	5 579	22.7%	708 554	1 771	661	400	1 062
DHMI	710 555	0	769	769	3.1%	97 639	1 992	357	49	406
DSNA	1 437 523	6 795	666	7 462	30.4%	947 649	2 840	506	334	840
EANS	21 822	0	0	0	0.0%	0	60	364	0	364
ENAIRE	849 544	1 029	503	1 532	6.2%	194 559	2 157	394	90	484
ENAV	731 058	264	145	409	1.7%	51 890	1 610	454	32	486
Fintraffic ANS	59 244	0	10	10	0.0%	1 261	150	396	8	404
HASP	175 820	827	612	1 439	5.9%	182 783	889	198	206	403
HungaroControl	120 114	1 011	1	1 012	4.1%	128 565	343	350	375	725
LFV	218 241	7	45	52	0.2%	6 575	447	489	15	503
LGS	25 665	0	0	0	0.0%	0	71	363	0	363
LPS	76 454	17	0	17	0.1%	2 160	102	750	21	771
LVNL	268 764	38	613	651	2.7%	82 701	288	932	287	1 219
MATS	20 921	0	0	0	0.0%	24	101	208	0	208
M-NAV	18 412	56	0	56	0.2%	7 132	53	350	136	486
MOLDATSA	9 472	0	0	0	0.0%	0	12	814	0	814
MUAC	237 433	276	n/appl	276	1.1%	35 096	606	392	58	450
NATS (Continental)	734 085	718	1 009	1 728	7.0%	219 410	1 861	394	118	512
NAV Portugal (Continental)	180 370	327	613	939	3.8%	119 304	565	319	211	530
NAVIAIR	131 823	56	352	408	1.7%	51 807	288	458	180	639
Oro Navigacija	30 236	0	2	2	0.0%	260	63	477	4	481
PANSA	247 692	136	42	178	0.7%	22 623	511	485	44	529
ROMATSA	279 689	121	0	121	0.5%	15 412	509	549	30	579
Sakaeronavigatsia	38 580	0	0	0	0.0%	0	103	375	0	375
skeyes	214 231	49	44	93	0.4%	11 772	190	1 129	62	1 191
Skyguide	461 138	155	308	463	1.9%	58 825	448	1 030	131	1 162
Slovenia Control	40 678	13	0	13	0.1%	1 654	74	548	22	571
SMATSA	113 825	442	1	443	1.8%	56 229	306	372	184	556
Total Pan-European System	9 696 014	18 248	6 299	24 548	100%	3 117 540	21 101	460	148	607

Annex 2 - Table 0.1: Economic cost-effectiveness indicator, 2023

ANNEX 3 – PERFORMANCE RATIOS

This Annex summarises the relationship between the three multiplicative components of financial cost-effectiveness (ATCO-hour productivity, employment costs per ATCO-hour and support cost ratio) and the two complementary components (ATCO employment costs per composite flight-hour and the support cost per composite flight-hour), described in Chapter 2. To facilitate the interpretation of the results, the concept of the "performance ratio" has been introduced.

The performance ratios represent the relationship between the value for an ANSP of an indicator and the value of that indicator for the Pan-European system as a whole[28]. Performance ratios are defined such that a value greater than one implies a performance better than the Pan-European average, in terms of the positive contribution it makes to cost-effectiveness. An ANSP with the same performance as the Pan-European system will have a performance ratio of one.

ANSPs for which a given component makes a particularly positive contribution to its cost-effectiveness (more than 1.30) are highlighted in green – those where a given component makes a particularly low contribution (less than 1/1.30) are in orange.

ANSPs	Country	Financial cost-effectiveness KPI indexes*	Performance ratios			Performance ratios	
			ATCO-hour productivity	ATCO employment costs per ATCO-hour*	Support cost ratio*	ATCO employment costs per composite flight-hour*	Support costs per composite flight-hour*
Airnav Ireland	IE	1.34	1.09	1.24	0.99	1.35	1.33
Albcontrol	AL	1.10	0.89	3.98	0.31	3.55	0.82
ANS CR	CZ	0.66	0.75	1.05	0.83	0.79	0.61
ARMATS	AM	1.03	0.34	3.98	0.77	1.34	0.92
Austro Control	AT	0.84	1.12	0.72	1.04	0.81	0.86
Avinor (Continental)	NO	1.37	0.93	1.17	1.25	1.09	1.56
BHANSA	BA	1.44	0.71	2.66	0.77	1.88	1.29
BULATSA	BG	1.27	1.04	1.18	1.03	1.23	1.29
Croatia Control	HR	1.44	1.00	1.31	1.10	1.31	1.52
DCAC Cyprus	CY	2.12	1.05	2.24	0.91	2.34	2.03
DFS	DE	0.69	1.10	0.50	1.27	0.55	0.80
DHMI	TR	1.29	0.99	2.31	0.57	2.28	1.06
DSNA	FR	0.91	0.83	1.08	1.01	0.90	0.91
EANS	EE	1.26	0.81	1.65	0.95	1.33	1.23
ENAIRE	ES	1.17	1.07	0.88	1.24	0.94	1.33
ENAV	IT	1.01	1.02	0.93	1.07	0.95	1.05
Fintraffic ANS	FI	1.16	0.74	1.56	1.01	1.15	1.17
HASP	GR	2.32	1.19	1.69	1.16	2.00	2.52
HungaroControl	HU	1.31	1.29	1.49	0.68	1.92	1.14
LFV	SE	0.94	0.81	0.81	1.43	0.66	1.19
LGS	LV	1.27	0.73	2.50	0.69	1.83	1.10
LPS	SK	0.61	0.64	1.10	0.87	0.70	0.58
LVNL	NL	0.49	0.94	1.31	0.40	1.24	0.38
MATS	MT	2.21	0.94	2.83	0.84	2.65	2.05
M-NAV	MK	1.31	0.58	2.37	0.96	1.37	1.28
MOLDATSA	MD	0.56	0.18	5.16	0.62	0.91	0.48
MUAC		1.17	2.27	0.42	1.24	0.94	1.33
NATS (Continental)	UK	1.17	1.28	0.92	0.99	1.17	1.16
NAV Portugal (Continental)	PT	1.44	1.43	0.75	1.34	1.07	1.73
NAVIAIR	DK	1.00	1.09	0.99	0.93	1.08	0.97
Oro Navigacija	LT	0.96	0.54	2.20	0.81	1.18	0.88
PANSA	PL	0.95	0.89	1.01	1.05	0.90	0.97
ROMATSA	RO	0.84	0.85	1.04	0.95	0.88	0.82
Sakaeronavigatsia	GE	1.23	0.71	4.79	0.36	3.39	0.93
skeyes	BE	0.41	0.78	0.83	0.63	0.65	0.34
Skyguide	CH	0.45	1.00	0.66	0.67	0.66	0.38
Slovenia Control	SI	0.84	0.66	1.24	1.02	0.82	0.85
SMATSA	RS/ME	1.23	0.85	1.70	0.85	1.44	1.15
Total Pan-European System		1.00	1.00	1.00	1.00	1.00	1.00

Annex 3 - Table 0.1: Components of gate-to-gate cost-effectiveness, 2023

Some ANSPs more than make up for a relatively low contribution from one component by a relatively high contribution from another and, as a result, are more cost-effective than the average (cost-effectiveness index greater than 1).

[28] For the ATCO employment costs per ATCO-hour, the support costs ratio, the ATCO employment costs per composite flight-hour and the support costs per composite flight-hour (asterisked in the Table above), the inverse ratio is used, since **higher** unit employment costs and **higher** support costs imply **lower** cost-effectiveness performance.

On the left-hand-side the three ratios are multiplicative; the product of the ratios for each of the components equals the performance ratio for overall financial cost-effectiveness (see financial cost-effectiveness index). The following example for ENAIRE illustrates the interpretation of the performance ratios:

1.17	ENAIRE's gate-to-gate **ATM/CNS costs per composite flight-hour** are **-14% lower** (1/1.17 - 1) than the Pan-European average.
= 1.07	**ATCO-hour productivity** is **+7%** (1.07/1-1) **higher than** the Pan-European average.
x 0.88	The **ATCO employment costs per ATCO-hour** of ENAIRE are **+14% higher** (1/0.88 - 1) than the Pan-European average.
x 1.24	**Support cost ratio** is **-20% lower** (1/1.24 - 1) than the Pan-European average.

