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SUMMARY

This report is a factual high-level comparison of Air Navigation Services (ANS) provision costs in Europe and the United States of America (US), based on comparable data and a well-established economic performance framework. It is an update of the comparison of ANS cost-efficiency trends published in 2013 and focuses on the period from 2006 to 2014.

The report was prepared by the EUROCONTROL Performance Review Unit (PRU) on behalf of the European Union (EU) in application of Annex 2 of the Memorandum of Cooperation NAT-I-9406 signed between the United States of America and the European Union on 12 February 2013.

Keywords

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1 Introduction

1.1 Background

This document is an update of the comparison of ANS cost-efficiency trends, published in 2013 [Ref. i]. It compares Air Navigation Services (ANS) provision costs in Europe and the United States of America (US) and focuses on the period from 2006 to 2014.

The paper was prepared by the EUROCONTROL Performance Review Unit (PRU) on behalf of the European Union (EU) in application of Annex 2 of the Memorandum of Cooperation NAT-I-9406 signed between the United States of America and the European Union on 12 February 2013.

The goal is to make a factual high-level comparison of ANS cost-efficiency performance between the US and Europe, based on comparable data and a well-established economic performance framework.

The analysis focuses on the costs of Air Traffic Management (ATM) and Communications, Navigation and Surveillance (CNS) provision and not the revenue or funding of these services. There is a fundamental difference in how ATM/CNS provision is funded across the two sides of the Atlantic.

European Air Navigation Service Providers (ANSPs) are primarily funded by specific route and terminal ANS charges paid by the users of the airspace. In contrast, the Federal Aviation Administration (FAA) in the US is partially funded by excise taxes deposited in the Airport and Airway Trust Fund (AATF) and partially funded by Congressional appropriations. In recent years, most US Federal Agencies have dealt with funding uncertainties resulting from sequestration, government shutdowns, and short-term reauthorization extensions, which made it difficult to commit to long term planning and investments.

The US Air Traffic Organization (ATO) was created in 2004, as the operations arm of the FAA, to apply business like practices to the delivery of air traffic services. The FAA-ATO's objectives are to increase efficiency, take better advantage of new technologies, accelerate modernisation efforts, and respond more effectively to the needs of the travelling public, while enhancing the safety, security, and efficiency of the US air transportation system [Ref. ii].

Due to its size and traffic density, the FAA-ATO is considered to be a realistic comparator for the European ANS system. It is however acknowledged that, even though many similarities exist between the FAA-ATO and the European ANS systems, there are different legal/regulatory, economic, social, cultural and operational environments which affect observed differences in performance. Whereas the US system is operated by one single ANSP, in Europe ANSPs are still largely organised by State boundaries with different working arrangements and cost structures and therefore many issues revolve around the level of fragmentation and its impact on ANS performance and costs.

Some of these differences have been extensively documented in the EUROCONTROL Performance Review Commission (PRC) report in 2003 [Ref. iii] and the more recent US/Europe comparison of operational performance in 2016 [Ref. iv].

Previous ANS costs-efficiency comparisons between Europe and the US identified that the lower unit costs of ATM/CNS provision in the US are partly attributable to much higher ATCO productivity in the US, and less fragmentation of ATM/CNS provision (see in particular the PRC report in 2003 [Ref. iii] and the Performance Review Body (PRB) report [Ref. v] published in 2010).

Since 2004, the single European sky (SES) initiative of the EU aims at reducing this fragmentation [Ref. vi]. It provides the framework for the creation of additional capacity and for improved efficiency and interoperability of the ATM system in Europe.

One element of the SES legislation is the SES performance scheme (SES PS) which came into force in 2010 [Ref. vii]. It focuses on planning and accountability for performance, target setting, incentives and corrective actions at both EU-wide and local level [Ref. viii]. The SES PS is coupled with a new Charging regime which replaces "full cost recovery" by a system of "determined costs" set at the same time as the performance targets. These performance targets (initially in the fields of safety, capacity, environment, and cost-efficiency) are legally binding for EU Member States and designed to encourage air navigation service providers (ANSPs) to be more efficient and responsive to traffic demand, while ensuring adequate safety levels. The goal is to achieve significant and sustainable performance improvements from the 1st reference period onwards (RP1: 2012-2014).

For the second reference period (RP2) from 2015 to 2019, there are already agreed EU-wide and national targets in place which mandate further improvements in cost-efficiency performance in Europe until 2019.

Expectations on both sides of the Atlantic to improve ANS cost-efficiency are high. However, in view of the size of the two ANS systems it is important to recall that performance changes are gradual and that initiatives aimed at improving performance take some time to be visible in system wide trend analysis.

1.2 Objectives

The objectives of this update are (1) to review and refine the data where necessary to ensure and further improve comparability and (2) to extend previous time series analyses with the latest available data (that is adding actual 2012, 2013 and 2014 data) to evaluate how cost-efficiency performance trends have changed over time. The update also coincides with the completion of the first reference period of the SES PS (RP1: 2012-2014).

