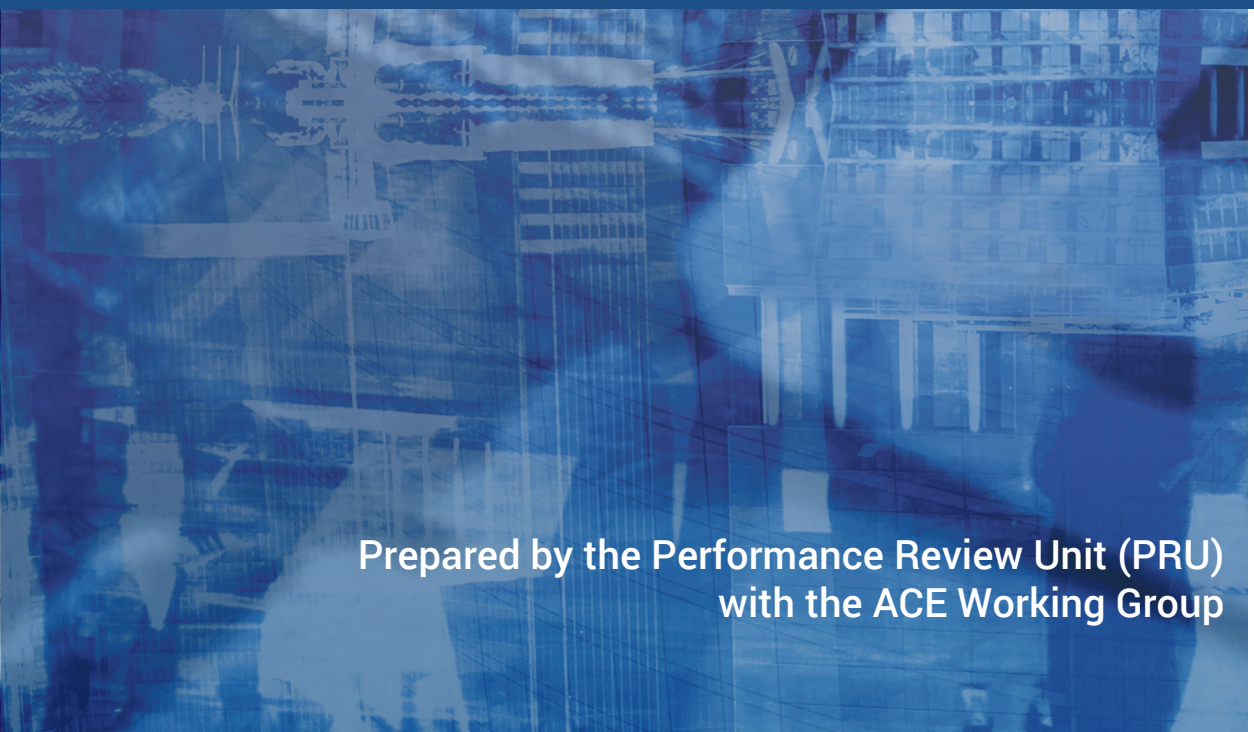
EUROCONTROL

ACE Benchmarking Report 2024 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 review 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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Abstract

This report is the 22nd 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 2022, including high level trend analysis spanning the years 2017-2022. Additionally, it examines the progressive recovery following the COVID-19 pandemic. A dedicated chapter delves into the analysis of regulatory, institutional, and corporate governance arrangements and their potential impact on ANSPs' economic performance.

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 2023 to 2027.

Keywords

Performance Review Commission – Economic information disclosure – Benchmarking – Exogenous factors – ATM/CNS cost-effectiveness comparisons – European Air Navigation Services Providers (ANSPs) – Functional Airspace Blocks (FABs) – Gate-to-gate - En-route and Terminal ANS – Inputs and outputs metrics – Performance framework – Quality of service – 2022 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 (2017-2022) – Financial indicators – Regulatory regime – Institutional setup – Corporate governance.

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EXECUTIVE SUMMARY

The ACE benchmarking work 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 is based on information provided by ANSPs in compliance with Decision No. 88 of the Permanent Commission of EUROCONTROL on economic information disclosure.

This ATM Cost-Effectiveness (ACE) benchmarking report, the 22nd in the series, presents a review and comparison of ATM cost-effectiveness for 38 Air Navigation Service Providers[1] (ANSPs) in Europe (see Figure 0.1 below). It examines 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. It also presents a new analysis describing the regulatory, institutional, and corporate governance setups in which ANSPs operate.

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.

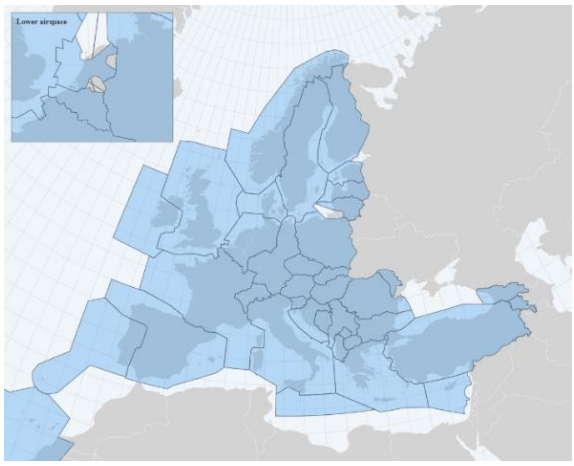


Figure 0.1: Geographic coverage of the ACE benchmarking analysis

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 2022, including changes[2] in percentage compared to 2019 and 2021, in real terms.

Composite flight-hours		Gate-to-gate revenues		ATM/CNS provision costs		Number of ATM/CNS staff (FTEs)	
19.0 M		**€9 023.8 M**		**€8 923.6 M**		**51 684**	
+58.3%	*(%) 2021-22*	*+55.3%*	*(%) 2021-22*	*+3.4%*	*(%) 2021-22*	*-0.9%*	*(%) 2021-22*
-13.3%	*(%) 2019-22*	*-14.9%*	*(%) 2019-22*	*-6.2%*	*(%) 2019-22*	*-2.5%*	*(%) 2019-22*
Number of ATCOs in OPS (FTEs)		NBV of gate-to-gate fixed assets		Gate-to-gate capital expenditures		ATFM delays (minutes)	
17 134		**€7 646.3 M**		**€1 140.2 M**		**18.9 M**	
+2.1%	*(%) 2021-22*	*-9.6%*	*(%) 2021-22*	*+0.3%*	*(%) 2021-22*	*+559.6%*	*(%) 2021-22*
-0.7%	*(%) 2019-22*	*-9.8%*	*(%) 2019-22*	*-23.3%*	*(%) 2019-22*	*-20.0%*	*(%) 2019-22*

Table 0.1: Key data at Pan-European system level, 2022

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

Traffic and revenues

In 2022, composite flight-hours rose by +58.3% at system level but are still lower than in 2019 (- 13.3%). At ANSP level, a wide range of traffic recovery rates is observed (from -51% to +14%).

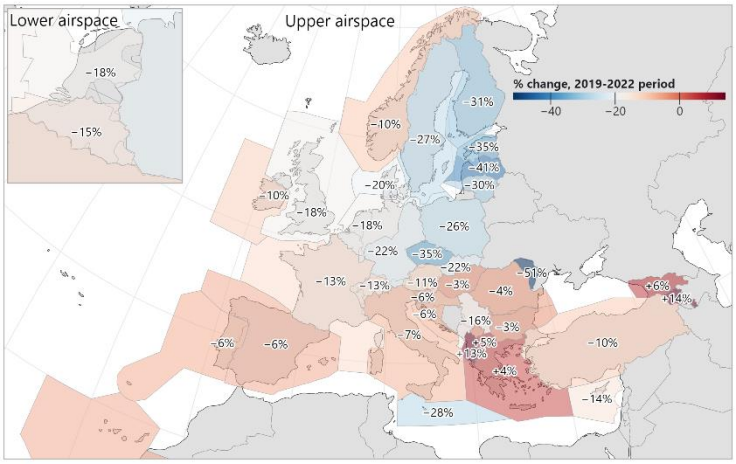


Figure 0.2: Changes in composite flight-hours between 2019 and 2022

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 €9.0 billion in 2022 (+55.3% compared to 2021). Despite this significant increase, ANSP revenues in 2022 remained below their pre-pandemic levels (- 14.9%, or - 1.6 billion). Short and long-term borrowings amounted to €5.7 billion in 2022, which is -10% less than in 2021 but remains nearly 3 times higher than in 2019.

Costs

Between 2021 and 2022, total ATM/CNS provision costs rose by +3.4%. However, when considering the savings already achieved in 2020 and 2021, ANSPs cost-bases were still - 6.2% (- €584.1M) lower than in 2019. Given the large increase in traffic in 2022, this resulted in -34.7% lower unit costs.

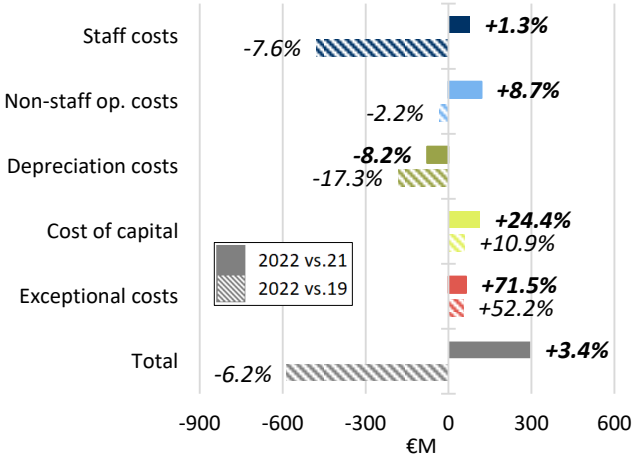


Figure 0.3: Breakdown of changes in ATM/CNS provision costs (real terms)

As shown in Figure 0.3, non-staff operating costs (+€119.7M or +8.7%), the cost of capital (+€113.7M or +24.4%), and staff costs (+€76.6M or +1.3%) were the main drivers of the overall increase in ATM/CNS provision costs in 2022 (+3.4%). Exceptional costs also increased (+€63.6M or +71.5%) mainly reflecting the obligation for ENAIRE to include a provision in its 2022 financial accounts in application of Law 26/2022. The purpose of this law is to recognise future liabilities to ATCOs being placed under a specific regime called "Special Active Reserve".

Although the changes presented in Figure 0.3 are expressed in real terms, it is important to consider that inflationary pressures became fully apparent in 2022, marking the end of a period of relatively low inflation. According to EUROSTAT, the inflation rate for the European Union (EU-27) stood at 9.2% in 2022. 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.

Economic cost-effectiveness

In 2022, the share of ATFM delays in the unit economic cost stood at 20%, close to the level reached in 2019, which was a year marked by significant capacity issues for several ANSPs.

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.

Figure 0.4 presents the comparison of all ANSPs gate-to-gate economic cost per composite flight-hour in 2022. It shows that unit economic costs ranged from €1 134 for skeyes to €231 for DCAC Cyprus; a factor of almost five.

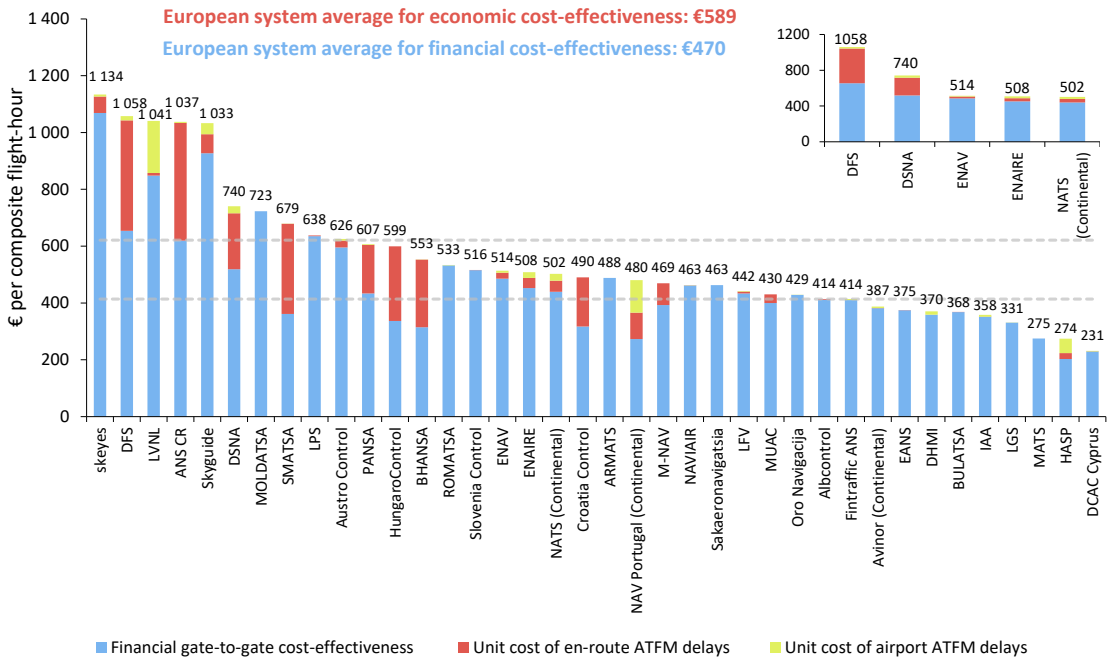


Figure 0.4: Economic gate-to-gate cost-effectiveness, 2022

Figure 0.5 shows that in 2022, the unit costs of ATFM delays increased by +316.7%. Meanwhile, ATM/CNS provision costs rose by +3.4%, and traffic by +58.3%. Consequently, the unit economic costs fell by -21.3%, amounting to €589.

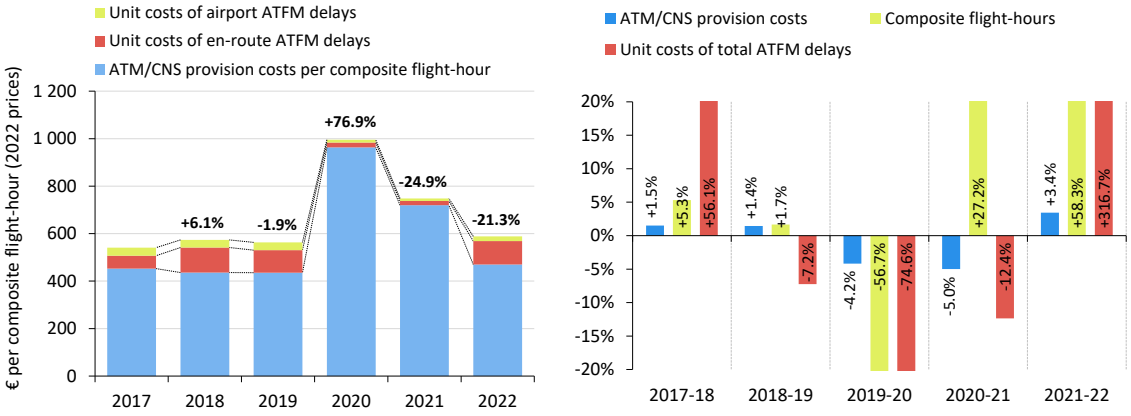


Figure 0.5: Changes in unit economic costs, 2017-2022 (real terms)

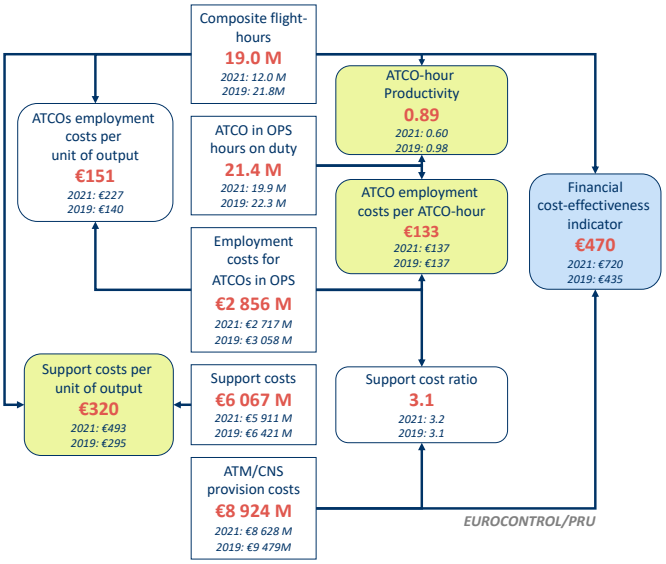


Figure 0.6: ACE performance framework, 2022

Figure 0.6 shows the analytical framework used in the ACE analysis to break down the financial cost-effectiveness indicator into basic economic drivers. These include:

a) ATCO-hour productivity (0.89 composite flight-hours per ATCO-hour),

b) ATCO employment costs per ATCO-hour (€133), and

c) support costs per unit of output (€320).

In 2022, ATCO-hours on duty rose by +7.7%, reflecting a +2.1% in the number of ATCOs in OPS and a +5.5% increase in the average number of hours worked per ATCO in OPS per year. Since traffic rose by +58.3%, ATCO-hour productivity increased by +47.0%. In the meantime, the average employment cost per ATCO-hour (€133) remained slightly below the values recorded over the past 5 years.

Number of staff

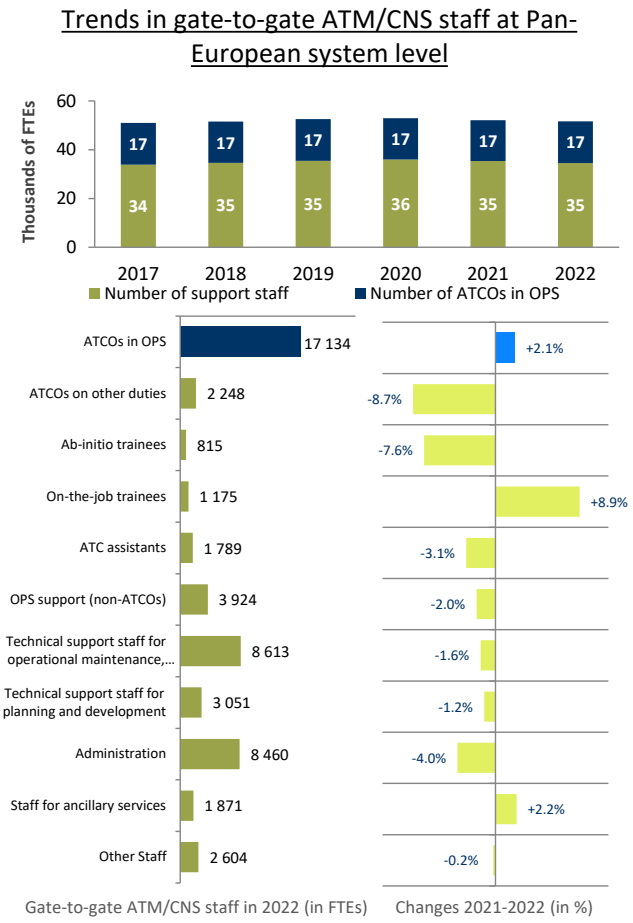


Figure 0.7: Total gate-to-gate ATM/CNS staff per staff category

In 2022, the number of ATM/CNS staff fell by -0.9% (-470 FTEs) compared to 2021, reflecting diverging trends for the number of ATCOs in OPS (+348 FTEs or +2.1%) and the number of support staff (-818 FTEs or - 2.3%).

Among support staff, the most significant reductions were observed for administrative staff (-355 FTEs, or -4.0%) and ATCOs on other duties (-215 FTEs or - 8.7%). To some extent, the changes observed for the ATCOs categories may reflect the fact that some ATCOs previously reported as "on other duties" following the traffic decrease in 2020 and the COVID-19 pandemic, are now re-allocated to OPS duties.

Decreases are also observed for technical support staff for operational maintenance (-1.6%), OPS support staff (-2.0%), ab-initio trainees (-7.6%), ATC assistants (- 3.1%), technical support staff for planning and development (-1.2%) and other staff (- 0.2%). Conversely, the number of on-the job trainees (+8.9%) and staff for ancillary services (+2.2%) rose in 2022.

Liquidity & cash indicators

After two years of deterioration, there are signs of improvement in the cash indicators used to monitor the impact of the COVID-19 crisis on ANSPs financial situation.

Figure 0.8 shows the changes in cash-on-hand days at Pan-European system level over the 2017-2022 period as well as the 1st quartile and the 3rd quartile of this indicator. Cash-on-hand days measures the length of time a company can pay its operating costs from its cash reserves. Values over the 2017-2022 period are based on 35 ANSPs.

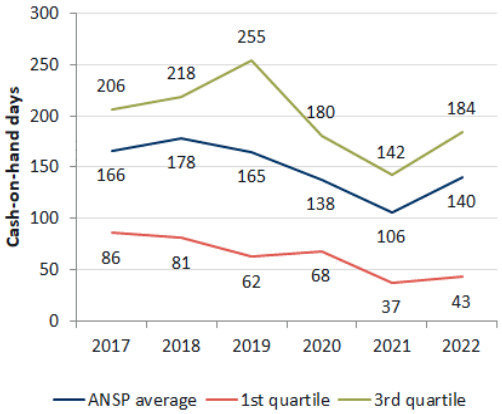


Figure 0.8: Cash-on-hand days

In 2022, the average cash-on-hand days amounted to 140 days, which represents an increase of +34 days compared to 2021. However, this figure still remains below the pre-pandemic levels (165 days in 2019)

Figure 0.9 shows the free cash flow and its components (net cash flow from operating activities and cash flow from capital expenditures) for the 34 ANSPs for which cash flow data is available from 2019 to 2022.

Following the unprecedented drop in traffic and resulting loss of revenues, the net cash flow from operating activities for these ANSPs turned negative in 2020 (-€2.4 billion, compared to +€2.4 billion in 2019). In 2021, the gap narrowed, yet the net cash-flow from operations remained negative (-€1.8 billion). **Nevertheless, by 2022, the net cash flow from operating activities returned to positive territory (+1.2 billion).**

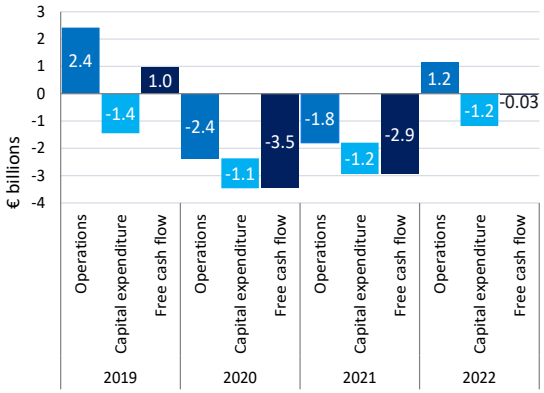


Figure 0.9: Cash flow, 2019-2022 (nominal terms)

Regulatory, institutional and corporate governance

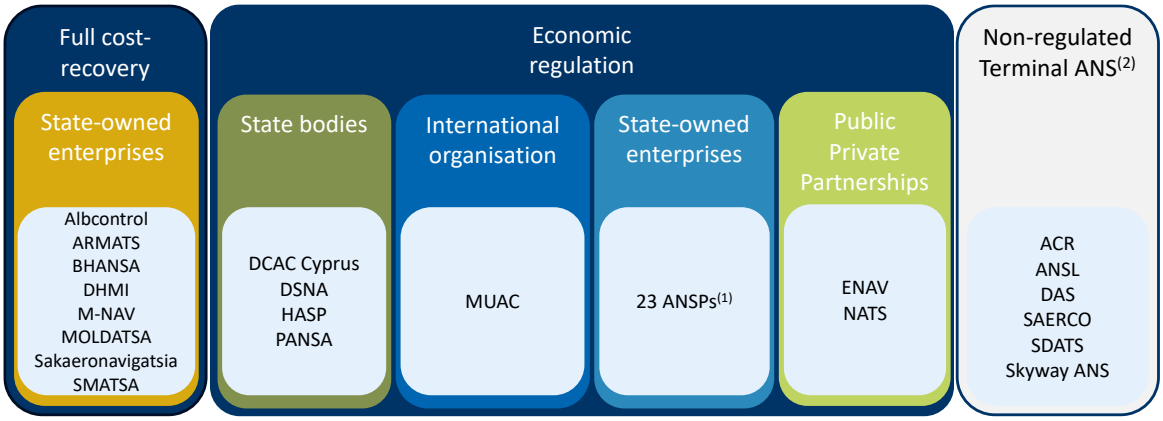
The institutional and governance arrangements for ANS in a particular country are set in place by the policies and specific aviation laws of each country. These factors are exogenous to the ANSP, but decision-making concerning some of them is largely driven by national aviation policymakers or relate to international requirements such as those imposed by the International Civil Aviation Organisation (ICAO), EUROCONTROL and the Single European Sky.

Institutional and governance arrangements include factors such as:

- the way ANS is regulated, including policies around market access and the degree of economic oversight/ regulation; and,
- the institutional structure surrounding ANS, the ANSP ownership and control structure.

These elements are expected to affect, among other factors, ANSPs behaviour, decision making processes and to some extent the observed level of cost-effectiveness performance.

Figure 0.10 below provides the framework used to structure the analysis and classify ANSPs into groups with similar characteristics in terms of regulatory regime and legal status.



(1) State-owned enterprises subject to economic regulation: ANS CR, Austro Control, Avinor, BULATSA, Croatia Control, DFS, EANS, ENAIRE, Fintraffic ANS, HungaroControl, IAA, LFV, LGS, LPS, LVNL, MATS, NAV Portugal, NAVIAIR, Oro Navigacija, ROMATSA, skeyes, Skyguide, Slovenia Control
(2) List of independent terminal ANS providers is not exhaustive and includes only the major providers in Europe.

Figure 0.10: ANSPs classification per regulatory regime and legal status

In 2012, a new set of regulations, the performance and charging schemes, were enforced in the European Union member States, Norway and Switzerland. These new regulations fundamentally changed the way air navigation services were financed, moving from a full cost-recovery to a determined cost regime, a mechanism expected to provide incentives for States/ANSPs to effectively control their costs. Although the UK left the EU at the end of 2020, it remained subject to economic regulation, under the sole remit of the UK Civil Aviation Authority. The system applicable in the UK slightly differs from that applicable to EU member States (notably in terms of processes, degree of stakeholder consultation, and actors involved) but it also shares many commonalities, especially considering the economic incentives. This report provides a case study on the economic regulation of NATS.

Under the influence of European legislation and, to some extent, the adoption of widespread practices, there is a trend towards convergence in the institutional structures. An emerging model of institutional structure involves the ANSP operating as an autonomous institution, either governed by its own statute, national company law, laws related to state-owned enterprises, or a combination of these. A management contract or a regulatory licence is often part of the mechanism of control. This report provides two case studies describing a) the institutional restructuration in Finland and b) the privatisation of ENAV in Italy.

This report also provides a high-level overview of the competition in the terminal air navigation services (TANS) market focussing on three States with the largest liberalised TANS markets – the United Kingdom, Spain, and Sweden. Detailed analysis shows that the market shares of the non-incumbent ANSPs in these countries represent 39%, 25% and 14%, respectively.

States opting for the liberalisation of their TANS markets usually aim to strengthen the performance of this segment of activity. In theory, competition for the market is expected to incentivise service providers to innovate and operate as efficiently as possible to either win contracts or maintain their position as incumbents.

In an attempt to have a quantitative view on the impact of economic regulation on ANSPs cost-effectiveness performance, ANSPs have been split into two groups:

- those operating under an economic regulation regime (30 ANSPs, including 29 operating under SES regulations and NATS), and;

- those operating under full cost-recovery (6 ANSPs[3]).

While there is heterogeneity within both groups, it is particularly important to note that, within the full cost-recovery group, DHMI accounted for 74% of ATM/CNS provision costs in 2022. Consequently, DHMI significantly influences the average levels and trends observed for that group.

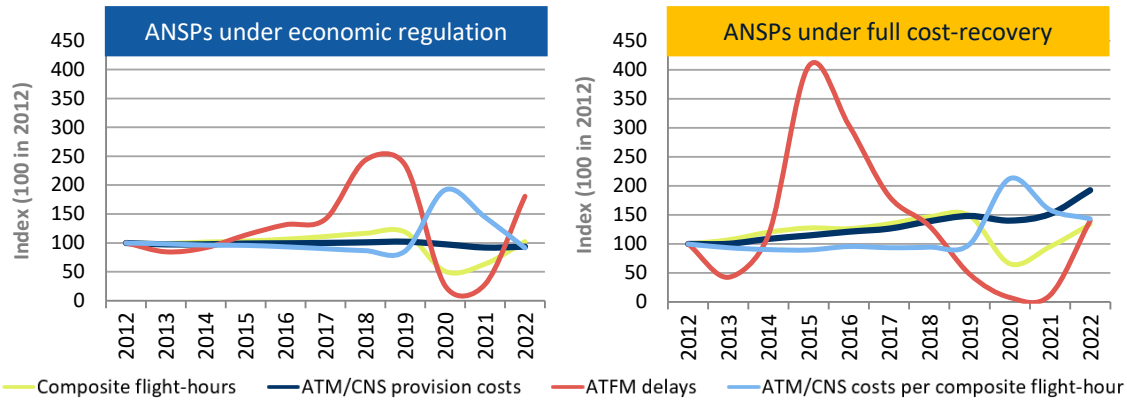


Figure 0.11: Changes in traffic, ATM/CNS provision costs, unit costs and ATFM delays (regulated vs. full cost-recovery)

While, at system level, ANSPs subject to economic regulation could maintain their cost-base fairly stable between 2012 and 2019, some of them exhibited substantial capacity issues especially in 2018 and 2019. Figure 0.11 also shows that the trends between the two ANSP groups differed during the COVID-19 crisis. Indeed, while ANSPs subject to economic regulation reduced ATM/CNS provision costs (-2.9% p.a. between 2019 and 2022), the costs of ANSPs operating under full cost-recovery rose by +9.1% p.a. over the same period. However, it is important to note that the latter is largely driven by DHMI.

Figure 0.12 also indicates that different legal statuses possibly played a role in the degree of flexibility ANSPs had to adjust to the drop in traffic following the COVID-19 crisis. Indeed, ANSPs operating as PPPs showed, on average, greater unit costs reductions than most of other economically regulated ANSPs. These ANSPs also showed greater flexibility to adjust ATCO-hours to lower traffic levels. This conclusion should however be nuanced since: a) NATS and ENAV (the two PPPs) show very different levels of performance and b) taken individually, some of the State bodies or State-owned ANSPs could demonstrate the same level of performance as the PPPs.

Figure 0.12: Changes in traffic and costs, 2019-2022

[3] Albcontrol, ARMATS, DHMI, M-NAV, MOLDATSA and SMATSA are the six ANSPs out of eight for which data is available starting 2012.

More detailed analysis of the different performance levels and trends by type of organization (including ATCO-hour productivity and employment costs, unit support costs and number of support staff) is provided in the core of the report.

Overall, the analysis did not allow to identify clear and straightforward relationships between each of these factors and individual ANSPs performance. This is certainly due to the fact that other elements such as the economic environment and the operational conditions in which the ANSP operate, or its organizational, managerial and financial setup also have an impact on its cost-effectiveness performance.

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 twenty second in a series of reports comparing the ATM cost-effectiveness of EUROCONTROL Member States' Air Navigation Service Providers (ANSPs)[4].

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 2022 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.

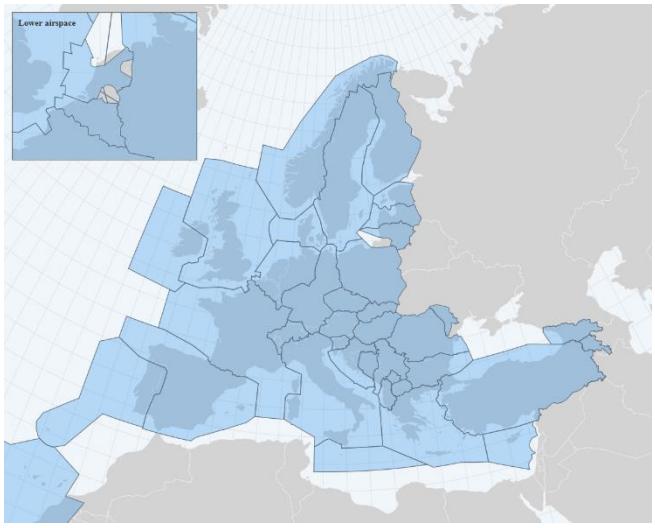


Figure 1.1: Geographic coverage of the ACE benchmarking analysis

Table 1.1 describes the States and ANSPs participating in the ACE 2022 data analysis. More detailed information on those aspects is provided in the ACE handbook[5].

Due to the ongoing war in Ukraine, UkSATSE is excluded from the analysis.

[4] Previous reports can be found at https://ansperformance.eu/publications/prc/ace/
[5] 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	Albcontrol	AL	Albania	Joint-stock company (State-owned)					x	
2	ANS CR	CZ	Czech Republic	State-owned enterprise						
3	ARMATS	AM	Armenia	Joint-stock company (State-owned)						
4	Austro Control	AT	Austria	Limited liability company (State-owned)					x	
5	Avinor	NO	Norway	Joint-stock company (State-owned)	x	x				
6	BHANSA	BA	Bosnia and Herzegovina	State-owned enterprise	x			x	x	
7	BULATSA	BG	Bulgaria	State-owned enterprise					x	
8	Croatia Control	HR	Croatia	Limited liability company (State-owned)	X			x	x	
9	DCAC Cyprus	CY	Cyprus	State body						
10	DFS	DE	Germany	Limited liability company (State-owned)	x		x			
11	DHMİ	TR	Türkiye	Autonomous State enterprise						x
12	DSNA	FR	France	State body (autonomous budget)				x		
13	EANS	EE	Estonia	Joint-stock company (State-owned)						
14	ENAIRE	ES	Spain	State-owned enterprise						
15	ENAV	IT	Italy	Listed company, Italian state is the majority shareholder					x	
16	Fintraffic ANS	FI	Finland	State-owned enterprise	x			x	x	
17	HASP	GR	Greece	State body						
18	HungaroControl	HU	Hungary	State-owned enterprise						
19	IAA	IE	Ireland	Joint-stock company (State-owned)		x				
20	LFV	SE	Sweden	State-owned enterprise	x			x	x	
21	LGS	LV	Latvia	Joint-stock company (State-owned)					x	
22	LPS	SK	Slovak Republic	State-owned enterprise	x					
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)						
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						
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 2022 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. This process is significantly constrained by the availability of ANSPs Annual Reports and Financial Statements. Typically, ANSPs Annual Reports for year N are published in the second quarter of year N+1. For this ACE report, 33 ANSPs out of 38 provided data within a month after the deadline. Conversely, five ANSPs (DCAC Cyprus, HASP, LVNL, MATS 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 5 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 economic and financial cost-effectiveness performance in 2022 at both Pan-European system and ANSP level. This chapter also analyses changes in ATM/CNS cost-effectiveness performance between 2017 and 2022, paying particular attention to the three main economic drivers of cost-effectiveness (productivity, employment costs and support costs).
- Chapter 4 presents a forward-looking analysis of cost-effectiveness performance covering the period 2023 to 2027.
- Chapter 5 provides complementary information to the ACE indicators, focusing on monitoring ANSPs' liquidity situation. It presents a set of financial indicators at Pan-European system level, covering the 2017-2022 period. These indicators are calculated from ANSPs' Financial Statements, and information at ANSP level is available on the ANSPs Financial Dashboard.
- Chapter 6 presents a study on ANSPs' regulatory, institutional, and corporate governance arrangements, examining whether these elements affect the level of performance in terms of economic cost-effectiveness.

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 2022, composite flight-hours rose by +58.3% at Pan-European system level but remained -13.3% lower than in 2019 (ranging from -51% to +14% 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 mostly affected 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 2022, composite flight-hours at Pan-European system level increased by +58.3% compared to the previous year. However, traffic remains -13.3% below 2019. As shown in Figure 2.1, the situation remains heterogeneous at ANSP level, partly due to different recovery rates following the COVID-19 crisis and the war in Ukraine (started on 24 February 2022), which significantly affected traffic flows.[6]

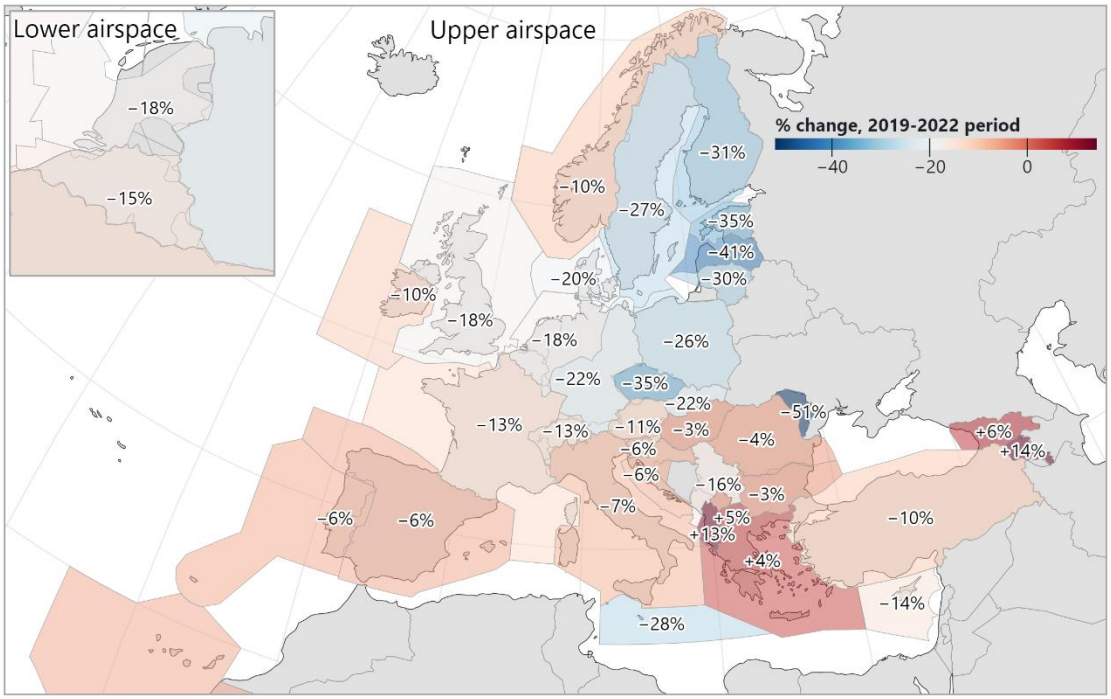

Figure 2.1: Changes in composite flight-hours between 2019 and 2022

In 2022, traffic was above 2019 levels for five ANSPs, specifically ARMATS (+14%), Albcontrol (+13%), Sakaeronavigatsia (+6%), M-NAV (+5%) and HASP (+4%). On the contrary, six other ANSPs reported traffic levels at least -30% lower than those recorded prior to the COVID-19 pandemic. Namely, Oro Navigacija (-30%), Fintraffic ANS (-31%), ANS CR (-35%), EANS (-35%), LGS (-41%) and MOLDATSA (- 51%). These differences are worth considering when analysing the level of performance achieved by these ANSPs in 2022.

[6] Figure 2.1 covers a total of 37 ANSPs, excluding BHANSA, which joined the ACE project in 2020.

Figure 2.2 and Figure 2.3 show that gate-to-gate ANS revenues reached €9.0 billion in 2022, marking a significant increase compared to 2021 (by +55.3%). Despite this rise, ANSPs revenues in 2022 remained below their pre-pandemic level (-14.9%). The revenues presented in Figure 2.2 include adjustments made for previous years under or over-recoveries. On the contrary, under-recoveries relating to the year 2022 will be charged only in 2024 and subsequent years.

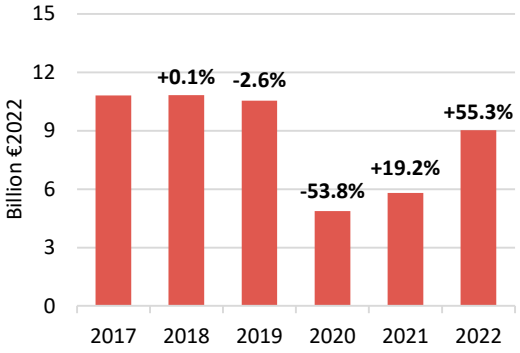

Figure 2.2: Gate-to-gate revenues, 2017-2022 (real terms)

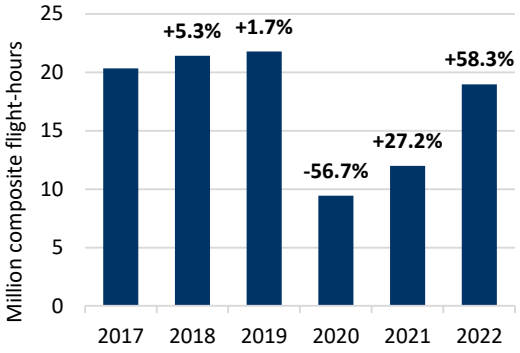

Figure 2.3: Composite flight-hours, 2017-2022

Table 2.1 below presents key data at Pan-European system level for 2021 and 2022.