On the right-hand-side, the two complementary performance ratios are normalised using the European average (note that these ratios are neither multiplicative nor additive):

0.94	ENAIRE's **ATCOs in OPS employment costs per composite flight-hour** are **+7% higher** (1/0.94 - 1) than the Pan-European average, while
1.33	The **support costs per composite flight-hour** are **-25% lower** (1/1.33 - 1) than the Pan-European average.

ANNEX 4 – EXCHANGE RATES, INFLATION RATES AND PURCHASING POWER PARITIES (PPPS) DATA

ANSPs	Countries	2023 Exchange rate (1€ =)	2023 Inflation rate (%)	2023 PPPs	Comments
Airnav Ireland	Ireland	1	5.2	1.19	
Albcontrol	Albania	108.304	4.8	62.56	
ANS CR	Czech Republic	23.968	12.0	20.31	
ARMATS	Armenia	423.042	2.0	241.11	PPPs from IMF database
Austro Control	Austria	1	7.7	1.13	
Avinor (Continental)	Norway	11.420	5.8	14.18	
BHANSA	Bosnia and Herzegovina	1.956	6.1	1.07	
BULATSA	Bulgaria	1.955	8.6	1.18	
Croatia Control	Croatia	1.000	8.4	0.68	
DCAC Cyprus	Cyprus	1	3.9	0.91	
DFS	Germany	1	6.0	1.12	
DHMI	Türkiye	25.713	54.0	11.33	
DSNA	France	1	5.7	1.09	
EANS	Estonia	1	9.1	0.92	
ENAIRE	Spain	1	3.4	0.90	
ENAV	Italy	1	5.9	0.96	
Fintraffic ANS	Finland	1	4.3	1.22	
HASP	Greece	1	4.2	0.81	
HungaroControl	Hungary	381.193	17.0	267.64	
LFV	Sweden	11.462	5.9	13.51	
LGS	Latvia	1	9.1	0.77	
LPS	Slovak Republic	1	11.0	0.80	
LVNL	Netherlands	1	4.1	1.18	
MATS	Malta	1	5.6	0.91	
M-NAV	North Macedonia	61.396	9.4	31.04	
MOLDATSA	Moldova	19.510	13.4	11.33	PPPs from IMF database
MUAC		1	4.1	1.18	Netherlands' PPPs and inflation rate used for MUAC
NATS (Continental)	United Kingdom	0.870	7.3	1.07	PPPs from IMF database
NAV Portugal (Continental)	Portugal	1	5.3	0.82	
NAVIAIR	Denmark	7.449	3.4	9.86	
Oro Navigacija	Lithuania	1	8.7	0.78	
PANSA	Poland	4.538	10.9	3.07	
ROMATSA	Romania	4.944	9.7	2.83	
Sakaeronavigatsia	Georgia	2.808	2.5	1.41	PPPs from IMF database
skeyes	Belgium	1	2.3	1.13	
Skyguide	Switzerland	0.975	2.3	1.54	
Slovenia Control	Slovenia	1	7.2	0.86	
SMATSA	Serbia and Montenegro	117.170	12.4	71.38	Data for Serbia only since ACE data is provided in Serbian Dinar

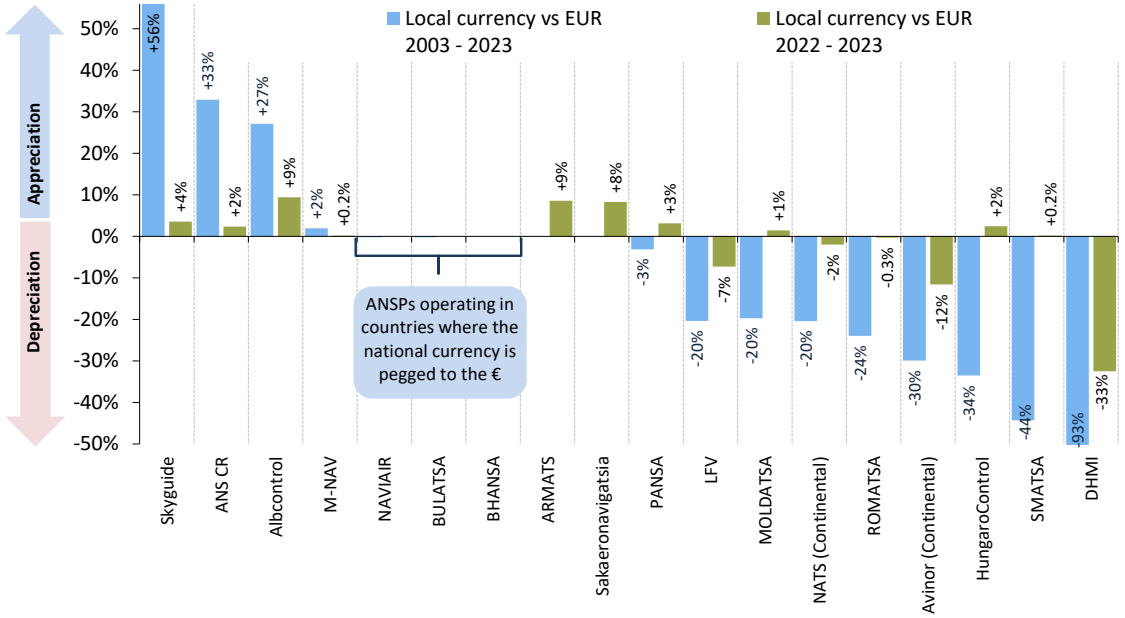
Annex 4 - Table 0.1: 2023 Exchange rates, inflation rates and PPPs data

According to the PPP values published in the IMF World Economic Outlook April 2025 database, there is a factor of 1.29 between the PPPs for Georgia (0.868 GEL per international Dollar in 2023) and the PPPs for France (0.671 Euro per international Dollar). This factor is applied to the PPPs for France as reported in the EUROSTAT database (i.e. 1.092) to express the PPPs for Georgia in PPS (1.41 = 1.092 × 1.29). A similar methodology is used to express Armenia, Moldova and the United Kingdom PPPs in PPS.

It is important to note that, for ANSPs operating outside of the Euro zone, substantial changes of the national currency against the Euro may significantly affect the level of 2023 unit ATM/CNS provision

costs when expressed in Euro (see Figure 3.1 on p.15). However, it should be noted that the changes in unit costs analysed in this report are not affected by changes in national currency against the Euro.

The Figure below shows the changes in exchange rates for ANSPs operating in countries which are not part of the Euro zone. The blue bar shows the long-term changes in exchange rate over the 2003-2023 period, while the green bar displays the short-term changes (2022-2023).



Annex 4 - Table 0.2: Cumulative variations in exchange rates against the Euro, 2003-2023 and 2022-2023

Significant changes are observed over the 2003-2023 period for several ANSPs part of the ACE analysis. For example, the Swiss Franc significantly appreciated (+56%) while the Turkish Lira substantially depreciated (-93%). Other substantial variations in exchange rates compared to the Euro include the depreciation of the Serbian Dinar (-44%) and Hungarian Forint (-34%) while the Czech Koruna appreciated by +33%.