1.3 Report scope

The analysis in this paper focuses on continental costs and activities. It does not address Oceanic ANS, services provided to military operational air traffic (OAT), or airport landside management operations.

For Europe, results are shown at European and at SES State level:

- "Europe" corresponds to 37 ANSPs included in the ACE benchmarking programme;
- "SES States" refers to the ANSPs of the EU27+2 States[1] which are subject to the SES performance scheme regulation in RP1 (2012-2014) [Ref. viii].

The "US" refers to the 48 contiguous States located on the North American continent south of the border with Canada (US CONUS) plus activity for Alaska, Hawaii, Puerto Rico, and Guam.

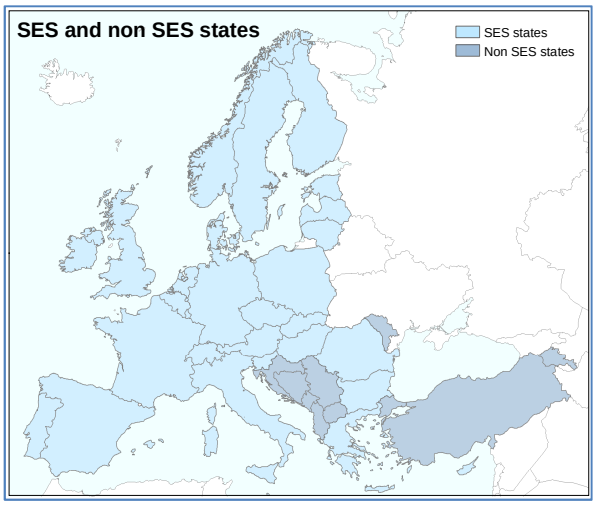

Figure 1-1: SES States and non-SES States (RP1)

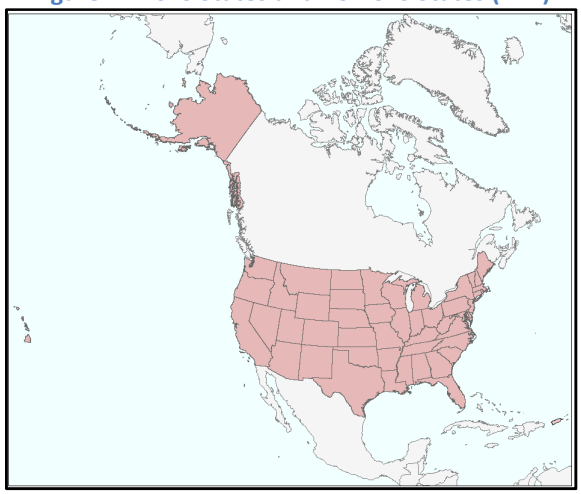

Figure 1-2: US geographical scope

1.4 Data sources

The data sets used for the update represent the latest year for which actual financial data are available for the US and for Europe[2]. The PRU would like to thank the FAA for the provision of data and their support in producing this cost-efficiency comparison.

The data compared in this paper reflect employees, costs and flight activity for the years 2006-2014. Specifically:

- for the European States, costs and operational data submitted by ANSPs to the PRU in July 2015 for the ATM cost-effectiveness (ACE) benchmarking reports [Ref. ix, Ref. x];
- for the US, costs and operational data provided by the FAA-ATO is consistent with the submission to the latest CANSO[3] Global Benchmarking Report [Ref. xi] which has underlying definitions of cost items and output metrics that are in line and consistent with those used in the context of the ACE benchmarking programme in Europe.

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1 28 National ANSPs (EU27 without Luxembourg, plus Norway and Switzerland) plus Maastricht Upper Area Control Centre operated by EUROCONTROL. EU27 is today's EU28 without Croatia.

2 The US the data refers to the financial years whereas for Europe the data refers to the calendar years.

3 The Civil Air Navigation Services Organization.

To the greatest degree possible, efforts have been made to reach comparability of economic data by excluding "other" or "unique" costs. A summary of the costs that are included and excluded in the comparison is provided in Table 1-1.

Cost type	US	Europe	SES States (RP1)
ATM/CNS (including depreciation)	Included	Included	Included
Return on equity & interest charges	Not applicable	Excluded	Excluded
Flow management coordination	Included	Network Manager (NM) costs included	NM costs included pro-rata
MET costs (internal/external)	Excluded	Excluded	Excluded
R&D (e.g. NextGen, SESAR, etc.)	Excluded if not FAA-ATO funded	Excluded	Excluded
ATC provision to military (OAT)	Excluded	Excluded	Excluded
Cost for contracted towers	Included	Excluded	Excluded

Table 1-1: Summary of included and excluded costs

As was the case in the previous report, the costs of meteorological services (MET), airport management and related services have been removed to the degree possible. Different from the previous report, the cost of flight services was added to the FAA-ATO continental costs in this report to ensure consistency with the CANSO data submission[4]. For Europe, the Network Manager (NM) costs have been revised upwards to take improved cost allocation into account and to better consider supporting services.

As the cost of capital (interest on debt and remuneration of equity) is not included in the US data, the cost of capital which represents around 4-5% of the total European cost base has been removed from the European figures.