	2021	2022	22/21
Gate-to-gate ANS revenues (not adjusted by over/under recoveries) (in € M):	**5 812**	**9 024**	**55.3%**
En-route ANS revenues	4 492	7 226	60.9%
Terminal ANS revenues	1 320	1 798	36.2%
Gate-to-gate ATM/CNS provision costs (in € M):	**8 628**	**8 924**	**3.4%**
En-route ATM/CNS costs	6 727	6 973	3.7%
Terminal ATM/CNS costs	1 901	1 951	2.6%
Institutional costs (in € M):	**1 207**	**1 178**	**-2.4%**
MET costs (including internal MET costs)	452	430	-4.9%
EUROCONTROL Agency costs	489	496	1.3%
Payment to national authorities and irrecoverable VAT	266	252	-5.1%
Gate-to-gate ANS costs (in € M)	**9 835**	**10 102**	**2.7%**
Gate-to-gate ATM/CNS staff:	**52 153**	**51 684**	**-0.9%**
ATCOs in OPS	16 785	17 134	2.1%
ACC ATCOs	9 175	9 363	2.0%
APPs + TWRs ATCOs	7 610	7 771	2.1%
NBV of gate-to-gate fixed assets (in € M)	**8 459**	**7 646**	**-9.6%**
Gate-to-gate capex (in € M)	**1 137**	**1 140**	**0.3%**
Outputs (in M)			
Distance controlled (km)	6 747	10 997	63.0%
Total IFR flight-hours controlled	9.5	15.2	59.4%
ACC flight-hours controlled	8.4	13.6	61.4%
IFR airport movements controlled	8.9	13.7	53.9%
IFR flights controlled	6.1	9.1	49.1%
Gate-to-gate ATFM delays ('000 min.)	**2 861**	**18 874**	**559.6%**

Table 2.1: Key ANS data for 2021 and 2022 (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 €8 924M in 2022. This represents a +3.4% increase compared

to the amount recorded in 2021. Both en-route and terminal ATM/CNS costs rose in 2022 (+3.7% and +2.6%, respectively).

In 2022, the Pan-European ANSPs employed a total of 52 500 staff (comprising 51 684 staff providing ATM/CNS services and 817 internal MET staff). Some 17 134 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.

Figure 2.4 presents the evolution of ANSPs' capital and reserves as well as borrowings over the 2017-2022 period.

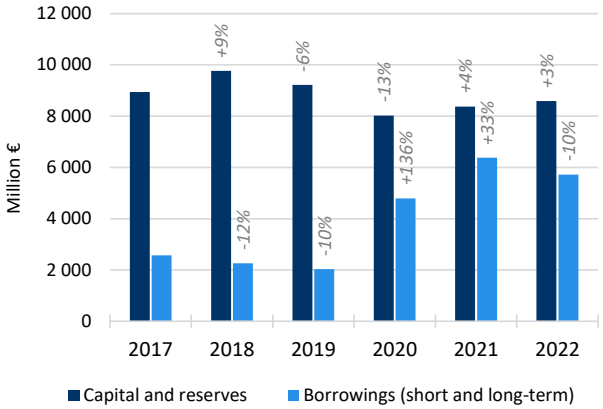

Figure 2.4: Main changes in ANSPs' liabilities, 2017-2022 (real terms)

The level of capital and reserves was affected in 2020 by the recording of losses and the use of reserves accumulated in previous years. Conversely, there were also equity injections from some ANSP shareholders (especially DFS in 2021, which received €300M from the Federal Republic of Germany).

In 2022, capital and reserves rose by +2.6%. This increase is mainly due to NATS generating profit in 2022, while losses were recorded in 2021. Without NATS, a slight decrease would be observed at Pan-European system level.

Short and long-term borrowings amounted to €5.7 billion in 2022, which is -10% less than in 2021. However, the level of indebtedness is still nearly 3 times higher than in 2019. The reduction in the total amount borrowed in 2022 (-€651.7M) reflects decreases for 18 ANSPs, with the most noticeable ones being DFS (- €161.7M, or -24.1%), DSNA (- €144.4M, or - 5.6%), and ENAV (- €123.1M, or -17.1%).

Staff costs amounted to €5.8 billion in 2022 and remain the largest cost category (65.3% of the total). These are followed by non-staff operating costs (18.4%, including exceptional costs), depreciation costs (9.8%) and the cost of capital (6.5%).

Additionally, Figure 2.5 shows that gate-to-gate ATM/CNS provision costs can be split into en-route (78.1%) and terminal (21.9%) 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

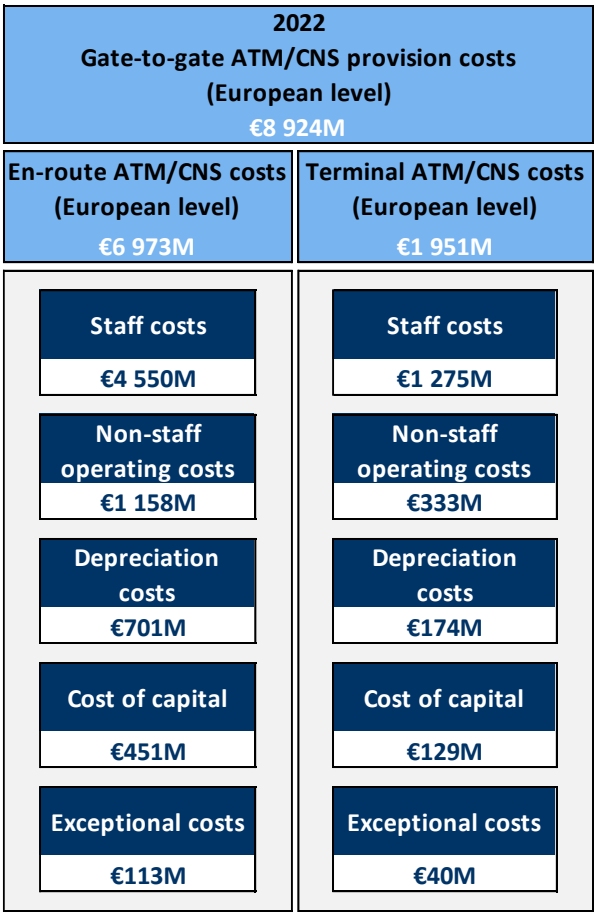

Figure 2.5: Breakdown of ATM/CNS provision costs, 2022

completeness, Annex 2 of this report provides the breakdown of the gate-to-gate cost-effectiveness indicator into en-route and terminal.

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.

The interpretation of this index suggests that to achieve an equivalent standard of living, earnings in, for instance, Switzerland or Norway (using market exchange rates) would need to be approximately four times higher than those in Türkiye (see Figure 2.6).

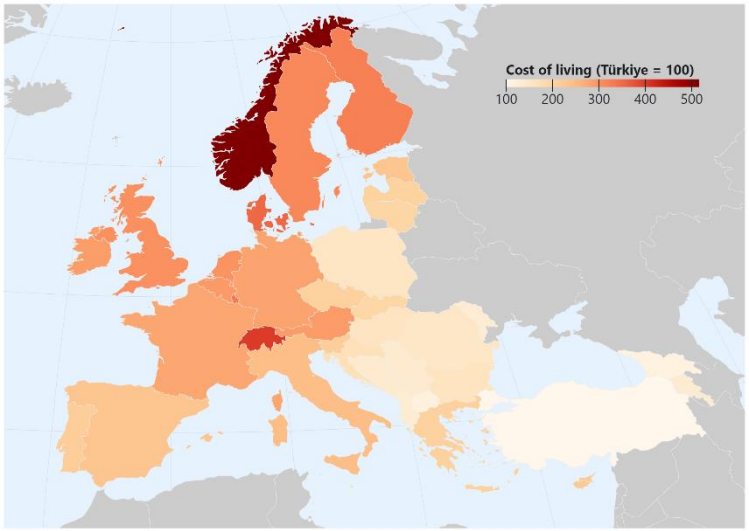

Figure 2.6: Cost of living indexes based on PPPs[7], 2022

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

[7] The cost of living indexes are based on the data published by the IMF in the World Economic Outlook database in April 2024, see Annex 4 for more details.
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.

the indicators are) and not normative (inferring what the indicator should be).

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.

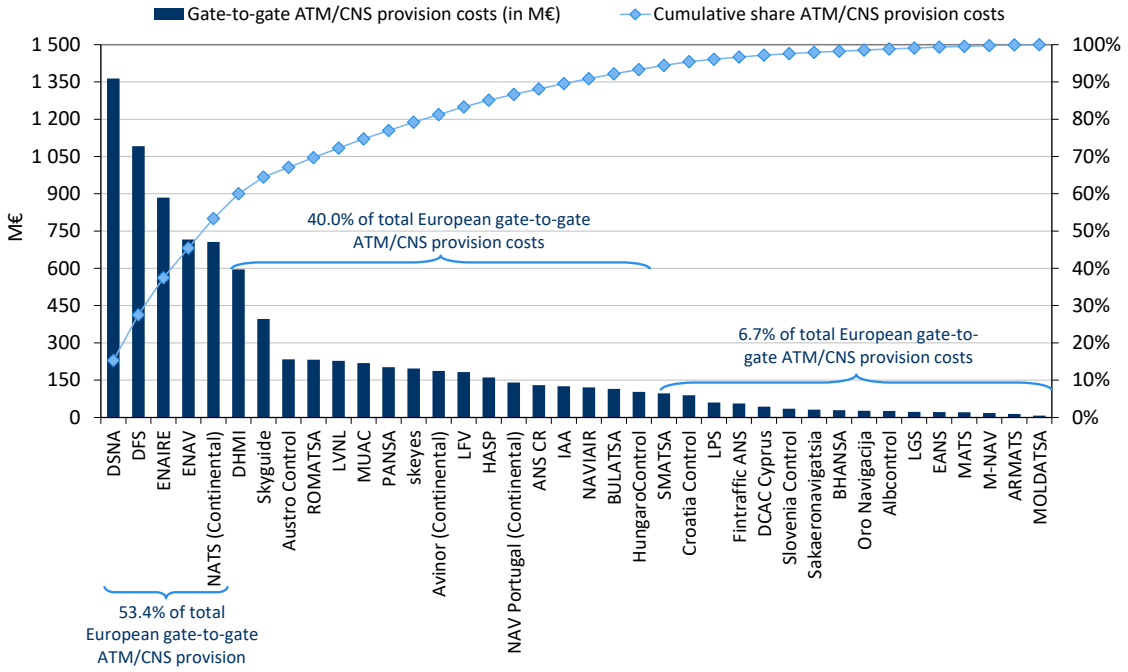

Figure 2.7: Distribution of ATM/CNS provision costs in 2022

In 2022, the five largest ANSPs (DSNA, DFS, ENAIRE, ENAV, and NATS) bore 53.4% of the total Pan-European gate-to-gate ATM/CNS provision costs, while accounting for 49.2% of the total traffic (see Figure 2.7).

This result contrasts with the expectation of increasing returns to scale in ANS provision, where larger ANSPs were expected to benefit from their size. However, larger ANSPs often develop customized ATM systems internally, which can result in higher costs compared to commercial off-the-shelf (COTS) solutions. Besides, it is important to acknowledge that size is not the only factor influencing ANSPs cost-effectiveness performance as shown in the framework presented in the ACE Handbook.

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3. COST-EFFECTIVENESS ANALYSIS

3.1 Economic cost-effectiveness

In 2022, although starting from a low base in 2021, ATFM delays increased almost six-fold to some 18.9M minutes. As a result, the share of ATFM delays in the unit economic costs amounts to 20%. This is close to the level reached in 2019, which was a year marked by significant capacity issues for several ANSPs.

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 plus the costs of ground ATFM delays[8, 9] for both en-route and airport operations, all expressed per composite flight-hour.

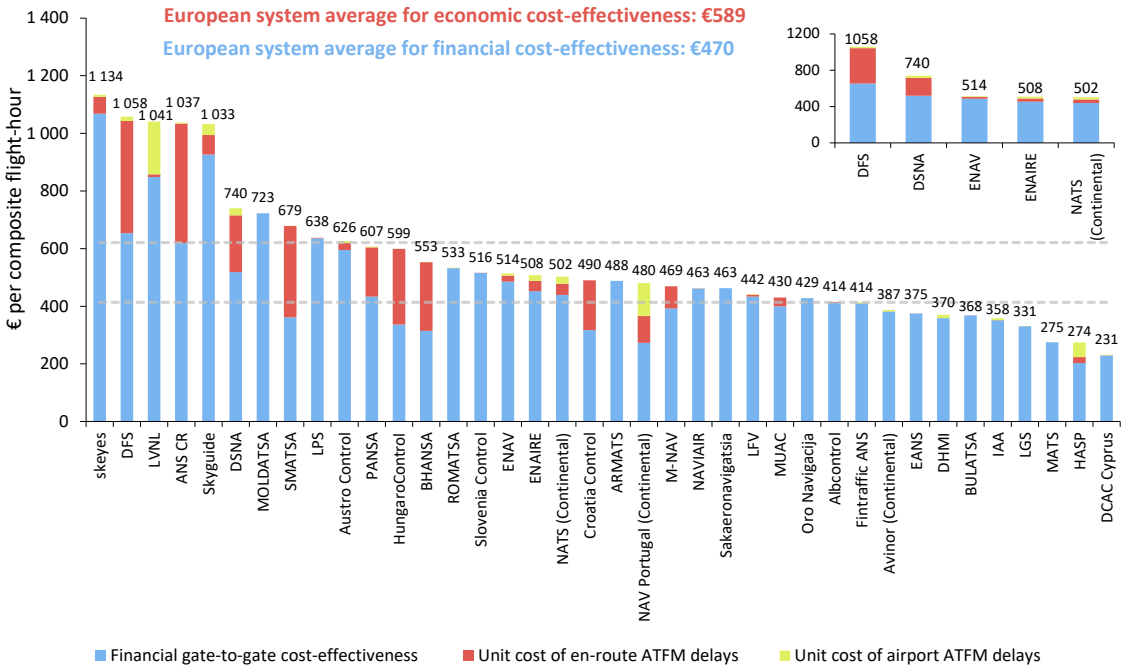


Figure 3.1: Economic gate-to-gate cost-effectiveness indicator, 2022

Figure 3.1 compares the gate-to-gate economic costs per composite flight-hour of all ANSPs in 2022. It shows that unit economic costs ranged from €1 134 for skeyes to €231 for DCAC Cyprus; nearly a five-fold difference. The two dotted lines in the figure represent the bottom (€414) and top (€621) quartiles, indicating the dispersion across ANSPs. In 2022, there was a €207 difference between these two quartiles, some -13% compared to 2021, which indicates a lower dispersion in the sample.

[8] The cost of ATFM delays (€119 per minute in 2022) 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.

[9] 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 for more information.

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 DFS and ANS CR both report unit economic costs slightly above €1 000 per composite flight-hour, the impact of DFS (controlling almost 8 times more traffic) on the Pan-European system is much higher. Further information on the size of ANSPs in terms of costs and traffic is available in Section 2.2. Similarly, more details on individual ANSPs contribution to the changes in ATFM delays between 2021 and 2022 are provided in Figure 3.7.

As a consequence, due to their weight in the Pan-European system and their relatively similar operational and economic characteristics (such as size, scope of service provided, economic conditions, and presence of major hubs), the ACE benchmarking reports place particular emphasis on the results of the five largest ANSPs (DFS, DSNA, ENAIRE, ENAV and NATS). Figure 3.1 shows that DFS (€1 058) had the highest unit economic costs among this group, followed by DSNA (€740), ENAV (€514) and ENAIRE (€508). NATS (Continental) records the lowest unit cost among the five (€502).

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 2022 when expressed in Euro. Annex 4 to this report provides detailed information on ANSPs exchange rates.

In 2022, although starting from a low base in 2021, ATFM delays increased almost six-fold to some 18.9M minutes and their share in the unit economic costs amounted to 20%. This is close to the level reached in 2019, which was a year marked by significant capacity issues for several ANSPs.

This share was substantially higher for some ANSPs, for instance SMATSA (46.8%), HungaroControl (43.8%), NAV Portugal (43.2%), BHANSA (43.1%) and ANS CR (40.3%), highlighting the significant impact of ATFM delays on their economic cost-effectiveness performance. In 2022, some ANSPs had to control higher than expected 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. However, it is important to note that ATFM delays related to the war in Ukraine were not considered in the post-ops data used in this report during the period the European Aviation Crisis Coordination Cell (EACCC) was activated because of the Russian invasion of Ukraine in 2022.

Figure 3.2 illustrates the breakdown of ATFM delays by segment and reason for the delay (after post-operations and eNM adjustments), using data recorded in the Network Manager database. The majority of ATFM delays generated at the Pan-European system level in 2022 were associated with en-route ATFM delays (83%), primarily related to en-route ATC capacity and staffing issues (49%), followed by other en-route constraints (28%) and en-route weather-related events (23%).

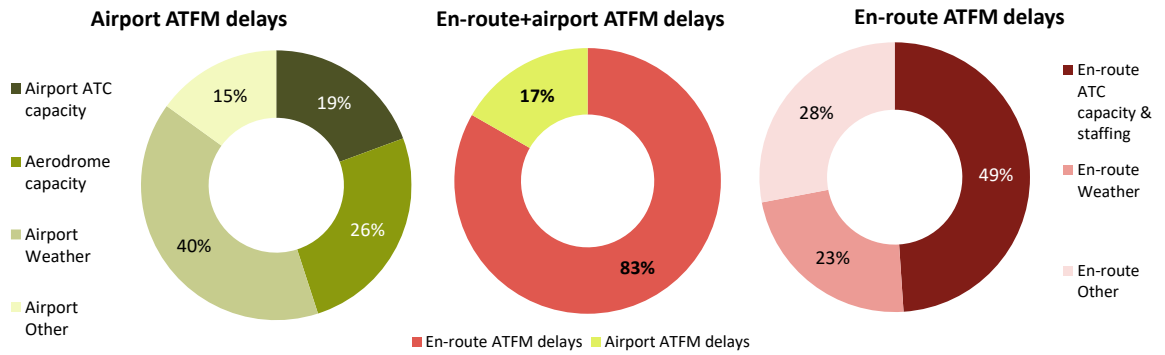


Figure 3.2: Causes of en-route and airport ATFM delays at system level, 2022

In 2022, airport ATFM delays represented 17% of the total ATFM delays, with 40% attributed to weather-related events at the airport, followed by capacity problems at the aerodrome (26%). While airport ATC capacity issues (19%) and other airport ATC constraints (15%) also deserve attention,

these are not directly controlled by the ANSPs (such as compliance with environmental regulations or issues associated with airport infrastructure).

Figure 3.3 analyses the changes in economic cost-effectiveness between 2017 and 2022 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.

Between 2017 and 2022, economic costs per composite flight-hour increased by +1.7 % p.a. in real terms. This mainly reflects the fact that unit ATM/CNS provision costs slightly increased by +0.8% p.a., while unit costs of ATFM delays rose substantially (+6.0% p.a.).

Figure 3.3 also shows that in 2022, unit economic costs fell by -21.3% compared to 2021 given that traffic rose faster (+58.3%) than ATM/CNS provision costs (+3.4%), while the unit costs of ATFM delays increased markedly (by +316.7%). The traffic growth observed in 2022 in terms of composite flight-hours is the largest since the shock caused by the COVID-19 pandemic in 2020 (-56.7% compared to 2019). It is also well above the increase observed in 2021 (+27.2%).

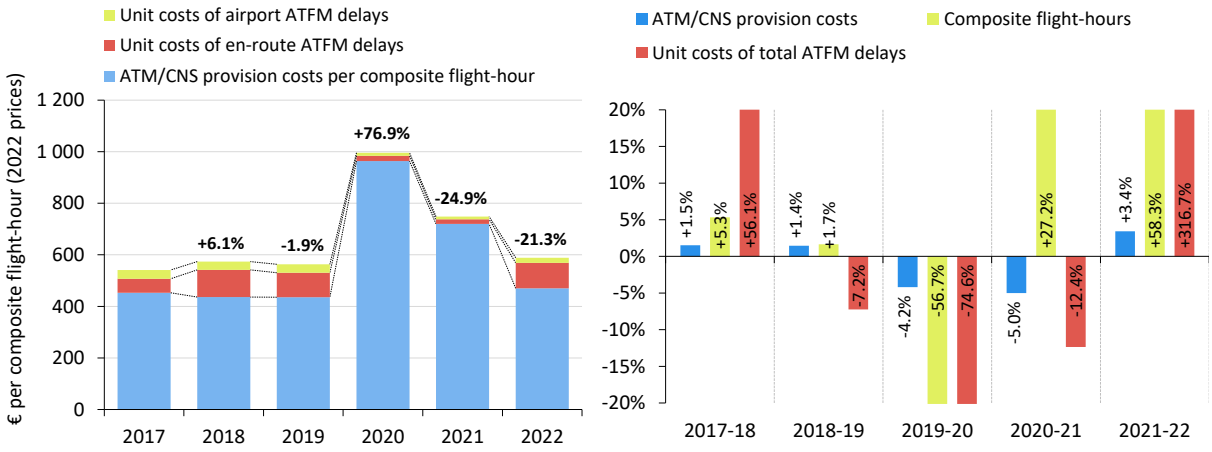


Figure 3.3: Changes in unit economic costs, 2017-2022 (real terms)

Figure 3.4 illustrates the long-term trends in terms of ATM/CNS provision costs, composite flight-hours, ATFM delays and unit economic costs. ATM/CNS provision costs (indexed to 2012 = 100) remained relatively stable between 2012 and 2022, with the largest amount recorded in 2019 (+4% above 2012) and the lowest in 2021 (-5% below 2012). The level of costs in 2022 was close to the values observed in 2013 and 2014.

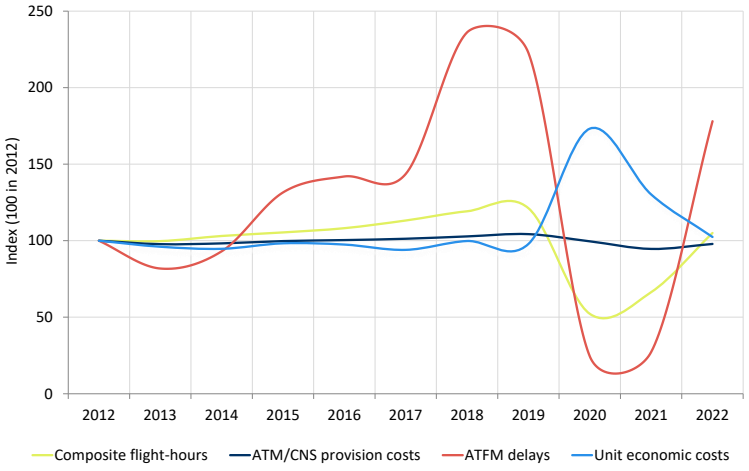


Figure 3.4: Long-term trends in traffic, ATM/CNS provision costs and ATFM delays

2012-2019 was a period of sustained traffic growth, during which ATFM delays rose significantly, reaching a peak in 2018. Consequently, the rising unit costs of ATFM delays outweighed the reductions in unit financial costs. 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. Overall,

in terms of ATM/CNS provision costs and traffic the situation in 2022 is close to 2012. The main difference with 2012 is that ATFM delays are +78% higher.

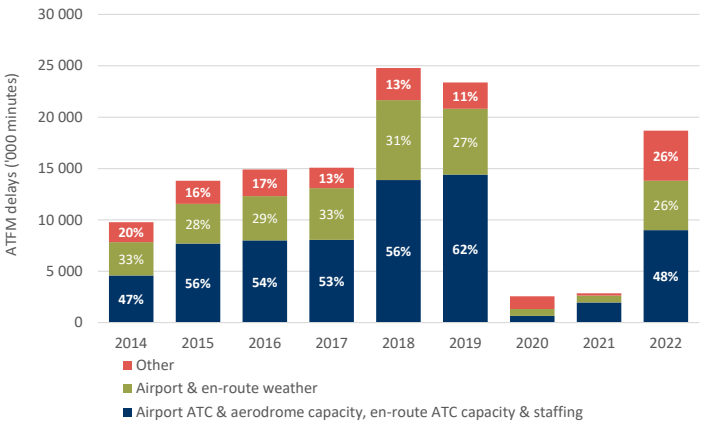


Figure 3.5: Changes in main reasons for ATFM delays (2014-2022)

Since ATFM delays result from a variety of different causes, Figure 3.5 shows the breakdown of ATFM delays into a) capacity and staffing related delays, b) weather delays, and c) all other delay reasons, for the 2014-2022 period.

It shows that between 2014 and 2019, the increase in ATFM delays was mainly associated with ATC capacity and staffing issues (see blue portion of the bars).

Although these reasons represented nearly half of the total ATFM delays in 2022, Figure 3.5 shows that the share of ATFM delays allocated to the "other" category increased compared to previous years (26% vs. 11%-13% in 2018-19). It is understood that, in 2022, part of these delays is associated with the implementation of capacity projects and new ATM systems for some ACCs.

Figure 3.6 shows that, between 2021 and 2022, gate-to-gate economic costs per composite flight-hour fell for 31 ANSPs. In most cases, this resulted from large decreases in unit ATM/CNS provision costs combined with marginal variations in the unit costs of delay. Some noticeable exceptions were DFS, DSNA, NAV Portugal and LVNL, for which the unit costs of ATFM delays increased very significantly while not completely offsetting the reduction in unit ATM/CNS provision costs.

On the other hand, Figure 3.6 also shows that unit economic costs rose for seven ANSPs. For all these ANSPs, significant increases in the unit costs of ATFM delays outweighed the reductions in unit ATM/CNS provision costs.

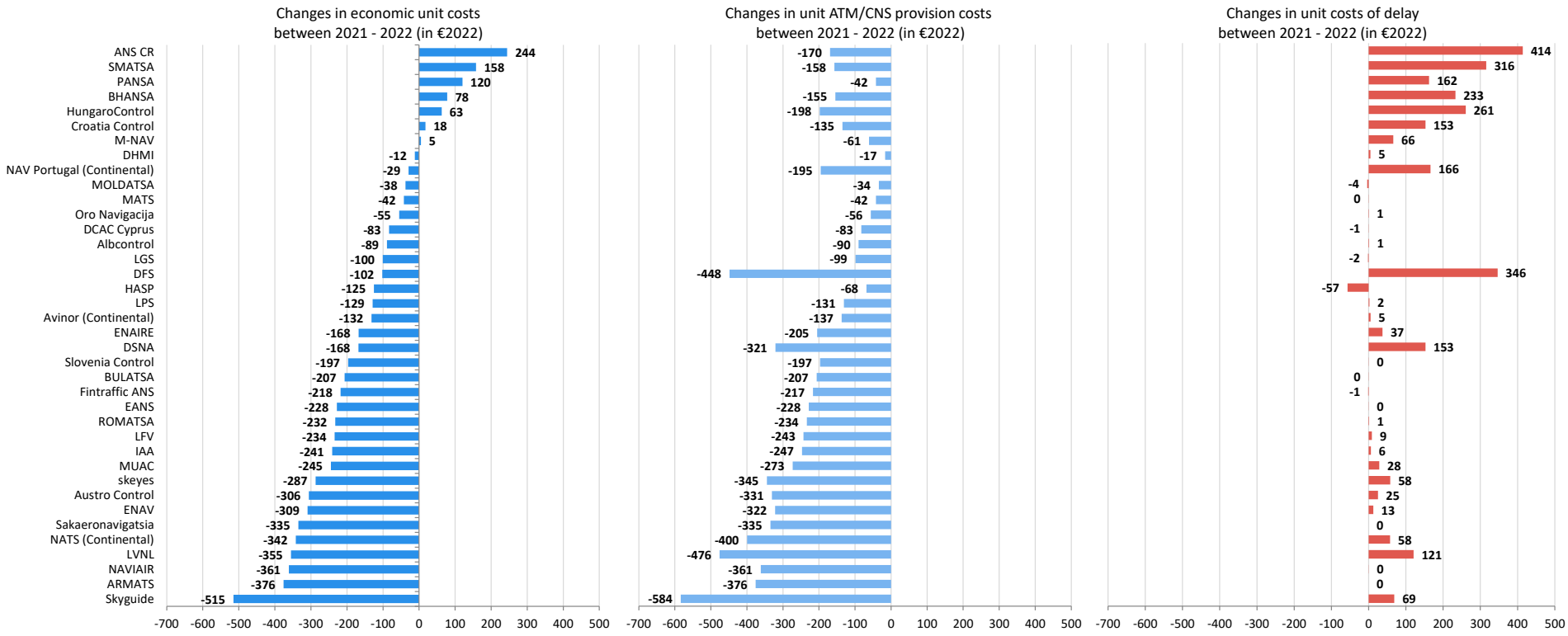


Figure 3.6: Changes in economic cost-effectiveness by ANSP, 2021-2022 (real terms)

Figure 3.7 shows the ANSPs most contributing[10] to the increase in all-reason ATFM delays observed in 2022 at Pan-European system level, for both en-route and terminal. It consists of two charts:

- The left-hand side chart displays the changes in ATFM delays generated by individual ANSPs between 2021 and 2022, 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 2022. 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 (20% in 2022).

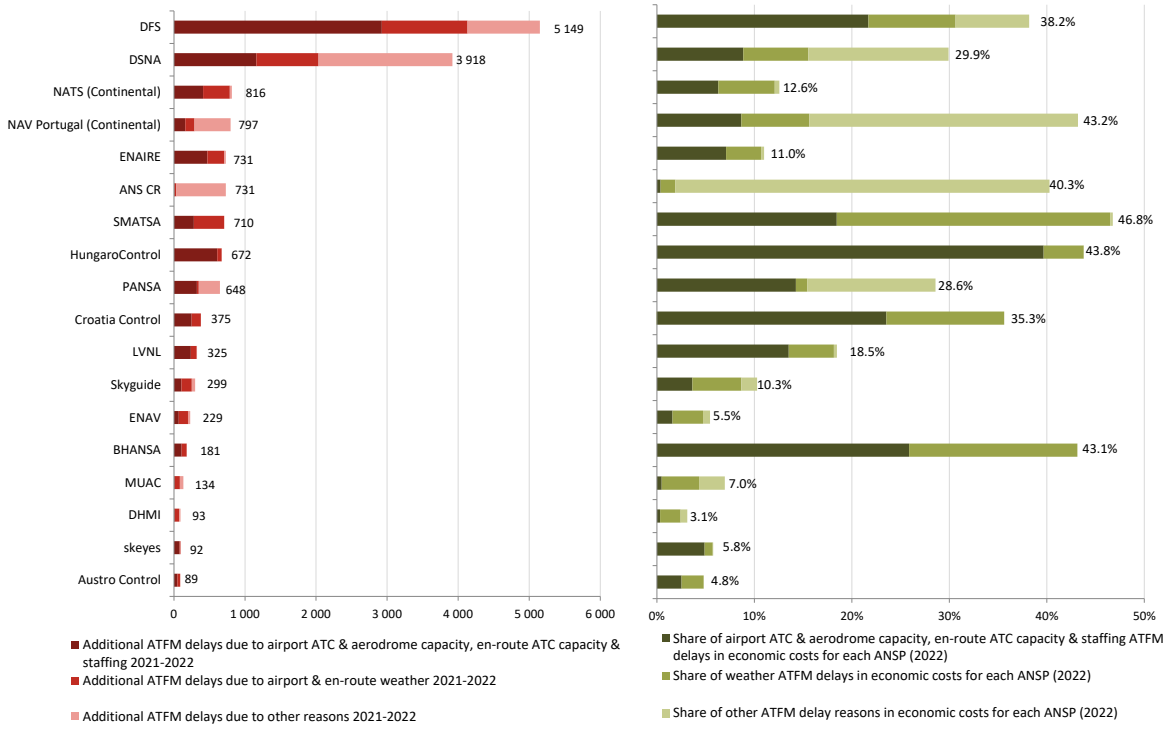


Figure 3.7: ANSPs contribution to ATFM delays increase at Pan-European system level in 2022

Another indicator that should be considered is the share of ATFM delays generated by each ANSP in the total economic costs of the 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 BHANSA, whose ATFM delays represented 1.0% of the Pan-European system, the share of ATFM delays in their economic costs was 43.1%. This value is much higher than for DSNA (29.9%), which accounted for 25.9% of the total ATFM delays generated at Pan-European system level. This comparison may highlight certain capacity issues for BHANSA, even though the ATFM delays generated in Bosnia and Herzegovina airspace only represent a small proportion of the Pan-European system ATFM delays. Annex 2 - Table 0.1 provides a comprehensive analysis of the ATFM delays generated by each ANSP in the total Pan-European system for the year 2022.

The left-hand side of Figure 3.7 indicates that the increase in ATFM delays at system level in 2022 mainly reflects substantial increases for a few ANSPs. More than half of the additional ATFM delays were generated by DFS and DSNA. For DFS, en-route ATC capacity accounted for 51.4% of the total

[10] ANSPs with ATFM delays varying by less than 50 000 minutes between 2021 and 2022 are not shown in Figure 3.7.

ATFM delays, while en-route weather issues contributed to 21.8%. For DSNA, the primary delay causes were special events (representing 23.3% of the total ATFM delays), en-route ATC capacity (19.1% of the total ATFM delays) and en-route weather issues (18.4% of the total ATFM delays). The main reason of special event delays was the implementation of the new ATM system 4-Flight.

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 2022. Additional information on ATFM delays can also be found on the Performance Review Unit data portal (http://ansperformance.eu/).

3.2 Financial cost-effectiveness performance

At Pan-European system level, unit ATM/CNS provision costs fell by -34.7% in 2022, reflecting the fact that composite flight-hours rose much faster (+58.3%) than ATM/CNS provision costs (+3.4%). Despite this reduction, unit ATM/CNS provision costs in 2022 (€470) remained +8.2% higher than before the COVID-19 pandemic, and close to the levels observed in 2015 and 2016.

Figure 3.8 shows the comparison of ANSPs gate-to-gate ATM/CNS provision costs per composite flight-hour in 2022. The two dotted lines represent the bottom and the top quartiles (€360 and €518, respectively) and provide an indication of the dispersion across ANSPs. At Pan-European level, unit ATM/CNS provision costs amounted to €470 per composite flight-hour.

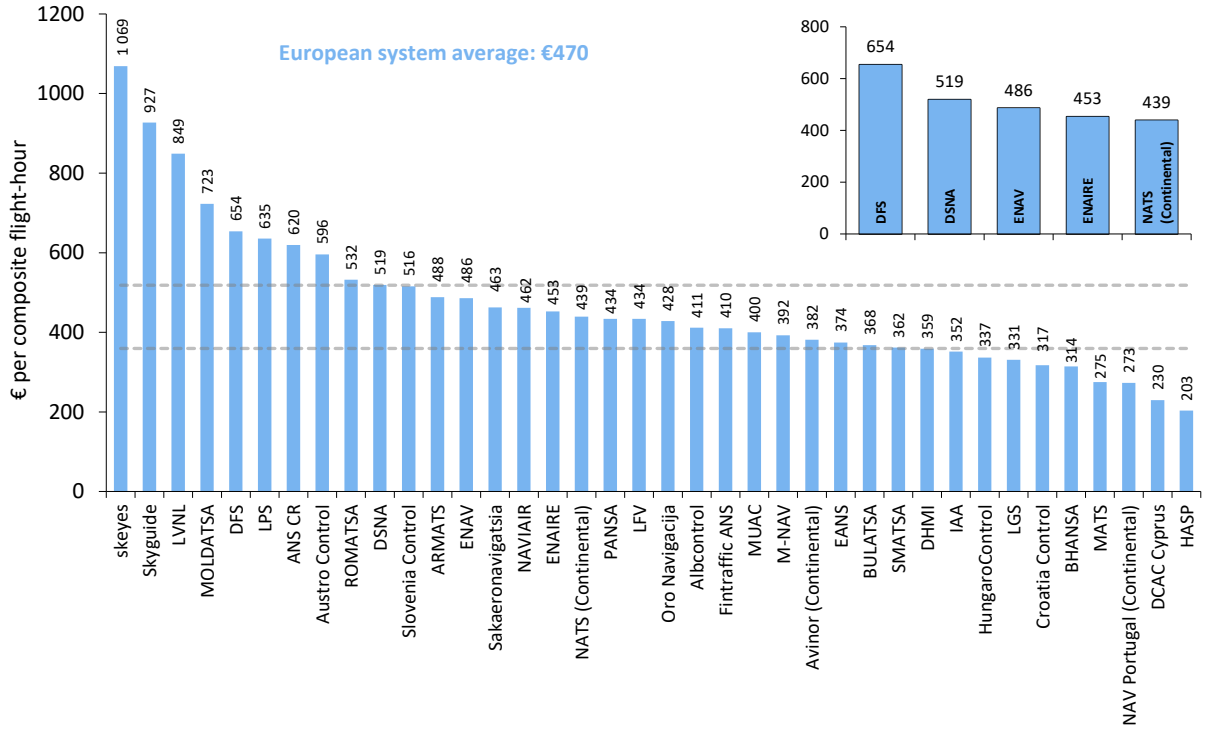


Figure 3.8: ATM/CNS provision costs per composite flight-hour, 2022

As introduced in Section 3.1, 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 2021 and 2022, substantial variations in exchange rates compared to the Euro include the appreciation of the Georgian Lari (+25%), the Swiss Franc (+7%), and the Czech Koruna (+7%), while a substantial depreciation of the local currency with respect to the Euro is observed for the Turkish Lira (-40%), the Hungarian Forint (-8%) and the Swedish Krona (-5%). Detailed information on ANSPs exchange rates is available in Annex 4 of this report.

Figure 3.8 indicates that in 2022 the unit ATM/CNS provision costs of various ANSPs operating in Central and Eastern European countries (e.g. MOLDATSA, LPS, ANS CR, ROMATSA and Slovenia Control) are higher or very close to the Pan-European system average, and in the same order of magnitude as the unit costs of ANSPs operating in Western European countries where the cost of living is much higher (see Figure 2.6). 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.

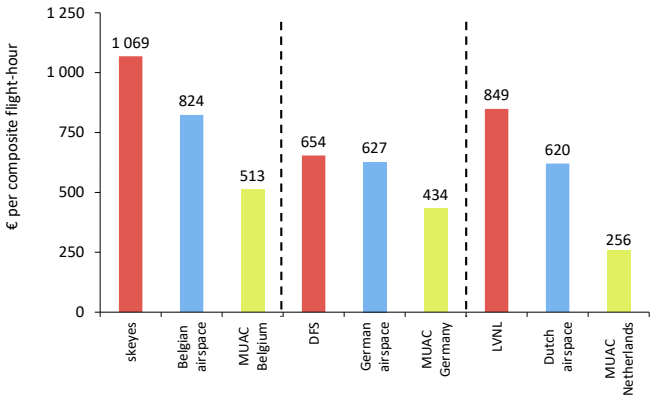
Figure 3.8 also shows that while the five largest ANSPs operate in relatively similar economic and operational environments, there is a substantial difference (49%) in unit ATM/CNS provision costs, ranging from DFS (€654) to NATS (€439).

In 2022, skeyes and LVNL rank at the 1st and 3rd highest positions, respectively. 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 consistently maintains higher unit ATM/CNS provision costs compared to LVNL (+20% on average over 2012-2022). 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 countries (Belgium, Germany, the Netherlands, and Luxembourg) national airspaces, MUAC costs and outputs are consolidated with the costs and outputs of the national providers. This adjustment is presented in Figure 3.9 below.

The bottom of Figure 3.9 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 FIRs (Belgium, the Netherlands, and Germany).

The top section of Figure 3.9 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 (€824) remain higher (+33%) than in Dutch airspace (€620).



MUAC	Belgium	Germany	The Netherlands
Flight-hours allocated to:	145 153	232 410	168 088
Costs allocated to:	€74.5M	€100.8M	€43.1M

Figure 3.9: Adjustment of the financial cost-effectiveness indicator for ANSPs operating in the four States airspace, 2022

It should also be noted that the MUAC costs allocated to Belgium (€74.5M) are significantly higher than those allocated to the Netherlands (€43.1M)[11].

Figure 3.10 below provides a long-term trend analysis showing the changes in traffic, ATM/CNS provision costs and unit costs between 2012 and 2022. 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.

[11] The cost-sharing arrangements between the four MUAC States are not based on traffic. Instead, they are based on ATCOs numbers 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.

Between 2012 and 2019, ATM/CNS provision costs rose by +0.6% p.a., which is less than the +2.8% p.a. increase in traffic. As a result, unit ATM/CNS provision costs decreased by -2.1% p.a. (or -14.0% in total over the period).

Between 2019 and 2022, traffic initially decreased due to the COVID-19 pandemic (-56.9% in 2020) before rebounding in 2021 (+27.1%). However, composite flight-hours in 2022 were still -13.3% lower than in 2019, albeit +5.0% higher than in 2012. Meanwhile, cost containment measures were implemented in 2020 and 2021, resulting in a cumulative reduction of -9.3% in ATM/CNS provision costs between 2019 and 2021. In 2022, this downward trend reversed, and ATM/CNS provision costs rose by +3.4% compared to the previous year, albeit they remain below the levels attained in 2019 (-6.2%) and 2012 (-2.1%).