ANNEX 5 – KEY DATA

	En-route ANS revenues (in €'000)										Terminal ANS revenues (in €'000)										Gate-to-gate ANS revenues (in €'000)									
ANSPs	Income from charges	Income for airport operator	Income received from other States for delegation of ANS	Income from the military	Income in respect of exempted flights	Other income from domestic government	Financial income	Other income	Exceptional revenue item	**Total revenues**	Income from charges	Income for airport operator	Income received from other States for delegation of ANS	Income from the military	Income in respect of exempted flights	Other income from domestic government	Financial income	Other income	Exceptional revenue item	**Total revenues**	Income from charges	Income for airport operator	Income received from other States for delegation of ANS	Income from the military	Income in respect of exempted flights	Other income from domestic government	Financial income	Other income	Exceptional revenue item	**Total revenues**
AirNav Ireland	125 767	0	0	0	1 249	0	1 021	0	0	128 037	31 486	0	0	0	0	0	207	0	0	31 693	157 253	0	0	0	1 249	0	1 228	0	0	159 730
Albcontrol	23 039	0	0	0	0	0	0	21	0	23 060	7 104	0	0	0	0	0	0	53	0	7 156	30 143	0	0	0	0	0	0	73	0	30 216
ANS CR	137 658	0	0	0	2 811	0	0	0	0	140 469	21 826	0	0	0	354	0	0	0	0	22 180	159 484	0	0	0	3 165	0	0	0	0	162 649
ARMATS	7 931	0	0	0	9	0	292	88	0	8 319	8 355	0	0	0	0	0	254	13	0	8 622	16 286	0	0	0	9	0	546	101	0	16 941
Austro Control	257 073	0	0	0	758	1 810	0	3 200	0	262 841	47 667	0	0	0	0	0	0	800	0	48 467	304 740	0	0	0	758	1 810	0	4 000	0	311 308
Avinor (Continental)	100 191	0	0	0	0	0	10 894	0	0	111 085	0	69 670	0	0	0	0	0	0	0	69 670	100 191	69 670	0	0	0	0	10 894	0	0	180 755
BHANSA	39 866	0	0	0	0	43	39	161	0	40 109	0	2 822	0	0	0	3	3	11	0	2 838	39 866	2 822	0	0	0	46	42	172	0	42 947
BULATSA	170 525	0	0	0	0	0	0	0	0	170 525	8 451	0	0	0	0	0	0	0	0	8 451	178 976	0	0	0	0	0	0	0	0	178 976
Croatia Control	100 110	0	2 981	0	303	0	0	0	0	103 395	18 685	0	0	0	197	0	0	0	0	18 883	118 795	0	2 981	0	501	0	0	0	0	122 278
DCAC Cyprus	59 957	0	0	0	0	0	0	0	0	59 957	0	0	0	0	0	8 958	0	0	0	8 958	59 957	0	0	0	0	8 958	0	0	0	68 914
DFS	813 103	0	0	0	0	0	120 295	0	0	933 398	293 702	0	0	0	0	0	43 452	0	0	337 154	1 106 805	0	0	0	0	0	163 747	0	0	1 270 552
DHMI	524 274	0	0	0	5 095	0	0	0	0	529 368	92 915	0	0	0	0	0	0	0	0	92 915	617 188	0	0	0	5 095	0	0	0	0	622 283
DSNA	1 540 504	0	0	0	16 658	0	0	0	0	1 557 163	234 190	0	0	0	43 864	26 000	0	0	0	304 054	1 774 694	0	0	0	60 523	26 000	0	0	0	1 861 217
EANS	16 037	0	0	0	0	0	0	0	0	16 037	1 871	0	0	0	0	0	0	0	0	1 871	17 907	0	0	0	0	0	0	0	0	17 907
ENAIRE	726 346	0	0	0	1 453	0	347	8 551	56	736 753	33 301	120 289	0	0	0	0	1	1 039	5	154 635	759 647	120 289	0	0	1 453	0	348	9 590	62	891 388
ENAV	694 951	0	0	0	9 347	16 259	0	10 606	0	731 162	213 989	0	0	0	1 436	8 228	0	4 573	0	228 225	908 940	0	0	0	10 782	24 487	0	15 178	0	959 388
Fintraffic ANS	28 909	0	0	262	0	380	0	0	0	29 551	15 239	10 116	0	21	0	102	0	0	0	25 477	44 148	10 116	0	282	0	482	0	0	0	55 028
HASP	186 582	0	0	0	0	0	0	0	-889	185 692	17 068	0	0	0	0	5 448	0	0	0	22 516	203 650	0	0	0	0	5 448	0	0	-889	208 208
HungaroControl	131 710	0	0	0	818	0	12 949	1 721	0	147 199	23 767	0	0	0	168	0	2 337	278	0	26 550	155 478	0	0	0	986	0	15 286	1 999	0	173 749
LFV	125 442	0	1 077	0	876	0	4 908	0	0	132 303	14 909	12 521	0	0	0	0	909	0	0	28 339	140 351	12 521	1 077	0	876	0	5 817	0	0	160 642
LGS	20 268	0	0	0	0	0	1	775	0	21 044	4 991	0	0	0	0	0	0	332	0	5 323	25 259	0	0	0	0	0	1	1 107	0	26 367
LPS	77 425	0	0	625	994	0	179	0	0	79 223	6 301	0	0	0	858	0	16	0	0	7 175	83 726	0	0	625	1 852	0	195	0	0	86 398
LVNL	182 208	0	0	0	666	0	40	9 533	0	192 447	79 658	0	0	0	0	0	17	5 566	0	85 241	261 866	0	0	0	666	0	57	15 099	0	277 688
MATS	22 807	0	0	0	0	0	0	0	0	22 807	6 643	1 056	0	0	0	1 863	950	0	0	10 513	29 450	1 056	0	0	0	1 863	950	0	0	33 319
M-NAV	19 915	0	0	0	0	0	32	0	0	19 947	3 219	0	0	0	0	0	0	0	0	3 219	23 134	0	0	0	0	0	32	0	0	23 166
MOLDATSA	4 086	0	0	0	0	0	0	0	0	4 086	5 110	0	0	0	0	0	0	0	0	5 110	9 197	0	0	0	0	0	0	0	0	9 197
MUAC											n/appl	n/appl	n/appl	n/appl	n/appl	n/appl	n/appl	n/appl	n/appl	n/appl										
NATS (Continental)	745 431	0	0	0	0	0	60 823	2 692	0	808 946	19 385	139 414	0	0	0	0	3 782	328	0	162 910	764 816	139 414	0	0	0	0	64 606	3 020	0	971 856
NAV Portugal (Continental)	193 992	0	0	0	0	0	0	4 514	0	198 505	48 951	0	0	0	0	0	0	1 132	0	50 083	242 943	0	0	0	0	0	0	5 646	0	248 589
NAVIAIR	75 003	0	0	0	5 407	0	1 050	1 663	0	83 124	28 707	4 158	0	0	71	0	149	179	0	33 264	103 710	4 158	0	0	5 479	0	1 199	1 842	0	116 388
Oro navigacija	24 914	0	0	155	0	0	249	211	0	25 529	8 356	0	0	52	0	0	83	71	0	8 562	33 270	0	0	207	0	0	332	282	0	34 091
PANSA	159 893	0	0	0	3 376	0	0	976	0	164 245	52 996	0	0	0	2 670	0	0	319	0	55 984	212 889	0	0	0	6 045	0	0	1 295	0	220 229
ROMATSA	238 478	0	0	0	2 551	0	1 466	567	0	243 062	35 658	0	0	0	668	0	1 379	0	0	37 705	274 136	0	0	0	3 219	0	2 845	567	0	280 767
Sakaeronavigatsia	40 569	0	0	0	58	0	998	0	0	41 625	14 094	0	0	0	62	0	348	0	0	14 503	54 662	0	0	0	120	0	1 346	0	0	56 129
skeyes	264 247	0	0	0	0	0	1 769	8 550	117	274 683	27 457	0	0	0	0	32 320	645	3 805	64	64 291	291 704	0	0	0	0	32 320	2 414	12 355	181	338 974
Skyguide	189 178	0	43 035	0	8 286	41 742	2 318	4 345	0	288 903	123 026	32 498	0	0	111	0	0	4 587	0	160 222	312 204	32 498	43 035	0	8 397	41 742	2 318	8 931	0	449 125
Slovenia Control	44 004	0	0	0	155	193	23	1 125	0	45 500	3 169	71	0	810	83	107	0	90	0	4 330	47 173	71	0	810	238	300	23	1 215	0	49 829
SMATSA	103 247	0	0	0	0	0	129	2	0	103 378	15 173	0	0	0	0	0	137	0	1 159	16 468	118 420	0	0	0	0	0	266	2	1 159	119 846

Annex 5 - Table 0.1: Breakdown of total ANS revenues (en-route, terminal and gate-to-gate), 2023