Whereas regulatory costs were not included in the European data (e.g. costs of National Supervisory Authorities, or Civil Aviation Authorities), a small portion of the FAA costs include regulatory costs which could not be excluded due to the FAA being a governmental entity. However, relative to the total costs the amount is small and does not significantly impact the overall results of the comparison.

Costs for the Air Traffic Control System Command Center (ATCSCC) are included in the US data and similarly the EUROCONTROL Network Manager Operations Centre (NMOC) costs are included in the overall European data. NMOC costs for SES States have been calculated on a pro-rata basis, allocating the overall European NMOC costs between SES (91%) and non-SES States (9%).

Nonetheless, there are inherent differences in the cost structures of government entities and privately-operated entities which are not easily quantified or removed. It should be noted that FAA-ATO funded R&D expenditures are included; however, the FAA is making significant investment into their NextGen program, some of which is not funded by the FAA-ATO and therefore not included in this report.

[4] The cost of flight services is estimated to be around 300 million USD.

Where necessary, some minor refinements were made to historic data reported in previous cost-efficiency comparisons in order to reflect improvements in cost allocation systems and to provide the reader with the most accurate picture.

For this update, it was decided in agreement with FAA-ATO to suppress the years 2004 and 2005 from the analyses because of differences in FAA-ATO accounting and personnel systems before 2006, which limit comparability over time.

1.5 Methodology and framework

The analysis is undertaken on a gate-to-gate ANS basis. Separate analysis of en-route and terminal ANS costs would be meaningless as cost allocation practices in the US and in Europe are not directly comparable.

1.5.1 Performance framework

The cost-efficiency analysis has been conducted within the framework shown in Figure 1-3, which heavily draws on the ACE analysis framework.

The central part of Figure 1-3 displays the key economic (inputs/output) data that are considered in the following sections:

- **The unit ATM/CNS provision costs** is the key cost-effectiveness indicator which reflects the ratio of total ATM/CNS provision costs and the output measured in terms of flight-hours controlled. To understand the underlying performance drivers, this key indicator is further broken down into:
  - **Air Traffic Controller (ATCO) employment costs per unit of output** (itself broken down into **ATCO productivity** and **ATCO employment costs per ATCO**); and
  - **Support costs per unit of output** (defined as ATM/CNS provision costs other than ATCO employment costs). Typically, these include support staff employment costs (i.e., non-ATCO employment costs, which include controllers in training and developmentals), operating costs, and depreciation/amortization.

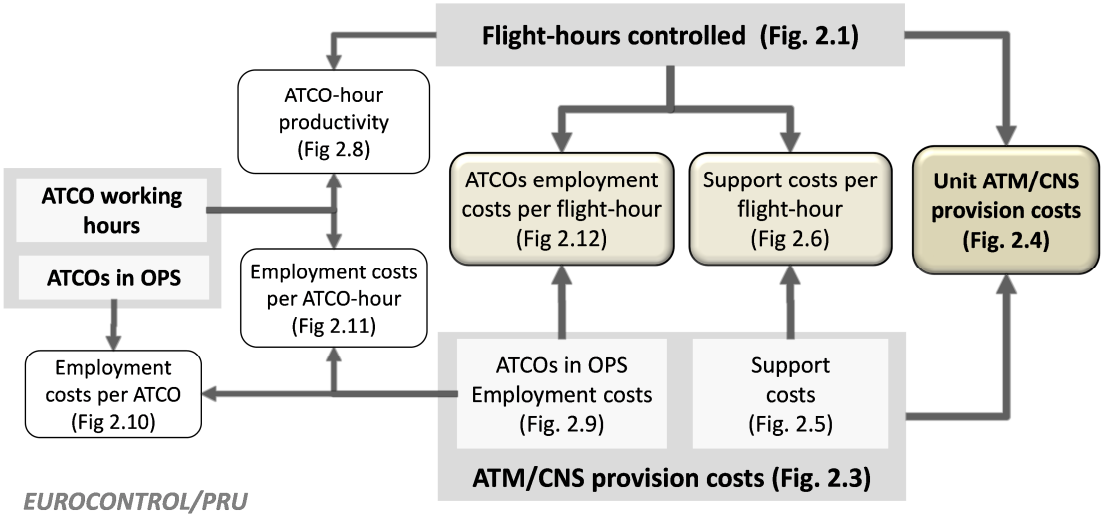

Figure 1-3: Cost-effectiveness analytical framework

1.5.2 Currency exchange rate

Figure 1-4 shows the considerable fluctuations in the spot €/US$ exchange rates between 2006 and 2015, with an average of 1.35 between 2006 and 2014 which is slightly higher than the 2013 and 2014 annual averages.

To enable cost-efficiency comparisons between the US and Europe, there is a need to convert the costs into a common currency.

However, the application of yearly exchange rates would introduce a bias for time series analysis and would not take differences in price levels between countries into account.