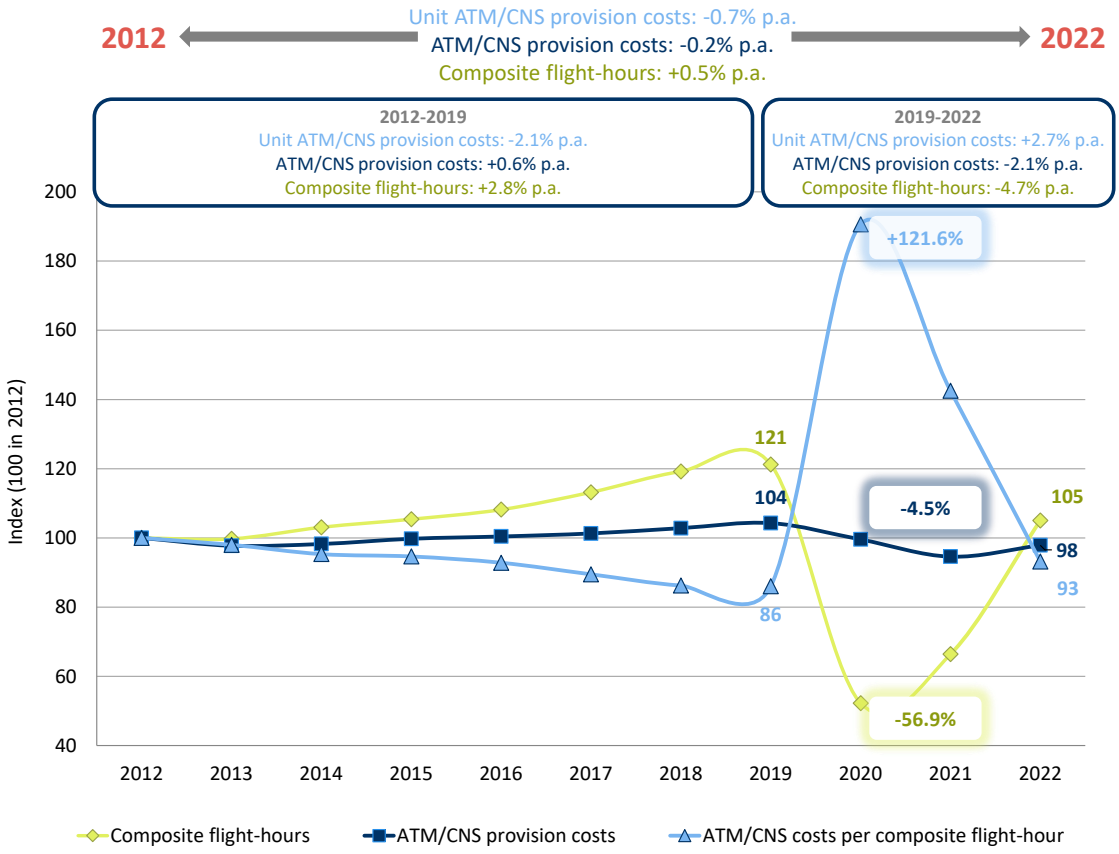


Figure 3.10: Long-term trends in traffic, ATM/CNS provision costs and unit costs

Figure 3.11 below shows that between 2021 and 2022 (plain coloured bars) total ATM/CNS provision costs rose by +3.4%, mainly reflecting increases in non-staff operating costs (+8.7% or +€119.7M) and in the cost of capital (+24.4% or +€113.7M). However, considering the savings already achieved in 2020 and 2021 at the system level, ANSPs cost-bases were still -€584.1M (-6.2%) lower than in 2019 (see striped bars in Figure 3.11).

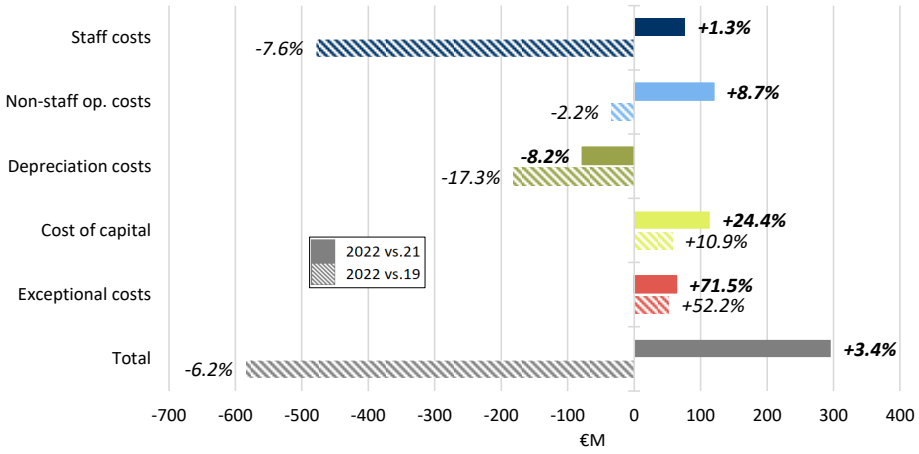


Figure 3.11: Breakdown of changes in ATM/CNS provision costs, 2021-2022 and 2019-2022 (real terms)

Inflationary pressures became fully apparent in 2022, marking the end of a period of relatively low inflation for most European States in the past decade. According to EUROSTAT, the inflation rate for European Union (EU-27) stood at 9.2% in 2022, marking a three-fold increase from 2.9% in 2021.

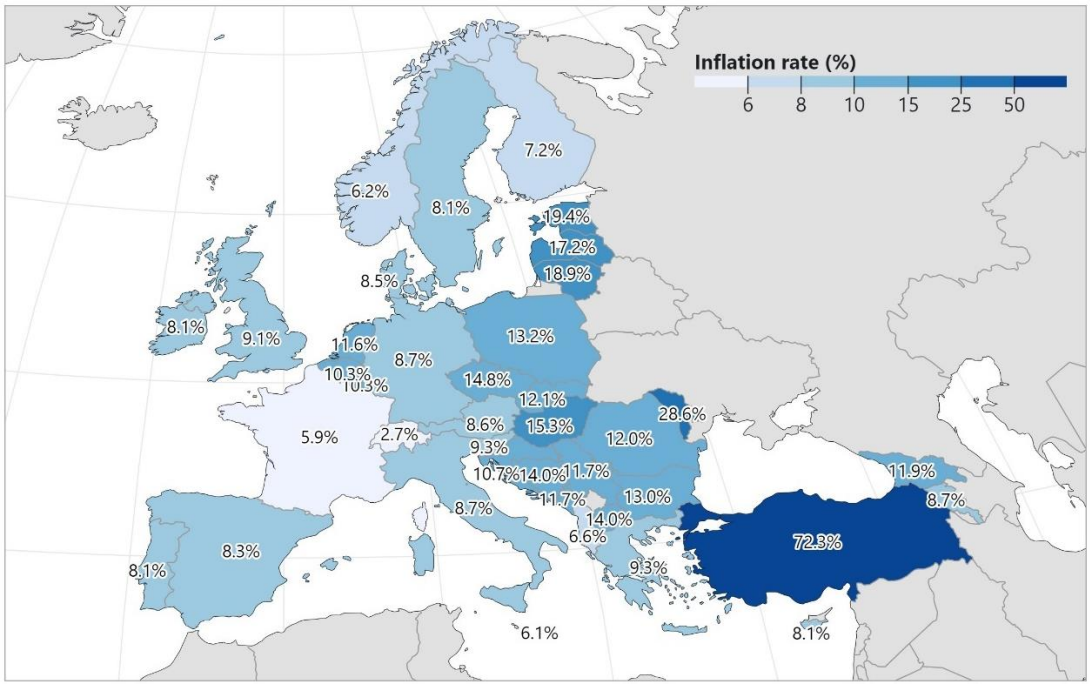


Figure 3.12: Annual inflation rates in 2022

Figure 3.12 shows the 2022 annual inflation rates,[12] ranging from 2.7% in Switzerland to 72.3% in Türkiye. Inflation rates exceeded 10% for 19 of the 38 countries analysed.

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.

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

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 (2022).

This approach ensures that ANSP's 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. 2017 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 2022:

- 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. Some ANSPs, such as DHMI, perform frequent revaluations of their fixed assets, somehow indexing the residual value of the asset to inflation.
- A higher inflation rate generally results in higher 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 3.13 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 2021 and 2022. In addition, the small lines in the 3rd column indicate the trends between 2019 and 2022. These trends are illustrative and the minimum and maximum values account for each ANSP's individual situation. Therefore, the magnitude of the variation cannot be compared across the different ANSPs.

Figure 3.13 indicates a general decrease in unit ATM/CNS provision costs for all ANSPs between 2021 and 2022. Except for MOLDATSA, these reductions were mainly driven by strong traffic increases (ranging from +9.6% for Oro Navigacija to +100.2% for NATS). For 12 ANSPs, the decrease in unit costs was also due to reductions in total ATM/CNS provision costs (varying from -0.4% for Avinor and Skyguide to -21.9% for MOLDATSA). In almost all cases, these reductions cumulate with decreases from previous years. For instance, this is the case of DFS (- €170.2M), DSNA (-€97.9M) and ENAV (-€53.1M), which recorded substantial cost reductions over 2019-2022.

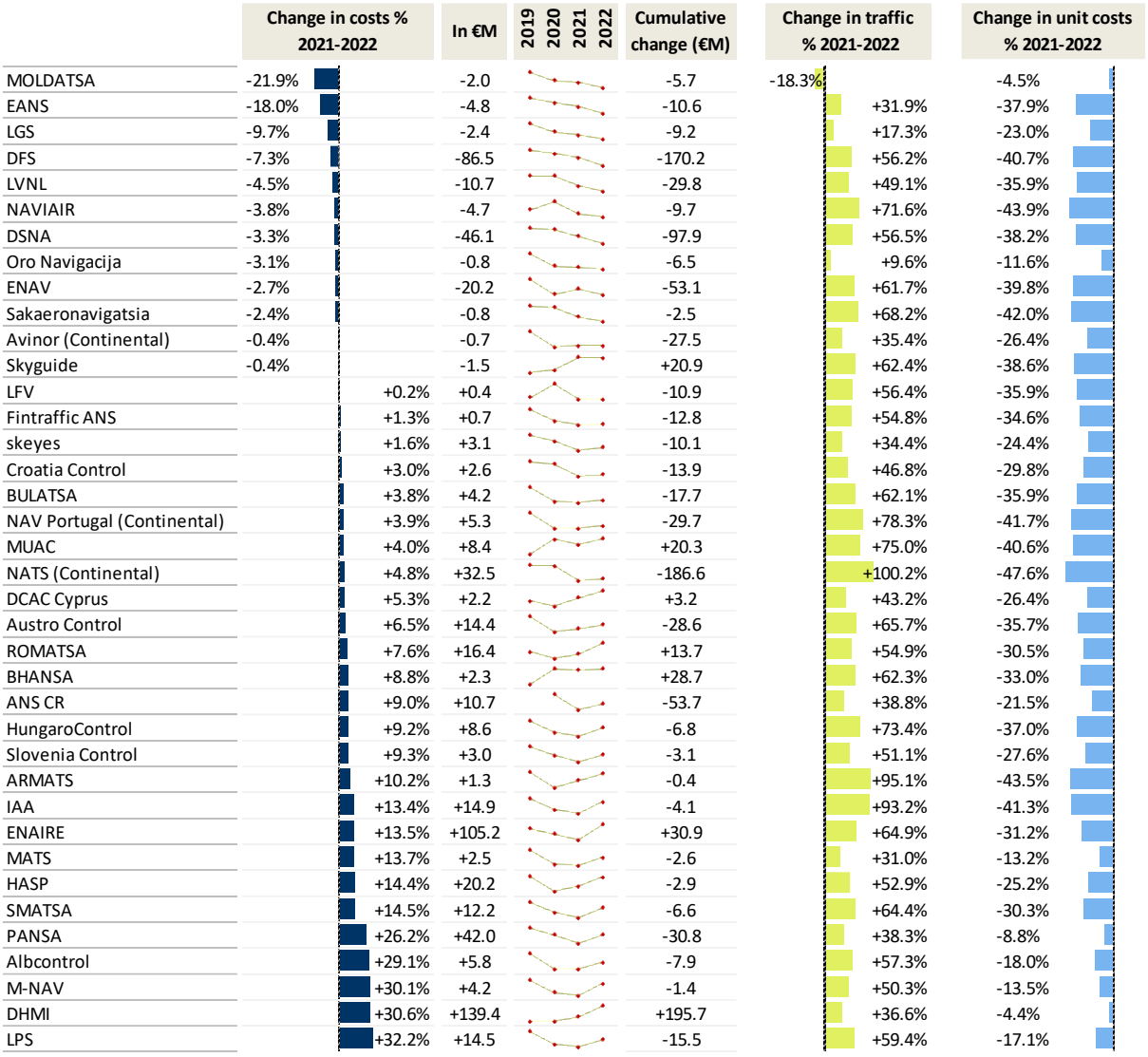


Figure 3.13: Changes in ATM/CNS provision costs, traffic and unit costs at ANSP level

As shown in Figure 3.13, ATM/CNS provision costs rose by more than +25% for five ANSPs between 2021 and 2022.

- For LPS (+32.2% or +€14.5M) the main driver for the observed increase is significantly higher staff costs (+48.7% or +€13.4M), mainly due to higher employment costs per employee (the total staff number increased by less than 1%, +4 in FTEs). However, this increase should be seen in perspective with the staff costs reductions achieved in 2020 (- 38.5%) and 2021 (- 18.0%), following the adoption of temporary measures in response to the COVID-19 crisis and the reduction of long-term reserves for retirement benefits due to changes in actuarial parameters.
- In the case of DHMI (+30.6% or +€139.4M), there were large increases in the cost of capital (+92.0% or +€87.7M), non-staff operating costs (+23.6% or +€35.2M) and staff costs (+15.6% or +€25.3M). The substantial increase in non-staff operating costs is mostly driven by the significant rise in energy prices and other expenses denominated in foreign currencies. Several factors contributed to the increase in the cost of capital, including a relatively large capital expenditure, a revaluation of the asset base partly indexed to inflation, and an increase in the rate of return on equity (from 12.3% to 21.4%). Concerning staff costs, the collective agreement applicable to civil servants in Türkiye foresees salary increases beyond the inflation

index (expressed in percentage points). The rapid inflation surge in 2022 prompted two rounds of salary increases.

- For M-NAV (+30.1% or +€4.2M) the primary reason for the observed increase is a rise in staff costs (+31.4% or +€3.5M), following the payment of withheld funds from employees' salaries between 2020 and 2022 and increased gross wages due to the transformation of the employment status of newly recruited ATCOs. However, this increase follows two consecutive years of reductions in the average employment costs. The significantly higher energy costs and other expenses incurred in 2022 also contributed to the observed increase in non-staff operating costs (+36.5% or +€0.6M).
- Albcontrol recorded a +29.1% (or +€5.8M) increase in ATM/CNS provision costs, mainly because of higher cost of capital (+147.4% or +€3.0M) and ATCO in OPS employment costs (+79.7% or +€1.1M). High financial expenses (i.e. conversion losses from exchange rate differences) and the cancellation of the measures implemented in response to the COVID-19 pandemic are some of the main reasons for the increase in costs.
- As for most of the ANSPs listed above, the increase in ATM/CNS provision costs for PANSA (+26.2% or +€42.0M) is largely driven by higher staff costs (+33.4% or +€33.8M), notably ATCO in OPS costs (+52.1% or +€24.5M). This is mainly due to the cancellation of COVID-19 measures implemented between 2020 and 2021 and to further changes to the remuneration scheme implemented in 2022. The cost of capital also increased significantly (+70.3% or +€5.9M), mainly due to higher WACC (+2.4 p.p.) following a substantial increase in the annual interest rate on debt and its share of financing.

Conversely, MOLDATSA and EANS were able to reduce ATM/CNS provision costs by more than -15%.

- For MOLDATSA (-21.9% or -€2.0M), the main driver for the observed reduction is lower ATCO in OPS employment costs (-33.2% or -0.8M). It is understood that MOLDATSA ATCOs in OPS have part of their remuneration linked to traffic volumes and associated complexity. Airspace closures, as well as reciprocal sanctions on air carriers issued by Western countries and Russia since February 2022, significantly impacted traffic flows in Europe, resulting in a substantial reduction in traffic for MOLDATSA (-18.3% vs. 2021 and -51.5% vs. 2019). The cost of capital also decreased between 2021 and 2022 (-64.8% or -€0.6M) due to a combined reduction in the asset base (-33.0%, linked to a large reduction in capital expenditures) and a lower rate of return on equity (2.9%).
- In the case of EANS (-18.0% or -€4.8M), the reduction is primarily driven by lower depreciation costs (-41.7% or -€2.7M), following adjustments in the implementation of new investments. Besides, lower ATCO in OPS employment costs (-17.2% or -€1.4M) along with a decrease in the cost of capital (-29.4% or -0.6M) also explain this reduction.

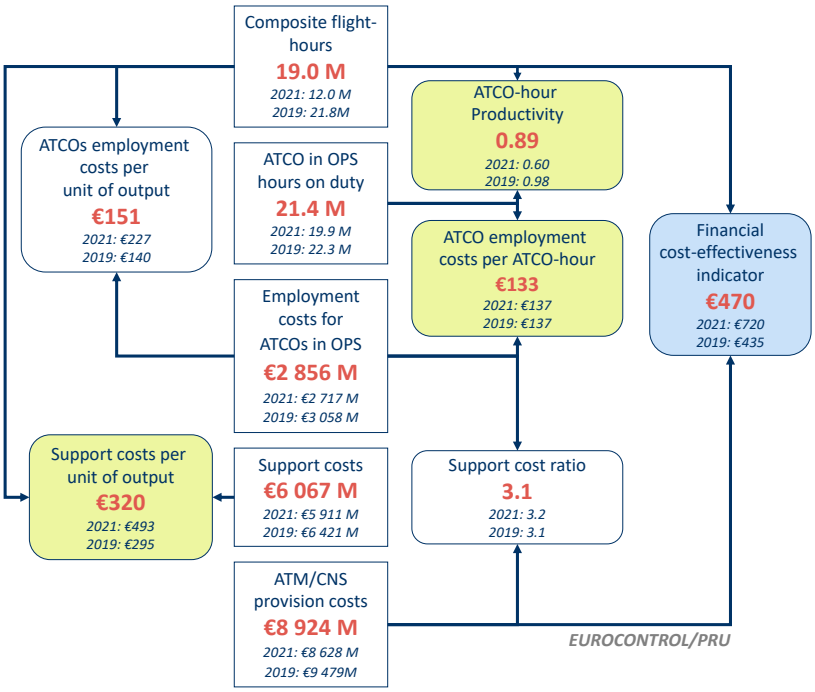
Among the five largest ANSPs, ATM/CNS provision costs fell for DFS, DSNA and ENAV but rose for NATS and ENAIRE.

- In the case of DFS (-7.3% or -€86.5M), although all cost categories fell in real terms, the main contribution comes from the absence of exceptional items in 2022 (-100% or -€64.8M). Over the past 15 years, DFS reported under exceptional costs accounting losses on balance sheet items stemming from the conversion from German Commercial Code (HGB) to IFRS in 2007. These losses were spread over the 2007-2021 period.
- For DSNA (-3.3% or -€46.1M), apart from the cost of capital, all other cost categories fell in real terms. In 2022, DSNA reorganised its central services and restructured its investment portfolios. Depreciation costs decreased by -13.5% (-€18.9M) due to the postponement of the commissioning of some projects until 2023, and the decision to redirect part of the investment towards service-oriented solutions.

- For ENAV (-2.7% or -€20.2M), the observed reduction is almost entirely due to decreases in depreciation costs (-10.4% or -€12.0M) and in the cost of capital (-12.2% or -€8.1M). It is understood that the main factors underlying these reductions were delays in investment plans and the use of a lower WACC to compute the cost of capital.
- NATS recorded a +4.8% (or +€32.5M) increase in total ATM/CNS provision costs, mainly due to higher non-staff operating costs (+45.0% or +€28.6M). In 2021, these costs were affected by exceptional factors, resulting in a significantly lower figure than in 2020 (following the implementation of cost containment measures and the release of a bad debt provision). In 2022, additional costs were also required to deliver large engineering projects, pay technical infrastructure costs and higher energy prices.
- For ENAIRE (+13.5% or +€105.2M), ATM/CNS provisions costs in 2022 comprise an exceptional amount (+€137.0M) related to future liabilities to ATCOs placed under a specific regime called "Special Active Reserve". This one-off expense reflects retroactive adjustments resulting from the application of Law 26/2022. The purpose of this law is to address the financing requirements arising from the difference between the retirement age stipulated in ENAIRE ATCOs Staff Labour Agreement (65 years), and the national legal retirement age set in the Spanish Social Security Pension Scheme (67 years).

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

Figure 3.14 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 (0.89 composite flight-hours per ATCO-hour);
b) ATCO employment costs per ATCO-hour (€133); and,
c) support costs per unit of output (€320).

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

Figure 3.14: ACE performance framework, 2022 (real terms)

Some 32% 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 3.15 shows that in 2022, ATCO employment costs per ATCO-hour fell by -2.4% while ATCO-hour productivity rose by +47.0%. As a result, ATCO employment costs per composite flight-hour decreased (-33.6%). In the meantime, unit support costs fell by -35.2% due to the combination of an

increase in composite flight-hours (+58.3%) and an increase in support costs (+2.6%). Consequently, in 2022, unit ATM/CNS provision costs fell by -34.7% at Pan-European system level.

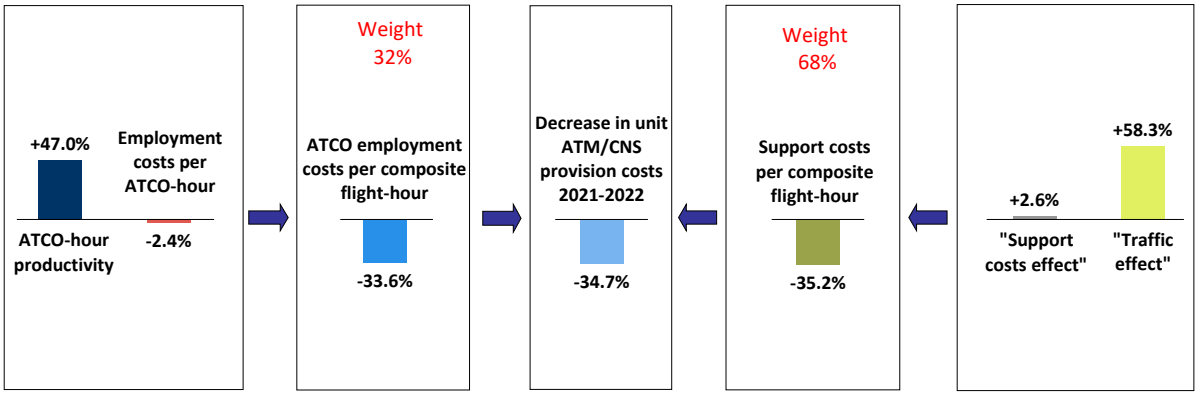


Figure 3.15: Changes in the financial cost-effectiveness indicator, 2021-2022 (real terms)

As the values of the 2021 indicators were significantly affected by the COVID-19 crisis, Figure 3.16 below presents an additional analysis using 2019 as a reference year. In 2022, traffic levels remained well below those of 2019 (-13.3%). Despite an overall reduction in total support costs (-5.8%), the unit support costs surpassed those of 2019 (+8.6%). A similar situation is observed concerning the ATCO employment costs, where the reduction in employment costs per ATCO-hour (-2.3%) was not sufficient to compensate for the decline in ATCO-hour productivity (-9.1%). Consequently, unit ATM/CNS provision costs in 2022 are +8.2% higher than in 2019.

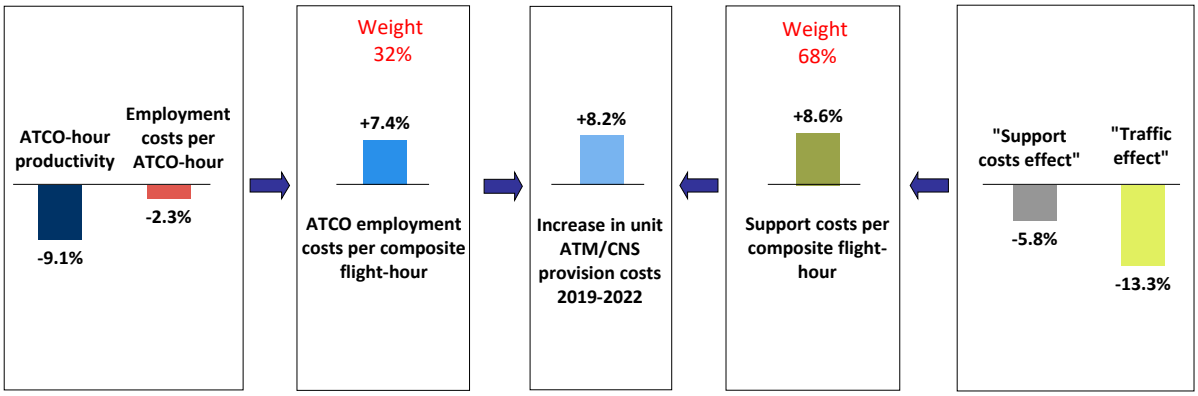


Figure 3.16: Changes in the financial cost-effectiveness indicator, 2019-2022 (real terms)

3.3 ATCO-hour productivity

In 2022, traffic (with a +58.3% increase in composite flight-hours) rose much faster than the number of ATCO-hours on duty (+7.7%). Consequently, ATCO-hour productivity increased by +47.0%, reaching 0.89 composite flight-hours per ATCO-hour on duty. This productivity level is close to that recorded in 2015, when similar traffic volumes were controlled at Pan-European system level.

Figure 3.17 and Figure 3.18 indicate that between 2015 and 2019, ATCO-hour productivity rose by +3.0% p.a., driven by the faster increase in composite flight-hours (+3.6% p.a.) compared to ATCO-hours on duty (+0.5% p.a.). However, despite a noticeable decrease in the number of ATCO-hours on duty in 2020 (by -13.0%), ATCO-hour productivity declined by some -50%, mainly due to an extraordinary drop in traffic (-56.9%).

This average ATCO-hour productivity measured in 2022 (0.89) is close to that recorded in 2015, when similar traffic volumes were controlled at Pan-European system level.

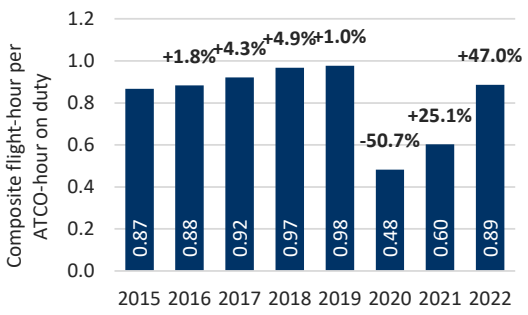


Figure 3.17: ATCO-hour productivity (2015-2022)

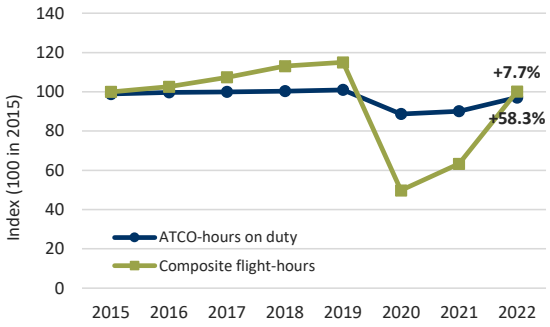


Figure 3.18: ATCO in OPS hours on duty and traffic (2015-2022)

After a first rebound in composite flight-hours in 2021 (+27.2%), traffic increased substantially in 2022 (+58.3%). In the meantime, ATCO-hours on duty in rose by +7.7% in 2022, resulting in a significantly higher ATCO-hour productivity indicator at system level (+47.0%). Nevertheless, despite this increase, the indicator remains -9.1% lower in 2022 than in 2019.

Figure 3.19 shows that the +7.7% increase in total ATCO-hours on duty results from the combination of an increase in the number of ATCOs in OPS (+2.1%) with higher average hours on duty per ATCO in OPS (+5.5%). In addition, it indicates that the number of ATCOs on other duties fell by -8.7%, reflecting that, in 2022, ATCOs allocated to non-operational duties during the years of low traffic levels went back to operational tasks.

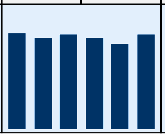
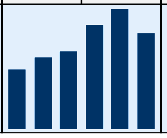
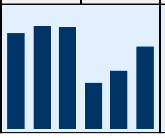
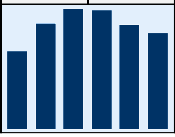
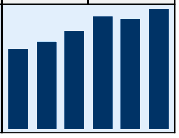
	ATCOs in OPS		ATCOs on other duties		Avg. hours on duty per ATCO in OPS		Ab-initio trainees		On-the-job trainees	
2021-2022 changes	+348 FTEs	***+2.1%***	-215 FTEs	***-8.7%***	+65 hours	***+5.5%***	-67 FTEs	***-7.6%***	+96 FTEs	***+8.9%***
2017-2022 trend										

Figure 3.19: Changes in the number of ATCOs and average hours on duty

Figure 3.20 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 2021 and 2022. The small lines in the 2nd, 4th and 6th columns display the trends between 2019 and 2022. 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.

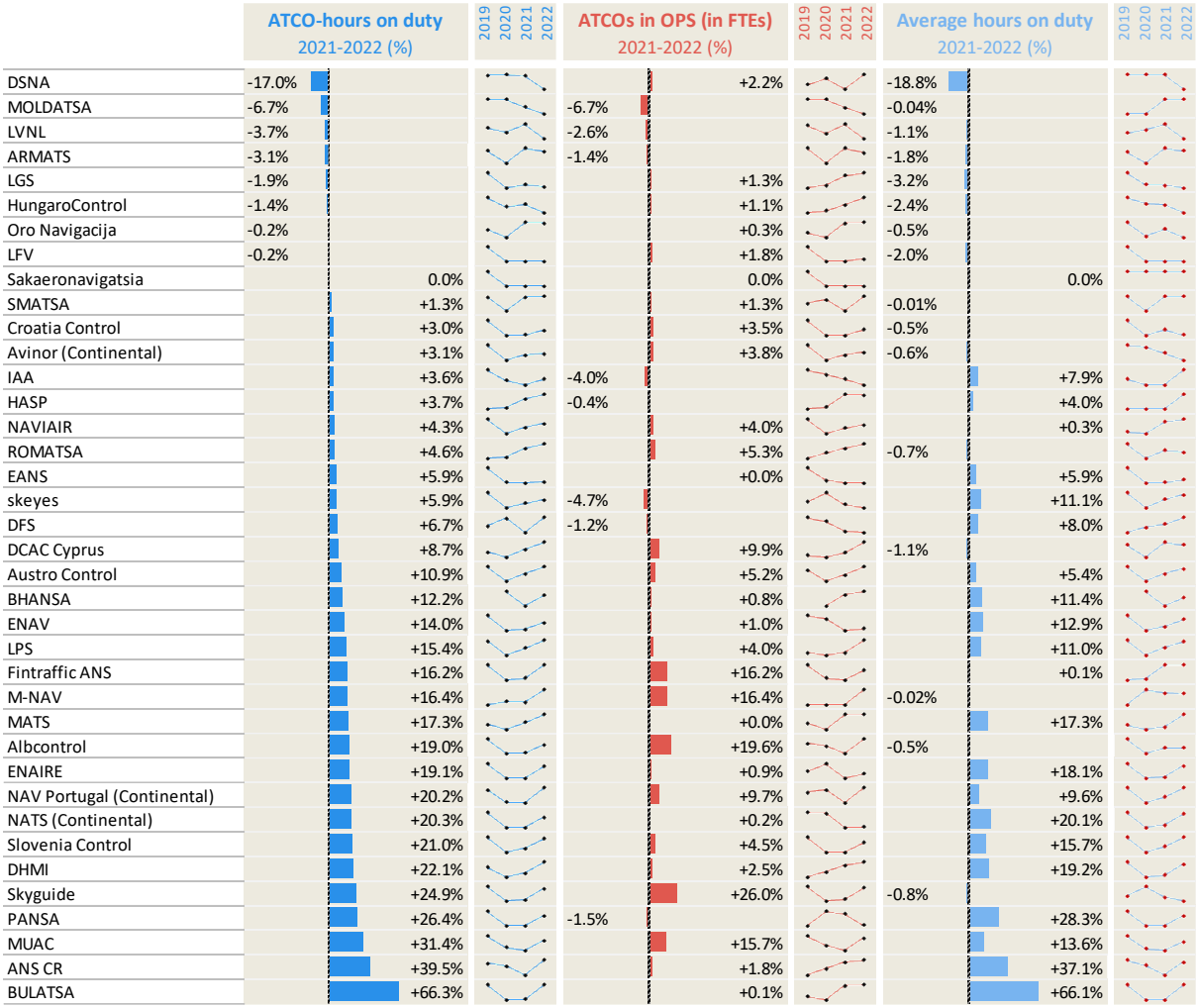


Figure 3.20: Changes in ATCO-hours on duty, number of ATCOs in OPS and average hours on duty at ANSP level (2021-2022)

DSNA shows the largest reduction in total ATCO-hours on duty (-17.0%). This results from the combination of a +2.2% increase in the number of ATCOs in OPS and a -18.8% decrease in the average hours on duty, following the utilisation of a more precise calculation to record hours worked.

In 2022, ATCO-hours on duty rose for 29 out of 38 ANSPs, with increases around or greater than +25% for five of them (i.e. Skyguide, PANSA, MUAC, ANS CR and BULATSA). In most cases, this increase mainly resulted from higher average hours on duty (see light blue bars on the right-hand side) except for MUAC and Skyguide, which increased the number of ATCOs in OPS (in FTEs) by +15.7% and +26.0%, respectively.

In 2022, the ATCO-hour productivity[13] of the Pan-European system amounted to 0.89 composite flight-hours per ATCO-hour. It is also important to note that the metric of ATCO-hour productivity 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

[13] 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 workload, hence also impacting ATCO-hour productivity.

detailed discussion of the factors to consider when interpreting this indicator is provided in the ACE handbook.

Figure 3.21 illustrates the ATCO-hour productivity for each ANSP in 2022. The vertical bars represent the value of the indicator in 2022, 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 2022 was higher than in 2019.

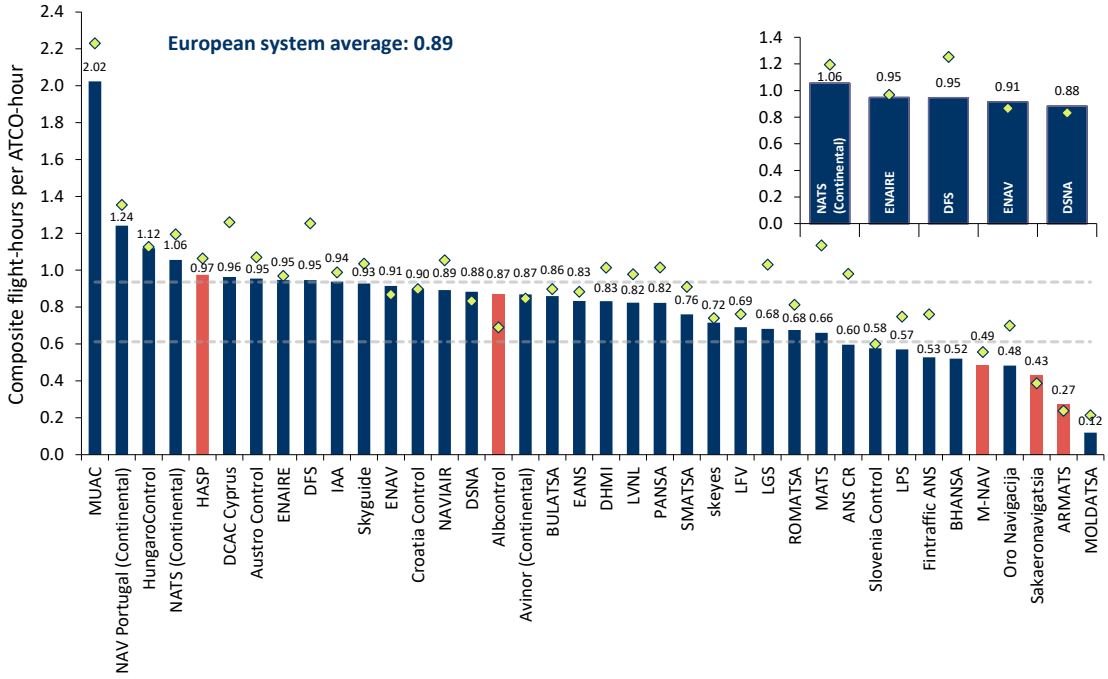


Figure 3.21: ATCO-hour productivity (gate-to-gate), 2022

The ATCO-hour productivity differs significantly across ANSPs. As in previous years, MUAC (2.02) is the ANSP with the highest ATCO-hour productivity. This is well above NAV Portugal (1.24) and HungaroControl (1.12), 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 Sakaeronavigatsia (0.43), ARMATS (0.27) and MOLDATSA (0.12). 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 3.21 highlights that for seven ANSPs, ATCO-hour productivity in 2022 was higher than in 2019 (indicated by yellow dots). Among those, Albcontrol, ARMATS and Sakaeronavigatsia handled more composite flight-hours than in 2019.

In 2022, 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). Not all of them were able to adjust ATCO-hours to lower traffic levels. 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. Figure 3.22 presents the 60 ACCs included in the ACE benchmarking analysis, which are grouped into five clusters based on two characteristics: (1) structural operational characteristics of an ACC; and (2) the number of area control sectors open at maximum configuration.

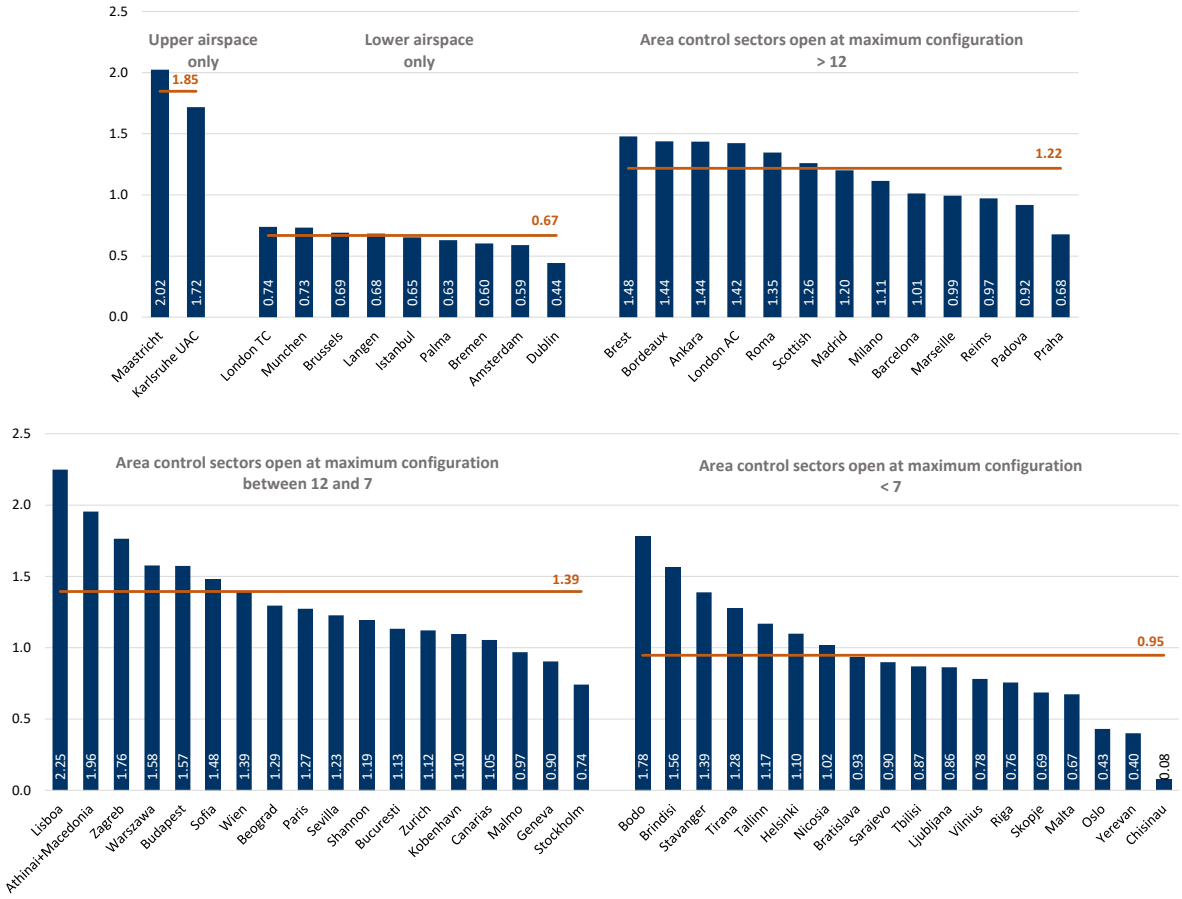


Figure 3.22: Summary of productivity results at ACC level, 2022

Each cluster is briefly described below:

- **Cluster 1 (ACCs serving upper airspace only)**, which includes only two ACCs. This cluster has the highest average productivity of the five (1.85 flight-hours per ATCO-hour). However, these two ACCs generated 27% of the Pan-European en-route ATFM delays in 2022. This result is driven mostly by Karlsruhe UAC, which generated the highest number of ATFM delays among all the Pan-European ACCs in 2022 (around 3.7 million minutes of en-route ATFM delays).
- **Cluster 2 (ACCs serving predominantly lower airspace)** has the lowest average ATCO-hour productivity of the five clusters (0.67 flight-hours per ATCO-hour). The ACCs included in this cluster generated some 11% of en-route ATFM delays at Pan-European level.
- **Cluster 3 (ACCs with more than 12 sectors at maximum configuration)** has an average productivity of 1.22 flight-hours per ATCO-hour. These ACCs controlled approximately 41% of the traffic at Pan-European level in terms of IFR flight-hours, with Ankara ACC recording the highest number of flight-hours controlled among all Pan-European ACCs. Some 33% of the Pan-European system's en-route ATFM delays were generated by these ACCs. In 2022, Reims and Marseille ACCs recorded 54% of all en-route ATFM delays generated in this cluster (around 2.5 million minutes).
- **Cluster 4 (ACCs with 7 to 12 sectors at maximum configuration)** has an average productivity of 1.39 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 2022 (2.25, 1.96, and 1.76 flight-hours per ATCO-hour, respectively). Overall, 28% of ATFM delays at system level were generated by ACCs in this cluster.

- **Cluster 5 (ACCs with less than 7 sectors at maximum configuration)** has an average productivity of 0.95 flight-hours per ATCO-hour, which ranks as the second lowest among the five clusters. However, it includes Bodo ACC, which has the 4th highest ACC productivity (1.78) among the ACE sample in 2022. These ACCs represent approximately 0.5% 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 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.