ANSPs	Gate-to-gate ANSP costs (in €'000)							
	ATM/CNS provision costs	MET costs	Payment for regulatory and supervision services	Payment to the State for provision of other services	EUROCONTROL costs	Payments for delegation of ANS	Irrecoverable value added tax (VAT)	**Total costs**
AirNav Ireland	140 904	8 613	5 809	3 453	7 958	0	0	166 737
Albcontrol	31 916	1 234	1 817	0	966	0	0	35 932
ANS CR	161 752	3 633	2 215	0	6 128	0	0	173 727
ARMATS	14 697	0	0	0	308	0	0	15 005
Austro Control	242 093	18 580	748	0	12 976	0	0	274 397
Avinor (Continental)	167 773	2 716	830	0	8 018	0	0	179 337
BHANSA	32 544	2 939	369	0	1 497	0	0	37 350
BULATSA	132 821	6 495	0	0	5 190	0	0	144 507
Croatia Control	100 174	8 318	0	0	0	0	0	108 492
DCAC Cyprus	46 729	4 569	3 717	16 357	0	0	0	71 372
DFS	1 171 220	0	980	0	0	0	0	1 172 200
DHMI	710 555	27 068	7 398	0	23 370	0	0	768 391
DSNA	1 437 523	86 530	7 574	0	81 848	48 607	64 395	1 726 476
EANS	21 822	423	0	0	0	0	0	22 245
ENAIRE	849 544	44 207	7 942	0	40 601	0	0	942 294
ENAV	731 058	23 117	0	0	42 947	0	0	797 123
Fintraffic ANS	59 244	4 837	480	0	3 707	225	0	68 493
HASP	175 820	11 025	6 083	8 079	8 092	0	0	209 098
HungaroControl	120 114	61	2 889	0	5 108	0	0	128 172
LFV	218 241	1 308	182	0	0	0	0	219 732
LGS	25 665	1 858	1 060	0	1 122	0	0	29 706
LPS	76 454	3 529	1 676	0	2 662	0	0	84 320
LVNL	268 764	0	0	0	0	0	19 062	287 826
MATS	20 921	744	4 177	0	1 069	0	0	26 910
M-NAV	18 412	1 293	0	0	0	0	0	19 705
MOLDATSA	9 472	1 320	0	0	265	0	0	11 057
MUAC	237 433	0	0	0	0	0	3	237 436
NATS (Continental)	734 085	600	4 925	0	0	718	-36	740 292
NAV Portugal (Continental)	180 370	7 859	1 488	6 148	7 502	0	0	203 367
NAVIAIR	131 823	0	0	0	0	0	0	131 823
Oro navigacija	30 236	0	0	0	0	0	0	30 236
PANSA	247 692	14 517	3 057	0	9 783	1 626	0	276 674
ROMATSA	279 689	15 264	1 518	0	10 085	0	0	306 555
Sakaeronavigatsia	38 580	1 219	289	0	940	0	0	41 028
skeyes	214 231	10 971	2 618	0	13 584	63 696	0	305 101
Skyguide	461 138	14 543	2 421	0	11 721	0	0	489 823
Slovenia Control	40 678	2 480	1 065	0	1 772	0	0	45 996
SMATSA	113 825	6 658	0	0	3 435	0	0	123 918
Total	9 696 014	338 527	73 327	34 037	312 651	114 873	83 424	10 652 852

Annex 5 - Table 0.2: Breakdown of total gate-to-gate ANSP costs, 2023

ANSPs	En-route ATM/CNS costs (in €'000)						Terminal ATM/CNS costs (in €'000)						Gate-to-gate ATM/CNS costs (in €'000)					
	Staff costs	Non-staff operating costs	Depreciation costs	Cost of capital	Exceptional items	**ATM/CNS provision costs**	Staff costs	Non-staff operating costs	Depreciation costs	Cost of capital	Exceptional items	**ATM/CNS provision costs**	Staff costs	Non-staff operating costs	Depreciation costs	Cost of capital	Exceptional items	**ATM/CNS provision costs**
AirNav Ireland	74 800	29 464	6 607	2 190	0	113 061	12 761	7 163	4 510	3 409	0	27 843	87 561	36 627	11 117	5 599	0	140 904
Albcontrol	5 918	10 117	5 189	4 368	0	25 592	2 169	2 675	649	831	0	6 324	8 087	12 792	5 838	5 199	0	31 916
ANS CR	76 866	17 365	23 200	9 162	0	126 593	23 906	3 968	5 531	1 753	0	35 159	100 772	21 333	28 731	10 915	0	161 752
ARMATS	5 660	560	873	1 096	0	8 189	4 897	526	473	612	0	6 508	10 557	1 086	1 346	1 708	0	14 697
Austro Control	147 308	22 898	17 337	3 560	4 170	195 274	33 945	5 151	5 179	1 031	1 512	46 819	181 253	28 049	22 516	4 592	5 682	242 093
Avinor (Continental)	54 861	35 658	2 808	4 813	0	98 141	55 372	10 775	820	2 665	0	69 632	110 233	46 433	3 628	7 479	0	167 773
BHANSA	20 728	6 069	2 893	708	0	30 398	1 424	321	332	69	0	2 146	22 152	6 390	3 224	778	0	32 544
BULATSA	84 670	10 824	11 504	12 509	0	119 507	11 048	941	785	540	0	13 314	95 718	11 765	12 289	13 049	0	132 821
Croatia Control	58 371	13 784	7 935	4 446	0	84 536	10 614	2 537	1 909	578	0	15 638	68 986	16 321	9 843	5 024	0	100 174
DCAC Cyprus	20 753	16 217	3 366	1 787	0	42 123	2 459	1 670	297	180	0	4 605	23 212	17 887	3 663	1 967	0	46 729
DFS	662 019	104 726	66 596	18 423	0	851 764	231 439	56 721	24 480	6 816	0	319 456	893 458	161 447	91 076	25 238	0	1 171 220
DHMI	198 744	178 061	37 978	150 643	0	565 427	50 821	38 837	9 041	46 430	0	145 129	249 564	216 898	47 020	197 073	0	710 555
DSNA	755 382	246 743	121 898	49 571	0	1 173 593	181 772	54 479	19 345	8 333	0	263 929	937 154	301 222	141 242	57 904	0	1 437 523
EANS	12 905	3 170	1 980	1 012	0	19 067	902	955	672	225	0	2 755	13 808	4 125	2 652	1 237	0	21 822
ENAIRE	483 385	60 673	95 928	34 899	0	674 885	149 923	11 279	10 225	3 232	0	174 659	633 308	71 952	106 153	38 131	0	849 544
ENAV	350 298	100 080	81 853	45 625	0	577 856	80 772	37 865	21 301	13 265	0	153 203	431 070	137 946	103 153	58 889	0	731 058
Fintraffic ANS	20 151	12 351	2 306	738	0	35 546	14 107	9 111	346	134	0	23 698	34 258	21 462	2 652	872	0	59 244
HASP	127 613	17 092	1 173	122	0	146 000	22 968	5 926	807	119	0	29 820	150 581	23 018	1 980	241	0	175 820
HungaroControl	51 937	24 269	13 566	9 882	0	99 654	11 204	3 263	2 917	3 076	0	20 460	63 142	27 532	16 482	12 958	0	120 114
LFV	138 891	28 571	13 211	6 143	0	186 816	25 719	4 316	856	534	0	31 425	164 610	32 887	14 067	6 677	0	218 241
LGS	12 045	3 184	3 297	1 035	0	19 562	3 405	668	1 559	472	0	6 104	15 450	3 853	4 856	1 507	0	25 665
LPS	45 173	9 313	7 450	2 657	0	64 593	9 478	1 295	818	270	0	11 861	54 651	10 608	8 268	2 927	0	76 454
LVNL	122 298	47 918	13 474	6 751	0	190 441	54 710	14 783	5 823	3 007	0	78 323	177 008	62 701	19 297	9 758	0	268 764
MATS	10 151	4 860	1 681	592	0	17 284	2 538	726	251	121	0	3 636	12 688	5 586	1 933	713	0	20 921
M-NAV	12 844	1 922	587	697	0	16 049	1 851	388	56	67	0	2 363	14 695	2 310	643	764	0	18 412
MOLDATSA	2 966	819	414	163	0	4 361	2 778	1 748	418	166	0	5 111	5 744	2 567	832	330	0	9 472
MUAC	202 642	27 916	6 114	762	0	237 433	n/appl	n/appl	n/appl	n/appl	n/appl	n/appl	202 642	27 916	6 114	762	0	237 433
NATS (Continental)	347 675	93 021	74 470	63 543	5 733	584 442	123 388	10 666	12 633	1 699	1 257	149 644	471 064	103 687	87 103	65 242	6 990	734 085
NAV Portugal (Continental)	110 267	13 219	16 948	3 057	0	143 490	32 261	1 878	2 479	262	0	36 880	142 528	15 097	19 427	3 319	0	180 370
NAVIAIR	59 107	18 603	12 713	7 139	0	97 562	24 460	5 481	2 177	2 143	0	34 261	83 567	24 084	14 890	9 282	0	131 823
Oro navigacija	13 867	3 057	2 784	1 394	0	21 101	6 187	1 240	1 127	581	0	9 135	20 054	4 298	3 911	1 975	0	30 236
PANSA	135 332	24 653	23 537	13 161	0	196 683	35 610	7 701	5 122	2 577	0	51 009	170 942	32 354	28 659	15 737	0	247 692
ROMATSA	189 009	18 389	8 952	8 479	0	224 830	44 430	6 899	1 915	1 614	0	54 859	233 440	25 288	10 867	10 093	0	279 689
Sakaeronavigatsia	13 334	4 866	3 462	2 033	0	23 695	8 194	2 563	2 621	1 507	0	14 885	21 529	7 429	6 083	3 540	0	38 580
skeyes	116 968	26 068	8 964	1 824	267	154 091	44 260	10 882	3 763	830	405	60 140	161 228	36 950	12 727	2 654	673	214 231
Skyguide	205 991	51 331	25 608	9 953	5 207	298 090	94 613	35 576	20 851	8 104	3 904	163 048	300 605	86 907	46 460	18 057	9 111	461 138
Slovenia Control	27 345	5 163	2 727	1 248	0	36 482	3 654	248	202	93	0	4 196	30 999	5 410	2 929	1 341	0	40 678
SMATSA	49 886	13 750	10 812	12 939	0	87 386	15 670	4 312	2 941	3 517	0	26 440	65 555	18 062	13 752	16 456	0	113 825
Total	5 028 159	1 306 745	742 195	499 121	15 377	7 591 597	1 435 712	365 532	175 230	120 863	7 079	2 104 417	6 463 872	1 672 277	917 426	619 984	22 456	9 696 014