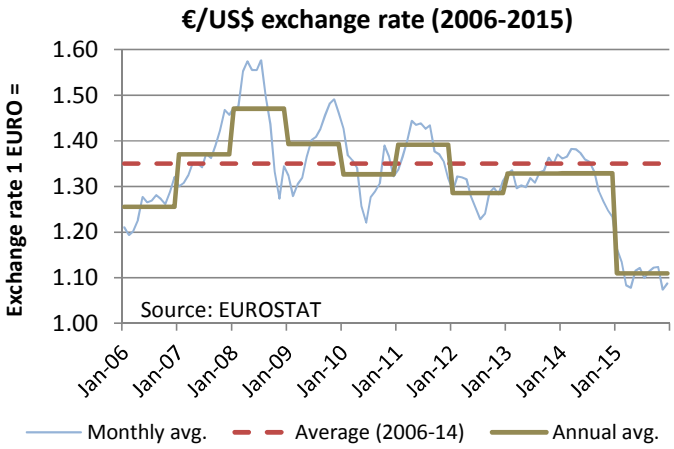

Figure 1-4: Time series of the €/US$ exchange rate (2006-2015)

In order to eliminate those effects, comparisons are often done by means of an artificial currency Purchasing Power Standards – PPS (see grey box).

Incidentally, in the case of the EURO vs. the US dollar, the average 2006-2014 exchange rate (US$1.35: €1) is close to the 2014 US PPS conversion rate of 1.34 against the EU27 average.

In order to be able to present the comparison in this paper in EURO instead of an artificial currency (PPS) while eliminating effects from exchange rates fluctuations, the 2006-2014 average exchange rate of US$1.35: €1 was consistently applied for the entire period.

All cost figures in this paper are expressed in 2014 terms, i.e. the nominal price series were deflated using the Consumer Price Index (CPI) deflator. The underlying data - including the cost comparison expressed in PPS - can be found in Annex I.

As shown in Figure 1-4, at the time of writing this report, the US dollar has appreciated significantly against the EURO which might have a notable impact

Purchasing Power Standards (PPS)

In order to compare costs expressed in different currencies, one could simply convert all figures into Euro at a given exchange rate of the currency to the Euro.

Although all costs are now formally expressed in the same currency, a simple conversion would not consider differences in price levels between countries. In order to avoid such a bias it is best practice to convert the figures into a common, artificial currency (PPS) and a common price level, using the Purchasing Power Parities (PPPs).

PPPs are indicators of price level differences across countries. They indicate how many currency units a given quantity (goods, services) will cost in different countries. PPPs can thus be used as currency conversion rates to convert expenditures expressed in national currencies into a common currency, eliminating differences in price levels across countries. This common currency is referred to as the Purchasing Power Standard (PPS).

for future updates of this ANS cost-efficiency comparison. In 2015, the average €/US$ exchange rate was US$1.11 which would increase the US ANS costs expressed in EURO by some 22% compared to the average 2006-2014 exchange rate used in this update. Without a doubt this would have a significant impact on the ANS cost efficiency comparison.

2 US-Europe comparison of ANS cost-efficiency trends

2.1 Operational context

The US and Europe have different operational structures for the provision of gate-to-gate ATM/CNS as summarised in Table 2-1 below.

2014	Europe (37 ANSPs)	SES RP1 Area (EU27+2 States)	US FAA-ATO
Geographic Area (million km^2)	11.5	9.4	14.8 [5]
Number of civil en-route ANS Providers	37	29	1
Number of Air Traffic Controllers (ATCOs in OPS)	17 513	14 771	12 959 [6]
Total staff	56 303	42 127	31 501
Flight-hours controlled (million)	14.6	12.7	22.9
Controlled flights (IFR) (million)	9.8	9.1	15.2
Number of en-route facilities	63	50	23
Number of terminal facilities/ approach control (stand alone and collocated)	280	212	161
Number of airports with ATC services	415	322	517
ATM/CNS provision costs (in billion €2014 for Europe and billion US$2014 for the USA)	€ 7.62	€ 6.94	$10.95
ATM/CNS provision costs (in billion €2014)	€ 7.62	€ 6.94	€ 8.11
Source	*EUROCONTROL*		*FAA-ATO*

Table 2-1: European and US operational structures and traffic (2014)

Europe comprises 37 ANSPs (29 for the SES area) and 63 Area Control Centres (ACC). In contrast, the US has one ANSP and 23 Air Route Traffic Control Centers (ARTCC). The US has 161 terminal/approach control facilities, compared to Europe's 280 terminal facilities. Some terminal facilities in the US are so large in terms of size of airspace and service provided that they are more comparable to some of the lower airspace European ACCs.

There were 415 airports with ATC services in Europe (322 in the SES area) in 2014 against 517 in the US, 264 serviced by FAA-ATO and 253 Federal Contracted Towers (FCTs)[7].

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5 10.4 million km^2 excluding Alaska and Hawaii.

6 This value reflects the CANSO reporting definition of a fully trained ATCO in OPS and includes supervisors. It is different from the total controller count in the FAA controller workforce plan which does not include supervisors. The number of ATCOs in OPS does not include 1 292 controllers reported for contract towers. The number of ATCOs in OPS including Oceanic is 13 138.