3.4 ATCOs in OPS employment costs

In 2022, ATCO employment costs per ATCO-hour fell by -2.4% compared to 2021 and reached a value lower than in 2017. Except for 2020 (+8.5%), 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. At Pan-European system level, the decrease in ATCO-employment costs per ATCO-hour reflects the fact that ATCO-hours on duty (+7.7%) rose faster than ATCO in OPS employment costs (+5.1%).

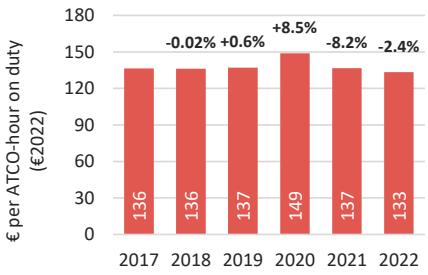


Figure 3.23: Changes in ATCO employment costs per ATCO-hour, 2017-2022 (real terms)

Figure 3.24 presents the changes in ATCO in OPS employment costs and employment costs per ATCO-hour between 2021 and 2022 (both in percentage and absolute value) at ANSP level. The small lines in the 3rd and 5th columns show the trends between 2019 and 2022. 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 3.24 highlights that in 2022, ATCO employment costs per ATCO-hour fell for 23 out of 38 ANSPs. In many cases, this reduction was a result of increased hours on duty, as the total ATCO in OPS employment costs rose for 27 out of 38 ANSPs.

Four ANSPs showed increases greater than +50%: Albcontrol (+79.7%), Skyguide (+54.4%), BHANSA (+54.2%) and PANSA (+52.1%). In absolute terms, the most significant increases in ATCOs employment costs were observed for Skyguide (+€37.1M), PANSA (+€24.5M), HASP (+€17.5M), ROMATSA (+€16.7M) and ENAV (+€14.2M).

- For Skyguide the higher ATCO employment costs resulted from a +26.0% increase in the number of ATCOs in OPS, equivalent to 70 FTEs. This increase was the response to a surge in traffic and the end of the short-time work arrangements introduced during the COVID crisis.
- For PANSA, the rise in ATCOs in OPS employment costs should be analysed in parallel with the decrease recorded in the previous year (following the implementation of cost containment measures in response to the COVID crisis). Additionally, in 2022 the level of ATCO employment costs was affected by the utilisation of unspent budget in 2021, along with further changes to the remuneration scheme implemented during the year.
- For HASP the increase is mainly due to payments made to the occupational pension fund of ATCOs and an increase in the contractual working hours of ATCOs in OPS.

- For ENAV, the higher ATCOs in OPS employment costs result from the renewal of the financial part of the National Collective Labour Agreement and the required higher presence and availability of staff on the sites to manage traffic during the summer season.
- For ROMATSA, this increase reflects a higher number of ATCOs in OPS (+5.3%, +28 FTEs) combined with higher pension costs and the recording of one-off payments for handling higher-than-planned traffic and for achieving the target set in terms of capacity performance.

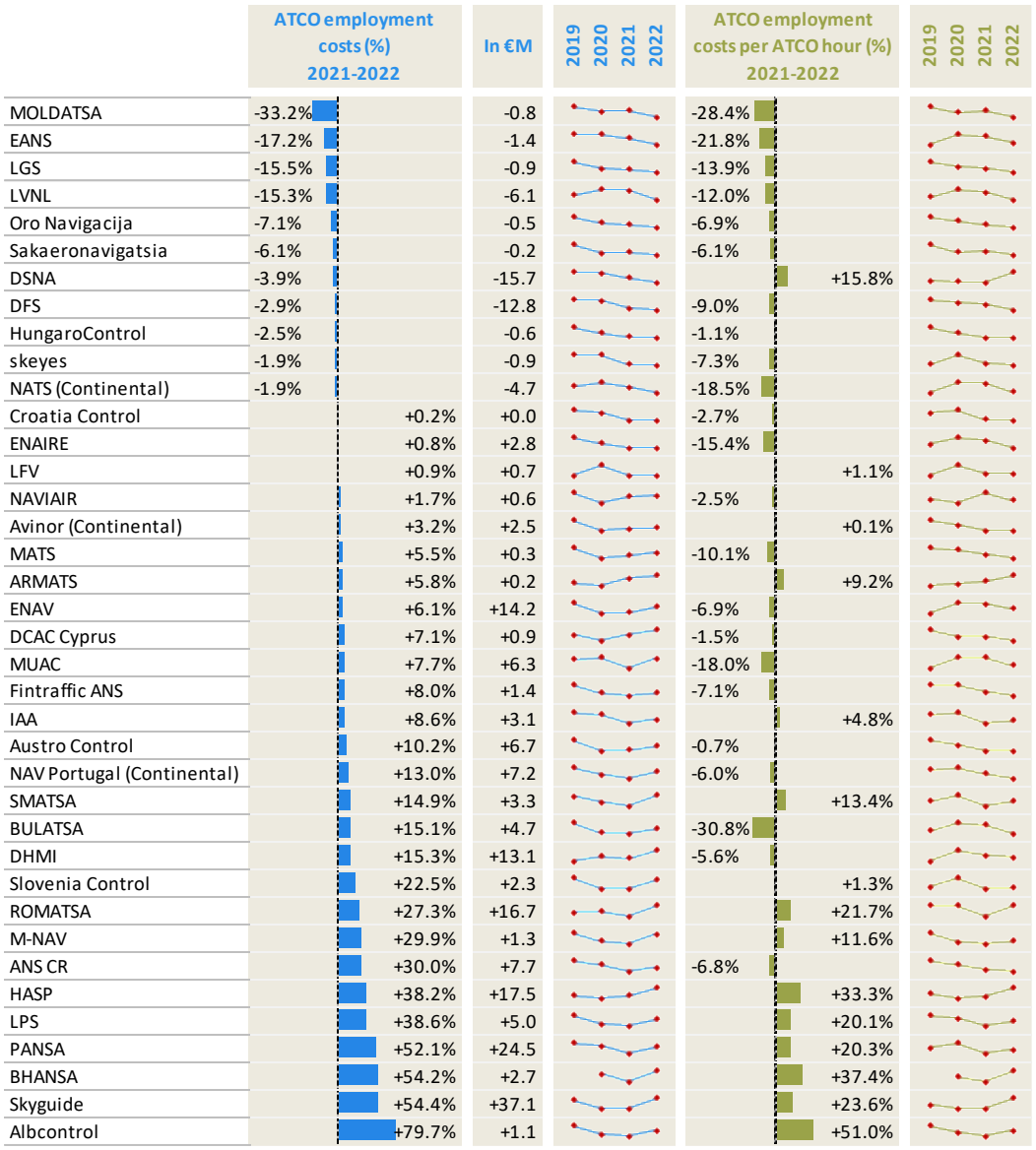


Figure 3.24: Changes in ANSPs ATCO in OPS employment costs (real terms)

On the other hand, 11 ANSPs reported lower ATCO in OPS employment costs in 2022, and for four of them the decrease is greater than -10%: MOLDATSA (-33.2%, or -€0.8M), EANS (-17.2%, or - €1.4M), LGS (-15.5%, or -€0.9M) and LVNL (-15.3%, or -€6.1M). In absolute terms, the most significant reductions were observed for DSNA (-€15.7M) and DFS (-€12.8M) in real terms.

The ATCO employment costs per ATCO-hour at Pan-European system level amounted to €133 in 2022. Figure 3.25 shows the values for this indicator for all the ANSPs.

As in previous years, MUAC (€328) shows the highest ATCO employment costs per ATCO-hour, standing well above DFS (€243) and Skyguide (€229), which rank second and third, respectively. Conversely, the lowest ATCO employment costs per ATCO-hour in 2022 were ARMATS (€28), Sakaeronavigatsia (€22) and MOLDATSA (€19).

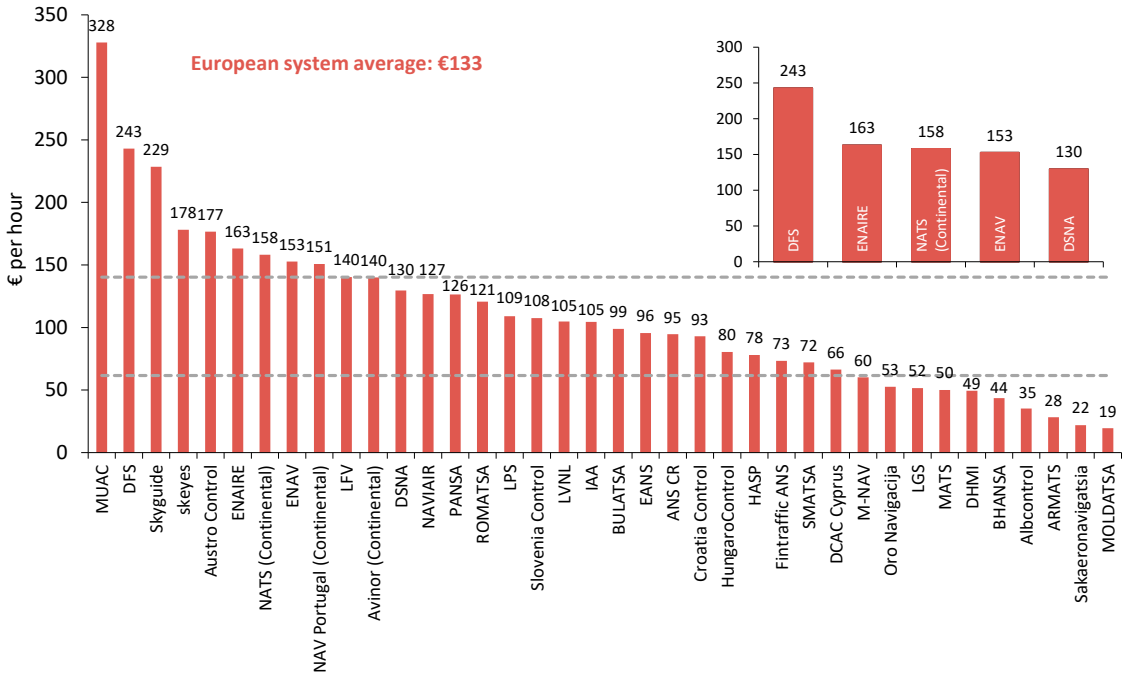


Figure 3.25: ATCO employment costs per ATCO-hour (gate-to-gate), 2022

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),[14] Figure 3.26 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 2022, as available from EUROSTAT and IMF databases.

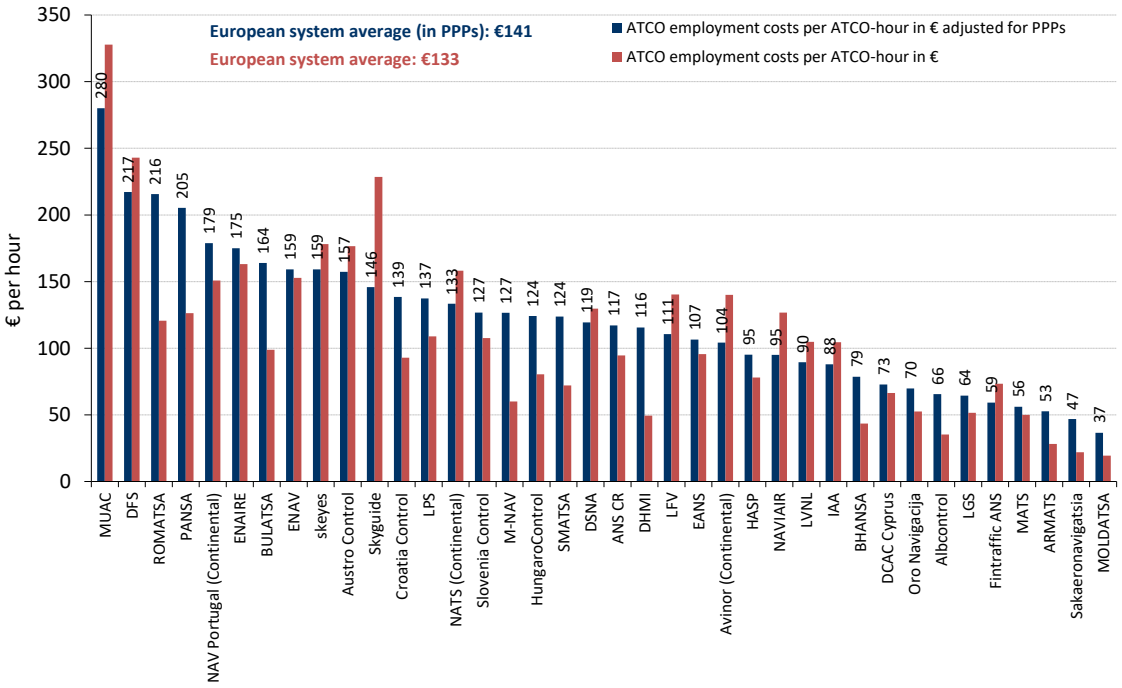


Figure 3.26: ATCO employment costs per ATCO-hour with and without PPPs, 2022

[14] 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.

It is important to note that the adjustment reduces the dispersion of this indicator. After PPP adjustment, the average unit employment costs per ATCO-hour amounts to €141 (compared to €133 without adjustment). For BULATSA, PANSA and ROMATSA, this adjustment brings their employment costs per ATCO-hour from below to above the European system average.

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 3.27 shows the ATCO employment costs per composite flight-hour in 2022.

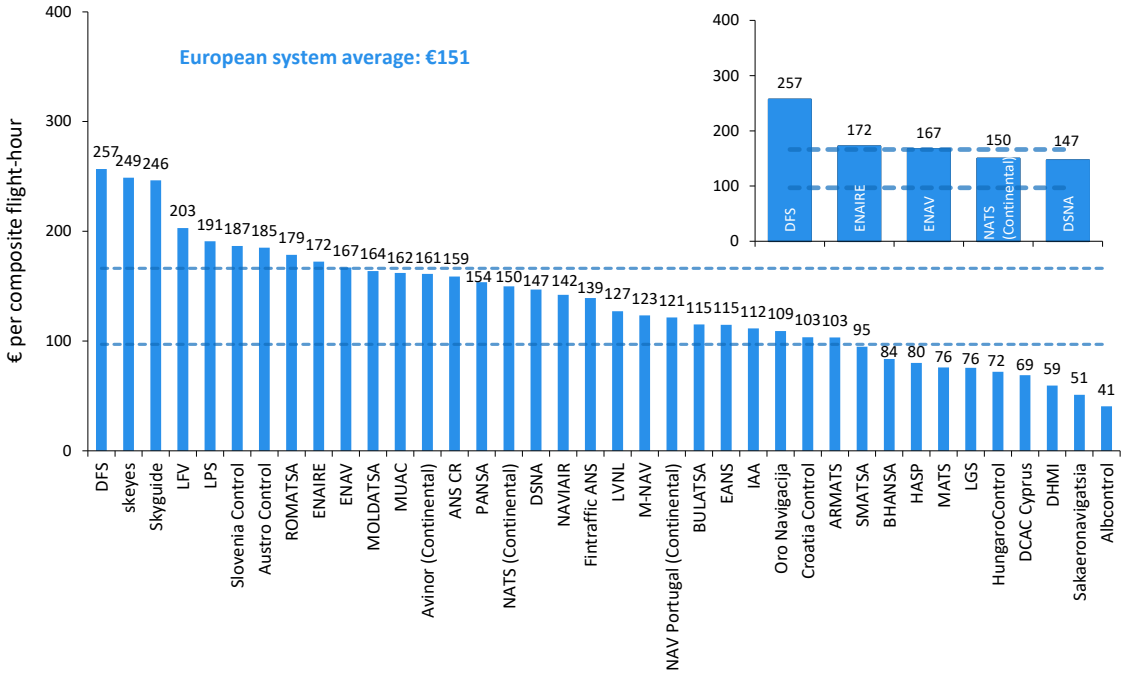


Figure 3.27: ATCO employment costs per composite flight-hour, 2022

This indicator results from combining two of the main components of the financial cost-effectiveness indicator: ATCO-hour productivity (Figure 3.21) and employment costs per ATCO-hour (Figure 3.25). 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.

3.5 Support costs

In 2022, unit ATM/CNS support costs fell by -35.2% compared to 2021, reaching €320. This decrease is the result of an increase in traffic (+58.3%) coupled with the growth of total support costs (+2.6%). However, this trend is significantly impacted by exceptional costs recorded by ENAIRE in 2022 and a substantial increase in the cost of capital for DHMI. Excluding these two cost items, a reduction in total support costs would be observed at the Pan-European system level.

Figure 3.28 illustrates the changes in support costs (expressed in real terms) per composite flight-hour. In 2022, unit ATM/CNS support costs fell by -35.2% compared to 2021 (down from €493 to €320). This is the result of a traffic increase (+58.3%) coupled with the rise in total support costs (+2.6%).

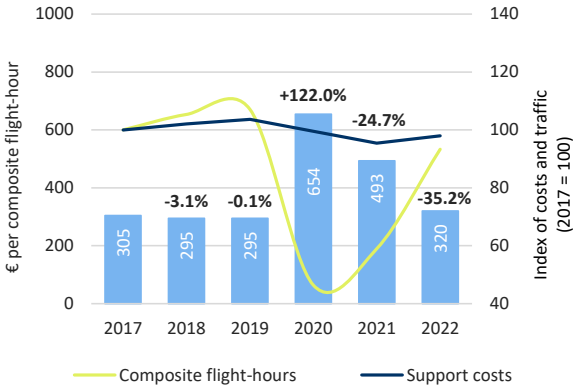


Figure 3.28: Changes in support costs (real terms) per composite flight-hour, 2017-2022

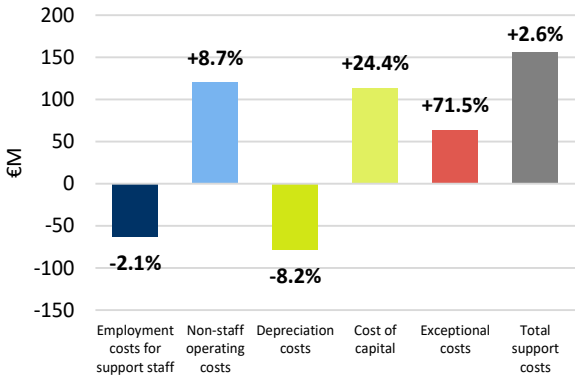


Figure 3.29: Breakdown of changes in support costs, 2021-2022 (real terms)

The year 2022 therefore marks a rebound in total support costs, after two years of reductions. This reflects the fact that some cost saving measures were released by ANSPs, after their implementation during the COVID-19 crisis.

As shown in Figure 3.29, total support costs increased by +€156.3M (or +2.6%) in 2022, primarily driven by higher non-staff operating costs (+€119.7M or +8.7%), cost of capital (+€113.7M or +24.4%) and exeptional costs (+€63.6M or +71.5%). The increase in exceptional costs mainly reflects the recording of a provision by ENAIRE for future liabilities to ATCOs being placed under a specific regime called "Special Active Reserve", following the application of Law 26/2022. The purpose of this law is to address the financing requirements arising from the difference between the retirement age stipulated in ENAIRE ATCOs Staff Labor Agreement (65 years), and the national legal retirement age set in the Spanish Social Security Pension Scheme (67 years).

Employment costs for support staff fell in 2022 (- €62.9M, or -2.1%), mainly due to decreases in the number of support staff. Meanwhile, the cancellation or deferral of non-essential investments resulted in a reduction in depreciation costs (- €77.8M, or -8.2%).

At Pan-European system level, when considering the savings achieved in 2020 and 2021, ANSPs support costs in 2022 were still - €374.9M (-5.8%) lower than in 2019.

Since employment costs for support staff represent nearly half (49%) 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 3.30 and Figure 3.31) and then puts the focus on the 2021-2022 period (see Figure 3.32).

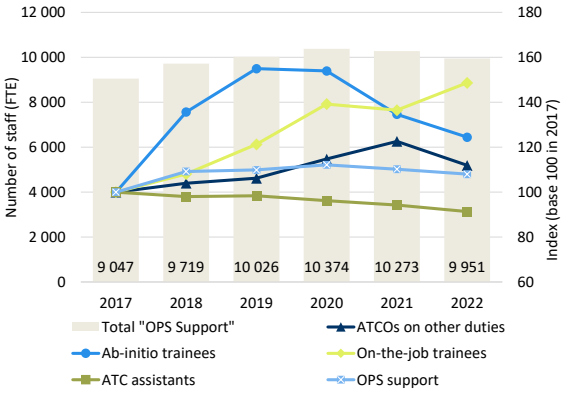


Figure 3.30: Changes in support staff relating to OPS activities (2017-2022)

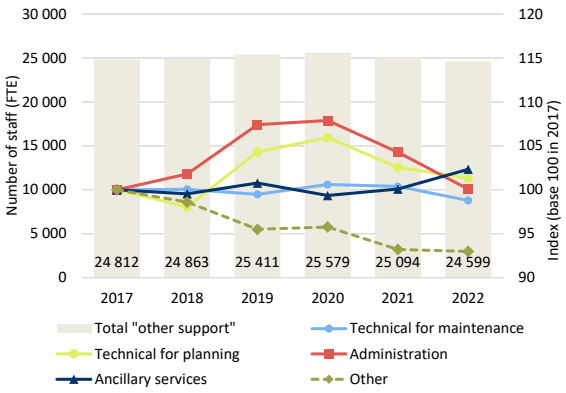


Figure 3.31: Changes in other support staff categories (2017-2022)

Figure 3.30 shows that, between 2017 and 2022, 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 +9%. This growth was mainly driven by substantial increases in the number of on-the-job trainees (+385 FTEs) and ATCOs on other duties (+228 FTEs). Between 2017 and 2022, the only staff category within this group that decreased was ATC assistants (-179 FTEs).

When considering the total number of support staff dedicated to "other" activities (those less directly connected to ATC operations, as shown in Figure 3.31), a slight decrease is observed in 2022 compared to 2017 (- 2%). There were significant reductions in technical support staff for maintenance (-201 FTEs) and staff allocated to other activities (i.e. security staff, drivers, etc.), which decreased by -250 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, resulting in a significant decrease in the total number of support staff. This trend continued in 2022 with the total count of support staff decreasing by -818 FTEs compared to 2021.

Support staff categories	Change over 2021 - 2022	in FTEs	2019 2020 2021 2022
ATCOs on other duties	-8.7%	-215	
Ab-initio trainees	-7.6%	-67	
On-the-job trainees	+8.9%	+96	
ATC assistants	-3.1%	-57	
OPS support (non-ATCOs)	-2.0%	-80	
Technical support staff for operational maintenance, monitoring and control	-1.6%	-139	
Technical support staff for planning and development	-1.2%	-37	
Administration	-4.0%	-355	
Staff for ancillary services	+2.2%	+41	
Other Staff	-0.2%	-6	
Total number of support staff	**-2.3%**	**-818**	

Figure 3.32: Changes in the number of support staff by category, 2021-2022

This was mainly due to reductions in the number of ATCOs on other duties (-215 FTEs), administrative staff (-355 FTEs) and technical support staff engaged in operational maintenance, monitoring, and control activities (-139 FTEs). It is noteworthy that the reduction in ATCOs on other duties is partly due to the fact that ATCOs allocated to other activities in 2020-21 went back into operations in 2022 as traffic was bouncing back.

Conversely, the number of on-the-job trainees saw a significant increase (+8.9% or +96 FTEs), mainly due to ab-initio trainees from 2021 becoming on-the-job trainees in 2022. 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 3.33 shows the changes between 2021 and 2022 in total support costs (in percentage and absolute values) and in the different categories of support costs (in percentage). In 2022, support costs fell for 18 out of 38 ANSPs, with substantial decreases (i.e. equal or above -10% and -€10M) observed for Skyguide (-11.7%, or -€38.6M) and DFS (-10.0%, or -€73.8M). Reductions were also significant for EANS (-18.4%, or -€3.4M), MOLDATSA (-17.9%, or -€1.2M), LGS (-7.8%, or -€1.5M), ENAV (-6.8%, or -€34.5M) and NAVIAIR (-6.0%, or -€5.3M).

- In the case of EANS, the reduction in support costs mainly reflects the large decreases in depreciation costs (-41.7% or -€2.7M) and cost of capital (-29.4%, or -€0.6M) in real terms (see also page 23 in Section 3.2 of this report).
- For MOLDATSA, reductions were observed across all support cost categories, notably in the cost of capital (-64.8%, or -€0.6M), non-staff operating costs (-24.3%, or -€0.4M), and support staff costs (-5.1%, or -€0.2M) (see also page 23 in Section 3.2 of this report).
- Skyguide's substantial decrease primarily reflects reductions in support staff costs (-24.2%, or - €46.6M). This large decrease is mainly due to the reallocation of ATCOs from other duties to operations. Depreciation costs (-12.3%, or -€7.2M) and, to a lesser extent, exceptional costs (- 7.9%, or -€0.1M) also decreased. However, these reductions were partly compensated by increases in the cost of capital (+55.1%, or +€7.5M) and non-staff operating costs (+12.2%, or +€7.7M).
- In the case of DFS, the reduction is mostly due to the absence of exceptional costs in 2022 (- 100.0%, or -64.8M). Over the past 15 years, DFS reported under exceptional costs accounting losses on balance sheet items stemming from the conversion from German Commercial Code (HGB) to IFRS in 2007. These losses have been spread over the 2007-2021 period.

At the same time, four ANSPs recorded significant increases in total support costs (i.e. above +10% and +€10M), namely DHMI (+34.1%, or +€126.4M), ENAIRE (+23.0%, or +€102.4M), IAA (+15.9%, or +€11.8M), and PANSA (+15.4%, or +€17.4M).

Other notable increases in support costs were observed in M-NAV (+30.1%, or +€2.9M), LPS (+29.6%, or +€9.5M), and Albcontrol (+25.2%, or +€4.7M). See more details about these changes in Section 3.2 of this report.

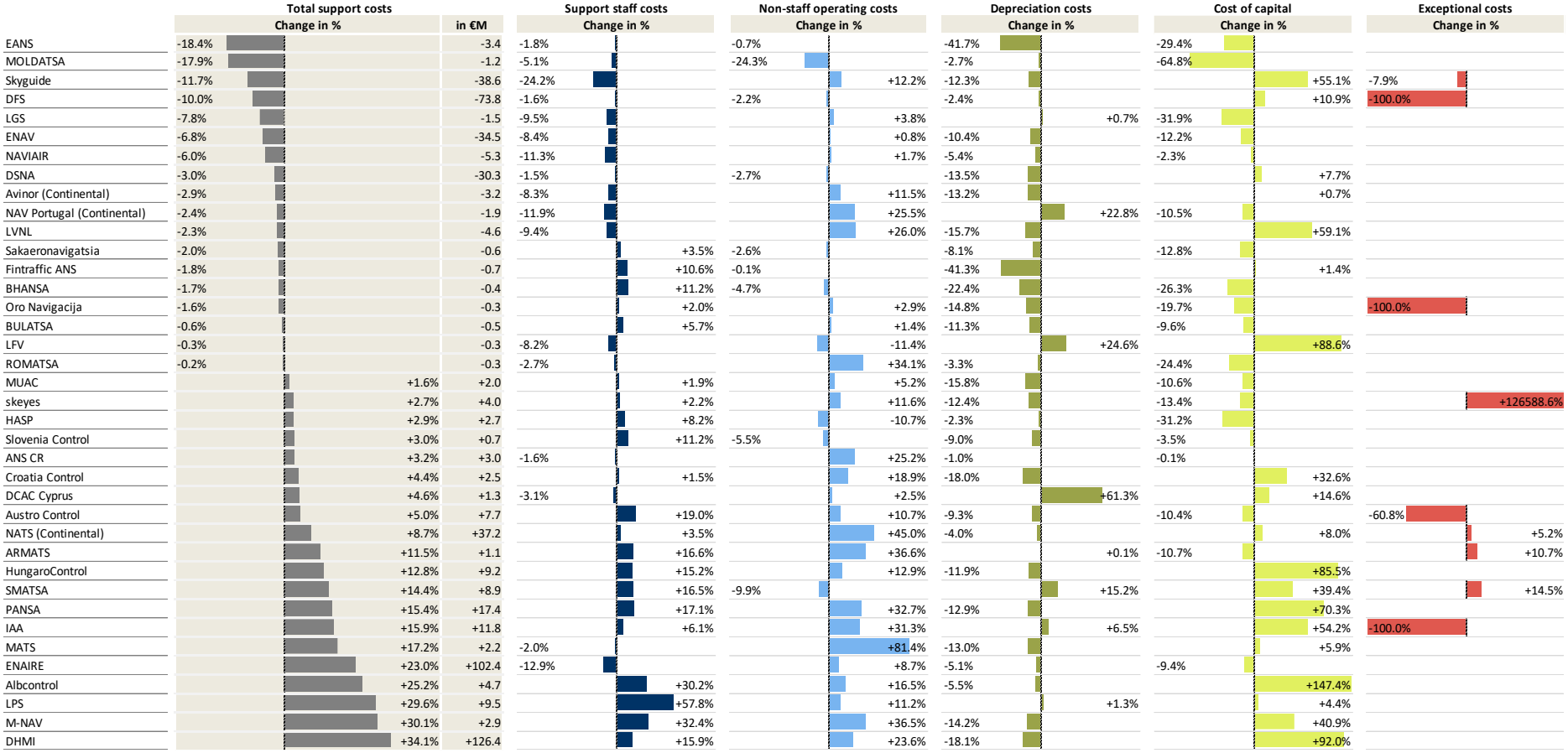


Figure 3.33: Changes in the components of support costs (2021-2022)

In 2022, at Pan-European system level, the average support costs per composite flight-hour stood at €320. Nevertheless, Figure 3.34 shows significant differences in the levels of unit support costs across ANSPs. The two dotted lines represent the bottom and the top quartiles (€243 and €382, respectively) and provide an indication of the dispersion across ANSPs, which reaches a factor of 6.7 between skeyes (€820) and HASP (€123). LVNL (€721) and Skyguide (€680) come second and third, respectively, on the list of ANSPs with higher unit support costs. Conversely, DCAC Cyprus (€161), NAV Portugal (€151) and HASP (€123) range among the ANSPs with the lowest unit support costs.

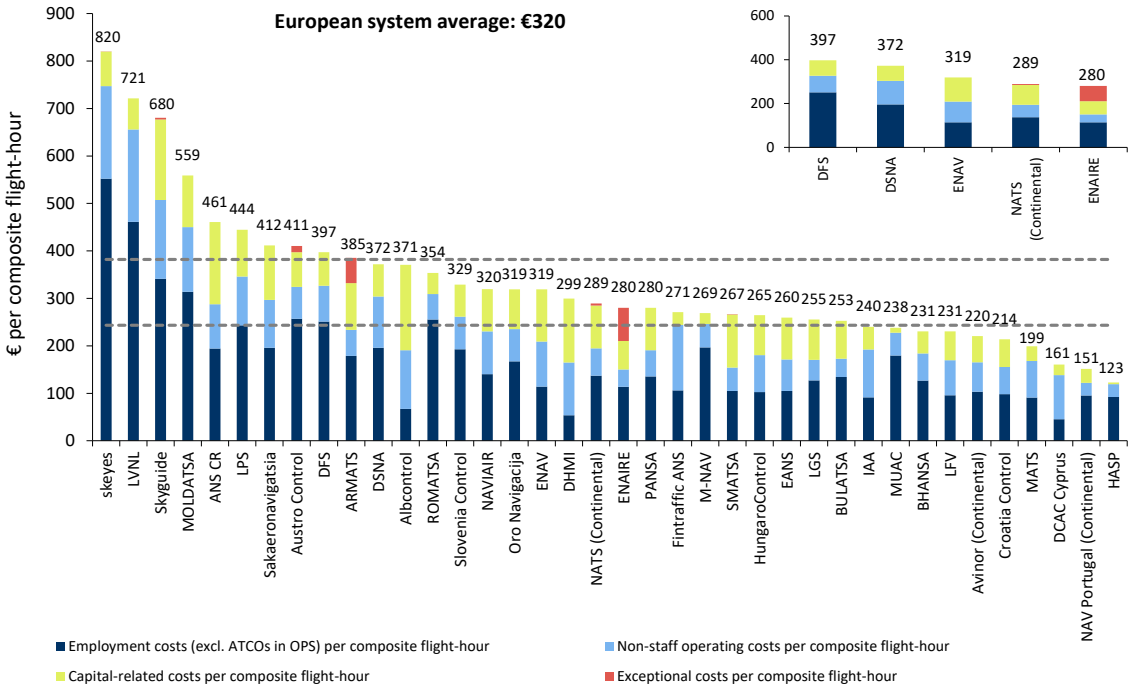


Figure 3.34: Support costs per composite flight-hour at ANSP level, 2022

In 2022, the unit support costs of various ANSPs operating in Central and Eastern European countries (e.g., MOLDATSA, ANS CR, LPS, Sakaeronavigatsia, ARMATS, Albcontrol, and ROMATSA) were higher than the Pan-European system average and above the unit support costs of ANSPs operating in some Western European countries (such as Austro Control, DFS and DSNA) 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 3.8).

Figure 3.35 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.

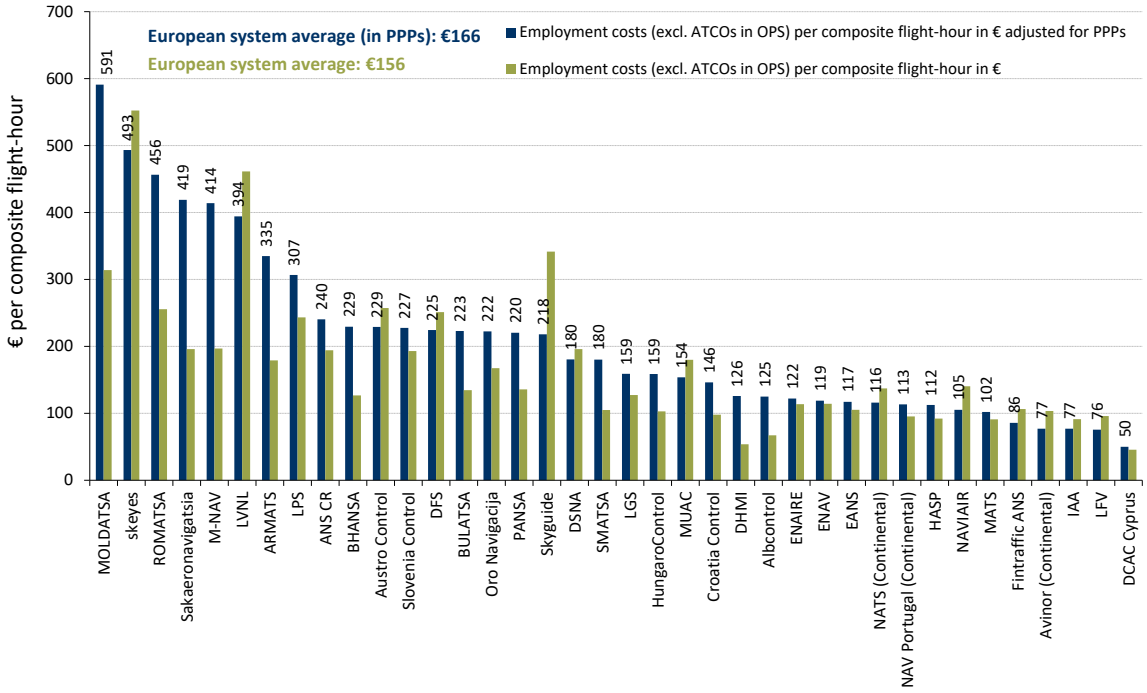


Figure 3.35: Employment costs (excl. ATCOs in OPS) with and without adjustment for PPPs, 2022

Notably, the unit employment costs in many Central and Eastern European ANSPs (such as MOLDATSA, ROMATSA, Sakaeronavigatsia, M-NAV, ARMATS, LPS, ANS CR, BHANSA, 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 would be crucial to sustaining the current staffing levels and associated employment costs.

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4. FORWARD-LOOKING COST-EFFECTIVENESS (2023-2027)

Considering those ANSPs for which information is available, the gate-to-gate unit ATM/CNS provision costs are planned to decrease by -2.5% p.a. between 2022 and 2027 at Pan-European System level. This mainly reflects the fact that traffic is expected to rise faster (+5.8% p.a.) than ATM/CNS provision costs (+3.1% p.a.) over this period.

According to the SEID V3.0, ANSPs are expected to submit forward-looking information covering the 2023-2027 period.

As shown in Figure 4.1, 33 out of 38 ANSPs provided a complete set of planned costs and traffic data in their ACE data submission.

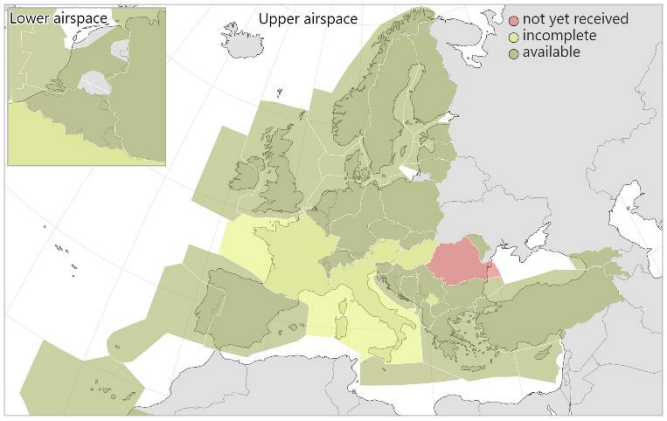

Figure 4.1: Status of forward-looking data availability (traffic and costs)

Five ANSPs (Austro Control, DSNA, ENAV, HungaroControl and ROMATSA) were unable to provide a complete or meaningful set of forecast traffic and cost data for the 2023-2027 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 32 ANSPs, while the data for the 2017-2022 period covers 38 ANSPs, where relevant.

Figure 4.2 illustrates the evolution of gate-to-gate unit ATM/CNS provision costs between 2022 and 2027. For the ANSPs included in the analysis, unit costs per composite flight-hour are expected to decrease by -12.0% between 2022 and 2027 (-2.5% p.a.). This trend primarily reflects the expectation that traffic will grow faster (by +32.3%, or +5.8% p.a. between 2022 and 2027) than total ATM/CNS provision costs (which will increase by +16.4%, or +3.1% p.a.).

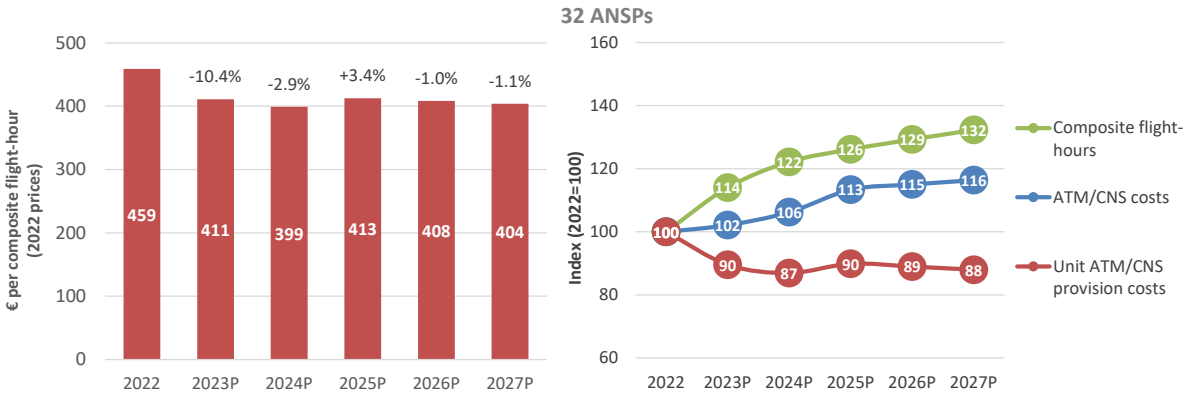

Figure 4.2: Forward-looking cost-effectiveness at Pan-European system level, trends in costs, traffic and unit costs, 2023-2027 (real terms)

Figure 4.3 indicates that all ANSPs are forecasting increases in traffic over the 2022-2027 period, ranging from +10.9% p.a. for Fintraffic ANS to +2.6% p.a. for ENAIRE. This expectation comes together with a planned increase in ATM/CNS provision costs, albeit of a lower magnitude than traffic in most cases. Consequently, 28 ANSPs expect reductions in their unit ATM/CNS provision costs.