Annex 5 - Table 0.3: Breakdown of ATM/CNS provision costs (en-route, terminal and gate-to-gate), 2023

ANSPs	ANSP BALANCE SHEET in (€'000)								
	NBV fixed assets in operation	NBV fixed assets under construction	Long-term financial assets and receivables	Current assets	**Total assets**	Capital and reserves	Long-term liabilities	Current liabilities	**Total liabilities**
AirNav Ireland	78 526	25 143	153 528	160 797	417 994	321 220	51 657	45 117	417 994
Albcontrol	27 785	3 913	2 671	136 082	170 451	65 313	50 063	55 074	170 451
ANS CR	169 987	10 496	17 261	87 537	285 281	171 401	61 471	52 409	285 281
ARMATS	9 830	164	21	11 367	21 382	18 892	570	1 920	21 382
Austro Control	160 453	17 383	184 542	213 075	575 453	47 241	471 384	56 828	575 453
Avinor (Continental)	49 634	8 338	50 500	213 398	321 869	39 776	228 693	53 400	321 869
BHANSA	12 602	5 649	533	25 168	43 952	37 098	2 426	4 428	43 952
BULATSA	92 706	12 206	45 238	116 960	267 110	183 085	42 234	41 791	267 110
Croatia Control	45 122	11 991	29 590	137 245	223 948	116 280	73 275	34 393	223 948
DCAC Cyprus	26 773	3 028	2 043	10 509	42 353	4 835	36 065	1 453	42 353
DFS	627 200	12 280	1 105 026	2 482 929	4 227 435	1 723 753	2 238 180	265 502	4 227 435
DHMI	639 760	94 418	125 745	381 674	1 241 596	959 891	155 642	126 063	1 241 596
DSNA	761 061	382 143	1 606 068	303 754	3 053 026	807 531	2 175 577	69 917	3 053 026
EANS	17 834	9 014	0	4 926	31 774	10 551	16 731	4 492	31 774
ENAIRE	500 678	245 639	293 289	413 312	1 452 918	856 204	368 030	228 684	1 452 918
ENAV	551 547	362 944	734 987	703 825	2 353 302	1 173 828	697 480	481 994	2 353 302
Fintraffic ANS	16 570	2 078	15 297	24 675	58 621	30 554	0	28 067	58 621
HASP	5 210	0	0	0	5 210	5 210	0	0	5 210
HungaroControl	96 880	24 410	13 560	143 164	278 014	154 901	46 391	76 722	278 014
LFV	158 162	58 583	352 598	504 160	1 073 503	67 224	933 266	73 012	1 073 503
LGS	20 269	5 090	4 547	14 198	44 104	26 003	14 600	3 501	44 104
LPS	47 458	4 455	407	56 692	109 012	79 404	10 695	18 913	109 012
LVNL	160 628	171 340	42 646	120 103	494 717	-173 761	582 070	86 408	494 717
MATS	6 255	2 975	40 559	41 209	90 998	33 267	46 370	11 361	90 998
M-NAV	5 081	5 878	0	15 784	26 744	21 021	3 664	2 060	26 744
MOLDATSA	6 098	6	1 785	3 442	11 331	9 979	0	1 353	11 331
MUAC	47 844	3 374	0	76 475	127 693	0	51 218	76 475	127 693
NATS (Continental)	556 574	777 544	878 599	549 413	2 762 131	960 401	1 485 263	316 467	2 762 131
NAV Portugal (Continental)	107 147	25 741	96 130	183 887	412 905	91 125	206 914	114 866	412 905
NAVIAIR	116 994	29 207	121 207	65 390	332 799	149 375	136 507	46 917	332 799
Oro navigacija	32 624	352	9 209	23 959	66 144	49 681	9 169	7 294	66 144
PANSA	233 624	44 948	191 804	207 467	677 843	321 103	258 082	98 658	677 843
ROMATSA	70 345	7 702	167 568	142 537	388 151	97 583	202 711	87 857	388 151
Sakaeronavigatsia	45 342	1 336	3 571	44 100	94 349	90 949	863	2 537	94 349
skeyes	86 779	30 718	10 156	431 397	559 050	290 251	117 828	150 970	559 050
Skyguide	278 456	51 229	23 701	158 057	511 442	210 594	226 709	74 140	511 442
Slovenia Control	20 013	2 157	800	13 585	36 556	12 397	15 378	8 781	36 556
SMATSA	140 383	15 328	6 741	43 747	206 199	95 191	85 509	25 500	206 199
Total	6 030 233	2 469 200	6 331 927	8 265 999	23 097 359	9 159 351	11 102 685	2 835 323	23 097 359