Overall, Table 2-1 shows that the FAA-ATO handled some 56% more traffic in terms of flight hours than the service providers in Europe in 2014, but with notably less ATCOs in OPS and total staff.

One key point in making this comparison was to use the ATCOs in operation (ATCO in OPS) definition employed by ACE and CANSO. This definition does not include controllers designated as "on-the-job training" in Europe or as "developmental or Certified professional controllers in training" (CPCITs) at the FAA.

For CANSO and this paper, only full time ATCOs were considered in the specific ATCO employment costs. Employment costs for developmental controllers, controllers in training and contract tower controllers were included in support costs. This distinction is made to facilitate international comparisons and differs from total controller counts reported in the FAA controller workforce plan [Ref. xii] which includes developmental controllers and controllers in training as part of the total count.

Using this definition, Europe operated with 35% more full time ATCOs than the US in 2014. However, this percentage narrows to 23% more controllers in Europe when FAA developmental controllers and European on-the job trainees are also considered. According to the FAA Controller workforce plan, a "developmental" controls live traffic with an ability to staff a limited subset of the positions at a facility.

Although there are undoubtedly less total ATCOs in the US than in Europe, more work is needed to compare European "on-the-job training" controllers with FAA developmentals and CPCITs in order to draw firmer conclusions on the staffing comparisons in both systems.

Figure 2-1 shows the evolution of controlled flight hours in the US and in Europe. Flight hours are generally considered to be a better measure of output for ANS cost-efficiency comparisons than controlled flights because they are closer associated with the ATCO work provided.

Overall, the FAA-ATO controlled 80.5% more flight hours than the service providers in SES States (RP1) in 2014. The trend over the analysis period differs notably between the US and Europe and the effect of the economic crisis starting in 2008 is clearly visible on both sides of the Atlantic.

Over the period from 2006 to 2014, the number of controlled flight hours in the FAA-ATO has decreased by -11.3%, whereas in Europe they have increased by +9.8% (SES States +4.7%).

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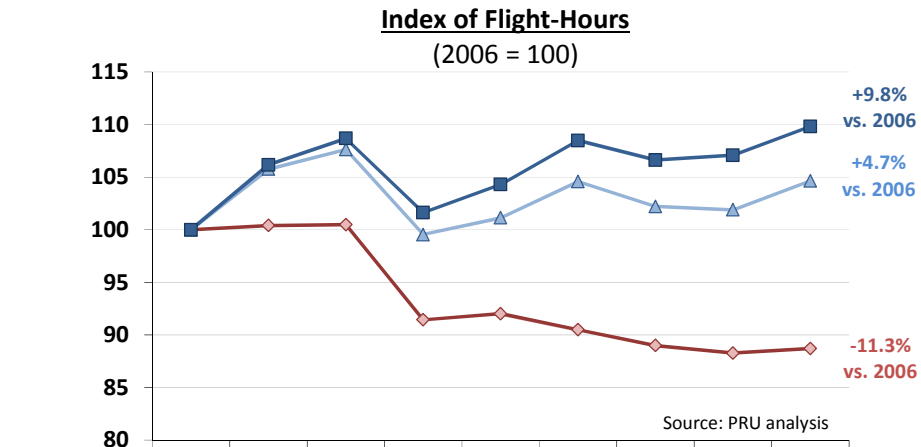
[7] The US staff figures exclude FCTs. The majority of these are regional airports which tend to handle low amounts of traffic compared to the airports operated by FAA-ATO. The European data does not include airports where ATC is provided by an operator which is different than the incumbent en-route ANSP (and for which no data at system level is available).



	2006	2007	2008	2009	2010	2011	2012	2013	2014
US FAA-ATO	100	100.4	100.5	91.4	92.0	90.5	89.0	88.3	88.7
SES (RP1)	100	105.8	107.6	99.5	101.1	104.6	102.2	101.9	104.7
Europe (37)	100	106.2	108.7	101.6	104.3	108.5	106.6	107.1	109.8

Figure 2-1: Trend in flight-hours (2006-2014)

Figure 2-2 shows the average number of seats per scheduled flight based on the analysis of Innovata data [Ref. xiii]. It is worth noting that the average number of seats per scheduled flight continuously increased in both regions over the analysis period, irrespective of the different trend in controlled flight hours.

Furthermore, the average flight lengths increased continuously in both systems over the analysis period. It suggests that airlines on both sides of the Atlantic responded to the economic crisis starting in 2008 with a reduction in the number of services but with, on average, larger aircraft. Additionally, in the US, the increase over the past four years seems to be fostered by the consolidation of the airline industry.