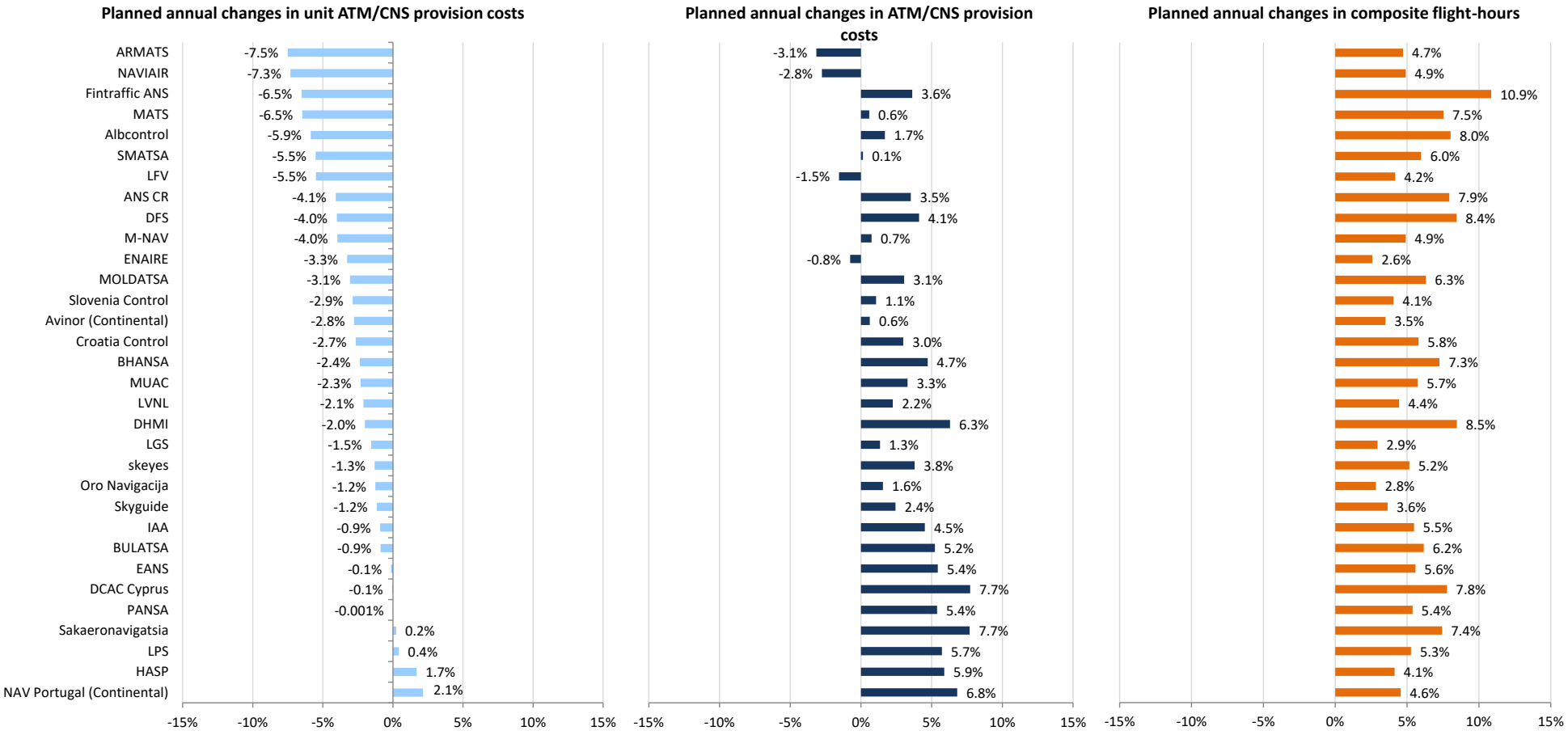

Figure 4.3: Planned annual changes in unit costs over the 2022-2027 period (in % p.a., real terms)

ANSPs showing the five largest reductions are: ARMATS (-7.5% p.a.), NAVIAIR (-7.3% p.a.), Fintraffic ANS (-6.5% p.a.), MATS (-6.5% p.a.) and Albcontrol (-5.9% p.a.),

- In the case of ARMATS and NAVIAIR, it results from a combination of planned cost reductions and traffic increase. The main sources of cost reductions are the absence of exceptional costs planned in 2027 for ARMATS (a cost item including exchange rate losses in 2022) and significantly lower staff costs for NAVIAIR.
- For Fintraffic ANS, MATS and Albcontrol, the main drivers for the expected reductions in unit costs are the planned increases in traffic (+10.9% p.a., +7.5% p.a. and +8.0% p.a., respectively) while ATM/CNS provision costs are planned to increase by +3.6% p.a., +0.6% p.a. and +1.7% p.a., respectively.

Conversely, NAV Portugal (+2.1% p.a.), HASP (+1.7% p.a.), LPS (+0.4% p.a.) and Sakaeronavigatsia (+0.2%) are planning for some increases in unit ATM/CNS provision costs.

- In the case of NAV Portugal, traffic growth is expected to be outweighed by substantial increases across all categories of ATM/CNS provision costs, in particular staff costs.
- For HASP, significant increases are expected in staff costs and capital-related costs, which would be only partially offset by higher traffic growth (+4.1% p.a.).

The left-hand side of Figure 4.4 illustrates the total capital expenditure and depreciation costs at Pan-European system level between 2017 and 2022. 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 2023 to 2027 for the 30 ANSPs that consistently reported this information in their ACE 2022 data submission.[15]

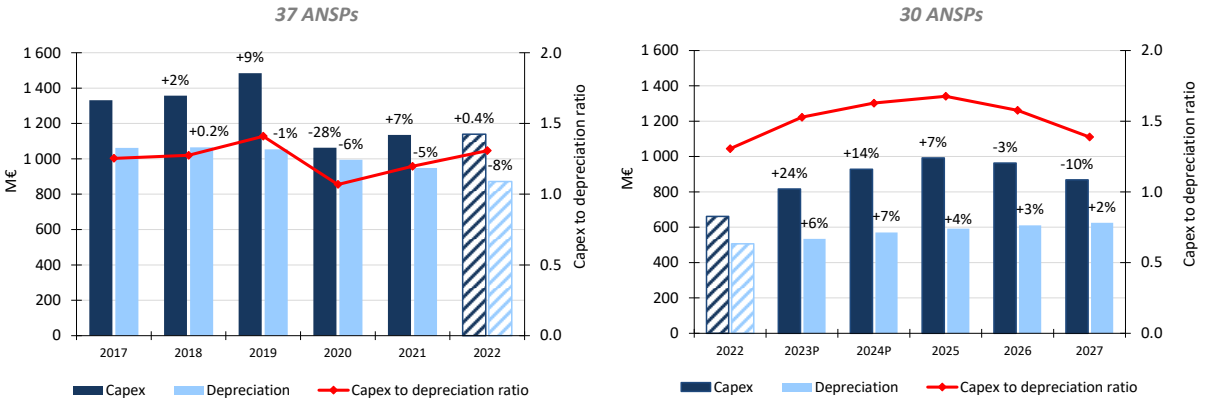

Figure 4.4: Capital expenditures and depreciation costs (2017-2027, real terms)

The total capex planned for the period 2023-2027 amounts to €4 568M or an average of €914M per year, while the planned depreciation costs amount to €2 932M (or €586M per year on average). The average capex to depreciation ratio planned over 2023-2027 stands at 1.56, which is higher than that observed over the 2017-2022 period (1.25). This indicates that, overall, ANSPs asset bases are expected to grow faster than in the past six years. The difference can be partially explained by the reductions or postponement of capital expenditures in 2020-2021 as a result of the COVID-19 crisis.

[15] On top of the ANSPs mentioned at the introduction of this section, EANS and MATS are excluded from the capex and depreciation costs analysis because of missing data.

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5. FINANCIAL INDICATORS CALCULATED FROM ANSPs FINANCIAL STATEMENTS

5.1 Introduction

The decline in demand for air travel resulting from the outbreak of COVID-19 pandemic led into an unprecedented reduction in ANSP revenues since 2020. To assess the impact of this crisis on ANSP finances, selected financial indicators started being measured in previous ACE reports. These indicators are employed to monitor the ability of ANSPs in recovering financially from the crisis.

It should be recognised that examining financial indicators on an annual basis will not capture any peaks and troughs in ANSPs' cash position during the year, or whether they are able, for example, to honour any bi-weekly interest commitments. This dimension is important when assessing the financial resilience of an organization. Nevertheless, these indicators help in understanding ANSPs' positions in a given year and facilitate the measurement of the crisis's impact, complementing the benchmarking analysis presented in this report.

This chapter provides an overview of ANSPs' financial situation over the 2017 - 2022 period, using three indicators: the **current ratio**, the **cash-on-hand days**, and **free cash flow**. These indicators have been calculated at Pan-European system level, using the data published in ANSPs' most recent financial statements. They are therefore consistent with the information published at individual ANSP level in the EUROCONTROL Aviation Intelligence Unit ANSPs Financial Dashboard[16]. This dashboard provides information for 36 ANSPs[17]. 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

Due to circumstances specific to each ANSP and each indicator, additional adjustments to the sample composition had to be made. These are presented below.

Current ratio and cash-on-hand days: LVNL is excluded due to missing information for the calculation of these indicators. As a result, the indicators are calculated using data from 35 ANSPs for 2017-2022.

Free cash flow: Skeyes and UkSATSE did not publish cash flow statements consistently over the 2017-2022 period. Consequently, the free cash flow is calculated using data from 34 ANSPs for 2017-2022.

Depending on the organisational setup of different ANSPs, the information reported in their financial statements covers a different scope of activities (e.g. it may include airport management operations, commercial activities, etc.) which does not always correspond with the ACE gate-to-gate scope. In the case of DFS, the financial reporting standards used to establish route charges and for ACE reporting (regulatory accounting) follow a modified approach based on IFRS, which differs in the treatment of the pension costs from the reporting standards used in DFS financial statements (IFRS).

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

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

5.2 Current ratio and cash-on-hand days

Table 5.1 presents the definitions of two financial indicators which have been introduced in previous ACE reports. Unlike previous years, where data for calculating the current ratio and cash on hand indicators were derived from ACE submissions, the calculations are now based on ANSPs' financial statements, ensuring consistency with the information published in the ANSP Financial Dashboard.

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 financial well-being for the organisation, as it can settle its short-term debt obligations with its current assets. Conversely, a ratio below 1 may suggest potential liquidity issues. A very high value may indicate that the organisation has excess cash that it is not using to invest in its business.
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 5.1: Financial indicators definitions

Figure 5.1 presents the changes in the average[18] current ratio between 2017 and 2022 as well as the 1st and 3rd quartiles. On average, the situation slightly improved in 2022 following four years of continuous deterioration, indicating a better capacity among ANSPs to meet their short-term debt obligations with their current assets. However, for 25% of the sample, the current ratio has shown almost no improvement since reaching its lowest level in 2020. This indicates that some ANSPs may still face liquidity challenges despite an overall improvement at Pan-European system level.

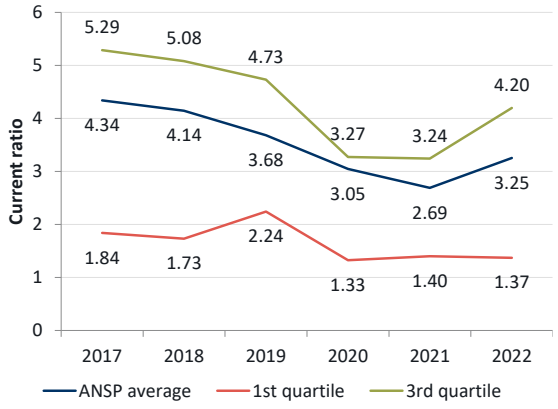


Figure 5.1: Trends in ANSPs current ratio, 2017-2022

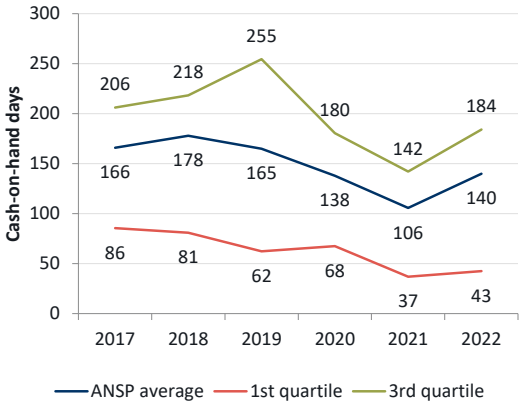


Figure 5.2: Trends in cash-on-hand days, 2017-2022

Figure 5.2 shows the changes in cash-on-hand days at Pan-European system level over the 2017 - 2022 period as well as the 1st quartile and the 3rd quartile of these indicators. In 2022, the average cash-on-hand days amounted to 140 days, which represents an increase of +34 days compared to 2021. However, this figure still remains below the pre-pandemic levels (165 days in 2019).

The observed improvement at Pan-European system level is linked to the traffic rebound and to the subsequent increase in revenues from air navigation charges. However, it is important to note the persistent presence of relatively high levels of debt compared to the pre-crisis situation (see Figure 2.4). This higher level of indebtedness directly influences the cash reserves recorded at year-end,

[18] The European average is calculated as the average of individual ANSPs ratios.

particularly if the contracted borrowings were not fully utilized during the year. This could suggest that although ANSPs have strengthened their cash reserves, they may have simultaneously accumulated additional debt to sustain their operations and capital expenditures.

Furthermore, it should be noted that for ANSPs belonging to the 1st quartile, the cash-on-hand days indicator showed only minor improvements in 2022 and remained below the levels observed in 2020 when the pandemic began. As observed when analysing the current ratio, there are contrasted situations across ANSPs, and it appears that some of them have not yet recovered the same financial strength as before the COVID-19 pandemic. Information on individual ANSPs' current ratio and cash-on-hand days indicator is available in the ANSPs Financial Dashboard.

5.3 Free cash flow

The free cash flow is a widely-used indicator reflecting the liquidity available to a company after paying its operating expenses and capital expenditures. This indicator is based on the information reported in ANSPs' cash flow statements.

Figure 5.3 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 2019 to 2022.

As a result of the unprecedented drop in traffic, the net cash flow from operating activities became negative in 2020 (-€2.4 billion compared to +€2.4 billion in 2019). In 2021, the gap was reduced, but the net cash-flow from operating activities remained negative (-€1.8 billion). Finally, in 2022, the net cash flow from operating activities returned to positive levels (+€1.2 billion).

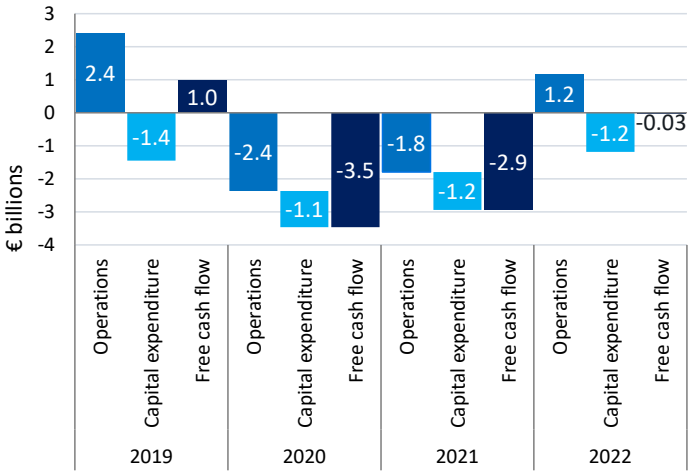


Figure 5.3: Cash flow, 2019-2022 (nominal terms)

When considering capital expenditures, the free cash flow amounted to -€3.5 billion in 2020 and - €2.9 billion in 2021, contrasting with the positive situation of 2019 (€1.0 billion).

In 2022, the cash flow from capital expenditure (-€1.2 billion) was matching the cash from operations (+€1.2 billion), leading to a free cash flow close to almost zero.

To compare ANSPs situation independently of their size, the free cash flow to revenue ratio is employed. Table 5.2 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 5.2: Free cash flow to revenue ratio definition

Figure 5.5 below shows at ANSP level, the 2022 free cash flow to revenue ratio, along with the free cash flow changes from 2019 to 2022.

ANSP	Free cash flow to revenue ratio, 2022	Free cash flow, €m 2019	2020	2021	2022	Free cash flow to revenue ratio, 2019-2022
ARMATS	+36.3%	3	-4	2	6	
BHANSA	+33.1%	-2	-8	-0	15	
Croatia Control	+30.5%	18	-44	-9	39	
MATS	+29.2%	6	-3	0	8	
Sakaeronavigatsia	+25.5%	-3	-3	1	13	
NAV Portugal	+24.0%	-58	-108	-30	51	
DHMI	+22.9%	95	-98	-278	152	
HungaroControl	+21.9%	14	-48	-24	34	
ENAV	+15.7%	224	-266	-239	147	
SMATSA	+13.6%	-6	-34	-21	14	
Slovenia Control	+12.2%	1	-13	-4	5	
Austro Control	+12.0%	16	-55	-37	36	
BULATSA	+12.0%	13	-40	-18	18	
LFV	+10.7%	15	114	17	27	
NATS	+6.9%	70	-387	-332	76	
ANS CR	+6.7%	-4	-56	-32	10	
IAA	+5.3%	32	-55	-35	11	
LPS	+4.4%	-1	-22	-14	3	
ROMATSA	+3.3%	-24	-92	-47	9	
Skyguide	-4.5%	55	-150	-79	-22	
Oro Navigacija	-4.7%	2	-8	-3	-1	
DSNA	-6.0%	6	-960	-777	-104	
Fintraffic ANS	-6.4%	12	0	-14	-5	
PANSA	-7.8%	-3	-81	-33	-20	
Avinor Flysikring	-9.1%	2	-74	-2	-19	
NAVIAIR	-10.0%	4	-50	-50	-13	
LGS	-14.5%	-2	-4	-7	-3	
ENAIRE	-19.1%	600	-200	-195	-141	
MOLDATSA	-20.4%	5	-2	-1	-1	
M-NAV	-21.3%	-1	-6	2	-2	
DFS	-21.9%	-43	-498	-531	-297	
LVNL	-27.1%	-82	-204	-150	-64	
EANS	-29.8%	5	-5	-1	-5	
Albcontrol	-48.5%	-3	2	-4	-11	

Figure 5.4: Free cash flow to revenue ratio at ANSP level (nominal terms)

Out of the 34 ANSPs, 19 generated positive free cash flow from their revenue in the year 2022. This marks a significant improvement compared to 2020 and 2021, when almost all ANSPs had a negative ratio. During those years, ANSPs had to rely on reserves or other liquidity measures, such as loans or State aid, to ensure ongoing service provision when reserves were insufficient.

The substantial improvement in free cash flow for a majority of ANSPs compared to the pre-pandemic year of 2019 signals a positive trajectory towards financial recovery and a more usual

situation. However, it is essential to recognize that despite the positive momentum, challenges persist for some ANSPs. Indeed, for several ANSPs, the positive free cash flows recorded in 2022 remain lower than the accumulated losses incurred during the preceding years (2020 and 2021). This situation highlights the persistent impact of the pandemic and the continued efforts needed from some ANSPs to improve their financial situation.

In 2022, 15 ANSPs recorded negative free cash flow to revenue ratios. For instance, Albcontrol[19], EANS, and LVNL show particularly low ratios.

Figure 5.5 below illustrates how the free cash flow to revenue ratio can be broken down into its components, at ANSP level for the years 2019 and 2022. While the free cash flow and the net cash flow from operating activities can be positive or negative depending on gains or losses, the capex to revenue ratio is consistently negative as capital expenditures represent a cash outflow.

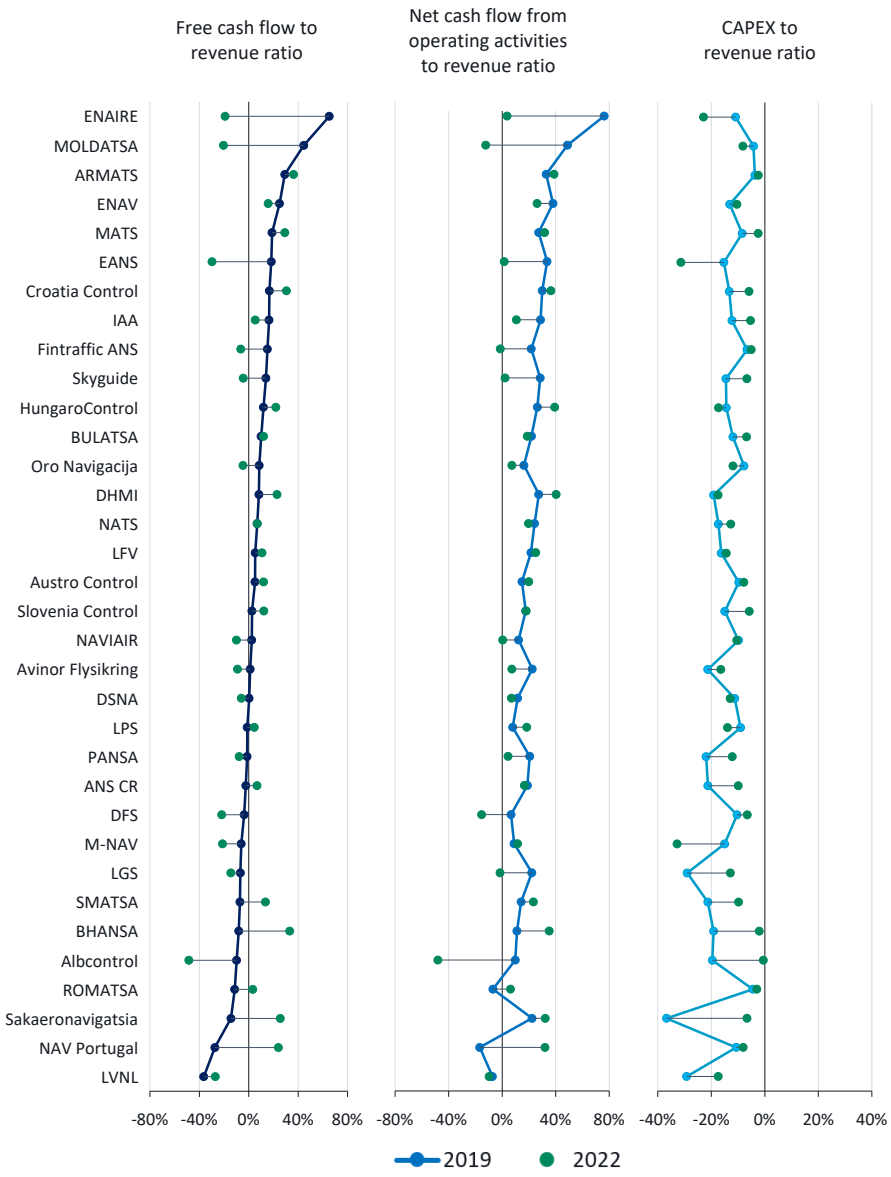


Figure 5.5: Free cash flow to revenues ratio and its components at ANSP level, 2019-2022

Although changes in the free cash flow are mainly driven by changes in the net cash flow from operating activities (see middle chart in Figure 5.5), it is interesting to note that when the free cash

[19] A judgement of 23 March 2022 of the Tribunal of first instance of Brussels, prevents EUROCONTROL from transferring the collected en-route and terminal charges to Albania/Albcontrol.

flow was negative in 2019, it was in several cases due to relatively large capital expenditures during the year.

In response to the challenges posed by the COVID-19 pandemic, many ANSPs implemented cost containment measures in 2020 and 2021. However, due to the magnitude of the traffic downturn, the impact of these measures was not always sufficient to offset the substantial reduction in revenue, resulting in a negative net cash flow from operating activities for most ANSPs.

For several ANSPs, the capex to revenue ratio (right hand chart in Figure 5.5) recorded in 2022 is close to its 2019 level. On the other hand, some ANSPs reported significantly smaller capex to revenue ratios in 2022 compared to 2019 (e.g. Sakaeronavigatsia, Albcontrol, BHANSA, SMATSA and LGS). This might be due to adjustments in capex prioritization or because the increase in capex was smaller than the increase in revenues in 2022.

Overall, the free cash flow to revenue ratio serves as an important indicator of an ANSP's financial health. ANSPs with positive ratios are better positioned to invest in infrastructure upgrades, technology enhancements, and other strategic initiatives, while those with negative ratios may need to address underlying financial challenges, like liquidity constraints, debt accumulation or limited capital expenditure, to ensure long-term sustainability.

6. REGULATORY, INSTITUTIONAL AND CORPORATE GOVERNANCE ARRANGEMENTS

6.1 Introduction

Following the Summer 2022 survey on ACE products, the PRC decided to launch a review of the regulatory and institutional context in which ANSPs operate and to look at the different corporate governance arrangements currently in place. These elements are expected to affect, among other factors, ANSPs behaviour, decision making processes and to some extent the observed level of cost-effectiveness performance.

This analysis draws on the information provided in Part I of ANSPs' ACE submission, as well as responses provided during the validation process. In addition, short case studies have been developed based on publicly available information and direct engagement with relevant ANSPs.

According to the Structure-Conduct-Performance paradigm,[20] a market's structure directly influences the firm's economic conduct, which in turn affects its performance. Figure 6.1 shows the framework used in the ACE benchmarking analysis to describe the exogenous (outside ANSPs' control) and endogenous (under ANSPs' control) factors which influence ANSPs' performance.[21]

Exogenous factors arise from the basic conditions in which an ANSP operates, which may differ from one country to another and are likely to influence the way they organise and conduct their business. In some cases, these may also affect the way an ANSP manages its costs and how the level of charges is determined. Capturing the local impact of an exogenous factor on ANSPs' performance is not a straightforward exercise. First, there is no guarantee that a given exogenous factor will affect all ANSPs in the same manner. It is possible that similar conditions could create effects working in opposite directions (bringing both benefits and difficulties). Second, similar exogenous factors may not necessarily affect different ANSPs to the same degree, either because of endogenous factors relating to how issues are managed, or by other exogenous factors constraining an ANSP's response. A given factor might create a small burden for one ANSP, while affecting another more seriously.

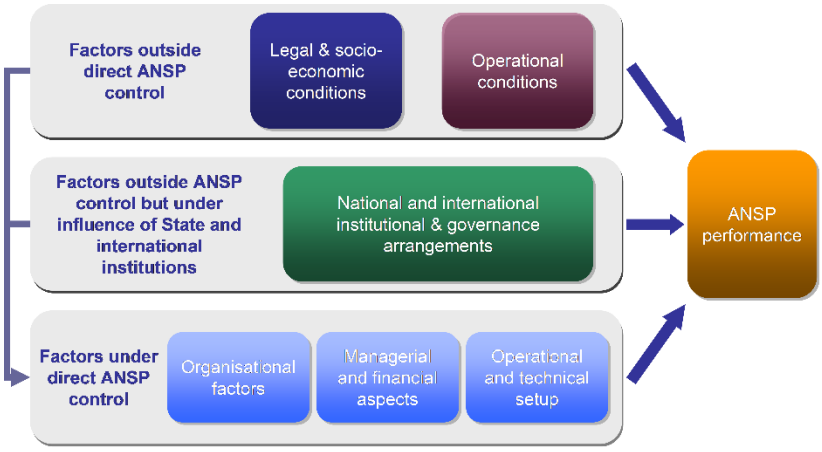


Figure 6.1: Factors affecting cost-effectiveness performance

The institutional and governance arrangements for ANS in a particular country are set in place by the policies and specific aviation laws of each country. These factors are exogenous to the ANSP, but decision-making concerning some of them is largely driven by national aviation policymakers. Some of these factors relate to international requirements such as those imposed by the International Civil

[20] See Bain, J. S. (1968). Industrial organization. Wiley, 2nd edition for a detailed description of the Structure Conduct Performance paradigm.
[21] See ACE Handbook.

Aviation Organisation (ICAO), EUROCONTROL and the Single European Sky. Institutional and governance arrangements include factors such as:

- the way ANS is regulated, including policies around market access and the degree of economic oversight/ regulation;
- the institutional structure surrounding ANS, the ANSP ownership and control structure; and,
- the civil/military arrangements.

It is generally considered that institutional and governance arrangements do not affect ATM cost-effectiveness directly; rather they act as influences or constraints affecting endogenous factors (such as the overall business objectives, internal organisation, flexibility in decision making, and adaptability to change).

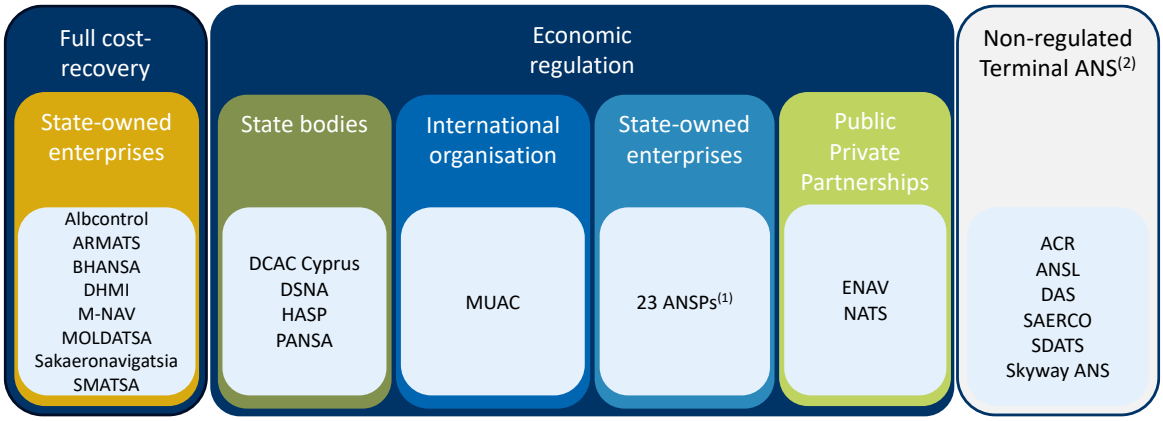
Over the past three decades, the air traffic industry in Europe has experienced significant growth and transformation. During this period, several key developments and milestones have shaped the industry and contributed to changes in regulatory and institutional arrangements.

- The **full cost-recovery system** was established in the 1980s after a phased introduction, based on ICAO principles adopted by States of the European Civil Aviation Conference Area in setting up the Central Route Charges Office (CRCO) and specifying the rules and procedures of the route charges system.
- The 1990s marked the **liberalisation of the European aviation market**. During this period, the **separation of oversight from airport business and from ANS provision** was implemented by some States in different stages or sequences,[22] a process that continued into the 2000s.
- Partly in response to a worsening ATM delay situation, described as having reached "crisis proportions during 1998"[23], an independent performance review system addressing all aspects of air traffic management was established. This led to the creation of the **Performance Review Commission** (PRC) to provide independent advice on Air Navigation Services (ANS) performance of the EUROCONTROL Member States and their respective ANSPs.
- The **Single European Sky (SES) initiative** was introduced in 2004 to enhance air traffic management and airspace efficiency by coordinating national airspace structures. SES regulations are binding on EU and associated States (currently Switzerland and Norway). Further details are given in section 6.2.3. The performance and charging schemes, initially outlined by the European Commission in 2009 for Reference Period 1 (starting in 2012), have evolved significantly. Updated versions of the performance and charging schemes regulations were released in 2019.
- The **COVID-19 pandemic** in 2020 significantly impacted the air traffic industry, causing a sharp decline in passenger numbers and flights. The downturn caused financial challenges and reduced operations, affecting all parts of the aviation system.
- Following a transition period, the **UK left the European Union** and the SES at the end of 2020. Since then, the UK ANSP is solely regulated under the UK's own oversight arrangements. As the industry recovered from the pandemic's effects, a renewed emphasis on sustainability and decarbonization has emerged.
- In parallel to the above-mentioned developments, the access to the **terminal ANS market has been opened to competition** in some Member States, so that ANSPs may compete for the provision of these services at individual airports.

[22] For example, in Nordic countries, combined airport service and ANS provision was separated from the oversight body first, before airport service provision and ANSPs were then separated from one another. In contrast, in the UK, airport service provision was separated from oversight and ANS provision first, before the ANSP was then separated from the oversight body.

[23] Annexes to COM (1999) 614

Figure 6.2 below provides the framework used in this chapter to structure the analysis and classify ANSPs into groups with similar characteristics in terms of regulatory regime and legal status[24].



(1) State-owned enterprises subject to economic regulation: ANS CR, Austro Control, Avinor, BULATSA, Croatia Control, DFS, EANS, ENAIRE, Fintraffic ANS, HungaroControl, IAA, LFV, LGS, LPS, LVNL, MATS, NAV Portugal, NAVIAIR, Oro Navigacija, ROMATSA, skeyes, Skyguide, Slovenia Control
(2) List of independent terminal ANS providers is not exhaustive and includes only the major providers in Europe.

Figure 6.2: ANSPs classification per regulatory regime and legal status

The remainder of the chapter is structured as follows:

- Section 6.2 describes the main regulatory regimes and principles for the provision of ANS in Europe;
- The global ANS institutional set-up, as well as ANSPs legal status and corporate governance arrangements, are presented in section 6.3;
- A view on ANS cost-effectiveness performance through regulatory, institutional and governance arrangements is provided in section 6.4;
- Finally, section 6.5 provides elements on the introduction of competition in the terminal ANS provision market.

6.2 Review of the main regulatory regimes and principles for the provision of ANS in Europe

This section provides some insight on the main regulatory regimes and principles under which European ANSPs operate. These are introduced in Figure 6.3 below and further detailed in subsections 6.2.1 to 6.2.4.

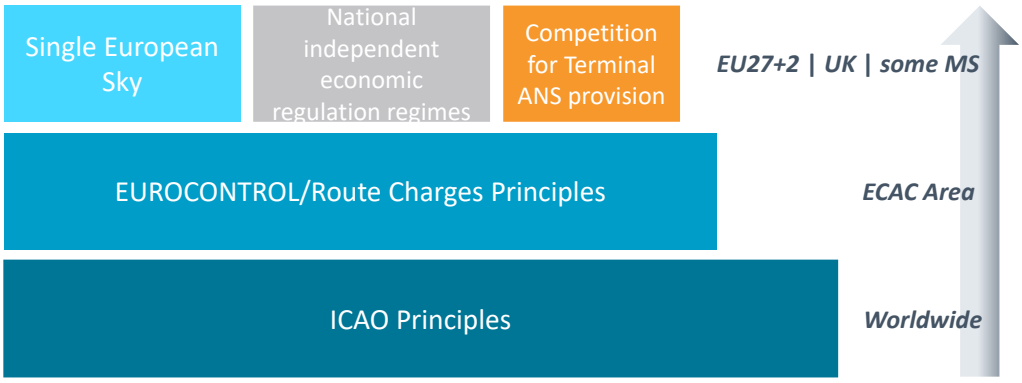


Figure 6.3: ANS regulatory regimes and principles in Europe

[24] See section 6.3.1 for more detailed information on ANSPs legal status.

6.2.1 ICAO principles

The four basic charging principles for airport operators and air navigation service providers established by ICAO are ***non-discrimination***, ***cost-relatedness***, ***transparency***, and ***consultation***.

The ICAO Manual on Air Navigation Services Economics sets out guidelines on the ownership and governance of air navigation services providers. ICAO guidelines determine that each State is ultimately responsible for the provision, operation and economic oversight of air navigation services in its FIRs.[25] ICAO recognizes the historical organisational structure of the ANSP as a fully integrated part of the State. In these cases, it states that regulatory and operational functions should be separated to prevent conflicts of interest, this may result in the ANSP being granted greater autonomy over its management and financial activities. ICAO has also recognised the increasing trend in recent years towards the separation and corporatisation of ANSPs, and the benefits this may bring. As a result, it recommends that "*where it is economically viable and in the best interest of ANSPs and users, States consider establishing autonomous entities to operate their air navigation services*".[25]

6.2.2 EUROCONTROL and Route Charges principles

The EUROCONTROL Member States have adopted basic principles for a harmonised regional en-route charges system involving a single charge per flight. The CRCO operates the route charges system on behalf of the Member States with due regard to the guidelines on charges for air navigation services recommended by ICAO, in particular those concerning non-discrimination and transparency.

ANSPs whose ANS costs are recovered through the EUROCONTROL route charges system are also required to provide economic information according to the Specification for Economic Information Disclosure (SEID) for performance review purposes.

6.2.3 Single European Sky

The Single European Sky (SES) was established in 2004 to reform European ATM and reduce fragmentation in a way that promotes safety, operational efficiency, quality of service and cost-efficiency. The SES is formed of five Basic Regulations (N° 549/2004, 550/2004, 551/2004, 552/2004 and 2018/1139) covering the provision of air navigation services (ANS), the organisation and use of airspace, the interoperability of the European Air Traffic Management Network (EATMN) and the establishment of common rules in the field of civil aviation and of the European Aviation Safety Agency (EASA).

Under the SES Framework and implementing rules, a performance and charging scheme applicable to States bound by SES regulations has been operational since 2012. The regulatory periods of the scheme are known as Reference Periods (RP), with RP1 covering the period from 2012 to 2015, RP2 the 2015-2019 period, and RP3 encompassing 2020-2024.

The scheme defines the key performance areas (KPAs) of safety, environment, capacity and cost-efficiency. The European Commission sets Union-wide performance targets for each Reference Period under each KPA. States, and in particular their National Supervisory Authorities (NSAs), are responsible for preparing Performance Plans, which are assessed and monitored under the scheme by the Performance Review Body (PRB).

The cost-efficiency of en-route ANS is primarily defined with reference to a single key performance indicator (KPI), representing the year-on-year percentage change in the average determined unit cost (DUC) of ANSPs.

Incentives are set for the cost efficiency and capacity KPAs:

[25] ICAO Manual on Air Navigation Services Economics, 2013, available online on: https://www.icao.int/publications/documents/9161_en.pdf.

- Cost-efficiency incentives are mainly embedded in the concept of determined costs, which comprises specific risk-sharing arrangements aiming at incentivising ANSPs economic performance. As part of the determined costs method, the costs planned for the reference period (RP) are set in advance and frozen for the whole duration of the RP. If actual costs are lower than the determined costs, then the State/ANSP can keep the difference. On the contrary, if actual costs are higher than determined, then the State or ANSP has to bear a loss. This mechanism is expected to provide incentives for States/ANSPs to effectively control their costs. In addition, the traffic risk sharing arrangements embedded in the scheme are shaped so that ANSPs can flexibly adapt to unforeseen changes in traffic volumes.
- Capacity incentives are based on a bonus and penalty, represented as a percentage of determined costs for both en-route and terminal targets, where these apply.

The implementation of the performance and charging schemes has significantly influenced States' and ANSPs' behaviours, particularly in terms of awareness regarding improved planning, targeted investment, and enhanced performance management.

6.2.4 National independent economic regulation regimes

The UK is the only case where at a national level an independent regulator, the UK Civil Aviation Authority (CAA) undertakes the economic regulation of an ANSP. This is due to the UK's competition and market power policies which apply to businesses and services holding a dominant market position or operating as a monopoly. In the case of aviation, this applies to the ANSP's en route, London approach and oceanic services as well as two major airports, London Heathrow and London Gatwick. This regulatory scheme does not apply to Terminal ANS services in the UK which are procured on a competitive basis by airports and are governed by market conditions.

Case study 1: ANS licensing and price control in the UK

The CAA undertakes economic regulation of UK airports and NATS En Route Limited (NERL). Economic regulation is based on the assessment of market power.

NATS En Route Limited (NERL) is the sole provider of en route services in the UK, operating as a monopoly. For this reason, it has significant market power and operates under a licence. Since its privatisation in 2001, it has been economically regulated by the UK CAA under the Transport Act 2000. It was subsequently economically regulated under the CAA and SES until the UK left the European Union at the end of 2020 and oversight returned to being under the CAA's remit alone.

The CAA is required to:

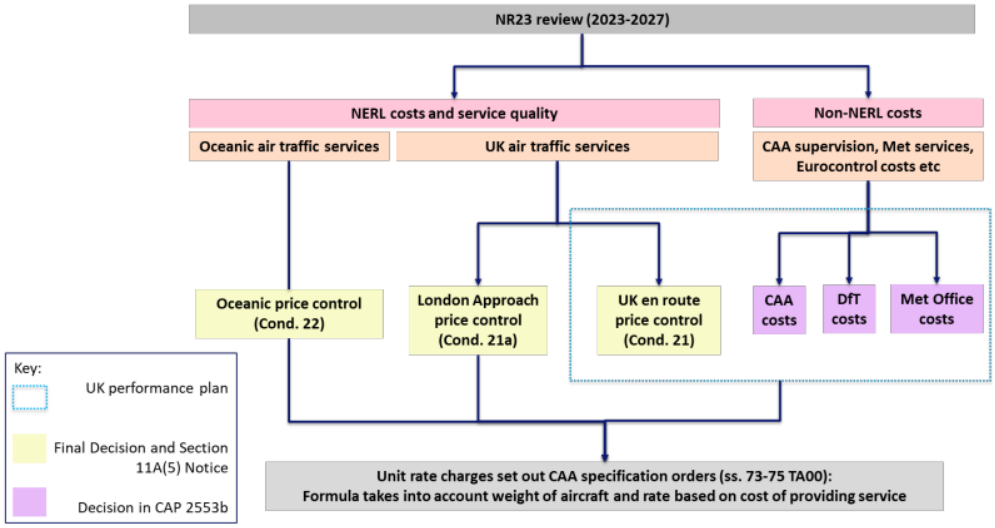
- promote efficiency and economy of the licence holders; and,
- secure that licence holders will not find it unduly difficult to finance activities authorised by their licences.

The Air Traffic Services Licence sets performance mechanisms for the four areas also covered by the SES, namely safety, cost efficiency, capacity and environment. Price controls for NERL are set out under determined regulatory periods which normally cover five years at a time.

Decisions on price controls go through an iterative process. For NR23 (covering 2023-2027), NERL carried out a consultation with its customers and provided the CAA with its business plan for the regulatory period. The CAA then issued its initial proposals which were subject to consultation. These consultations typically generate a response from NERL, airspace users, airports and labour unions. Stakeholders' views are published on the CAA website. The CAA then issues its provisional decisions which are subject to further consultation before issuing final decisions for the regulatory period. Additional evidence and clarification can also be requested from NERL ahead of the final decision. Once published, NERL and airspace users have the right to appeal the decision, in which case the Competition and Markets Authority (CMA) can investigate the decision. Reference period 3 was subject to appeal and assessment by the CMA.

Core services under NERL's licence include UK En route Air Traffic Control Service, Oceanic En route Air Traffic Control Service, Advisory Control Service, and London Approach Service.

The figure below shows the scope of the CAA's economic oversight with respect to the unit rate charged to airspace users.



Source: CAA

NERL operates under a scheme which includes the setting up of a regulatory asset base and the planning of costs and revenues for the period under review. Determined Unit Costs are calculated by dividing the total Determined Costs by the total service units. NERL's Determined costs are made up of building blocks including operational costs, pension costs, regulatory depreciation, return on the Regulated Asset Base (RAB) and non-regulatory revenue.