Annex 5 - Table 0.4: Balance Sheet data at ANSP level, 2023

ANSPs	ATCOs in OPS	ATCOs on other duties	Ab-initio trainees	On-the-job trainees	ATC assistants	OPS support (non-ATCO)	Technical support staff for operational maintenance	Technical support staff for planning & development	Administration	Staff for ancillary services	Internal MET	Other	**Total staff**	ACC ATCOs in OPS	ACC ATCO-hours on duty	APPs+TWRs ATCOs in OPS	APPs+TWRs ATCO-hours on duty	Employment costs for ATCOs in OPS (€'000)
AirNav Ireland	241	39	0	0	32	68	69	18	54	13	0	0	534	177	295 059	64	106 688	45 972
Albcontrol	67	12	0	0	2	0	77	0	70	22	16	41	307	35	44 170	32	47 392	3 259
ANS CR	224	11	8	12	95	108	139	27	220	29	0	62	935	136	202 110	88	127 081	44 457
ARMATS	72	0	0	3	6	13	90	0	33	19	0	35	271	22	31 680	50	73 050	3 729
Austro Control	312	22	26	51	42	95	95	98	76	31	79	0	927	144	189 228	168	234 767	83 518
Avinor (Continental)	371	46	24	15	75	0	0	1	54	119	0	16	721	156	241 382	215	331 778	69 451
BHANSA	127	11	0	0	9	30	96	8	74	49	39	54	497	70	91 840	57	62 643	8 226
BULATSA	292	45	0	0	45	47	313	52	191	32	42	81	1 140	157	201 183	135	174 960	45 298
Croatia Control	251	35	23	13	18	79	99	23	115	32	72	0	757	100	135 117	150	201 492	36 510
DCAC Cyprus	129	10	0	0	50	0	0	0	48	19	0	0	255	96	169 604	33	51 085	13 962
DFS	1 549	234	153	238	274	485	653	617	502	79	0	312	5 095	1 153	1 271 761	396	448 445	490 441
DHMI	1 845	60	32	90	10	433	2 010	15	1 430	589	0	862	7 376	867	1 146 174	978	1 010 274	132 546
DSNA	2 850	404	142	357	88	859	1 113	371	1 214	116	0	0	7 514	1 566	2 010 744	1 284	1 648 656	478 755
EANS	62	13	0	0	0	1	33	0	10	27	0	39	185	32	43 595	30	36 135	6 866
ENAIRE	1 627	345	0	75	162	78	557	456	598	20	0	99	4 017	1 036	1 407 135	591	748 346	348 622
ENAV	1 336	250	7	81	49	37	87	139	577	145	187	233	3 128	795	970 991	541	722 380	258 205
Fintraffic ANS	161	19	0	0	6	0	53	8	14	73	1	0	335	37	48 479	124	168 739	19 800
HASP	520	31	34	0	0	37	430	30	75	9	0	369	1 535	189	291 438	331	510 402	67 401
HungaroControl	188	6	12	26	28	65	99	46	180	28	0	64	742	113	171 498	75	112 515	27 063
LFV	392	105	0	19	27	29	65	32	146	30	5	0	850	207	306 749	185	280 090	103 167
LGS	79	4	0	7	0	45	85	0	54	10	11	10	305	50	64 450	29	38 918	5 865
LPS	111	17	9	10	28	34	114	15	115	28	0	0	480	67	100 043	44	70 737	22 030
LVNL	197	38	35	66	69	258	115	167	210	0	0	73	1 229	72	113 809	125	213 235	35 356
MATS	54	0	0	0	0	2	54	0	21	15	0	22	168	36	77 724	18	37 422	5 768
M-NAV	72	19	0	10	12	25	51	0	55	30	20	16	310	46	61 962	26	35 061	5 808
MOLDATSA	51	2	0	0	0	16	36	12	33	11	29	36	226	17	23 562	34	47 294	1 946
MUAC	256	34	64	0	38	60	147	13	55	0	0	10	676	256	285 746	n/appl	n/appl	97 310
NATS (Continental)	1 219	138	131	64	254	388	408	552	683	0	0	0	3 836	809	993 209	410	560 429	240 616
NAV Portugal (Continental)	209	27	0	31	22	43	75	44	160	32	5	9	657	78	162 162	131	262 131	79 952
NAVIAIR	191	60	3	4	88	25	93	26	99	12	0	0	601	83	121 378	109	161 770	40 402
Oro navigacija	82	8	0	2	0	32	61	8	67	22	0	0	282	31	46 698	51	79 549	8 122
PANSA	572	20	54	36	43	314	295	61	315	42	0	26	1 779	174	176 299	398	436 994	85 723
ROMATSA	543	116	28	22	78	0	333	0	364	0	124	0	1 606	241	311 850	302	330 809	87 553
Sakaeronavigatsia	102	4	18	0	17	23	260	15	164	54	53	100	810	37	56 388	65	99 060	4 601
skeyes	242	5	56	19	18	93	158	41	123	19	74	50	897	86	92 754	156	166 822	44 285
Skyguide	351	83	28	24	74	185	237	48	201	35	0	20	1 285	194	257 237	157	223 171	102 604
Slovenia Control	88	23	16	0	19	3	39	0	35	22	0	0	244	52	71 400	36	48 264	13 710
SMATSA	312	50	0	16	29	25	85	130	121	69	84	0	921	143	181 896	169	202 800	32 093
Total	17 347	2 347	901	1 290	1 805	4 035	8 724	3 071	8 556	1 881	840	2 638	53 434	9 561	12 468 504	7 786	10 111 382	3 200 991

Annex 5 - Table 0.5: Total staff and ATCOs in OPS data, 2023

ANSPs	Size of controlled airspace	Number of ACC operational units	Number of APP operational units	Number of TWR operational units	Number of AFIS	Total IFR flights controlled by the ANSP	Total IFR km controlled by the ANSP	Total flight-hours controlled by the ANSP	IFR Airport movements controlled by the ANSP	Composite flight-hours
AirNav Ireland	457 000	2	3	3	0	664 639	262 032 976	331 211	285 910	410 167
Albcontrol	36 000	1	1	1	1	303 114	48 008 064	62 322	50 811	76 354
ANS CR	76 700	1	2	4	0	621 228	143 053 667	194 893	131 554	231 223
ARMATS	29 700	1	2	2	0	85 685	13 924 401	20 815	43 870	32 930
Austro Control	80 700	1	6	6	0	1 195 044	267 246 058	359 408	304 936	443 618
Avinor (Continental)	731 000	3	17	16	28	546 969	192 994 133	340 393	572 246	498 422
BHANSA	38 900	1	4	4	0	437 807	77 637 249	96 193	21 752	102 200
BULATSA	147 000	1	3	5	0	973 535	280 953 676	342 298	88 706	366 794
Croatia Control	118 000	1	6	10	0	812 670	219 516 028	281 231	122 203	314 978
DCAC Cyprus	173 000	1	2	2	0	402 218	152 607 130	191 955	86 430	215 823
DFS	390 000	4	15	15	0	2 691 040	916 777 827	1 329 631	1 597 589	1 770 816
DHMI	982 000	2	48	52	0	1 599 193	1 242 596 557	1 613 341	1 371 078	1 991 973
DSNA	1 000 000	5	20	75	0	3 184 246	1 753 639 556	2 371 325	1 697 403	2 840 074
EANS	77 300	1	2	2	0	148 187	36 169 143	50 258	35 282	60 001
ENAIRE	2 190 000	5	17	21	0	2 191 932	1 218 777 954	1 721 932	1 575 816	2 157 104
ENAV	732 000	4	27	16	9	1 854 449	902 018 591	1 242 479	1 330 843	1 610 000
Fintraffic ANS	409 000	1	5	15	7	211 743	59 532 105	97 468	188 840	149 617
HASP	536 000	1	16	18	15	1 000 766	555 382 096	738 472	545 844	889 210
HungaroControl	104 000	1	1	1	0	1 168 909	249 606 441	313 567	107 397	343 226
LFV	627 000	2	11	11	0	582 314	241 869 126	352 610	340 822	446 730
LGS	96 000	1	1	4	0	198 623	38 170 522	53 662	61 989	70 781
LPS	48 900	1	2	5	0	530 297	74 328 098	93 888	29 066	101 915
LVNL	53 000	1	3	4	0	554 150	73 391 223	150 323	499 959	288 390
MATS	232 000	1	2	1	0	136 280	63 493 446	84 404	59 196	100 751
M-NAV	24 900	1	2	2	1	266 756	36 416 500	46 137	23 322	52 578
MOLDATSA	34 800	1	2	2	0	24 140	2 385 524	4 995	24 058	11 639
MUAC	262 000	1	0	0	0	1 711 251	501 757 054	605 633	n/appl	605 633
NATS (Continental)	880 000	3	16	16	0	2 334 508	935 023 066	1 419 774	1 598 468	1 861 202
NAV Portugal (Continental)	671 000	1	4	6	0	673 475	331 356 171	444 139	438 462	565 223
NAVIAIR	158 000	1	7	6	1	570 000	135 296 332	201 890	310 201	287 554
Oro navigacija	75 300	1	4	4	0	167 683	34 227 462	48 220	55 119	63 442
PANSA	333 000	1	4	15	0	684 573	277 737 562	391 511	432 535	510 959
ROMATSA	255 000	1	3	17	0	768 564	349 673 940	452 938	204 532	509 421
Sakaeronavigatsia	87 700	1	3	3	2	229 955	71 036 234	88 954	50 417	102 877
skeyes	39 500	1	4	5	1	560 126	52 602 143	100 450	323 513	189 790
Skyguide	69 300	2	4	7	0	1 212 069	222 094 737	326 789	437 200	447 525
Slovenia Control	20 500	1	3	4	0	395 777	52 476 998	67 568	23 918	74 173
SMATSA	99 400	1	8	7	1	896 112	214 642 061	274 035	114 297	305 599
Total		60	280	387	66		12 300 451 850	16 907 113	15 185 584	21 100 711