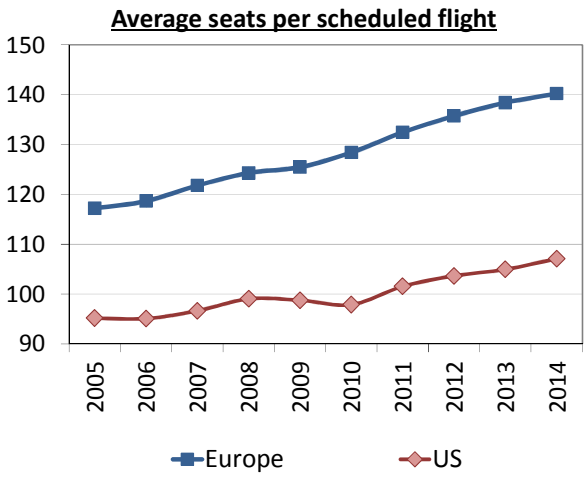


Figure 2-2: Average seats per scheduled flight

Overall, the average number of seats in the US in 2014 is 24% lower than in Europe. The notable difference observed in aircraft gauge in the two regions is tied to the different practices of airlines, which are linked to demand, market competition, and other factors.

More information on differences in operational performance can be found of the recently published US/Europe comparison of ATM-related operational performance [Ref. iv].

2.2 Comparison of ANS cost-efficiency

Although both figures for the SES States and Europe are shown in the analysis in this chapter, for sake of simplicity and clarity only differences between the FAA-ATO and the SES States are highlighted and commented.

Table 2-2 provides a high level comparison of ATM/CNS provision costs (€2014) in the US and Europe.

The FAA-ATO total costs of 8.1 billion Euro are based on the conversion of an amount of US$10.9 billion to Euro using the average 2006-2014 exchange rate of US$1.35: €1.

The FAA-ATO costs represent around 68% of the total FAA net cost of operations for FY 2014 (US$16.1 billion). The other 32% relate to costs outside the FAA-ATO (such as airports, certification, etc.) but also to FAA-ATO costs falling outside the scope of this study, such as oceanic services and weather (overall accounting for some 1.1% of FAA-ATO costs in FY 2014)[Ref. xiv].

ATM/CNS provision costs 2014 (M€2014)	Europe (37 ANSPs)	SES (RP1)	US FAA-ATO	US vs. Europe	US vs. SES
Staff costs	€ 5 110	€ 4 732	€ 4 223	-17%	-11%
Other operating costs	€ 1 587	€ 1 385	€ 3 133	97%	126%
Depreciation costs	€ 919	€ 825	€ 754	-18%	-9%
Total costs	**€ 7 616**	**€ 6 942**	**€ 8 110**	**+6%**	**+17%**

Exchange rate of US$1.35: €1

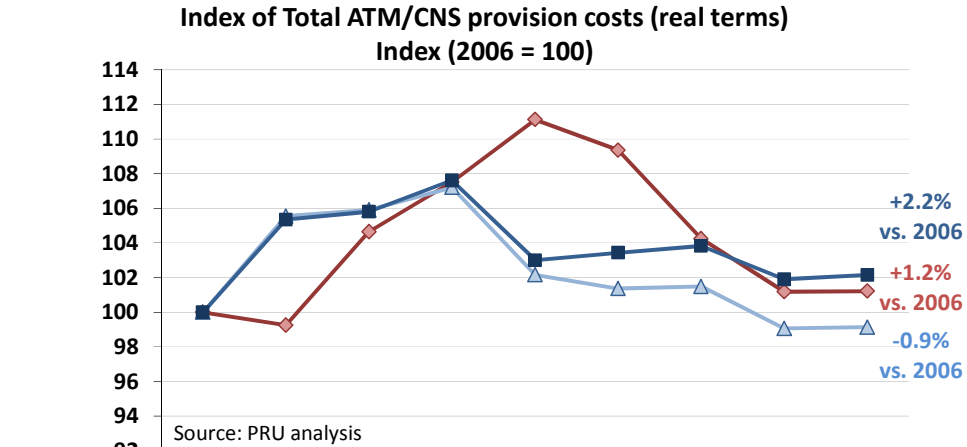
Table 2-2: Headline cost comparison between the US and Europe (€2014)

In 2014, the US controlled +80.5% more flight hours than service providers in the SES States (+56.4% vs. Europe). At the same time, the total ATM/CNS provision costs in the US were some 17% higher than in the SES States (+6% vs. Europe).

The data also shows that, while staff and depreciation costs are higher in Europe, they are offset by other operating costs which in Europe tend to be lower than in the US.

2.2.1 ATM/CNS provision costs

Figure 2-3 shows the trend in total ATM/CNS provision costs in real terms for the US FAA-ATO and Europe between 2006 and 2014.



	2006	2007	2008	2009	2010	2011	2012	2013	2014
US FAA-ATO	100	99.2	104.6	107.5	111.1	109.4	104.2	101.2	101.2
SES (RP1)	100	105.5	105.9	107.2	102.2	101.4	101.5	99.1	99.1
Europe (37)	100	105.3	105.8	107.6	103.0	103.4	103.8	101.9	102.2

Figure 2-3: Trends in total ATM/CNS provision costs (2006-2014)

Overall total US ATM/CNS provision costs increased by +1.2% compared to 2006 levels whereas in the SES States the total cost base decreased by -0.9% vs. 2006 (Europe +2.2%). The cost trends need to be seen in the context of a -11.3% traffic decrease in the US and a 4.7% traffic increase in the SES States (+9.8% in Europe) during the same time.