Incentives are set for the cost efficiency, capacity and environment KPAs. Cost efficiency incentives take the form of determined costs and a traffic risk-sharing mechanism aligned with the SES. Meanwhile, capacity and environment incentives are based on a bonus and penalty, representing a percentage of determined costs. The extent and level of revenue at risk from service performance incentives is relatively small, limited to a maximum bonus of 0.8% of total determined costs and a maximum penalty of 1.75%. It is noteworthy that NERL is required to undertake regular customer consultation on its service and investment plan, and that the adherence to this engagement is financially incentivised with a potential penalty. Separately, the UK CAA may conduct an ex-post efficiency review of NERL's capital expenditure. If the CAA identifies inefficient expenditure, it may adjust NERL's Regulatory Asset Base (RAB) for future periods, reducing it to reflect any disallowed expenditure.

Despite the UK's detachment from the SES, the economic regulation process of its ANSP is comparable in a number of areas, including the length of the regulatory periods, key performance areas and baseline traffic forecasts. Whilst each Member State is responsible for setting targets and incentives for capacity within a given range provided by the SES implementing regulation, the UK has adopted its own target definitions for both capacity and environment and in the case of environment has adopted its own tool (3Di). The table below summarises key elements of economic regulation for the SES performance and charging scheme and the UK regulation.

	SES performance and charging scheme	UK economic regulation of NATS (En-route)
Regulatory reference periods	Five-year regulatory periods (reference periods) – currently in RP3 (2020-2024)	Five-year regulatory periods – currently in NR23 (2023-2027)
Traffic forecasts	EUROCONTROL STATFOR forecasts to inform performance targets	EUROCONTROL STATFOR forecasts + NERL develops a STATFOR derived forecast for Oceanic
Cost efficiency KPI	En-route determined unit costs (en-route determined costs per service unit)	

Incentives	Cost efficiency is incentivised through the determined cost and traffic risk sharing concepts. Financial incentives are set for capacity (based on one indicator), capped at a maximum 2% of DC bonus and 4% of DC penalty.	Cost efficiency is incentivised through the determined cost and traffic risk sharing concepts. Financial incentives are set for capacity (based on multiple indicators) and environment (based on one indicator), accumulating to 0.8% of DC bonus and 1.75% of DC penalty.
Key stakeholders	National Supervisory Authorities, Civil Aviation Authorities, Member States, ANSPs, Performance Review Body, Airspace users.	Civil Aviation Authority, ANSP (NATS), Competition Markets Authority, Airspace users, Airports and Labour unions.

Incentives for ANSPs within the SES and the UK economic regulation regimes are based on a percentage of the determined cost base with surrounding deadbands before penalties or bonuses are applied. Both systems consider stakeholder's engagement in their target-setting process. In the UK, NERL can challenge the CAA's decision ex-post. This occurred with respect to RP3, resulting in the determination being taken to the Competition Markets Authority for independent assessment.

In November 2023, the UK CAA released its final decision for the next price control review (NR23) according to which NERL en-route determined unit costs are expected to decrease by some -19% in real terms between 2022 and 2027. Determined costs are planned to slightly increase during this period (+2.4%) while service units are forecast to rise by some +27%.

Finally, it is noteworthy that terminal ANS services in the UK are open to competition for the market at each airport and as such are not subject to economic regulation (see also Section 6.5 below).

6.3 Institutional set-up, ANSPs' legal status and corporate governance arrangements

The institutional landscape for ANS in Europe comprises a number of actors, with some operating at European level, establishing common rules, and driving harmonisation and interoperability, and others at national level.

The main entities at European level are:

- The **European Commission** (EC) – it sets airspace safety, operation and licencing rules that are overseen by the European Aviation Safety Agency (EASA). It is also responsible for drafting the Implementing Regulations under the Single European Sky framework, along with issuing decisions on performance targets and EU-wide and local levels. The EC is supported by the Performance Review Body (PRB) in implementing the SES performance and charging scheme.
- **EUROCONTROL** – the Pan-European, civil-military organisation houses a number of functions that support the aviation system, including the Network Manager which supports optimised operational performance, the CRCO which offers a harmonised regional en-route charges system with due regard to the guidelines recommended by ICAO and the Single European Sky regulations, and other services, including aviation intelligence, support to research & innovation, and training.
- The **European Aviation Safety Agency** (EASA) – it oversees safety in the EU. It supports the EC in shaping the regulations relating to ATM/ANS oversight, ATCO licencing and wider aviation safety regulations, standards and rules of the air. It also helps shape new regulations for emerging airspace users such as drones.
- The **European Defence Agency** (EDA) – it forms a 'hub' for European defence cooperation, including cooperation with other European organisations to enhance civil ATM performance while safeguarding national security and defence needs.

The main entities at national level are:

- **Member States** – they are responsible for monitoring the safe and efficient provision of ANS and for the control of compliance by ANSPs with the common requirements established at EU and international level. Their involvement in ANS takes different forms with different departments involved in the decision-making process. Departments providing oversight to the ANSP typically involve the ministry of transport and infrastructure, ministry of defence and in some cases the ministry of finance. Member States are responsible for signing off the national performance plans under the SES. For those countries not part of the SES, Member States continue to provide important oversight of the ANSP alongside Civil Aviation Authorities.
- **Civil Aviation Authorities** – are required to be functionally separate from the ANSP to prevent conflicts of interest. They oversee and enforce safety and airspace regulation in each Member State and in certain cases also undertake economic regulation. In the EU, many CAAs take the role of the National Supervisory Authority, required to oversee the regulatory framework and certifying and designating ANSPs.
- **Air Navigation Service Providers** – they provide all or some of the following services to air traffic during all phases of operations (en-route, approach and aerodrome): air traffic management; communication, navigation and surveillance; meteorological; search and rescue; and aeronautical information services to air traffic.
- **Meteorological authorities** – they may provide meteorological services for air navigation alongside ANSPs.
- **Military authorities** – they hold airspace for military use, often controlled by a dedicated military air traffic control organisation. Military airspace interfaces with civil airspace and can sometimes be used jointly or flexibly by civil and military aviation.
- **Airport authorities** – are responsible for offering airport services in collaboration with a wide range of providers (ground handling, fuel suppliers, ANSPs, etc.) covering activities at airports. The approach to Terminal ANS provision varies across Europe, where certain States implement market competition (i.e. at the airport), while in others, terminal ANS are provided by the main en-route ANSP and may be subject to economic regulation under the SES.

Under the influence of European legislation and, to some extent, the adoption of widespread practices, there is a trend towards convergence in the institutional structures. An emerging model of institutional structure involves the ANSP operating as an autonomous institution, either governed by its own statute, national company law, laws related to state-owned enterprises, or a combination of these. A management contract or a regulatory licence is often part of the mechanism of control.

As already indicated, over the past 30 years the ANS industry has undergone substantial changes in several States, progressively separating the ANS provision from the oversight functions and/or airport management. Since the start of the ACE benchmarking activity, these changes have been observed, inter alia, in Denmark, Finland, North Macedonia, Norway, Spain, Slovenia and Sweden.

In addition, as of 30th April 2023, the Irish ANSP is formally separated from the Irish Aviation Authority (IAA) which is in charge of regulatory and oversight activities. ANS in Ireland is then provided by the Irish Air Navigation Service (AirNav Ireland) from 2023 onwards. A similar process is also on-going in Greece with the separation of HCAA from the ANSP HASP.

Case study 2: Institutional restructuring of ANS provision in Finland

The Finnish ANSP, Fintraffic ANS, has undergone significant institutional changes, including the separation of service provision from regulatory and oversight functions, the separation of ANSP from the airport operator, ANSP corporatisation and, finally, the incorporation into a multimodal transport management group.

Figure 6.4 summarises the main institutional and corporate changes of Fintraffic ANS over the past two decades.

Figure 6.4: Timeline of institutional changes of Fintraffic ANS

Separation from airport operator Finavia and corporatisation of ANS Finland

Prior to the separation, the ANS services were provided by the airport operator Finavia, a previously common service provision model in Europe. In 2016, based on Finavia's proposal, the Ministry of Transport and Communications approved the incorporation of air navigation operations into a separate entity independent of Finavia. The grounds for the separation of ANS and airport management services were:

- Compliance with elements of the Single European Sky Regulations package.
- Ensuring more transparent operational service provision.
- Supporting more efficient development of activities through a separate company.
- Enabling the airport operator Finavia to tender ATC services in network airports.
- Preparing the ANS provision to be tendered-out across national boundaries in Nordic ANS market.

In 2017, just one year after the decision to separate, Air Navigation Services Finland Ltd. was established. The demerger of the two companies involved the transfer of Finavia's air navigation and air navigation training-related personnel at Avia College, as well as administrative staff, including previously shared staff (e.g. HR, finance, etc.), some of whom were transferred to the newly incorporated company. Similarly, the separation of assets was completed with air navigation assets transferred to ANS Finland and airport-related assets retained by Finavia. At the same time, the separation of activities resulted in the re-allocation of costs, but also required a clear separation of income streams and the definition of ANS charges at non-major airports.

Incorporation into Fintraffic Group

In 2019, the ownership of ANS Finland was transferred to a new parent company – Traffic Management Finland Ltd. – a State-owned company which incorporates maritime, air, railway and road traffic control and management services. It aims at:

- Improving traffic safety, efficiency, and fluency.
- Better use of data flows.
- Enabling new services.
- Improving cost efficiency.

This is a unique institutional setup in Europe and reflects the implementation of the Finnish Government's broader strategy of improving the capability of the administrative sector to respond to changes in customer needs and the operating environment. It also seeks to strengthen the strategic guidance of the administrative sector and create synergies. A single holding company also allows for the consolidation of traffic data streams, which is the first step towards building a transport data ecosystem in Finland.

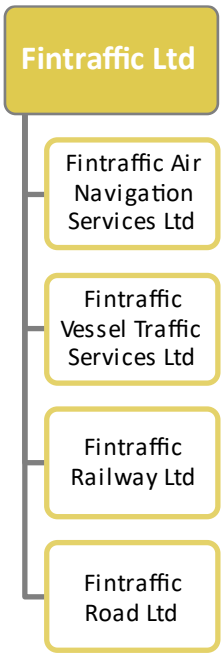


Figure 6.5: Structure of Fintraffic Group

In 2021, the Traffic Management Finland Ltd was rebranded as Fintraffic Group, with ANS Finland renamed as Fintraffic ANS (see Figure 6.5). In 2022, the Fintraffic group employed more than 1 100 staff, with some 80% employed in ANS air and rail traffic management, and reported overall group revenues of around €229 million.

The integration led to better cooperation between different traffic modes, as well as some economies of scale. For instance, the parent company took over the provision of common services, including human resources, IT, and finance for all the group companies. In the case of Fintraffic ANS, some of these functions were previously sourced from Finavia. Fintraffic also provides necessary equity capital for group companies and facilitates access to debt financing at more competitive market rates. The Fintraffic Group has also provided financial aid to group companies following the COVID-19 pandemic and, in the case of Fintraffic ANS, also due to the war in Ukraine. To that end, Fintraffic ANS received €8.0M contribution to equity from the Fintraffic Group to strengthen its balance sheet in 2021, as well contributions totalling around €14.1M between 2020 and 2022 aimed at improving financial liquidity.

Figure 6.6 presents long-term trends in composite flight-hours, ATM/CNS provision costs and unit costs for Fintraffic ANS over the 2006-2022 period. It shows that between 2006 and 2019, unit costs decreased by -0.6% p.a., since traffic grew by +0.5% p.a. while the costs remained mostly stable (-0.1% p.a.). It is noteworthy that during this period, traffic grew at much slower pace than for the Pan-European system and mostly remained below 2006 levels.

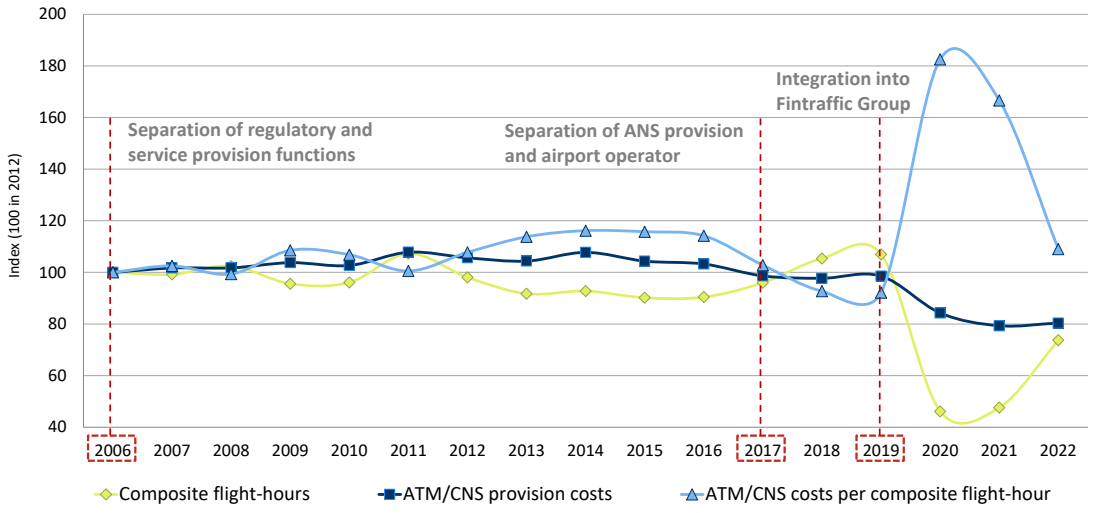


Figure 6.6: Long-term trends in costs, traffic and unit costs for Fintraffic ANS

Fintraffic ANS has been particularly affected by the traffic shifts following the war in Ukraine, recording a much slower traffic recovery than the pan-European system average, with traffic in 2022 being -31.1% below 2019 levels. At the same time, Fintraffic ANS has also significantly reduced ATM/CNS provision costs over this period (-18.5% vs. 2019). As a result, the financial cost-effectiveness indicator in 2022 was +18.3% above pre-pandemic levels.

6.3.1 ANSPs' ownership models and legal statuses

The dominant ownership model across ANSPs is 100% State ownership (with ENAV and NATS being the only examples with a significant non-governmental shareholding). However, there are various legal forms associated with a full State ownership, ranging from part of a government department, through autonomous statutory bodies, to a state-owned enterprise. The actual separation between ownership and control may vary significantly, even within apparently similar legal forms. Several concepts can be used to describe ANSPs legal statuses and ownership models. For the sake of simplicity, it is proposed to consider the following four categories:

- **State body** – *"A state body which is established by or under an enactment and which is controlled, directly or indirectly, by the Government"*[26]. State bodies are government departments and do not have Supervisory Boards. They differ from the government in their legal, financial and human resource aspects, but the majority are closely aligned on all dimensions.
- **International organisation** – MUAC is part of EUROCONTROL and it is therefore treated separately in this chapter.
- **State owned enterprise** – *"A state-owned enterprise (SOE) is a legal entity that is created to undertake commercial activities on the State's behalf. It can be either wholly or partially owned by the State and is typically earmarked to participate in specific commercial activities"*[27]. State owned enterprises are typically legally separated from the government and have autonomy over their own budgets and human resource arrangements under the supervision of their supervisory and executive boards. The State-owned enterprise structure can be further split into two additional sub-categories:
    - A *limited liability company* is similar to a corporation but provides a legal structure whereby the corporate loss will not exceed the amount invested by its investors.
    - A *joint stock company* is a business owned by its investors similar to a corporation. The liability on a joint stock company could be unlimited.

  The rationale for this form of ownership, according to the OECD, includes maximising value for society through an efficient allocation of resources. This is the case where the State ownership is deemed more reliable or efficient than contracting to private operators. It is also the case where there exists a) a natural monopoly or b) where the enterprise serves strategic goals within the national interest.
- **Public Private Partnership** – *"Public-private partnerships involve collaboration between a State agency and a private-sector company"*.[28] Public private partnerships remain predominantly owned by the State but in the case of ANSPs, private sector involvement, particularly from airlines, may result in a greater influence over the services they are receiving. Whilst public private partnerships remain a minority amongst European ANSPs, they have become increasingly prevalent in airports as a means of driving investment, diversification and quality of service.

[26] https://www.lawinsider.com/dictionary/state-body
[27] https://www.investopedia.com/terms/s/soe.asp
[28] https://www.investopedia.com/terms/p/public-private-partnerships.asp.

Figure 6.7 provides an overview of ANSPs classified by their legal status:

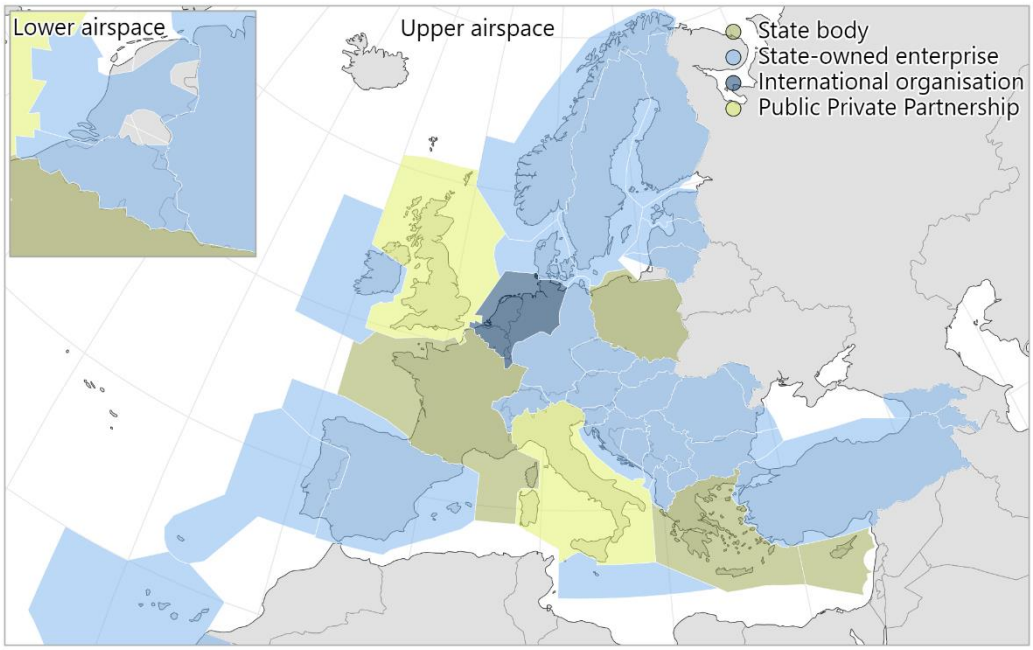


Figure 6.7: ANSPs classified by legal status in 2024

The majority of ANSPs (31 out of 38) in the Pan-European system are State-owned enterprises. These ANSPs typically operate as legally separate with control over their own budget and staffing rules.

Four ANSPs (DSNA, DCAC Cyprus, HASP and PANSA) operate as State bodies and MUAC is part of EUROCONTROL.

Only two ANSPs (NATS and ENAV) operate under a public private partnership legal structure with private companies having a share in their ownership. NATS is 49% State-owned and 42% owned by the Airline Group[29], 4% by London Heathrow and 5% by NATS employees. ENAV is the only publicly listed ANSP with 47% of shares traded on the Milan Stock Exchange, while the remaining 53% are owned by the State.

Case study 3: Privatisation of ENAV

Ente Nazionale di Assistenza al Volo (ENAV) was created in 1996 and incorporated as ENAV S.p.A. in 2001 – a public limited company wholly owned by the Italian Ministry of Economy and Finance (MEF) exercising its rights in agreement with the Ministry of Infrastructure and Transport.

The decision to partly privatise ENAV, issued in May 2014, was part of much wider privatisation plans by the Italian government which also included the partial privatisation of National Postal Service (Poste Italiane) in 2015. Figure 6.8 provides an overview of the main developments for ENAV.

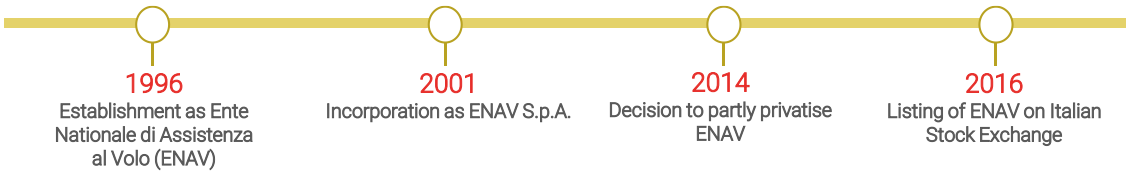


Figure 6.8: Timeline of corporate changes of ENAV

[29] The Airline Group is a consortium including British Airways plc, the Pension Protection Fund, easyJet Airline Company Limited and USS Sherwood Limited. Nominal shareholdings in The Airline Group are retained by Alix Partners, Deutsche Lufthansa AG, TUI Airways Limited and Virgin Atlantic Airways Limited.

According to the decision of the Italian Government, the privatisation was aimed to strengthen ENAV, boost the Italian capital market and identify financial resources for debt reduction. The decision also stipulated that the Italian State retained the controlling stake in the company of no less than 51%.

The initial public offering (IPO, i.e. the process to make company's shares available to the public for the first time) included 230 million shares representing around 42.5% of ENAV's share capital (57.5% remaining State owned) at a set price of €3.30 per share, totalling some €759M for the IPO. Of these shares, 207 million, or 90% of the shares offered, were reserved for institutional investors while 10% were targeted at retail[30] investors and employees. ENAV was listed on the Milan Stock Exchange on 26 July 2016 and currently is the only Air Navigation Service Provider listed on an equity market in Europe.

Following the IPO, the Ministry of the Economy and Finance exercised the greenshoe option[31] on an additional package of 22.6 million shares, bringing the proportion of the share capital available on the market to 46.6% (with MEF retaining a 53.4% stake in the company at that time) and the total value of ENAV privatisation to some €834M.

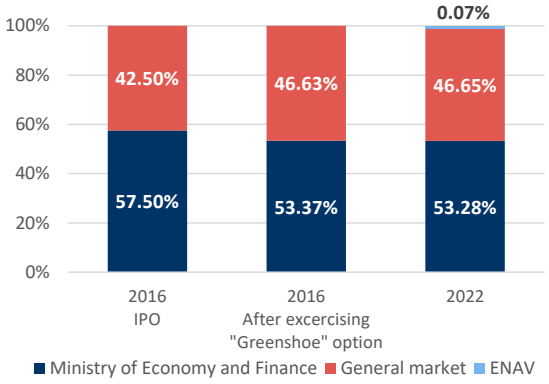


Figure 6.9: Changes in ENAV ownership structure

At the end of 2022, ENAV's share capital amounted to €541.7M, broken down as follows: 53.28% of ENAV shares are held by the MEF, 0.07% by ENAV itself, as treasury shares, and 46.65% by the general market. Figure 6.9 summarizes the changes in the ownership structure of ENAV following the IPO.

Organizational and legal changes related to listing on the stock exchange

The transition entailed legal and organisational changes to conform with strict transparency and reporting requirements applicable for listed companies. As a listed company, ENAV has adopted the Corporate Governance Code requested by the Italian law and according to CONSOB authority guidelines. ENAV also established an Investor Relations department, a Risk Management office and expanded its Internal Audit departments' remit to include prevention of corruption and fraud.

From the corporate governance perspective, the main change was an increase in the number of members of the Board of Directors from five to nine, six being appointed by the main public shareholder and three by the minority lists. Moreover, three Board committees have been created to provide recommendations and advice: the Control, Risks and Related Parties Committee, the Remuneration and Appointments Committee and, afterwards, the Sustainability Committee. The transparency requirements also necessitated changes in reporting processes, preparation and publication of specific investor presentations and quarterly financial results. To that end, ENAV also transitioned to IAS/IFRS prior to listing and had to adapt its accounting system as well as a corporate governance system to that of listed companies.

According to ENAV 2016 financial statements, the costs stemming from the privatisation process amounted to some €7.5M, reflecting advertising costs as well as expenses for legal and financial advisers.

[30] Institutional investor is a company or organisation investing on behalf of other (e.g. banks, pension funds, mutual funds etc.). Retail investors are individuals investing on their own behalf.

[31] Provision in an IPO underwriting agreement that grants the underwriter the right to sell more shares than initially planned.

ENAV Group was already operating a diversified business with investments in regulated and non-regulated activities prior to listing, including:

- Techno Sky – the management and maintenance of hardware and software platforms (2007);
- ESSP – EGNOS satellite navigation services (2008);
- Enav Asia Pacific – air traffic control consulting services in Malaysia (2013); and,
- Enav North Atlantic with the participation in Aireon – a global satellite surveillance system (2014).

The non-regulated side of the business has been further expanded following privatisation with investments in:

- d-flight – management system for unmanned aerial vehicles (2018); and,
- IDS AirNav – aeronautical information management systems (2019).

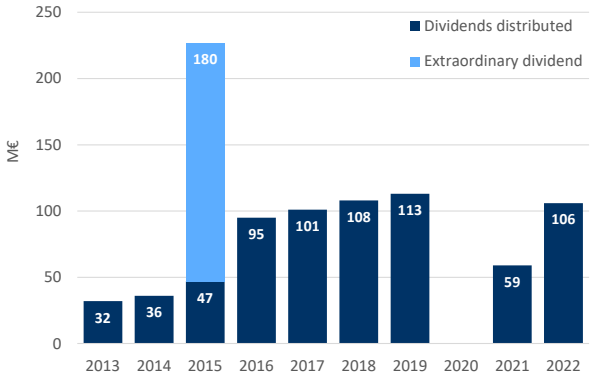


Figure 6.10: Dividends distributed to shareholders

It should also be noted that ENAV has significantly increased its dividend distribution[32] which has tripled from some €36M in 2014 to €106M in 2022 (see Figure 6.10). Figure 6.11 below presents trends in composite flight-hours, ATM/CNS provision costs and unit costs for ENAV over the 2012-22 period. It shows that between 2012 and 2019, the unit costs reduced by -1.0% p.a. since the traffic grew slightly (+1.2 p.a.) while the costs remained mostly stable (+0.2% p.a.). It is noteworthy that traffic remained stagnant throughout most of this period.

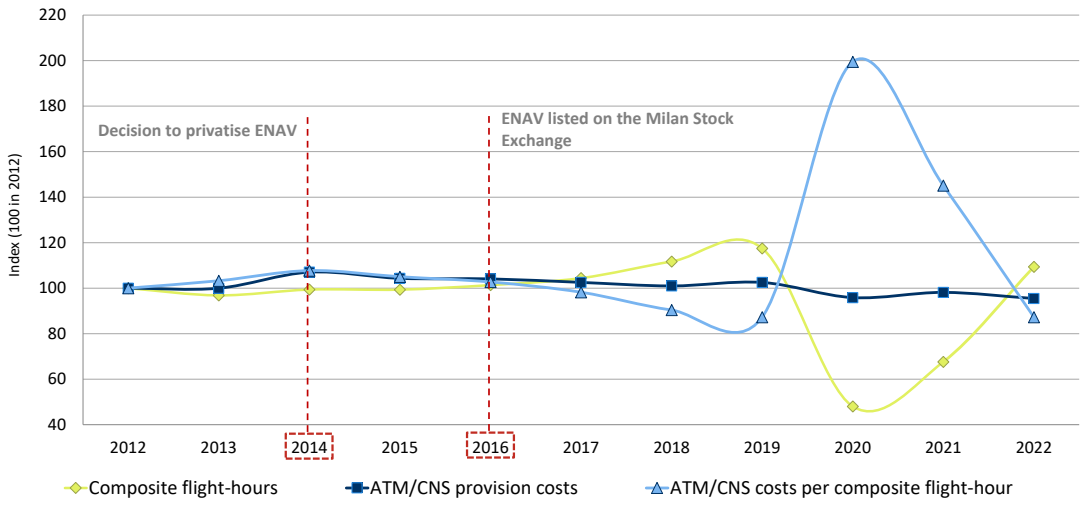


Figure 6.11: Trends in costs, traffic and unit costs for ENAV

ENAV has been significantly affected by the traffic decline in 2020 (-59.1%), and although the traffic has recovered substantially by 2022, it remained below 2019 levels (-6.9%). In the meantime, cost-containment measures led to a reduction in ATM/CNS provision costs (-6.9% vs. 2019). As a result, the financial cost-effectiveness indicator in 2022 almost matched pre-pandemic levels (+0.01% vs. 2019).

[32] Extraordinary dividend distributed in 2015 following voluntary reduction in shareholder equity. No dividends were paid out for 2020 due to COVID-19 pandemic.

6.3.2 ANSPs' corporate governance arrangements and decision making processes

Corporate governance arrangements can significantly impact the performance incentives for an organisation, although this impact may depend on certain characteristics of the arrangements that are not always apparent in the structures.

One observable factor is the widespread practice in governance arrangements such as the separation of responsibilities between a supervisory board and a management or executive board. This, as well as the composition of the Board, may create incentives at the highest level of the ANSP to prioritise performance management.

Based on information collected as part of the ACE benchmarking process, it appears that a majority of ANSPs are governed by a supervisory board which oversees the appointment of the executive board of directors. By construction, DSNA, DCAC Cyprus, HASP and PANSA, which are State bodies, have no supervisory board structure. MUAC's activities are supervised by a group composed of civil and military representatives of the four States (Belgium, Germany, Luxembourg and the Netherlands).

A more detailed description of each ANSP corporate governance structure is available in their individual factsheet[33].

The exercise of government control may influence the behaviour and decisions of the ANSP when it comes to, among others, investment strategies, staff and recruitment policies. A key element which can affect ANSP's behaviour is the process by which decisions are made and signed off. Another element to consider is the existence of public service obligations. These are services or actions that the ANSP is obliged to undertake by the government for public service reasons, yet they might not directly contribute to improve performance. An example found in some European ANSPs is the obligation to provide terminal ANS at regional airports.

[33] Available online on https://ansperformance.eu/economics/ace/ansp-institutional/

6.4 A view on ANS cost-effectiveness performance through regulatory, institutional and governance arrangements

6.4.1 Trends in traffic, ATM/CNS provision costs, unit costs and ATFM delays

Figure 6.12 provides a long-term trend analysis showing the changes in traffic, ATM/CNS provision costs, unit costs and ATFM delays over the 2004-2022 period. It should be noted that this analysis is based on a reduced sample of ANSPs which consistently provided ACE data since 2004 (ARMATS, BHANSA, PANSA, Sakaeronavigatsia and SMATSA are excluded). For this reason, the changes shown in this section may differ from the information presented in other sections of the report.

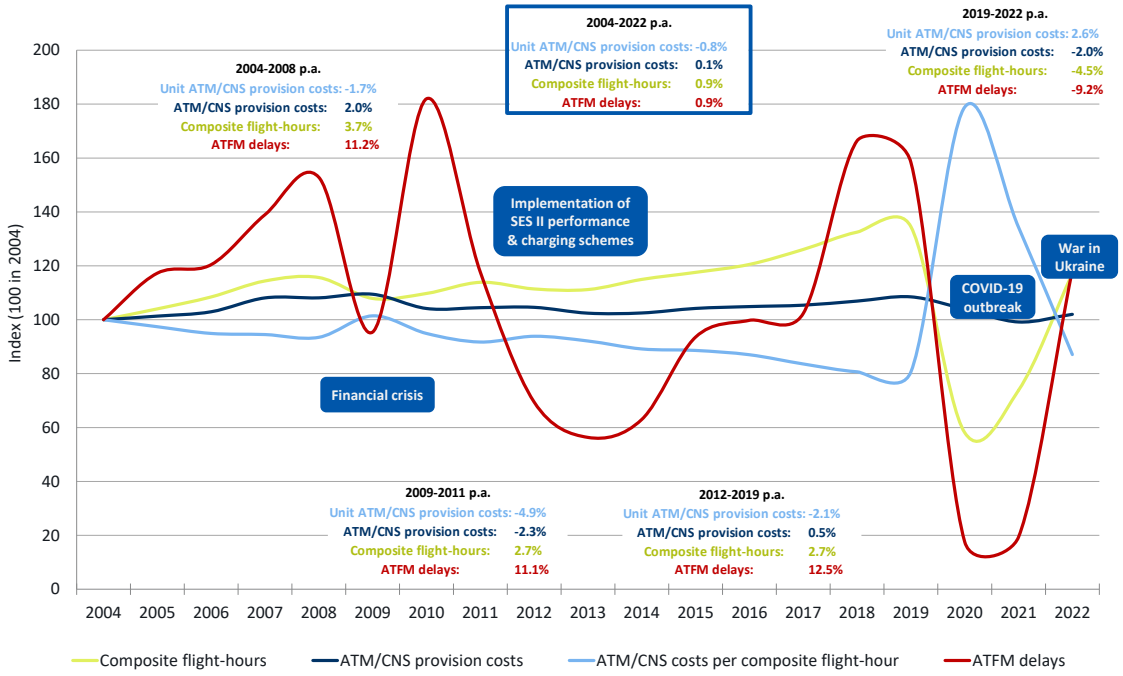


Figure 6.12: Long-term trends in traffic, ATM/CNS provision costs, unit costs and ATFM delays

Between 2004 and 2008, a period of sustained traffic growth, the number of composite flight-hours rose faster (+3.7% p.a.) than ATM/CNS provision costs (+2.0% p.a.). As a result, unit ATM/CNS provision costs decreased by an average of -1.7% p.a. This showcased the ability of the ATM industry to reduce unit costs in a context of a strong and steady traffic growth. However, ATM delays rose by +11.2% over this period, indicating the presence of capacity issues in some ANSPs.

In 2009, following the **global financial crisis**, traffic fell by -6.7% compared to 2008. Meanwhile, ATM/CNS provision costs continued to grow (+1.2%). As a result, unit ATM/CNS provision costs increased by +8.5%, reaching a level slightly higher than in 2004. ATFM delays substantially fell that year (-37.6%) as a direct result from the decrease in traffic.

Over the 2009-2011 period, traffic recovered (+2.7% p.a.) and ATM/CNS provision costs decreased by -2.3% p.a., leading to a substantial reduction in unit ATM/CNS provision costs (-4.9% p.a.). This performance improvement reflects the impact of the cost containment measures implemented by a majority of ANSPs in the wake of the sharp traffic decrease in 2009. However, ATFM delays exceptionally rose in 2010 (by +90.7% compared to the preceding year), reflecting staff shortages following the implementation of new systems in some ACCs and social tensions.

Between 2012 and 2019, ATM/CNS provision costs slightly rose (+0.5% p.a.) in a context of traffic growth (+2.7% p.a.). As a result, unit ATM/CNS provision costs reduced by -2.1% p.a. over this period. The **implementation of the SES II performance and charging schemes** regulations with the first and second reference periods (RP1 covering 2012-2014 and RP2 covering 2015-2019) had an impact on the trends in costs and unit costs for ANSPs operating in States bound to SES regulations. Figure 6.12

shows that during this period, ATFM delays substantially rose (+12.5% p.a.) reflecting significant capacity issues for several ANSPs.

In 2020, the **COVID-19 pandemic** and ensuing mobility restrictions led to an unprecedented downturn in traffic (-56.8%) and as a result, unit ATM/CNS costs more than doubled.

Despite successive increases in 2021 and 2022, the number of composite flight-hours in 2022 remains some -13% lower than in 2019. ATM/CNS provision costs decreased over this period (-2.0% p.a.) and they remain some -6% lower in 2022 than in 2019. **Russia's invasion of Ukraine** in February 2022 had a profound impact on the traffic flows in Europe, leading to airspace closures as well as reciprocal sanctions on air carriers issued by the Western countries and the Russian Federation.

Overall, in 2022 the main ACE indicators and metrics are close to the levels observed in 2004. However, Figure 6.12 and the analysis presented above demonstrate that comparing the start and end points of these time series may be misleading. The ANS industry faced a number of changes and challenges during this period which substantially affected cost and traffic developments. Therefore, for the purposes of this Chapter, focus will be directed towards the 2012-2022 period, characterised by the implementation of the performance and charging schemes regulations.

In an attempt to have a quantitative view on the impact of economic regulation on ANSPs cost-effectiveness performance, ANSPs will be split into two groups:

- those operating under an economic regulation regime (30 ANSPs, including 29 operating under SES regulations and NATS), and;
- those operating under full cost-recovery (6 ANSPs[34]).

While there is heterogeneity within both groups, it is particularly important to note that, within the full cost-recovery group, DHMI accounted for 74% of ATM/CNS provision costs in 2022. Consequently, DHMI significantly influences the average levels and trends observed for that group.

The figures below show the changes in traffic, ATM/CNS provision costs, unit costs and ATFM delays over the 2012-2022 period for ANSPs operating under economic regulation (Figure 6.13) and those operating under the full cost-recovery regime, respectively (Figure 6.14).

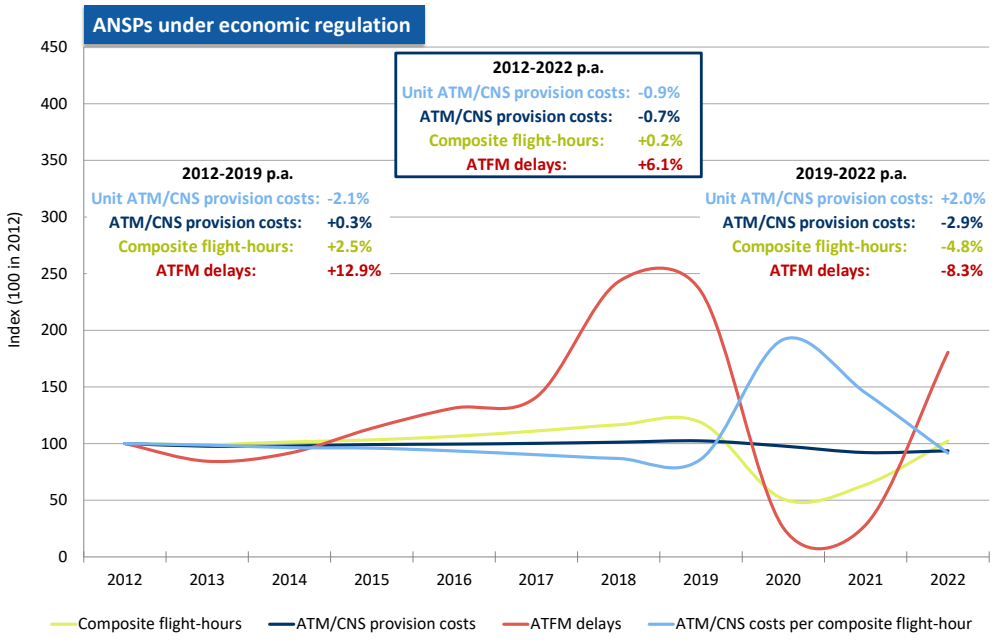


Figure 6.13: Changes in traffic, ATM/CNS provision costs, unit costs and ATFM delays for ANSPs under economic regulation

[34] Albcontrol, ARMATS, DHMI, M-NAV, MOLDATSA and SMATSA.

Between 2012 and 2019, unit ATM/CNS provision costs decreased for ANSPs under economic regulation (-2.1% p.a.) as costs remained rather constant (+0.3% p.a.) amidst an increase in traffic (+2.5% p.a.). The target-setting and monitoring processes integral to SES II regulations contributed to provide incentives for these ANSPs to effectively manage their costs during RP1 and RP2.

For the ANSPs operating under full cost-recovery, ATM/CNS provision costs and composite flight-hours rose at the same pace (+5.8% p.a.). As a result, unit ATM/CNS provision costs remained relatively stable for these ANSPs (-0.1% p.a.).

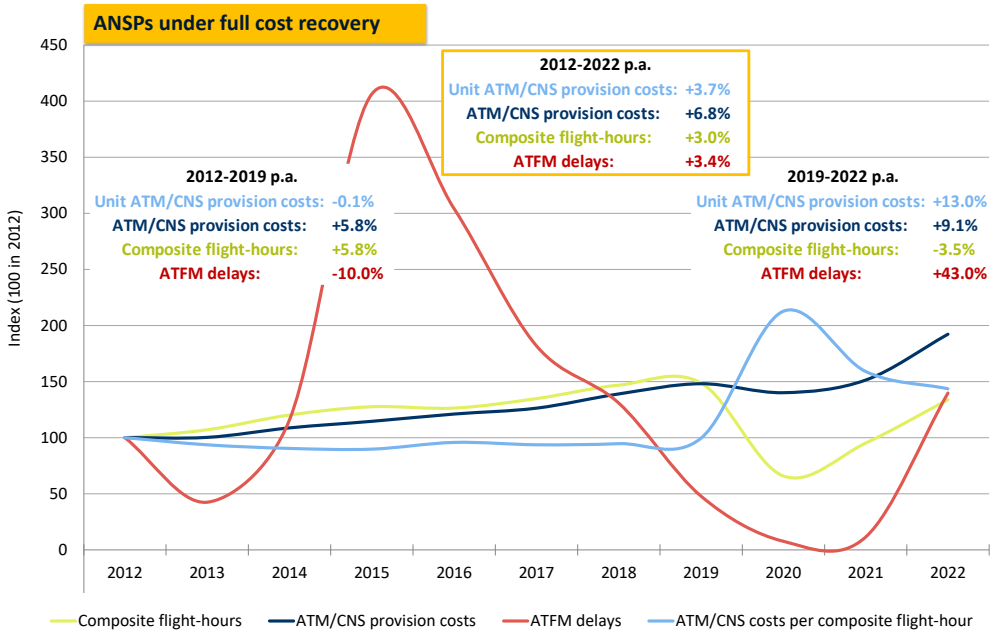


Figure 6.14: Changes in traffic, ATM/CNS provision costs, unit costs and ATFM delays for ANSPs under full cost-recovery

Between 2012 and 2019, the number of minutes of ATFM delays generated by the ANSPs operating under economic regulation significantly increased (+12.9% p.a.) reflecting the emergence of capacity challenges for some ANSPs amid rising traffic demand (+2.5% p.a.). Conversely, ATFM delays for ANSPs operating under full cost-recovery reduced (-10.0% p.a.) over this period. However, Figure 6.14 indicates that, for these ANSPs, a massive amount of ATFM delays was generated in 2015 (some 2.6 million minutes), mainly attributed to DHMI and reflecting airport capacity and weather issues at Istanbul airports.