Annex 5 - Table 0.6: Operational data at ANSP level, 2023

ANSPs	ACC Name	Flight-hours controlled	ATCO-hours on duty	ATCO-hour productivity	Average transit time in minutes	IFR ACC Movements	Size of the controlled area	ATCOs in OPS	Size of OPS room area (m^2)	Number of sectors open at maximum configuration	Sum of sector-hours
AirNav Ireland	Dublin	42 386	80 016	0.53	10	252 482	23 100	48	441	5	23 907
AirNav Ireland	Shannon	267 889	215 043	1.25	33	492 022	449 000	129	576	11	48 545
Albcontrol	Tirana	62 193	44 170	1.41	12	303 096	36 000	35	265	3	18 240
ANS CR	Praha	172 221	202 110	0.85	17	619 214	76 700	136	950	13	78 846
ARMATS	Yerevan	13 225	31 680	0.42	11	73 088	29 700	22	168	1	8 760
Austro Control	Wien	287 752	189 228	1.52	16	1 049 190	79 300	144	900	13	44 664
Avinor (Continental)	Bodo	75 395	51 917	1.45	25	181 010	400 000	34	450	6	26 174
Avinor (Continental)	Oslo	62 444	141 767	0.44	12	322 604	111 000	92	605	6	18 774
Avinor (Continental)	Stavanger	85 705	47 698	1.80	22	231 337	216 000	31	250	4	17 509
BHANSA	Sarajevo	91 781	91 840	1.00	13	430 822	38 900	70	320	4	17 864
BULATSA	Sofia	325 594	201 183	1.62	21	947 549	147 000	157	1 183	12	39 443
Croatia Control	Zagreb	252 507	135 117	1.87	19	777 343	118 000	100	800	11	29 700
DCAC Cyprus	Nicosia	175 142	169 604	1.03	26	401 908	173 000	96	250	6	29 000
DFS	Bremen	135 130	212 021	0.64	17	470 142	175 000	185	1 050	11	68 457
DFS	Karlsruhe UAC	659 119	381 167	1.73	22	1 761 325	260 000	361	1 850	29	135 896
DFS	Langen	314 939	397 641	0.79	17	1 090 011	108 000	361	1 300	22	115 324
DFS	Munchen	220 443	280 932	0.78	14	932 445	119 000	246	1 400	20	91 519
DHMI	Ankara	1 255 062	802 454	1.56	50	1 503 879	982 000	607	1 998	21	120 967
DHMI	Istanbul	251 936	343 720	0.73	19	809 459	116 000	260	420	8	59 860
DSNA	Bordeaux	502 766	367 224	1.37	32	930 850	212 000	286	1 295	16	103 860
DSNA	Brest	527 770	394 188	1.34	31	1 031 760	400 000	307	850	18	99 684
DSNA	Marseille	424 480	502 044	0.85	23	1 117 580	298 000	391	1 310	29	134 900
DSNA	Paris	401 150	403 176	0.99	21	1 120 100	167 000	314	1 250	12	85 392
DSNA	Reims	279 440	344 112	0.81	16	1 038 550	115 000	268	1 040	14	86 344
EANS	Tallinn	56 557	43 595	1.30	24	139 341	77 300	32	269	3	9 360
ENAIRE	Barcelona	424 045	390 424	1.09	26	975 490	266 000	298	1 989	22	84 742
ENAIRE	Canarias	220 275	199 563	1.10	35	380 172	1 360 000	145	750	11	48 288
ENAIRE	Madrid	639 589	509 905	1.25	32	1 188 722	435 000	365	1 789	25	115 076
ENAIRE	Palma	89 104	141 622	0.63	15	346 175	51 300	110	739	9	33 461
ENAIRE	Sevilla	216 955	165 621	1.31	26	495 704	179 000	118	797	9	38 799
ENAV	Brindisi	159 547	104 504	1.53	23	419 799	159 000	85	550	6	25 105
ENAV	Milano	308 248	258 140	1.19	19	953 117	79 600	237	593	21	82 940
ENAV	Padova	213 315	218 921	0.97	17	757 469	79 800	178	375	14	52 785
ENAV	Roma	506 774	389 427	1.30	33	918 573	416 000	295	1 600	23	97 677
Fintraffic ANS	Helsinki	65 349	48 479	1.35	25	158 597	409 000	37	240	3	16 787
HASP	Athinai+Makedonia	646 937	291 438	2.22	41	956 823	536 000	189	1 000	12	64 936
HungaroControl	Budapest	290 693	171 498	1.70	15	1 158 023	92 700	113	720	9	28 877
LFV	Malmo	194 842	180 792	1.08	26	446 821	226 000	122	840	12	58 440
LFV	Stockholm	99 648	125 957	0.79	20	305 770	479 000	85	820	11	38 926
LGS	Riga	53 203	64 450	0.83	16	198 305	96 000	50	169	3	18 250
LPS	Bratislava	88 205	100 043	0.88	10	516 008	48 900	67	813	5	16 007
LVNL	Amsterdam	71 764	113 809	0.63	8	524 311	53 000	72	1 800	5	21 902
MATS	Malta	71 405	77 724	0.92	32	135 319	232 000	36	121	2	17 500
M-NAV	Skopje	42 535	61 962	0.69	10	257 680	24 900	46	202	3	12 239
MOLDATSA	Chisinau	2 068	23 562	0.09	6	19 839	34 800	17	144	2	17 520
MUAC	Maastricht	605 633	285 746	2.12	21	1 711 251	262 000	256	1 050	21	65 131
NATS (Continental)	London AC	576 123	386 781	1.49	18	1 973 718	286 000	315	1 090	23	79 479
NATS (Continental)	London TC	294 265	345 237	0.85	14	1 294 229	53 500	279	987	22	126 623
NATS (Continental)	Prestwick	363 935	261 191	1.39	24	923 478	632 000	215	1 020	24	89 522
NAV Portugal (Continental)	Lisboa	376 566	162 162	2.32	36	622 930	671 000	78	663	9	47 177
NAVIAIR	Kobenhavn	148 356	121 378	1.22	18	487 366	158 000	83	600	7	20 525
Oro Navigacija	Vilnius	38 823	46 698	0.83	14	164 886	75 300	31	336	3	9 469
PANSA	Warszawa	272 155	176 299	1.54	27	601 520	330 000	174	1 300	10	34 961
ROMATSA	Bucuresti	410 726	311 850	1.32	32	759 595	255 000	241	1 391	12	60 970
Sakaeronavigatsia	Tbilisi	79 787	56 388	1.41	22	218 363	87 700	37	250	2	17 568
skeyes	Brussels	67 751	92 754	0.73	7	554 987	39 500	86	1 054	6	18 891
Skyguide	Geneva	106 744	124 882	0.85	11	592 587	29 700	93	1 113	6	24 345
Skyguide	Zurich	144 914	132 355	1.09	11	760 567	39 600	101	960	7	28 794
Slovenia Control	Ljubljana	65 289	71 400	0.91	10	392 694	20 600	52	360	4	17 436
SMATSA	Beograd	245 055	181 896	1.35	17	872 373	99 400	143	744	12	32 317
Total		15 143 649	12 468 504	1.21	22	41 070 368	12 789 300	9 561		673	3 076 455