After a small decrease between 2006 and 2007 (in nominal terms costs increased between 2006 and 2007), the real US ATM/CNS provision costs increased notably between 2007 and 2010 and decreased again at almost the same rate between 2010 and 2014. The decrease was partly due to a decrease in the FAA operating budget which is controlled by the US Congress, savings in a number of areas, and the allocation of expenses based on the reorganisation of FAA lines of business.

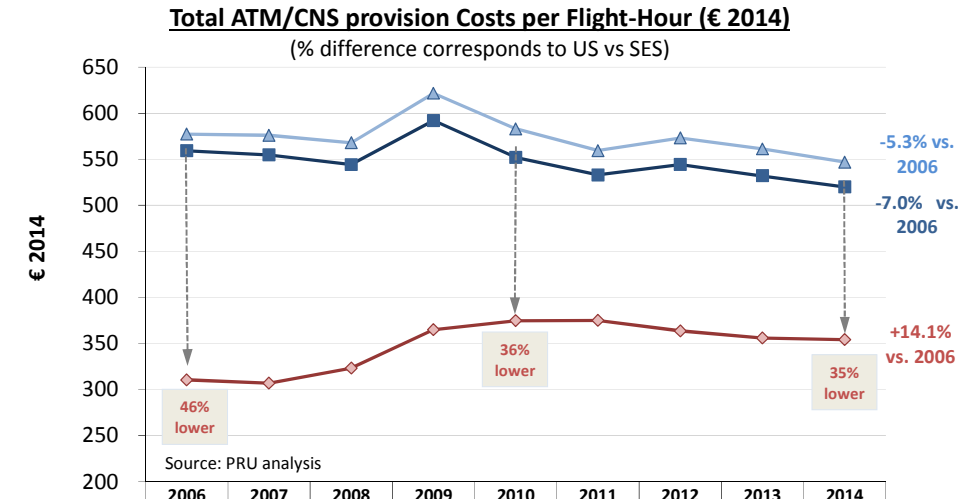
The ATM/CNS provision costs in the SES States increased at a slower rate than in the US until 2009 before they show a notable decrease in 2010. After a slight increase between 2010 and 2012, ATM/CNS provision costs in SES States fell again until 2014.

The notable reduction of the cost base in Europe is predominantly driven by specific cost containment measures implemented by many European ANSPs between 2009 and 2012 in response to the lower traffic volumes following the economic downturn starting in 2009.

The first reference period of the Single European Sky Performance scheme between 2012 and 2014, which required the setting of binding cost-efficiency targets for SES States, also contributed to a further reduction of the cost base during that period.

2.2.2 Unit ATM/CNS provision costs

In 2014, total ATM/CNS provision costs in the US in 2014 were 18% higher than in SES States (€8.1 billion in the US vs. €6.9 billion in SES States) but the FAA-ATO serviced almost twice the level of traffic. As a result of the significantly higher level of controlled flight hours, the ATM/CNS unit provision costs in the US were notably lower than in SES States throughout the entire analysis period (see Figure 2-4).



	2006	2007	2008	2009	2010	2011	2012	2013	2014
US FAA-ATO	310	307	323	365	375	375	363	356	354
SES (RP1)	577	576	568	622	583	559	573	561	547
Europe (37)	559	555	544	592	552	533	544	532	520

Figure 2-4: Trends in unit ATM/CNS provision costs (2006-2014)

Unit costs in the SES States peaked in 2009 as a result of the substantial traffic decrease, following the economic crisis which coincided with the peak in total ATM/CNS provision costs. As of 2010, the cost containment measures implemented by many European ANSPs took effect and, supported by a positive traffic growth, unit costs started to decrease again in Europe.

In the US, ATM/CNS unit provision costs increased notably until 2010 but, due to substantial cost reductions (see Figure 2-3), decreased again between 2010 and 2014. The unit cost reduction needs to be seen in the context of a continuous traffic decrease during that period (see Figure 2-1) which makes it more difficult to reduce unit costs.

Table 2-3 summarises the changes in ATM/CNS provision costs and traffic between 2006 and 2014.

Annual average growth rates (AAGR) between 2006 and 2014	Europe (37)	SES States (RP1)	US FAA-ATO
Controlled flight hours (AAGR)	+1.2% ↑	+0.6% p.a. ↑	-1.5% p.a. ↓
ATM/CNS provision costs (AAGR)	+0.3% ↑	-0.1% p.a. ↓	+0.2% p.a. ↑

Table 2-3: Changes in ATM/CNS provision costs and traffic between 2006 and 2014

Whereas in 2006 the US unit costs were 46% lower than in the SES States, the gap in 2014 has reduced to 35% which corresponds to a reduction of 11 percent points over the past 8 years. As shown in Table 2-3, the observed reduction has been driven by opposing traffic and ATM/CNS cost trends over the entire analysis period (2006-2014).

2.2.3 Support costs

As illustrated in the analysis framework in Figure 1-3 on page 5, the support costs can be further broken down into:

- support staff employment costs;
- other operating costs; and,
- depreciation/amortization.