Figure 6.13 and Figure 6.14 also show that the trends between the two groups differed during the COVID-19 crisis. Indeed, while ANSPs subject to economic regulation reduced ATM/CNS provision costs (-2.9% p.a.), the costs of ANSPs operating under full cost-recovery rose by +9.1% p.a. on average over 2019-2022 period. The latter is largely driven by DHMI whose ATM/CNS provision costs grew by +14.2% p.a. over this period. Excluding DHMI from the full cost-recovery group would result in significantly different trends. Over the period from 2012 to 2022, the change in unit ATM/CNS provision cost would be - 0.7% p.a., which is much closer to the average trend observed in the economically regulated group (-0.9% p.a.).

Figure 6.15 shows the changes in ATM/CNS provision costs and traffic between 2012 and 2019 for economically regulated and full cost-recovery ANSPs. It shows significant dispersion within the two groups.

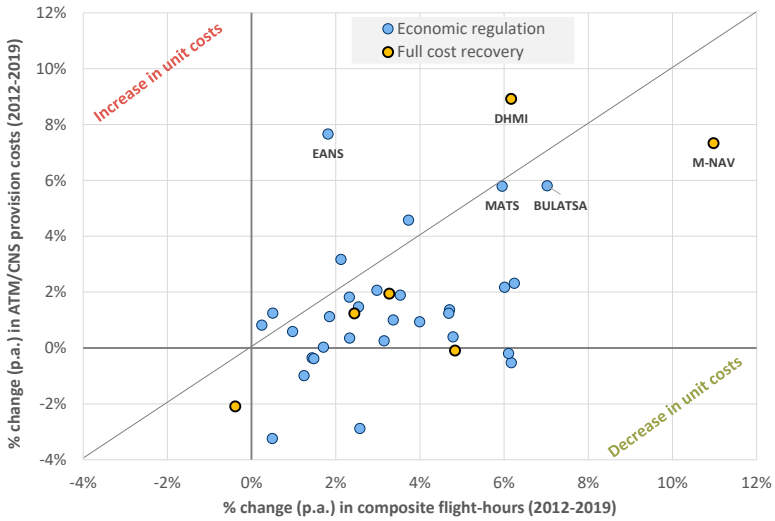


Figure 6.15: Changes in traffic and costs, 2012-2019

For example, among the ANSPs recording the largest cost increases (exceeding +5% p.a.), three operate under economic regulation (EANS, MATS and BULATSA) while two (DHMI and M-NAV) are under full cost-recovery. It is noteworthy that, except for EANS, these ANSPs faced a strong traffic growth over this period exceeding +6% annually.

Although the unit costs at Pan-European level remained relatively stable between 2012 and 2019, 30 out of 36 ANSPs managed to absorb traffic increase with a cost rise that was less than proportional, resulting in a reduction in unit costs for these ANSPs (see ANSPs below the diagonal line).

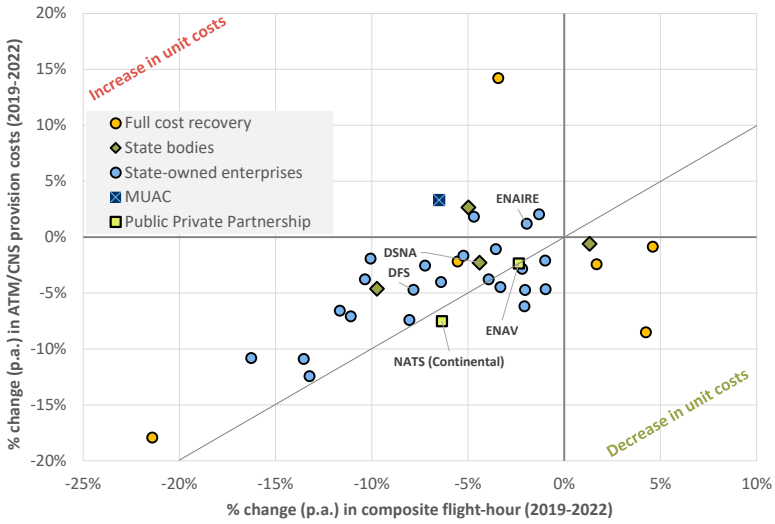


Figure 6.16: Changes in traffic and costs, 2019-2022

Figure 6.16 shows the changes in ATM/CNS provision costs and traffic between 2019 and 2022 for the ANSPs based on their legal status and regulatory regime. It should be noted that all full cost-recovery ANSPs operate as state-owned enterprises, therefore, for simplicity, they are indicated as "Full cost-recovery" in the figure while the "State-owned enterprises" refer to economically regulated ANSPs.

In the period from 2019 to 2022, a majority of ANSPs have managed to reduce their costs in response to the COVID-19 pandemic. When considering the differences in regulatory regimes and legal status, it is difficult to draw a clear link with performance. Nevertheless, focusing on the five largest ANSPs, which share commonalities such as size, regulatory regime and comparable cost of living, distinct variations based on their legal statuses are observed. In particular, NATS and ENAV (both Public Private Partnerships) achieved greater reductions in unit costs compared to DFS and ENAIRE (State-owned enterprises) or DSNA (State body). The position of ENAIRE should however be interpreted with caution since large exceptional costs were recorded in 2022. If these costs were excluded, ENAIRE would show a reduction in unit costs between 2019 and 2022.

6.4.2 ATCO-hour productivity

Figure 6.17 below presents the average ATCO-hour productivity levels and trends for the ANSPs subject to economic regulation and those operating under full cost-recovery. For the second group, the bars indicate the group average (six ANSPs) and the dots depict the average when DHMI is excluded from the group.

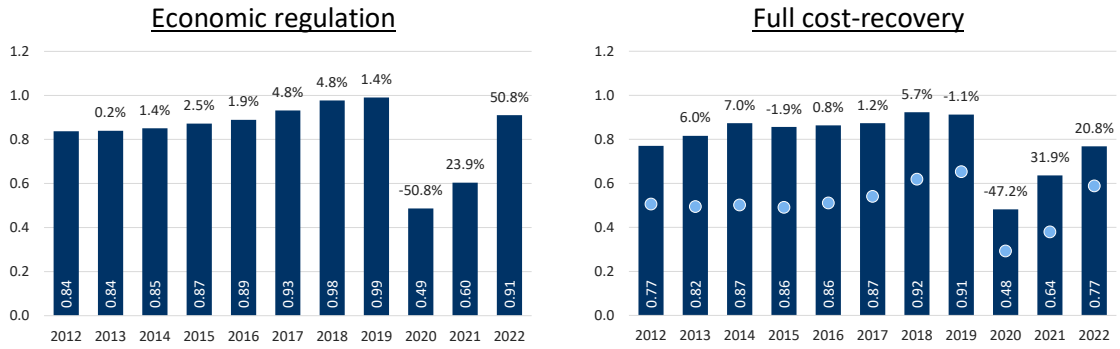


Figure 6.17: Trends in ATCO-hour productivity (regulated vs. full cost-recovery)

Figure 6.17 shows that, on average, ATCO-hour productivity for full cost-recovery ANSPs is slightly lower than that of the economically regulated ANSPs. However, the gap between the two groups becomes more pronounced when excluding DHMI.

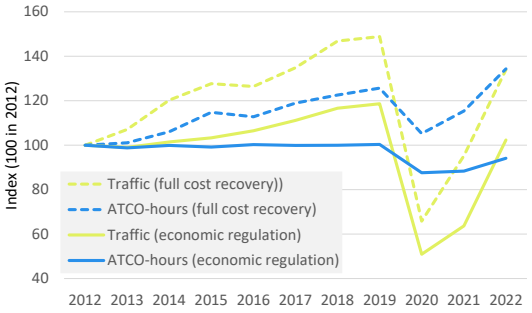


Figure 6.18: Trends in traffic and ATCO-hours (regulated vs. full cost-recovery)

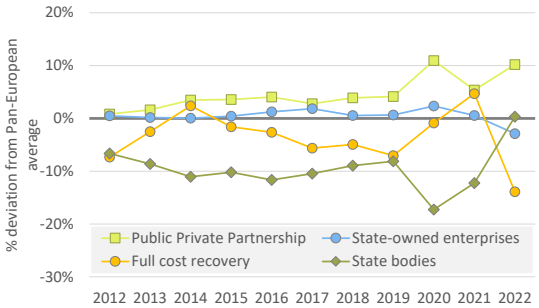


Figure 6.19: Productivity for ANSPs by regulatory and legal status

Between 2012 and 2019, the ATCO-hour productivity increased for both groups but driven by different trends. The ANSPs subject to economic regulation (represented by plain lines in Figure 6.18) maintained the ATCO-hours mostly constant, while ANSPs operating under full cost-recovery (represented by dotted lines) increased the ATCO-hours on duty, albeit at a slower pace than traffic.

Figure 6.19 presents an analysis of the average ATCO-hour productivity for ANSPs, categorized by their legal status[35] and regulatory regime[36], showing the percentage deviation of these different groups from the Pan-European average. Generally, for economically regulated ANSPs, those operating as state-owned enterprises (represented by blue dots) remained close to the average, those operating as State bodies consistently fell below the average (except in 2022), while the PPPs consistently exceeded the Pan-European average productivity.

Notably, in 2020, when traffic collapsed, State bodies and PPPs exhibited contrasting trends: State bodies experienced a more significant productivity drop, while PPPs saw a less severe decline. This discrepancy may indicate varying degrees of flexibility influenced by the legal status of the ANSPs. However, the observed trends remain average values sometimes masking very different situations at ANSP level, and the fact that many other factors affect ANSPs productivity.

6.4.3 ATCO employment costs per ATCO-hour

Figure 6.20 below presents the ATCO employment costs per ATCO-hour for the ANSPs subject to economic regulation and those operating under full cost-recovery. For the second group, the bars

[35] Although the privatisation of ENAV took place in 2016, ENAV has been classified in the public private partnership group for the whole period (2012-2022).
[36] All ANSPs operating under full cost-recovery are State-owned enterprises.

indicate the average calculated for the six ANSPs, and the dots depict the average when DHMI is excluded from the group.

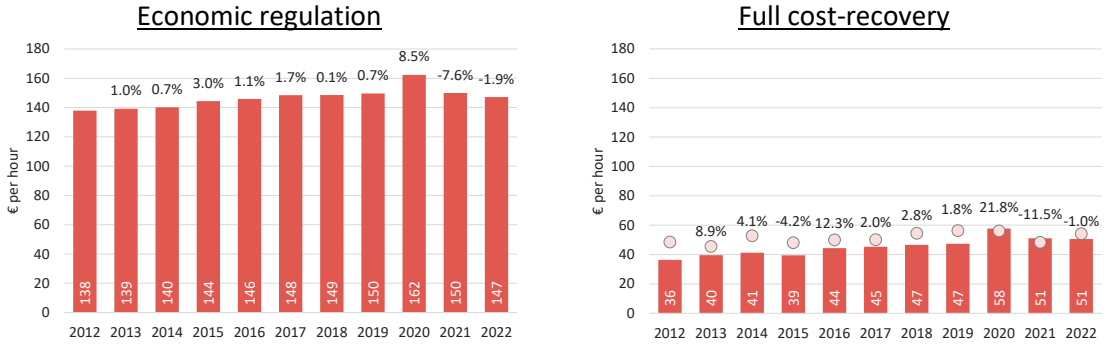


Figure 6.20: Trends in ATCO employment costs per ATCO hour (regulated vs. full cost-recovery)

Figure 6.20 above shows that ATCO employment costs for ANSPs subject to economic regulation were, on average, triple those for full cost-recovery ANSPs. It also shows that between 2012 and 2022, unit ATCO employment costs grew significantly more for ANSPs under full cost-recovery. To that end, it is important to remember that full cost-recovery ANSPs typically operate in countries with a lower cost of living. As shown in section 3.4, when adjusting the employment costs for cost of living, the disparity continues to exist, but in a significantly reduced magnitude.

6.4.4 Support costs per composite flight-hour

Figure 6.21 below presents the support costs per composite flight-hour for the ANSPs subject to economic regulation and those operating under full cost-recovery. For the second group, the bars indicate the average calculated for the six ANSPs, and the dots depict the average when DHMI is excluded from the group.

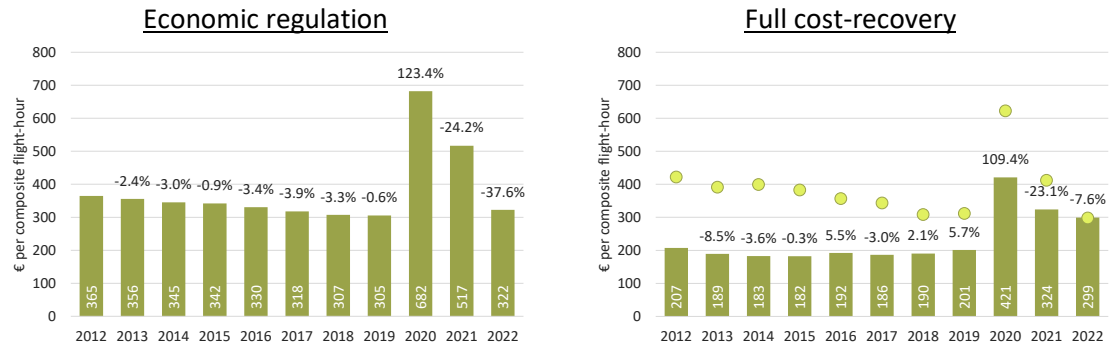


Figure 6.21: Trends in support costs per composite flight-hour (regulated vs. full cost-recovery)

Figure 6.21 shows that unit support costs for full cost-recovery ANSPs are substantially lower than those for economically regulated ANSPs. However, when DHMI is excluded, a different situation is observed, with relatively higher unit support costs for the full cost-recovery group and a 2012-2019 trend which is more in line with that observed for economically regulated ANSPs.

Support staff costs being a main component for support costs, it is interesting to look at differences in the number of staff employed by the different types of organisations. Given the large heterogeneity of ANSPs in terms of size, the indicator used for this analysis is the number of support staff per composite flight-hour.

Figure 6.23 shows that, on average, full cost-recovery ANSPs employed more support staff per composite flight-hour and recorded a greater reduction in support staff numbers between 2012 and 2019. In addition to the incentives possibly created by differences in regulatory regime or legal status, it is important to consider that apart from DHMI, full cost-recovery ANSPs are relatively small, which limits the possibility to exploit economies of scale. Considering the ANSPs subject to economic regulation, those operating as public private partnerships consistently recorded a lower number of support staff per unit of output over the 2012-2022 period.

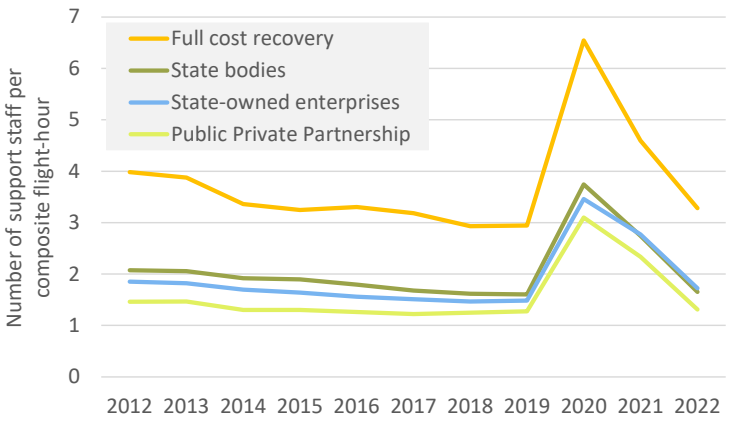


Figure 6.23: Trends in the number of support staff per composite flight-hour by regulatory and legal status of ANSPs

Following the unprecedented decline in traffic in 2020, several ANSPs implemented temporary or permanent redundancy programmes. Figure 6.22 illustrates that numerous ANSPs achieved significant reductions in support staff, regardless of regulatory regime and legal status. However, it should be noted that for some full cost-recovery ANSPs (ARMATS, MOLDATSA, M-NAV and Albcontrol), the relatively large reductions mostly reflect the fact that these ANSPs started from a position of very high number of support staff per composite flight-hour. In contrast, some ANSPs such as EANS, HASP, LFV and NATS could also achieve noteworthy reductions even though they began from a relatively lower staffing position.

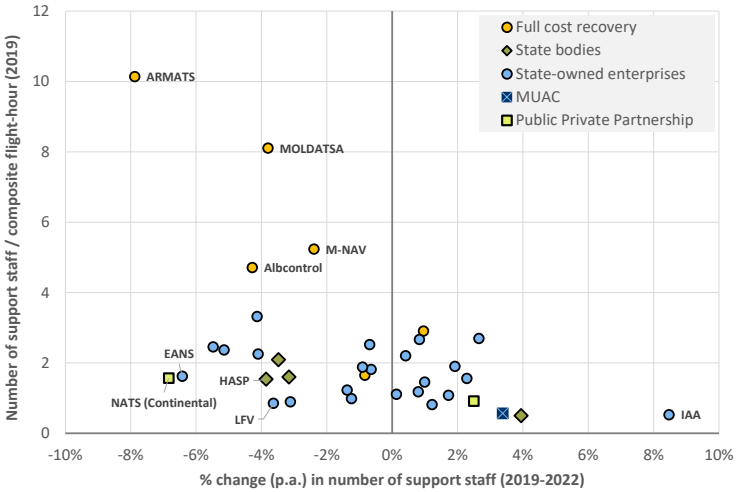


Figure 6.22: Changes in number of support staff (2019-2022)

The analysis presented in this chapter was a first attempt to examine the levels and trends in performance in the context of different regulatory and legal set-up of ANSPs. The analysis developed at system level clearly showed that while, overall, ANSPs subject to economic regulation could maintain their cost-base fairly stable between 2012 and 2019, some of them exhibited substantial capacity issues especially in 2018 and 2019.

It is generally considered that factors such as the regulatory, institutional and governance arrangements will not affect ANSPs cost-effectiveness performance directly; rather they act as incentives or constraints affecting other elements (e.g. the overall business objectives or the internal organization). The analysis developed in this chapter did not allow to identify clear and straightforward relationships between each of these factors and individual ANSPs performance. This is certainly due to the fact that other elements such as the economic environment and the operational conditions in which the ANSP operate, or its organizational, managerial and financial setup also have an impact on its cost-effectiveness performance.

6.5 Introduction of competition for the terminal ANS provision market

The aim of this section is to provide a high-level overview of the competition in the terminal air navigation services (TANS) market. While the TANS market has been liberalised to some degree in several European countries, this analysis focuses on three States with the largest liberalised TANS markets – the United Kingdom, Spain, and Sweden.

ANS in Europe have traditionally been provided by monopoly entities. These organisations typically have exclusive rights to provide en-route services in their home countries, limiting competition within and for the market. To promote liberalisation, a certain form of competition has been introduced for the terminal ANS market.

States opting for the liberalisation of their TANS markets usually aim to strengthen the performance of this segment of activity. In theory, competition for the market is expected to incentivise service providers to innovate and operate as efficiently as possible to either win contracts or maintain their position as incumbents.

In some countries, ANSPs can compete for licenses to provide terminal services at specific airports through a bidding process. Once awarded, the ANSP holds the right to provide services at the airport for a determined period, typically ranging from 5 to 10 years, after which a new bidding process is launched. Franchise bidding processes for the provision of TANS are mainly implemented at regional airports. One notable exception is London Gatwick – a major national airport, where TANS have been provided by Air Navigation Solutions (ANSL), a subsidiary of DFS, between 2016 and 2022. Although the focus is mainly on ATC provision, the scope of services tendered out varies across airports, and can also include AFIS, CNS, aeronautical engineering, as well as consultancy and training services.

Table 6.1 below shows high-level information on the service providers selected to provide ANS in the airports of the United Kingdom, Spain, and Sweden. The table also indicates the number of airports where a franchise bidding process is in place, as well as their market share in terms of IFR airport movements in the country.

Country	Service provider	Number of airports serviced	Market share (% of total IFR airport movements)
UK[37]	NATS	16	61%
	Other ANS providers	101	39%
Spain	ENAIRE	21	75%
	SAERCO	14	12%
	Skyway ANS	8	13%
Sweden	LFV	11	86%
	Aviation Capacity Resources AB (ACR)	17	12%
	Saab Digital Air Traffic Solutions (SDATS)	4	2%
	Arvidsjaur airport	1	1%

Table 6.1: Overview of selected liberalised TANS markets in 2022

Given the competitive nature of tendering in a liberalised TANS market, there is limited disclosure of information underpinning the service provision contracts signed between the ANS provider and the airport or the civil aviation authority. Therefore, it is difficult to quantitatively assess the impact and potential cost-effectiveness improvements that could be achieved following the implementation of a competitive bidding process.

In the United Kingdom, the publication of the Airports Act (c. 31) in 1986 initiated, among others, the liberalisation of the provision of ANS in the country (see also Case Study 1, p.55). In 2022 NATS, the incumbent ANSP, provided TANS in 16 airports out of 117[37] where terminal ANS provision is

[37] Only the airports with more than 50 IFR airport movements in 2022 are considered for this list.

open for competition. While there are more than 50 other terminal ANS providers certified by the Civil Aviation Authority (CAA),[38] most of these providers represent local providers or insourcing of tower control and terminal activities by the airport. This is the case, for instance, at Birmingham, East Midlands and Newcastle airports. In 2022, NATS held a market share of some 61% of the total IFR airport movements.

In the case of Spain, the liberalisation of TANS at airports began in 2011 with the opening of 12 airports to competition. Currently, two companies operate in the Spanish TANS market alongside ENAIRE – SAERCO, which in 2022 was providing services in 14 Spanish airports, and Skyway ANS providing TANS in 8 airports. In 2022, these two private providers represented some 25% of the total IFR airport movements controlled in Spain.

Sweden is also among the countries that opened up the provision of TANS to competition in regional airports. In 2022, certified ATC service providers in Sweden include LFV – the national ANSP, providing TANS in 11 airports, followed by ACR (which provides ATC/AFIS at 17 airports), SDATS (4 airports), and Arvidsjaur airport which internalised TANS provision. These three providers, taken together, controlled approximately 14% of IFR airport movements in Sweden in 2022.

It should also be mentioned that terminal ANS market has been liberalised in Norway. In addition to Avinor Flysikring, which operates most of the civil airports, SAERCO provides terminal ANS in two airports – Alesund and Kristiansand Kjevik totalling 27 thousand IFR airport movements (compared to some 570 thousand controlled by LFV). Similarly, in Germany DFS Aviation Services (a for-profit subsidiary of DFS) provided ATC services in 9 German airports in 2022 representing some 100 thousand movements (compared to almost 1.5M served by DFS).

As shown in this section, over the years, competition for the provision of ANS has been gradually introduced in the terminal market. Overall, liberalisation is expected to foster innovation, improve service quality, and drive efficiencies while ensuring the safety and reliability in the provision of air navigation services. This is another important institutional change for the ANS industry that adds up to the elements already identified in this chapter such as the implementation of the SES regulations, the changes in ANSPs structure, legal status, or ownership.

[38] The full list is available on the UK CAA website.

ANNEX 1 – STATUS OF ANSPS 2022 ANNUAL REPORTS

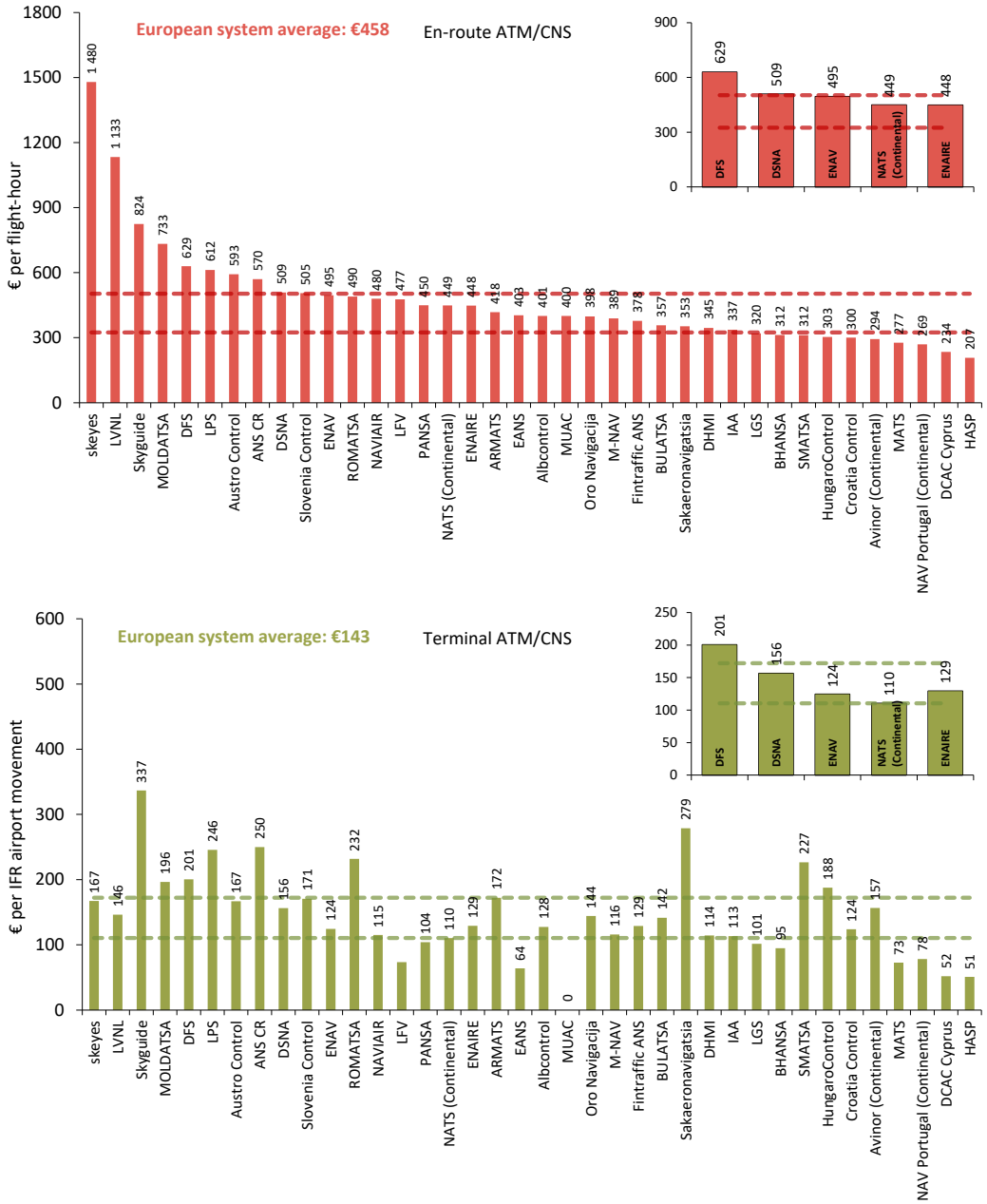
	Availability of a public Annual Report (AR)	Availability of Management Report	Availability of Annual Accounts	Independent audited accounts	Separate disclosure of en-route and terminal ANS costs	Information provided in English	Accounts fully or partially prepared according to IFRS	PRU comments
Albcontrol	✓	✓	✓	✓	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	✓	✓	
IAA	✓	✓	✓	✓	No	✓	✓	The financial statements are prepared in accordance with Financial Reporting Standard 102 ('FRS102') which is IFRS for medium sized entities.
LFV	✓	✓	✓	✓	No	✓	No	
LGS	✓	✓	✓	✓	No	No	✓	
LPS	✓	✓	✓	✓	No	✓	✓	
LVNL	✓	✓	✓	✓	✓	No	✓	Separate disclosure of aggregated figures for en-route and terminal ANS.
MATS	✓	No	✓	✓	✓	✓	✓	
M-NAV	✓	✓	✓	✓	No	No	✓	
MOLDATSA	✓	✓	✓	✓	No	No	No	
MUAC	✓	✓	✓	✓	n/appl	✓	✓	
NATS	✓	✓	✓	✓	✓	✓	✓	Several Annual Reports for individual group companies.
NAV Portugal	✓	✓	✓	✓	✓	✓	✓	
NAVIAIR	✓	✓	✓	✓	✓	✓	No	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	✓	✓	✓	✓	✓	
ROMATSA	✓	No	✓	✓	No	No	✓	
Sakaeronavigatsia	✓	No	✓	✓	No	✓	✓	Only annual accounts are available in English.
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 2022 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, 2022

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€119 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
Albcontrol	25 727	1	0	1	0.0%	161	63	411	3	414
ANS CR	129 919	730	6	736	3.9%	87 606	210	620	418	1 037
ARMATS	13 896	0	0	0	0.0%	0	28	488	0	488
Austro Control	233 790	78	21	99	0.5%	11 825	393	596	30	626
Avinor (Continental)	186 924	3	20	24	0.1%	2 809	490	382	6	387
BHANSA	28 737	183	0	183	1.0%	21 801	91	314	239	553
BULATSA	114 852	0	0	0	0.0%	6	312	368	0	368
Croatia Control	88 889	408	0	408	2.2%	48 518	280	317	173	490
DCAC Cyprus	43 041	0	2	3	0.0%	298	187	230	2	231
DFS	1 091 344	5 456	210	5 666	30.0%	674 244	1 669	654	404	1 058
DHMI	595 219	0	161	161	0.9%	19 186	1 658	359	12	370
DSNA	1 363 412	4 343	548	4 890	25.9%	581 967	2 627	519	222	740
EANS	21 759	0	0	0	0.0%	10	58	374	0	375
ENAIRE	884 452	588	331	919	4.9%	109 381	1 955	453	56	508
ENAV	716 020	254	94	347	1.8%	41 337	1 474	486	28	514
Fintraffic ANS	56 320	0	4	4	0.0%	502	137	410	4	414
HASP	160 564	138	336	474	2.5%	56 358	790	203	71	274
HungaroControl	102 952	674	0	674	3.6%	80 235	306	337	262	599
IAA	125 653	1	18	19	0.1%	2 266	357	352	6	358
LFV	182 250	22	8	30	0.2%	3 621	420	434	9	442
LGS	22 427	0	0	0	0.0%	2	68	331	0	331
LPS	59 659	2	0	2	0.0%	233	94	635	2	638
LVNL	227 574	20	413	433	2.3%	51 548	268	849	192	1 041
MATS	20 898	0	0	0	0.0%	0	76	275	0	275
M-NAV	17 965	30	0	30	0.2%	3 524	46	392	77	469
MOLDATSA	7 101	0	0	0	0.0%	0	10	723	0	723
MUAC	218 298	138	n/appl	138	0.7%	16 371	546	400	30	430
NATS (Continental)	706 261	530	322	853	4.5%	101 481	1 608	439	63	502
NAV Portugal (Continental)	140 396	404	493	897	4.8%	106 717	515	273	207	480
NAVIAIR	120 673	1	2	2	0.0%	280	261	462	1	463
Oro Navigacija	26 511	0	0	0	0.0%	48	62	428	1	429
PANSA	202 333	669	11	680	3.6%	80 945	466	434	174	607
ROMATSA	232 466	0	5	5	0.0%	582	437	532	1	533
Sakaeronavigatsia	30 947	0	0	0	0.0%	0	67	463	0	463
skeyes	196 616	90	11	101	0.5%	12 052	184	1 069	66	1 134
Skyguide	396 326	242	140	381	2.0%	45 384	428	927	106	1 033
Slovenia Control	34 932	0	0	0	0.0%	19	68	516	0	516
SMATSA	96 460	711	1	712	3.8%	84 738	267	362	318	679
Total Pan-European System	8 923 563	15 716	3 158	18 874	100%	2 246 051	18 976	470	118	589

Annex 2 - Table 0.1: Economic cost-effectiveness indicator, 2022

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[39]. 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	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*
Albcontrol	AL	1.14	0.98	3.78	0.31	3.71	0.86
ANS CR	CZ	0.76	0.67	1.41	0.80	0.95	0.69
ARMATS	AM	0.96	0.31	4.73	0.66	1.46	0.83
Austro Control	AT	0.79	1.08	0.75	0.97	0.81	0.78
Avinor (Continental)	NO	1.23	0.98	0.95	1.32	0.93	1.45
BHANSA	BA	1.50	0.59	3.06	0.83	1.80	1.39
BULATSA	BG	1.28	0.97	1.35	0.98	1.31	1.26
Croatia Control	HR	1.48	1.01	1.43	1.02	1.45	1.50
DCAC Cyprus	CY	2.05	1.09	2.01	0.94	2.18	1.99
DFS	DE	0.72	1.07	0.55	1.23	0.59	0.81
DHMI	TR	1.31	0.94	2.70	0.52	2.53	1.07
DSNA	FR	0.91	1.00	1.03	0.88	1.02	0.86
EANS	EE	1.26	0.94	1.39	0.96	1.31	1.23
ENAIRE	ES	1.04	1.07	0.82	1.19	0.87	1.14
ENAV	IT	0.97	1.03	0.87	1.07	0.90	1.00
Fintraffic ANS	FI	1.15	0.60	1.82	1.06	1.08	1.18
HASP	GR	2.31	1.10	1.71	1.23	1.88	2.60
HungaroControl	HU	1.40	1.26	1.66	0.67	2.09	1.21
IAA	IE	1.34	1.06	1.27	0.99	1.35	1.33
LFV	SE	1.08	0.78	0.95	1.46	0.74	1.39
LGS	LV	1.42	0.77	2.58	0.71	1.99	1.25
LPS	SK	0.74	0.64	1.22	0.94	0.79	0.72
LVNL	NL	0.55	0.93	1.27	0.47	1.18	0.44
MATS	MT	1.71	0.75	2.66	0.86	1.98	1.61
M-NAV	MK	1.20	0.55	2.22	0.98	1.22	1.19
MOLDATSA	MD	0.65	0.13	6.85	0.71	0.92	0.57
MUAC		1.18	2.28	0.41	1.27	0.93	1.34
NATS (Continental)	UK	1.07	1.19	0.84	1.07	1.00	1.11
NAV Portugal (Continental)	PT	1.72	1.40	0.88	1.39	1.24	2.11
NAVIAIR	DK	1.02	1.01	1.05	0.96	1.06	1.00
Oro Navigacija	LT	1.10	0.54	2.53	0.80	1.38	1.00
PANSA	PL	1.08	0.93	1.05	1.11	0.98	1.14
ROMATSA	RO	0.88	0.76	1.10	1.05	0.84	0.90
Sakaeronavigatsia	GE	1.02	0.49	6.08	0.34	2.95	0.78
skeyes	BE	0.44	0.81	0.75	0.73	0.60	0.39
Skyguide	CH	0.51	1.05	0.58	0.83	0.61	0.47
Slovenia Control	SI	0.91	0.65	1.24	1.13	0.81	0.97
SMATSA	RS/ME	1.30	0.86	1.85	0.82	1.59	1.20
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, 2022

[39] 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.

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.

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).

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:

1.04	ENAIRE's gate-to-gate **ATM/CNS costs per composite flight-hour** are **-4% lower** (1/1.04 - 1) than the Pan-European average.
= 1.07	**ATCO-hour productivity** is **+7%** (1.07/1-1) **higher than** the Pan-European average.
x 0.82	The **ATCO employment costs per ATCO-hour** of ENAIRE are **+22% higher** (1/0.82 - 1) than the Pan-European average.
x 1.19	**Support cost ratio** is **-16% lower** (1/1.19 - 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):

0.87	ENAIRE's **ATCOs in OPS employment costs per composite flight-hour** are **+14% higher** (1/0.87 - 1) than the Pan-European average, while
1.14	The **support costs per composite flight-hour** are **-12% lower** (1/1.14 - 1) than the Pan-European average.

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

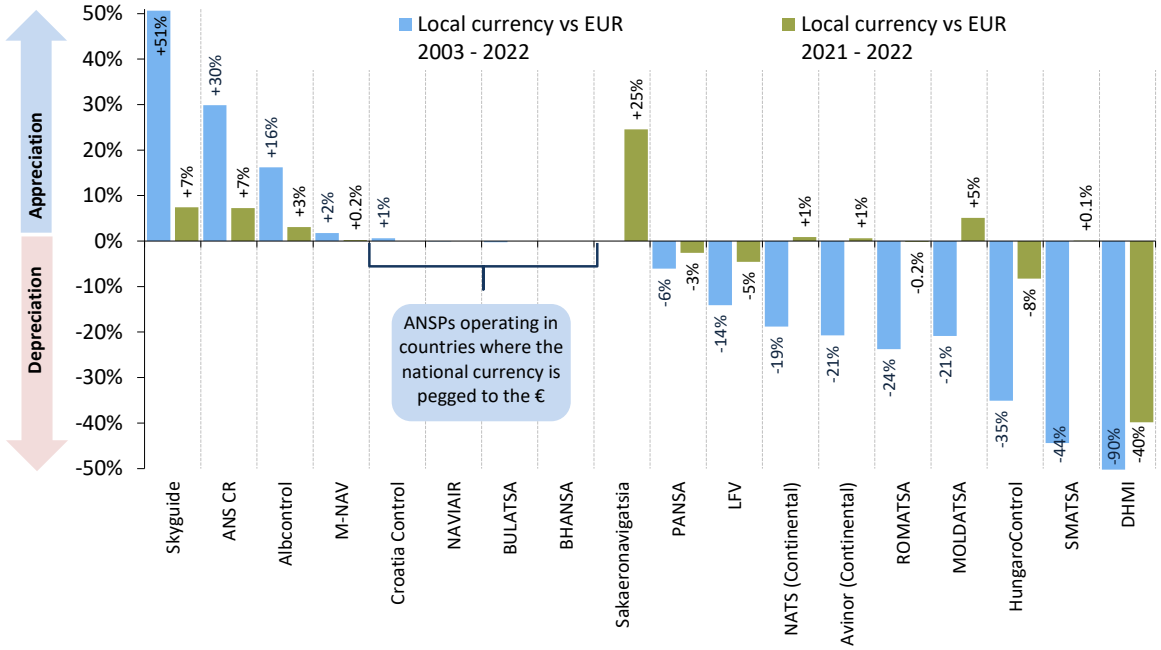
ANSPs	Countries	2022 Exchange rate (1€ =)	2022 Inflation rate (%)	2022 PPPs	Comments
Albcontrol	Albania	118.480	6.7	63.62	
ANS CR	Czech Republic	24.530	14.8	19.82	
ARMATS	Armenia	459.288	8.7	245.54	PPPs from IMF database
Austro Control	Austria	1	8.6	1.12	
Avinor (Continental)	Norway	10.096	6.2	13.56	
BHANSA	Bosnia and Herzegovina	1.956	14.0	1.08	
BULATSA	Bulgaria	1.955	13.0	1.18	
Croatia Control	Croatia	7.531	10.7	5.05	
DCAC Cyprus	Cyprus	1	8.1	0.91	
DFS	Germany	1	8.7	1.12	
DHMI	Türkiye	17.350	72.3	7.42	
DSNA	France	1	5.9	1.09	
EANS	Estonia	1	19.4	0.90	
ENAIRE	Spain	1	8.3	0.93	
ENAV	Italy	1	8.7	0.96	
Fintraffic ANS	Finland	1	7.2	1.24	
HASP	Greece	1	9.3	0.82	
HungaroControl	Hungary	390.405	15.3	252.86	
IAA	Ireland	1	8.1	1.19	
LFV	Sweden	10.624	8.1	13.47	
LGS	Latvia	1	17.2	0.80	
LPS	Slovak Republic	1	12.1	0.79	
LVNL	Netherlands	1	11.6	1.17	
MATS	Malta	1	6.1	0.89	
M-NAV	North Macedonia	61.493	14.2	29.21	
MOLDATSA	Moldova	19.788	28.6	10.51	PPPs from IMF database
MUAC		1	11.6	1.17	Netherlands' PPPs and inflation rate used for MUAC
NATS (Continental)	United Kingdom	0.852	9.1	1.01	PPPs from IMF database
NAV Portugal (Continental)	Portugal	1	8.1	0.84	
NAVIAIR	Denmark	7.437	8.5	9.91	
Oro Navigacija	Lithuania	1	18.9	0.75	
PANSA	Poland	4.680	13.2	2.88	
ROMATSA	Romania	4.928	12.0	2.76	
Sakaeronavigatsia	Georgia	3.041	11.9	1.42	PPPs from IMF database
skeyes	Belgium	1	10.3	1.12	
Skyguide	Switzerland	1.009	2.7	1.58	
Slovenia Control	Slovenia	1	9.3	0.85	
SMATSA	Serbia and Montenegro	117.389	12.0	68.47	Data for Serbia only since ACE data is provided in Serbian Dinar

Annex 4 - Table 0.1: 2022 Exchange rates, inflation rates and PPPs data

According to the PPP values published in the IMF World Economic Outlook April 2024 database, there is a factor of 1.31 between the PPPs for Georgia (0.935 GEL per international Dollar in 2022) and the PPPs for France (0.714 Euro per international Dollar). This factor is applied to the PPPs for France as reported in the EUROSTAT database (i.e. 1.086) to express the PPPs for Georgia in PPS (1.42 = 1.086 × 1.31). 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 2022 unit ATM/CNS provision costs when expressed in Euro (see Figure 3.8 on p.17). 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 2003-2022 period, while the orange bar displays the short-term changes (2021-2022).



Annex 4 - Table 0.2: Cumulative variations in exchange rates against the Euro, 2003-2022 and 2021-2022

Significant changes are observed over the 2003-2022 period for several ANSPs part of the ACE analysis. For example, the Swiss Franc significantly appreciated (51%) while the Turkish Lira substantially depreciated (90%). Other substantial variations in exchange rates compared to the Euro include the depreciation of the Serbian Dinar (44%) and Hungarian Forint (35%) while the Czech Koruna appreciated by 30%.