Annex 5 - Table 0.7: Operational data at ACC level, 2023

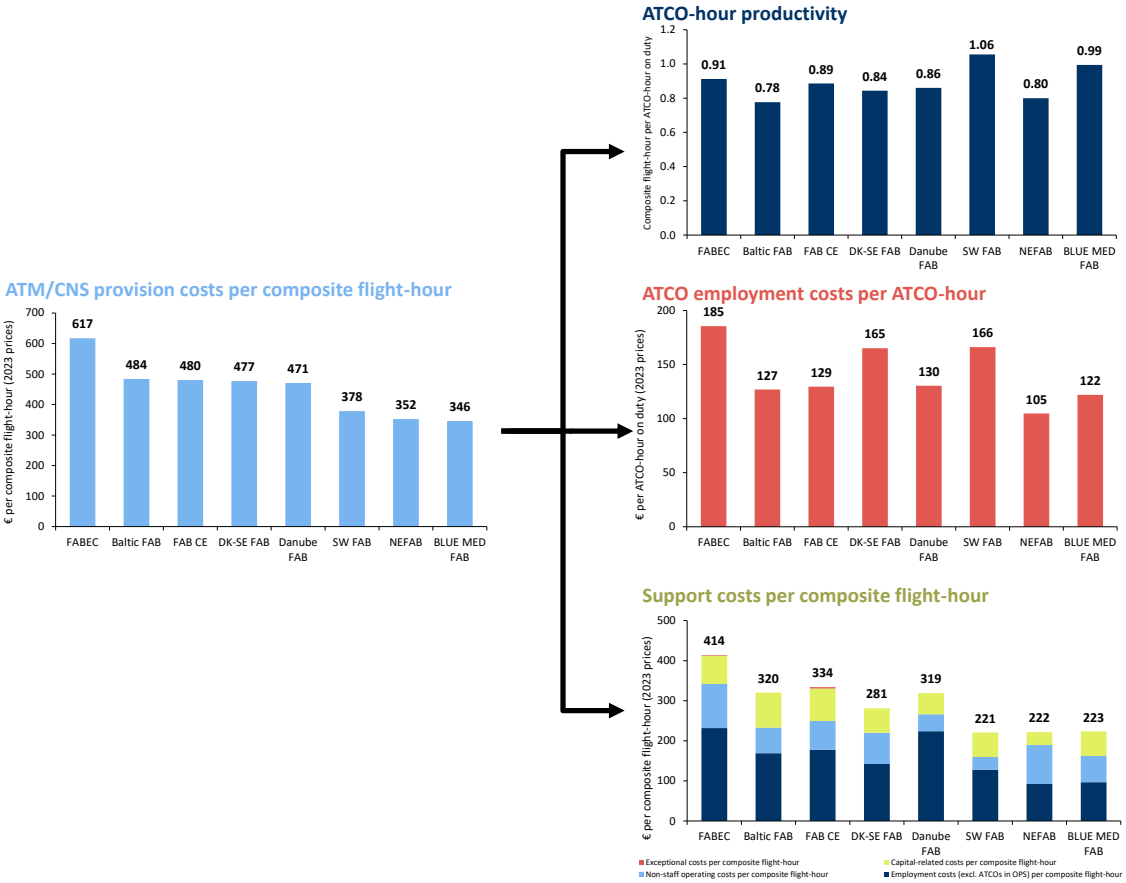
ANNEX 6 – PERFORMANCE INDICATORS AT FAB LEVEL

This Annex provides a breakdown of the **financial** cost-effectiveness indicator at FAB level by ATCO-hour productivity, ATCO employment costs per ATCO-hour and support costs per composite flight-hour.

The figures shown at FAB level have been computed taking into account the ANSPs participating to the ACE analysis in 2023 and which were formally part of a FAB initiative:

- FABEC: DFS, DSNA, LVNL, MUAC, skeyes and Skyguide.
- FAB CE: ANS CR, Austro Control, BHANSA, Croatia Control, HungaroControl, LPS and Slovenia Control.
- SW FAB: ENAIRE and NAV Portugal.
- BLUE MED FAB: DCAC Cyprus, ENAV, HASP and MATS.
- Danube FAB: BULATSA and ROMATSA.
- DK-SE FAB: LFV and NAVIAIR.
- Baltic FAB: Oro Navigacija and PANSA.
- NEFAB: Avinor, EANS, Fintraffic ANS and LGS.

Following the departure of the UK from the EU on 31 January 2020, the UK-Ireland FAB is no longer included in this presentation. The Figure below represents a break-down of unit ATM/CNS provision costs into ATCO-hour productivity, ATCO employment costs per ATCO-hour and unit support costs at FAB level.



Annex 6 - Figure 0.1: Breakdown of cost-effectiveness indicator at FAB level, 2023

GLOSSARY

ACC	Area Control Centre
ACE	Air Traffic Management Cost-Effectiveness
AFIS	Aerodrome Flight Information Service
AirNav Ireland	Irish Air Navigation Services Provider
Albcontrol	National Air Traffic Agency, Albania
ANS	Air Navigation Services
ANS CR	Air Navigation Services of the Czech Republic
ANSP	Air Navigation Service Provider
APP	Approach Control Unit
ARMATS	Armenian Air Traffic Services
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
Austro Control	Austro Control Österreichische Gesellschaft für Zivilluftfahrt mbH, Austria
Avinor	Avinor Flysikring AS, Norway
B	Billion
BHANSA	Bosnia and Herzegovina Air Navigation Services Agency
BULATSA	Bulgarian Air Traffic Services Authority
CAA	Civil Aviation Authority
CAA	Common Aviation Area
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditure
CNS	Communications, Navigation and Surveillance
COTS	Commercial off-the-shelf
COOPANS	Industrial partnership between 5 ANSPs (Austro Control, Croatia Control, AirNav Ireland, LFV and NAVIAIR)
Croatia Control	Hrvatska kontrola zračne plovidbe d.o.o., Croatian Air Navigation Services
DCAC Cyprus	Department of Civil Aviation of Cyprus
DFS	Deutsche Flugsicherung GmbH, Germany
DHMİ	Devlet Hava Meydanları İsletmesi, Türkiye
DSNA	Direction des services de la navigation aérienne, France
DUC	Determined Unit Cost
EANS	Estonian Air Navigation Services
EASA	European Aviation Safety Agency
EATMN	European Air Traffic Management Network
EC	European Commission
ECAA	European Common Aviation Area
ECAC	European Civil Aviation Conference
ENAIRE	Air Navigation Service Provider of Spain
ENAV	Italian Air Navigation Service Provider, Italy
EU	European Union
FAB	Functional Airspace Block
FIR	Flight Information Region
Fintraffic ANS	Air Navigation Service Provider of Finland (previously ANS Finland)
FTE	Full-Time Equivalent

GAAP	Generally Accepted Accounting Principles
GDP	Gross Domestic Product
HASP	Hellenic Air Navigation Service Provider, Greece
HungaroControl	Hungarian Air Navigation Services, Hungary
iCAS	iTEC Centre Automation System
IFR	Instrument Flight Rules
IFRS	International Financial Reporting Standards
KPA	Key Performance Area
KPI	Key Performance Indicator
LFV	Luftfartsverket, Sweden
LGS	Latvijas Gaisa Satiksme, Latvia
LHS	Left Hand Side
LPS	Letové Prevádzkové Služby Slovenskej Republiky, Státny Podnik, Slovak Republik
LVNL	Luchtverkeersleiding Nederland, Netherlands
M	Million
MATS	Malta Air Traffic Services Ltd
MET	Aeronautical Meteorology
M-NAV	Air Navigation Services Provider of the Republic of North Macedonia
MOLDATSA	Moldavian Air Traffic Services Authority
MUAC	Maastricht Upper Area Control Centre
NATS	National Air Traffic Services, United Kingdom
NAV Portugal	Navegação Aérea de Portugal – NAV Portugal, EPE
NAVIAIR	Air Navigation Services – Flyvesikringstjenesten, Denmark
NBV	Net Book Value
NM	EUROCONTROL Network Manager
NMB	Network Management Board
NSA	National Supervisory Authority
OAT	Operational air traffic
OPS	Operations
Oro Navigacija	State Enterprise Oro Navigacija, Lithuania
PANSA	Polish Air Navigation Services Agency
PPPs	Purchasing power parities
PPS	Purchasing power standard
PRB	Performance Review Body
PRC	Performance Review Commission
PRR	Performance Review Report
PRU	Performance Review Unit
REA	Ready Message
RHS	Right Hand Side
ROMATSA	Romanian Air Traffic Services Administration
RP1	Reference Period 1 (2012 – 2014)
RP2	Reference Period 2 (2015 – 2019)
RP3	Reference Period 3 (2020 – 2024)
Sakaeronavigatsia	SAKAERONAVIGATSIA Ltd., Georgia
SEID	Specification for Economic Information Disclosure
SES	Single European Sky
skeyes	skeyes (previously Belgocontrol), Belgium
Skyguide	Skyguide, Switzerland

Slovenia Control	SLOVENIA CONTROL Ltd, Slovenia
SMATSA	Serbia and Montenegro Air Traffic Services Agency
TC	Terminal Control
TWR	Traffic Controlled Tower
UAC	Upper Area Control
UkSATSE	Ukrainian State Air Traffic Service Enterprise
VAT	Value-Added Tax
VFR	Visual Flight Rules