ANNEX 5 – KEY DATA

ANSPs	En-route ANS revenues (in €'000)										Terminal ANS revenues (in €'000)										Gate-to-gate ANS revenues (in €'000)									
	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**
Albcontrol	17 458	0	0	0	0	0	0	15	0	17 473	5 583	0	0	0	0	0	0	27	0	5 610	23 041	0	0	0	0	0	0	42	0	23 083
ANS CR	113 278	0	0	0	2 605	0	0	0	0	115 883	17 411	0	0	0	379	0	0	0	0	17 791	130 689	0	0	0	2 984	0	0	0	0	133 674
ARMATS	9 474	0	0	0	12	0	52	53	0	9 591	6 299	0	0	0	0	0	17	94	2	6 412	15 773	0	0	0	12	0	69	147	2	16 003
Austro Control	218 678	0	0	0	817	1 440	0	3 400	0	224 335	40 520	0	0	0	0	0	0	840	0	41 360	259 198	0	0	0	817	1 440	0	4 240	0	265 695
Avinor (Continental)	102 346	0	0	0	0	0	6 845	0	0	109 191	0	82 151	0	0	0	0	0	0	0	82 151	102 346	82 151	0	0	0	0	6 845	0	0	191 342
BHANSA	43 232	0	0	0	0	43	49	220	0	43 544	0	2 679	0	0	0	3	4	16	0	2 702	43 232	2 679	0	0	0	46	53	237	0	46 246
BULATSA	137 820	0	0	0	0	0	0	0	0	137 820	7 482	0	0	0	0	0	0	0	0	7 482	145 302	0	0	0	0	0	0	0	0	145 302
Croatia Control	104 152	0	4 548	0	344	0	0	0	0	109 044	18 319	0	0	0	186	0	0	0	0	18 505	122 471	0	4 548	0	530	0	0	0	0	127 549
DCAC Cyprus	45 932	0	0	0	0	0	0	0	0	45 932	0	0	0	0	0	7 861	0	0	0	7 861	45 932	0	0	0	0	7 861	0	0	0	53 793
DFS	629 960	0	0	0	0	0	94 364	0	0	724 324	228 317	0	0	0	0	0	34 200	0	0	262 517	858 277	0	0	0	0	0	128 565	0	0	986 842
DHMI	287 589	0	0	0	2 444	0	0	0	0	290 033	43 999	0	0	0	0	0	0	0	0	43 999	331 588	0	0	0	2 444	0	0	0	0	334 032
DSNA	1 368 078	0	0	0	19 178	0	0	0	0	1 387 256	190 601	0	0	0	43 056	26 000	0	0	0	259 657	1 558 679	0	0	0	62 234	26 000	0	0	0	1 646 913
EANS	14 089	0	0	0	0	0	0	0	0	14 089	1 572	0	0	0	0	0	0	0	0	1 572	15 661	0	0	0	0	0	0	0	0	15 661
ENAIRE	578 455	0	0	0	3 781	0	219	4 370	553	587 377	23 407	122 285	0	0	0	0	5	1 182	64	146 943	601 862	122 285	0	0	3 781	0	224	5 552	617	734 321
ENAV	648 162	0	0	0	9 767	16 277	0	11 490	0	685 696	194 080	0	0	0	1 548	8 299	0	5 068	0	208 996	842 243	0	0	0	11 315	24 577	0	16 558	0	894 693
Fintraffic ANS	26 169	0	0	187	0	3 242	0	0	0	29 598	11 981	9 851	0	20	0	0	0	0	0	21 852	38 150	9 851	0	207	0	3 242	0	0	0	51 450
HASP	176 499	0	0	0	0	0	0	0	0	176 499	16 267	0	0	0	0	3 739	0	0	0	20 006	192 766	0	0	0	0	3 739	0	0	0	196 505
HungaroControl	133 923	0	0	0	817	0	6 316	1 695	0	142 751	22 020	0	0	0	149	0	1 039	322	0	23 530	155 943	0	0	0	967	0	7 355	2 017	0	166 282
IAA	122 268	0	0	0	1 265	0	466	0	0	123 999	24 937	0	0	0	0	0	103	0	0	25 040	147 205	0	0	0	1 265	0	569	0	0	149 039
LFV	135 677	0	1 036	0	945	0	1 617	0	0	139 275	0	10 262	0	0	0	0	290	0	0	10 553	135 677	10 262	1 036	0	945	0	1 908	0	0	149 828
LGS	14 502	0	0	0	0	0	0	1 004	0	15 506	3 972	0	0	0	0	0	0	430	0	4 402	18 474	0	0	0	0	0	0	1 434	0	19 908
LPS	65 964	0	0	625	1 000	0	1	0	0	67 590	5 465	0	0	0	883	0	0	0	0	6 348	71 429	0	0	625	1 883	0	1	0	0	73 938
LVNL	142 066	0	0	0	643	0	25	8 373	0	151 106	66 827	0	0	0	0	0	11	6 238	0	73 076	208 893	0	0	0	643	0	35	14 611	0	224 182
MATS	21 160	0	0	0	1 547	0	209	764	0	23 680	4 386	1 048	0	0	317	0	90	327	0	6 168	25 546	1 048	0	0	1 863	0	299	1 092	0	29 848
M-NAV	18 714	0	0	0	0	0	28	0	0	18 742	2 294	0	0	0	0	0	0	0	0	2 294	21 008	0	0	0	0	0	28	0	0	21 036
MOLDATSA	1 407	0	0	0	0	0	0	0	0	1 407	4 249	0	0	0	0	0	0	0	0	4 249	5 656	0	0	0	0	0	0	0	0	5 656
MUAC											n/appl	n/appl	n/appl	n/appl	n/appl	n/appl	n/appl	n/appl	n/appl	n/appl										
NATS (Continental)	592 129	0	0	0	0	0	7 913	1 764	0	601 806	12 547	121 601	0	0	0	0	1 400	13	0	135 561	604 676	121 601	0	0	0	0	9 313	1 777	0	737 368
NAV Portugal (Continental)	155 955	0	0	0	0	0	0	1 391	0	157 346	37 615	0	0	0	0	0	0	95	0	37 710	193 570	0	0	0	0	0	0	1 487	0	195 057
NAVIAIR	68 125	0	0	0	2 517	0	897	1 459	0	72 998	24 613	4 066	0	0	90	0	200	170	0	29 139	92 738	4 066	0	0	2 607	0	1 097	1 629	0	102 136
Oro navigacija	15 095	0	0	180	0	0	56	53	362	15 746	4 977	0	0	60	0	0	18	18	119	5 192	20 072	0	0	240	0	0	74	71	481	20 938
PANSA	140 221	0	0	0	5 949	0	136	795	0	147 101	38 554	0	0	0	2 418	0	0	196	0	41 167	178 775	0	0	0	8 367	0	136	991	0	188 269
ROMATSA	223 425	0	0	0	2 218	0	1 065	461	0	227 168	28 291	0	0	0	582	0	398	0	0	29 271	251 715	0	0	0	2 800	0	1 463	461	0	256 439
Sakaeronavigatsia	41 544	0	0	0	78	0	201	0	0	41 824	10 411	0	0	0	46	0	50	0	0	10 506	51 955	0	0	0	124	0	251	0	0	52 330
skeyes	242 010	0	0	0	0	0	117	7 107	17	249 251	25 149	0	0	0	0	28 731	27	2 447	11	56 365	267 159	0	0	0	0	28 731	144	9 554	28	305 616
Skyguide	143 678	0	42 988	0	7 885	40 369	1 105	3 460	0	239 485	92 451	29 090	0	0	93	0	0	3 743	0	125 378	236 130	29 090	42 988	0	7 979	40 369	1 105	7 203	0	364 863
Slovenia Control	36 092	0	0	0	254	266	0	840	0	37 452	2 997	56	0	600	91	129	0	58	0	3 930	39 088	56	0	600	345	395	0	898	0	41 382
SMATSA	92 477	0	0	0	0	0	96	2	0	92 575	11 713	0	0	0	0	0	438	0	389	12 540	104 190	0	0	0	0	0	534	2	389	105 115

Annex 5 - Table 0.1: Breakdown of total ANS revenues (en-route, terminal and gate-to-gate), 2022

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**
Albcontrol	25 727	812	1 241	0	778	0	0	28 558
ANS CR	129 919	3 388	2 128	0	5 797	0	0	141 232
ARMATS	13 896	0	0	0	271	0	0	14 167
Austro Control	233 790	15 878	0	512	11 118	0	0	261 298
Avinor (Continental)	186 924	2 896	1 528	0	6 488	0	0	197 836
BHANSA	28 737	1 945	173	0	1 338	0	0	32 194
BULATSA	114 852	6 728	7	0	4 355	0	1	125 942
Croatia Control	88 889	7 679	0	0	0	0	0	96 569
DCAC Cyprus	43 041	4 449	3 309	14 642	0	0	0	65 441
DFS	1 091 344	0	845	0	0	0	0	1 092 189
DHMI	595 219	22 412	4 553	0	22 847	0	0	645 031
DSNA	1 363 412	88 420	7 881	0	71 178	48 874	58 268	1 638 033
EANS	21 759	389	0	0	0	0	0	22 147
ENAIRE	884 452	37 990	5 568	0	38 446	0	0	966 457
ENAV	716 020	22 247	4 766	0	36 201	0	0	779 234
Fintraffic ANS	56 320	4 302	430	0	3 242	225	0	64 519
HASP	160 564	8 993	3 448	11 616	7 180	0	0	191 801
HungaroControl	102 952	72	2 631	0	4 155	0	0	109 810
IAA	125 653	8 205	4 722	3 137	7 420	0	0	149 137
LFV	182 250	1 775	213	0	0	0	0	184 238
LGS	22 427	1 453	1 085	0	1 019	0	0	25 984
LPS	59 659	3 104	1 472	0	2 374	0	0	66 609
LVNL	227 574	0	0	0	0	0	16 894	244 468
MATS	20 898	768	2 362	0	968	0	0	24 997
M-NAV	17 965	1 322	0	0	0	0	0	19 287
MOLDATSA	7 101	940	0	0	136	0	0	8 176
MUAC	218 298	0	0	0	0	0	13	218 311
NATS (Continental)	706 261	565	5 780	0	0	767	0	713 372
NAV Portugal (Continental)	140 396	7 753	1 460	5 468	6 283	0	0	161 361
NAVIAIR	120 673	0	0	0	0	0	0	120 673
Oro navigacija	26 511	0	0	0	0	0	0	26 511
PANSA	202 333	10 096	3 004	0	10 838	1 009	0	227 280
ROMATSA	232 466	12 918	2 197	0	7 807	0	0	255 389
Sakaeronavigatsia	30 947	1 012	251	0	808	0	0	33 018
skeyes	196 616	10 875	2 366	0	12 384	59 085	0	281 327
Skyguide	396 326	14 036	2 338	0	12 035	0	0	424 735
Slovenia Control	34 932	1 987	831	0	1 601	0	0	39 350
SMATSA	96 460	5 792	0	0	3 009	0	0	105 260
Total	8 923 563	311 201	66 590	35 375	280 076	109 960	75 175	9 801 940

Annex 5 - Table 0.2: Breakdown of total gate-to-gate ANSP costs, 2022

	En-route ATM/CNS costs (in €'000)						Terminal ATM/CNS costs (in €'000)						Gate-to-gate ATM/CNS costs (in €'000)					
ANSPs	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**
Albcontrol	5 052	5 737	5 746	4 268	0	20 804	1 682	1 995	544	702	0	4 923	6 734	7 732	6 291	4 970	0	25 727
ANS CR	56 629	16 107	20 791	8 426	0	101 953	17 415	3 522	5 283	1 745	0	27 966	74 044	19 629	26 074	10 171	0	129 919
ARMATS	4 285	677	925	848	1 132	7 868	3 742	879	533	496	377	6 028	8 027	1 557	1 458	1 344	1 510	13 896
Austro Control	140 727	21 629	18 346	3 769	3 670	188 141	32 823	4 776	5 480	1 058	1 512	45 649	173 550	26 405	23 826	4 827	5 182	233 790
Avinor (Continental)	64 981	14 412	8 645	9 979	0	98 016	64 628	16 003	3 509	4 769	0	88 908	129 609	30 414	12 153	14 748	0	186 924
BHANSA	17 970	4 924	2 984	774	0	26 652	1 278	308	409	90	0	2 085	19 248	5 232	3 393	864	0	28 737
BULATSA	68 879	11 205	11 438	12 162	0	103 684	8 991	769	874	533	0	11 168	77 871	11 973	12 312	12 696	0	114 852
Croatia Control	47 690	13 445	7 696	5 963	0	74 794	8 788	2 623	1 866	818	0	14 095	56 479	16 067	9 562	6 781	0	88 889
DCAC Cyprus	19 531	15 815	2 432	1 536	0	39 314	1 918	1 578	105	125	0	3 727	21 449	17 394	2 537	1 661	0	43 041
DFS	630 301	78 960	66 125	20 194	0	795 581	217 533	47 096	23 074	8 060	0	295 763	847 833	126 057	89 200	28 254	0	1 091 344
DHMI	151 215	151 892	31 281	126 071	0	460 459	36 689	32 502	8 630	56 941	0	134 761	187 904	184 393	39 911	183 011	0	595 219
DSNA	724 384	231 867	102 327	49 723	0	1 108 301	176 464	51 502	18 992	8 153	0	255 111	900 848	283 369	121 318	57 876	0	1 363 412
EANS	11 940	3 131	3 273	1 144	0	19 487	840	709	490	233	0	2 272	12 780	3 840	3 763	1 377	0	21 759
ENAIRE	432 628	59 292	81 947	22 980	101 669	698 517	126 412	12 135	9 829	2 222	35 337	185 935	559 040	71 427	91 776	25 202	137 006	884 452
ENAV	336 254	101 380	82 317	45 743	0	565 694	77 993	38 319	21 144	12 871	0	150 327	414 247	139 698	103 461	58 614	0	716 020
Fintraffic ANS	19 532	10 890	2 514	641	0	33 577	14 168	8 027	413	135	0	22 743	33 700	18 917	2 927	776	0	56 320
HASP	116 745	16 260	1 453	175	0	134 633	19 482	5 206	1 086	157	0	25 931	136 227	21 466	2 539	332	0	160 564
HungaroControl	43 603	20 378	13 046	7 530	0	84 556	9 795	3 402	2 966	2 231	0	18 395	53 399	23 780	16 012	9 761	0	102 952
IAA	61 880	25 939	7 022	2 273	0	97 114	10 642	10 156	4 443	3 300	0	28 540	72 521	36 095	11 465	5 572	0	125 653
LFV	107 342	27 576	16 356	7 717	0	158 990	18 286	3 504	850	620	0	23 260	125 627	31 080	17 206	8 337	0	182 250
LGS	10 938	2 478	2 353	1 028	0	16 797	2 805	451	1 892	482	0	5 630	13 743	2 929	4 245	1 510	0	22 427
LPS	35 708	8 665	6 112	2 265	0	52 749	5 051	981	640	237	0	6 911	40 759	9 646	6 752	2 502	0	59 659
LVNL	108 342	39 438	11 054	972	0	159 806	49 453	12 749	5 030	537	0	67 769	157 795	52 187	16 084	1 508	0	227 574
MATS	10 523	4 890	1 612	349	0	17 375	2 155	966	330	71	0	3 523	12 679	5 857	1 942	420	0	20 898
M-NAV	12 845	1 958	525	458	0	15 786	1 808	292	46	33	0	2 179	14 653	2 250	571	491	0	17 965
MOLDATSA	2 369	338	381	148	0	3 236	2 323	1 002	373	167	0	3 865	4 692	1 340	754	315	0	7 101
MUAC	186 519	26 044	5 566	169	0	218 298	n/appl	n/appl	n/appl	n/appl	n/appl	n/appl	186 519	26 044	5 566	169	0	218 298
NATS (Continental)	347 069	85 114	76 765	56 835	5 287	571 070	114 744	6 974	10 379	1 377	1 716	135 190	461 813	92 089	87 145	58 212	7 003	706 261
NAV Portugal (Continental)	85 039	11 914	10 346	2 332	0	109 631	26 599	1 778	2 055	334	0	30 766	111 638	13 692	12 401	2 666	0	140 396
NAVIAIR	51 552	17 536	12 453	6 283	0	87 823	22 285	6 072	2 331	2 162	0	32 850	73 837	23 608	14 784	8 444	0	120 673
Oro navigacija	12 046	3 056	2 797	936	0	18 836	5 064	1 143	1 160	308	0	7 675	17 110	4 200	3 957	1 244	0	26 511
PANSA	107 626	20 449	22 511	11 924	0	162 509	27 274	5 358	4 878	2 315	0	39 824	134 899	25 807	27 388	14 239	0	202 333
ROMATSA	155 361	16 963	8 768	7 288	0	188 380	34 188	6 491	2 000	1 406	0	44 085	189 549	23 454	10 768	8 694	0	232 466
Sakaeronavigatsia	10 550	4 471	3 186	1 474	0	19 681	5 965	2 280	2 084	937	0	11 265	16 514	6 750	5 270	2 411	0	30 947
skeyes	108 329	26 083	8 208	1 025	15	143 661	39 034	9 810	3 558	555	0	52 956	147 363	35 893	11 765	1 580	15	196 616
Skyguide	180 214	42 363	27 764	11 412	891	262 643	71 172	28 559	23 464	9 813	675	133 682	251 386	70 922	51 228	21 225	1 566	396 326
Slovenia Control	22 484	4 385	3 318	995	0	31 182	3 227	260	202	61	0	3 750	25 711	4 645	3 520	1 055	0	34 932
SMATSA	41 087	10 100	10 488	13 252	150	75 077	12 254	3 045	2 815	3 225	43	21 383	53 341	13 145	13 303	16 478	193	96 460
Total	4 550 170	1 157 761	700 871	451 061	112 814	6 972 676	1 274 969	333 222	173 757	129 278	39 660	1 950 887	5 825 139	1 490 983	874 628	580 339	152 474	8 923 563

Annex 5 - Table 0.3: Breakdown of ATM/CNS provision costs (en-route, terminal and gate-to-gate), 2022

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**
Albcontrol	30 193	2 035	2 358	68 069	102 654	59 512	16 924	26 218	102 654
ANS CR	165 137	21 969	13 172	81 863	282 141	161 664	74 680	45 797	282 141
ARMATS	9 319	452	19	9 088	18 878	15 983	583	2 312	18 878
Austro Control	169 691	17 249	183 650	161 372	531 962	5 291	464 829	61 842	531 962
Avinor (Continental)	53 821	11 552	55 651	254 811	375 835	51 498	260 226	64 111	375 835
BHANSA	11 771	416	537	26 849	39 573	31 066	2 822	5 684	39 573
BULATSA	93 199	8 611	48 486	77 036	227 332	179 221	30 915	17 197	227 332
Croatia Control	42 725	10 676	36 069	125 244	214 715	106 158	73 074	35 483	214 715
DCAC Cyprus	17 971	8 334	2 878	9 272	38 455	-4 827	40 993	2 289	38 455
DFS	651 723	14 543	1 196 722	2 237 682	4 100 670	1 670 460	2 012 623	417 588	4 100 670
DHMI	557 187	89 588	239 669	180 267	1 066 711	708 058	281 610	77 044	1 066 711
DSNA	759 767	378 778	1 685 840	430 131	3 254 516	750 575	2 455 043	48 897	3 254 516
EANS	17 427	5 537	0	6 360	29 324	13 614	2 623	13 087	29 324
ENAIRE	441 924	246 412	117 953	289 916	1 096 206	572 027	307 320	216 858	1 096 206
ENAV	614 041	320 963	823 259	689 094	2 447 357	1 174 581	431 549	841 228	2 447 357
Fintraffic ANS	8 937	6 699	22 417	20 282	58 336	26 824	0	31 512	58 336
HASP	7 172	0	0	0	7 172	7 172	0	0	7 172
HungaroControl	85 856	26 117	10 727	85 635	208 334	126 388	43 328	38 618	208 334
IAA	80 582	25 437	148 776	204 843	459 638	363 232	49 625	46 781	459 638
LFV	159 215	58 915	355 000	482 993	1 056 122	72 511	901 345	82 267	1 056 122
LGS	21 177	6 743	3 822	3 893	35 635	27 833	3 634	4 168	35 635
LPS	49 296	3 853	25	49 053	102 226	77 396	11 764	13 067	102 226
LVNL	154 378	157 726	61 146	123 400	496 650	-158 967	577 093	78 524	496 650
MATS	6 180	3 171	43 122	30 474	82 946	25 944	46 155	10 848	82 946
M-NAV	4 481	6 156	0	11 646	22 283	16 816	3 224	2 243	22 283
MOLDATSA	6 806	357	0	3 003	10 166	9 135	0	1 031	10 166
MUAC	45 307	4 852	0	73 368	123 526	0	50 159	73 368	123 526
NATS (Continental)	611 487	738 395	1 097 099	535 479	2 982 461	1 008 849	1 505 285	468 327	2 982 461
NAV Portugal (Continental)	124 116	22 659	126 871	161 068	434 714	105 173	228 341	101 200	434 714
NAVIAIR	127 828	20 247	112 561	63 167	323 803	146 965	132 499	44 339	323 803
Oro navigacija	36 030	349	9 510	15 672	61 561	49 160	6 804	5 597	61 561
PANSA	226 002	34 829	176 759	140 824	578 415	306 479	160 886	111 050	578 415
ROMATSA	74 068	6 661	160 225	128 651	369 605	93 882	198 834	76 889	369 605
Sakaeronavigatsia	41 466	1 315	1 006	25 823	69 609	66 644	833	2 133	69 609
skeyes	89 218	18 643	10 814	416 861	535 535	281 264	125 460	128 811	535 535
Skyguide	270 614	74 642	17 349	182 846	545 451	195 714	249 734	100 003	545 451
Slovenia Control	21 154	1 109	495	9 342	32 100	8 276	14 441	9 383	32 100
SMATSA	126 232	25 785	7 632	45 439	205 088	87 344	83 047	34 698	205 088
Total	6 013 498	2 381 774	6 771 618	7 460 815	22 627 706	8 438 912	10 848 304	3 340 490	22 627 706

Annex 5 - Table 0.4: Balance Sheet data at ANSP level, 2022

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)
Albcontrol	61	14	0	0	2	0	74	0	76	21	16	41	305	35	40 425	26	31 512	2 537
ANS CR	229	11	2	6	93	100	139	26	206	28	0	62	902	141	220 659	88	131 450	33 306
ARMATS	73	0	0	1	6	13	91	0	34	20	0	32	270	22	31 409	51	72 670	2 935
Austro Control	301	26	21	52	41	92	97	99	74	31	79	0	914	138	181 156	163	230 141	72 636
Avinor (Continental)	370	54	14	15	74	0	74	72	67	127	0	17	883	157	236 913	213	326 772	78 919
BHANSA	132	11	0	0	9	30	96	8	74	46	36	54	496	72	90 000	60	85 800	7 652
BULATSA	282	54	0	1	44	47	295	52	188	33	46	81	1 122	146	185 949	137	177 228	35 920
Croatia Control	237	48	26	16	18	72	100	23	116	30	68	0	752	99	125 928	138	186 024	28 994
DCAC Cyprus	119	11	0	7	45	0	0	0	46	15	0	0	242	89	150 303	30	44 218	12 916
DFS	1 543	241	150	234	285	466	660	612	533	87	0	287	5 098	1 153	1 305 851	390	457 948	428 562
DHMI	1 741	64	100	95	21	443	1 881	11	1 427	559	0	905	7 247	819	1 041 768	922	952 426	98 545
DSNA	2 856	170	115	289	88	867	1 106	380	1 222	131	0	0	7 223	1 517	1 580 885	1 339	1 395 606	385 958
EANS	57	17	0	0	0	0	33	0	5	27	0	36	175	29	34 388	28	35 392	6 672
ENAIRE	1 642	335	0	76	169	62	573	402	593	17	0	75	3 944	1 034	1 342 201	608	721 425	336 704
ENAV	1 346	255	5	78	63	31	109	118	577	122	180	200	3 086	787	900 212	559	710 957	246 088
Fintraffic ANS	158	19	0	0	4	0	51	7	14	73	1	0	327	34	53 654	124	206 653	19 100
HASP	526	34	0	15	0	40	441	27	75	7	0	399	1 564	188	289 896	338	521 196	63 306
HungaroControl	183	7	25	12	31	43	86	47	192	53	0	65	744	111	164 946	72	108 432	21 985
IAA	239	37	0	0	27	61	62	19	49	13	0	0	507	174	277 530	65	103 675	39 854
LFV	400	105	0	31	26	30	64	31	127	26	5	0	845	215	318 256	185	289 636	85 309
LGS	77	6	0	9	0	46	88	0	63	11	10	10	320	52	68 276	25	31 025	5 123
LPS	107	18	11	11	27	27	110	15	110	24	0	0	460	58	86 437	49	78 058	17 925
LVNL	207	39	24	44	74	255	112	148	189	0	0	69	1 161	71	112 177	136	213 342	34 111
MATS	54	0	0	0	0	2	59	0	21	15	0	23	174	36	77 724	18	37 422	5 768
M-NAV	71	14	0	6	12	28	47	0	58	30	19	17	302	42	55 058	29	38 924	5 650
MOLDATSA	56	2	0	0	0	13	36	12	37	10	28	36	230	18	26 802	38	55 898	1 609
MUAC	249	38	68	0	39	55	137	14	54	0	0	11	664	249	269 691	n/appl	n/appl	88 403
NATS (Continental)	1 185	133	141	27	228	371	388	562	630	0	0	0	3 666	798	966 378	387	557 611	241 028
NAV Portugal (Continental)	203	63	0	11	23	41	68	45	144	39	5	10	652	71	153 644	132	260 832	62 507
NAVIAIR	197	48	5	15	77	27	88	28	87	11	0	0	582	83	122 216	114	170 923	37 159
Oro navigacija	82	8	0	3	0	32	60	8	65	22	0	0	278	32	49 895	50	78 472	6 752
PANSA	574	16	7	45	40	317	290	67	341	43	0	26	1 766	169	160 358	405	406 656	71 647
ROMATSA	553	122	11	28	80	0	320	0	341	0	125	0	1 579	238	304 753	315	341 487	77 991
Sakaeronavigatsia	102	8	17	0	15	18	259	14	171	55	57	89	805	37	56 388	65	99 060	3 410
skeyes	191	57	33	13	21	93	153	44	118	19	60	40	842	72	93 355	119	163 741	45 782
Skyguide	341	87	27	21	75	174	240	41	185	35	0	18	1 245	187	246 021	154	215 025	105 358
Slovenia Control	86	23	13	1	10	3	41	0	34	21	0	0	232	50	69 043	36	48 449	12 640
SMATSA	304	51	0	13	24	27	84	121	119	70	82	0	895	141	166 944	163	183 864	25 314
Total	17 134	2 248	815	1 175	1 789	3 924	8 613	3 051	8 460	1 871	817	2 604	52 500	9 363	11 657 489	7 771	9 769 951	2 856 075

Annex 5 - Table 0.5: Total staff and ATCOs in OPS data, 2022

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
Albcontrol	36 000	1	1	1	1	250 080	40 401 532	51 932	38 602	62 533
ANS CR	76 900	1	2	4	0	550 194	130 770 252	178 983	111 878	209 708
ARMATS	29 700	1	2	2	2	78 926	12 936 251	18 834	35 005	28 448
Austro Control	80 700	1	6	6	0	1 049 628	233 281 678	317 434	273 466	392 536
Avinor (Continental)	731 000	3	17	16	28	525 297	183 162 252	333 849	568 028	489 847
BHANSA	38 900	1	4	4	0	378 898	68 128 359	85 365	22 006	91 408
BULATSA	147 000	1	3	5	0	822 087	238 094 309	290 422	78 877	312 084
Croatia Control	118 000	1	6	10	0	712 861	193 285 267	249 018	113 680	280 238
DCAC Cyprus	173 000	1	2	2	0	343 957	132 679 728	167 670	71 855	187 404
DFS	390 000	4	15	15	0	2 502 186	866 826 415	1 263 985	1 474 929	1 669 047
DHMI	982 000	2	48	52	0	1 354 857	1 029 689 165	1 334 764	1 178 562	1 658 434
DSNA	1 192 000	5	20	75	0	2 919 200	1 589 896 735	2 178 853	1 632 420	2 627 167
EANS	77 300	1	2	2	0	141 577	34 942 832	48 360	35 490	58 107
ENAIRE	2 190 000	5	17	21	0	1 980 990	1 098 597 631	1 558 956	1 440 331	1 954 516
ENAV	732 000	4	27	16	10	1 664 146	821 816 151	1 141 849	1 208 431	1 473 722
Fintraffic ANS	409 000	1	5	14	8	192 580	54 237 013	88 850	176 464	137 313
HASP	538 000	1	16	18	15	895 730	489 573 783	650 415	509 429	790 320
HungaroControl	104 000	1	1	1	0	1 024 875	221 612 705	278 836	97 982	305 745
IAA	457 000	2	3	3	0	582 360	227 607 713	288 261	251 808	357 415
LFV	627 000	2	11	11	0	541 132	228 067 688	333 262	316 805	420 267
LGS	96 000	1	1	4	0	187 979	37 282 705	52 501	55 497	67 742
LPS	48 900	1	2	5	0	470 158	68 525 428	86 171	28 135	93 897
LVNL	53 000	1	3	4	0	515 029	67 589 405	141 002	463 018	268 161
MATS	231 000	1	2	1	0	104 143	45 748 367	62 700	48 476	76 013
M-NAV	24 900	1	2	2	1	233 688	31 999 504	40 619	18 791	45 780
MOLDATSA	34 800	1	1	2	0	21 638	2 165 538	4 416	19 685	9 822
MUAC	262 000	1	0	0	0	1 549 498	453 429 616	545 651	n/appl	545 651
NATS (Continental)	880 000	3	16	16	0	2 100 958	849 532 378	1 271 793	1 224 120	1 607 975
NAV Portugal (Continental)	671 000	1	4	6	0	606 631	300 783 813	406 816	392 791	514 689
NAVIAIR	158 000	1	7	6	1	516 284	121 665 708	183 043	285 283	261 390
Oro navigacija	75 300	1	4	4	0	163 350	31 522 649	47 286	53 181	61 891
PANSA	333 000	1	4	15	0	613 073	252 834 990	361 376	382 479	466 417
ROMATSA	255 000	1	3	16	0	656 325	291 468 538	384 582	190 256	436 833
Sakaeronavigatsia	87 700	1	3	3	2	144 603	43 717 377	55 780	40 419	66 880
skeyes	39 500	1	4	5	1	515 973	50 190 219	97 089	316 425	183 989
Skyguide	69 300	2	4	7	0	1 152 707	217 842 939	318 606	396 957	427 623
Slovenia Control	20 500	1	3	4	0	360 890	47 830 734	61 705	21 971	67 739
SMATSA	99 400	1	8	7	1	775 513	187 631 846	240 919	94 355	266 832
Total		60	279	385	70		10 997 369 213	15 221 954	13 667 887	18 975 585

Annex 5 - Table 0.6: Operational data at ANSP level, 2022

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
Albcontrol	Tirana	51 758	40 425	1.28	12	250 064	36 000	35	265	3	18 240
ANS CR	Praha	149 389	220 659	0.68	17	532 737	76 900	141	950	13	81 022
ARMATS	Yerevan	12 574	31 409	0.40	11	70 570	29 700	22	168	1	8 760
Austro Control	Wien	251 718	181 156	1.39	16	920 081	79 300	138	900	12	42 554
Avinor (Continental)	Bodo	77 216	43 263	1.78	25	183 922	400 000	29	450	6	27 084
Avinor (Continental)	Oslo	58 983	136 866	0.43	12	299 441	111 000	91	605	6	17 894
Avinor (Continental)	Stavanger	78 820	56 784	1.39	22	216 136	216 000	38	250	4	16 768
BHANSA	Sarajevo	80 858	90 000	0.90	13	373 342	38 900	72	320	4	17 201
BULATSA	Sofia	275 352	185 949	1.48	21	799 321	147 000	146	1 183	11	34 772
Croatia Control	Zagreb	222 227	125 928	1.76	20	679 347	118 000	99	800	10	27 610
DCAC Cyprus	Nicosia	153 232	150 303	1.02	27	343 646	173 000	89	250	5	21 868
DFS	Bremen	131 375	217 635	0.60	18	441 773	175 000	188	1 050	11	70 290
DFS	Karlsruhe UAC	621 939	362 179	1.72	23	1 645 296	260 000	336	1 850	28	129 899
DFS	Langen	300 192	438 885	0.68	18	1 021 910	108 000	385	1 300	31	116 714
DFS	Munchen	210 479	287 152	0.73	15	860 659	119 000	244	1 262	23	86 215
DHMI	Ankara	1 038 981	723 768	1.44	49	1 276 154	979 000	569	1 998	21	129 091
DHMI	Istanbul	207 642	318 000	0.65	18	701 406	116 000	250	420	8	55 610
DSNA	Bordeaux	449 738	312 655	1.44	32	833 753	212 000	286	1 295	16	90 016
DSNA	Brest	485 771	328 575	1.48	31	939 202	400 000	300	850	16	90 246
DSNA	Marseille	386 801	389 260	0.99	23	1 025 531	298 000	373	1 310	27	105 215
DSNA	Paris	377 372	296 385	1.27	22	1 038 257	167 000	312	1 250	12	82 260
DSNA	Reims	246 781	254 010	0.97	16	905 021	115 000	246	1 040	14	75 652
EANS	Tallinn	40 172	34 388	1.17	18	133 066	77 300	29	269	4	9 360
ENAIRE	Barcelona	376 295	372 037	1.01	26	874 335	266 000	295	1 989	21	79 433
ENAIRE	Canarias	200 597	190 212	1.05	34	351 584	1 360 000	143	750	10	47 179
ENAIRE	Madrid	582 655	485 096	1.20	32	1 077 010	435 000	368	1 789	25	108 368
ENAIRE	Palma	86 556	137 477	0.63	16	333 124	51 400	113	739	8	34 229
ENAIRE	Sevilla	193 072	157 379	1.23	26	438 286	179 000	115	797	9	37 010
ENAV	Brindisi	151 417	96 860	1.56	24	381 071	159 000	84	550	6	24 238
ENAV	Milano	284 263	254 953	1.11	20	874 061	79 600	245	593	21	78 944
ENAV	Padova	192 196	209 334	0.92	17	672 087	79 900	181	375	13	50 357
ENAV	Roma	456 727	339 065	1.35	34	817 894	417 000	278	1 600	23	101 957
Fintraffic ANS	Helsinki	58 957	53 654	1.10	25	144 231	409 000	34	240	3	16 671
HASP	Athinai+Macedonia	566 860	289 896	1.96	40	854 467	538 000	188	1 000	12	63 477
HungaroControl	Budapest	259 527	164 946	1.57	15	1 016 910	104 300	111	720	9	35 515
IAA	Dublin	36 749	82 940	0.44	10	220 865	23 100	52	441	5	20 440
IAA	Shannon	232 532	194 590	1.19	33	425 979	449 000	122	576	11	38 000
LFV	Malmo	184 998	190 940	0.97	27	417 546	226 000	129	840	12	58 790
LFV	Stockholm	94 365	127 316	0.74	20	283 743	479 000	86	820	11	36 680
LGS	Riga	51 593	68 276	0.76	17	187 359	96 000	52	169	3	18 250
LPS	Bratislava	80 786	86 437	0.93	11	457 584	48 900	58	813	5	15 319
LVNL	Amsterdam	66 206	112 177	0.59	8	480 150	53 000	71	1 800	5	21 902
MATS	Malta	52 345	77 724	0.67	31	101 310	231 000	36	121	2	17 500
M-NAV	Skopje	37 755	55 058	0.69	10	226 256	24 900	42	202	3	11 525
MOLDATSA	Chisinau	2 039	26 802	0.08	7	17 791	34 800	18	144	2	17 520
MUAC	Maastricht	545 651	269 691	2.02	21	1 549 498	262 000	249	1 050	21	61 822
NATS (Continental)	London AC	531 651	373 666	1.42	18	1 780 523	286 000	312	1 090	23	77 607
NATS (Continental)	London TC	245 166	332 112	0.74	13	1 138 359	53 600	277	987	22	122 561
NATS (Continental)	Prestwick	328 379	260 600	1.26	24	830 715	641 000	209	1 020	24	80 116
NAV Portugal (Continental)	Lisboa	345 602	153 644	2.25	37	560 992	671 000	71	663	9	46 038
NAVIAIR	Kobenhavn	134 025	122 216	1.10	18	439 435	158 000	83	600	7	19 908
Oro Navigacija	Vilnius	38 961	49 895	0.78	15	160 810	75 300	32	336	3	19 190
PANSA	Warszawa	252 878	160 358	1.58	28	543 435	330 000	169	1 300	8	33 334
ROMATSA	Bucuresti	345 410	304 753	1.13	32	648 058	255 000	238	1 391	12	60 516
Sakaeronavigatsia	Tbilisi	48 999	56 388	0.87	22	134 868	87 700	37	250	2	17 568
skeyes	Brussels	64 546	93 355	0.69	8	510 583	39 500	72	1 054	6	18 794
Skyguide	Geneva	108 801	120 369	0.90	11	581 257	29 700	94	1 113	7	25 074
Skyguide	Zurich	140 961	125 651	1.12	12	727 938	39 600	93	960	8	28 279
Slovenia Control	Ljubljana	59 549	69 043	0.86	10	357 910	20 500	50	360	4	16 358
SMATSA	Beograd	216 190	166 944	1.29	17	755 934	99 400	141	744	9	28 870
Total		13 564 631	11 657 489	1.16	22	36 864 593	12 722 300	9 363		670	2 943 677

Annex 5 - Table 0.7: Operational data at ACC level, 2022

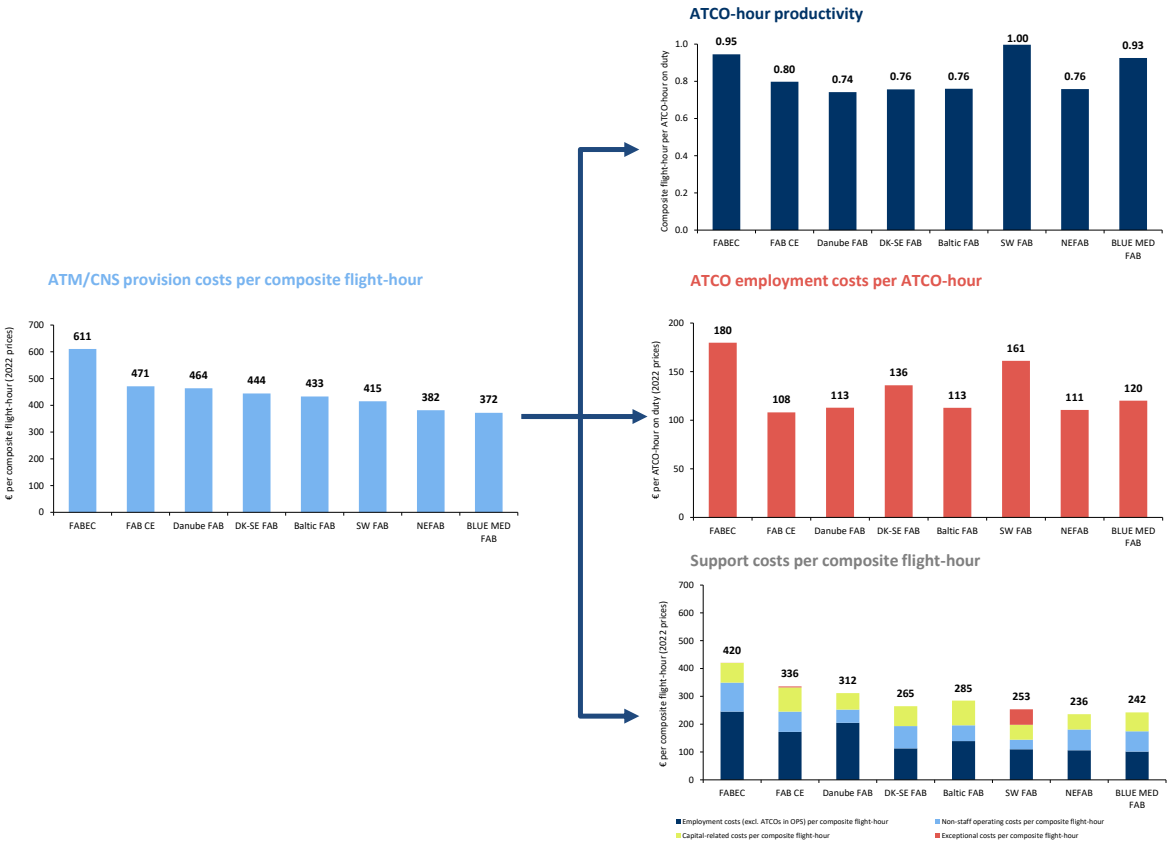
ANNEX 6 – PERFORMANCE INDICATORS AT FAB LEVEL

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 2022 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, 2022

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GLOSSARY

ACC	Area Control Centre
ACE	Air Traffic Management Cost-Effectiveness
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
CAPEX	Capital Expenditure
CNS	Communications, Navigation and Surveillance
COTS	Commercial off-the-shelf
COOPANS	Industrial partnership between 5 ANSPs (Austro Control, Croatia Control, IAA, 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
GDP	Gross Domestic Product
HASP	Hellenic Air Navigation Service Provider, Greece
HungaroControl	Hungarian Air Navigation Services, Hungary
IAA	Irish Aviation Authority, Ireland

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
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
NSA	National Supervisory Authority
OAT	Operational air traffic
OPS	Operations
Oro Navigacija	State Enterprise Oro Navigacija, Lithuania
PANSA	Polish Air Navigation Services Agency
PPPs	Public Private Partnerships
PPPs	Purchasing power parities
PRB	Performance Review Body
PRC	Performance Review Commission
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
UkSATSE	Ukrainian State Air Traffic Service Enterprise
VFR	Visual Flight Rules

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