Overall, total support costs in the US (see Figure 2-5) were 34.1% higher than in SES States in 2014 - but for 80.5% more flight hours controlled (see Table 2-1).

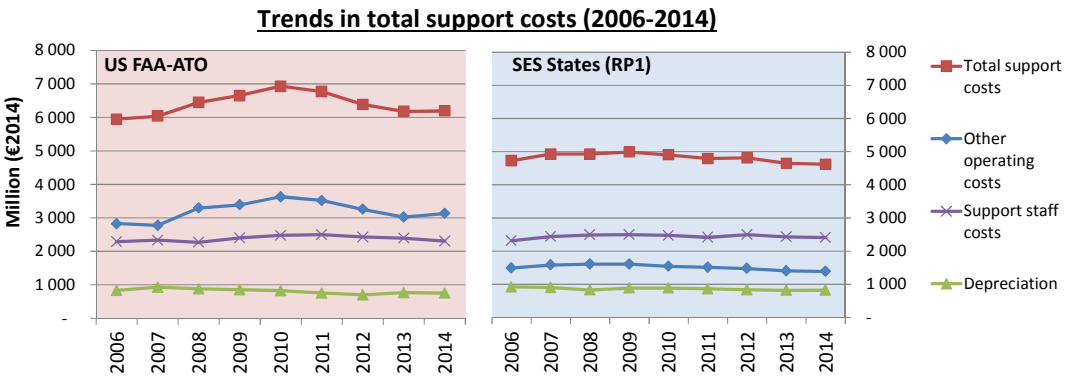


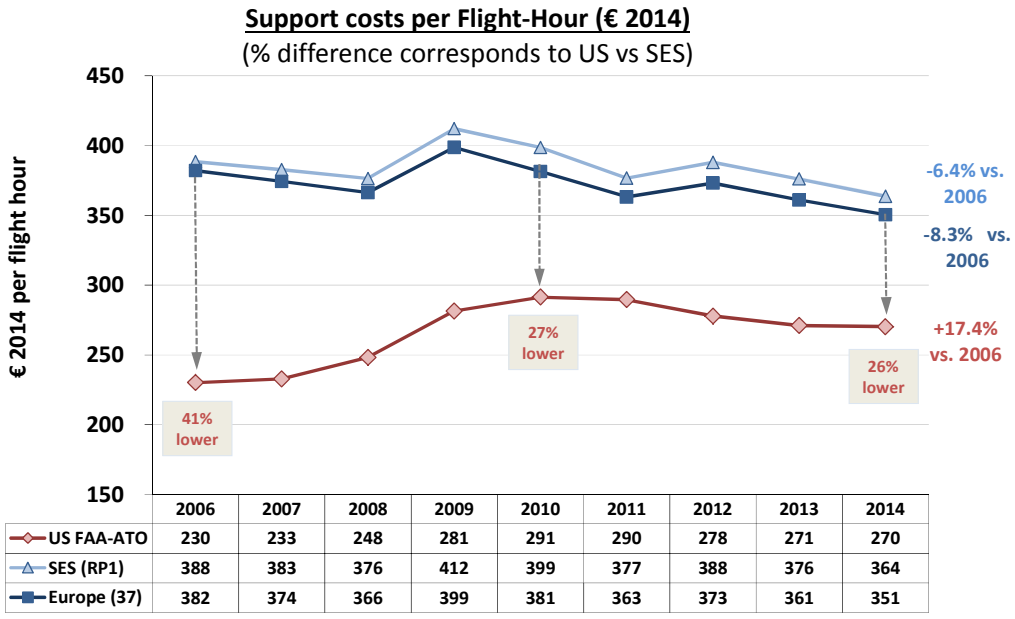
Figure 2-5: Trends in total support costs (2006-2014)

In the US, support costs accounted for around 76% of the total ATM/CNS provision costs in 2014 whereas in SES States the relative share of support costs in total ATM/CNS provision costs was 9% lower (67% in 2014). As shown in Figure 2-5, total support costs in SES States remained relatively stable over the analysed period while in the US they increased notably between 2007 and 2010 but decreased again at almost the same rate between 2010 and 2014.

According to the FAA, the observed increase in FAA-ATO support costs is driven by other operating costs, mostly attributable to the change in the Facilities and Equipment (F&E) purchasing associated with NextGen[8].

While in the past, equipment was being purchased and depreciated over many years, more recently, the FAA-ATO has been purchasing NextGen Services that are paid for within the same year. Thus, the support costs appear to be increasing, but in effect they have stayed the same, as services have been purchased and expensed instead of capitalised and depreciated.

Unit support costs (defined as all ATM/CNS provision costs other than ATCO employment costs per flight hour) followed a similar pattern as observed for ATM/CNS provision unit costs between 2006 and 2014 (see Figure 2-6).



	2006	2007	2008	2009	2010	2011	2012	2013	2014
US FAA-ATO	230	233	248	281	291	290	278	271	270
SES (RP1)	388	383	376	412	399	377	388	376	364
Europe (37)	382	374	366	399	381	363	373	361	351

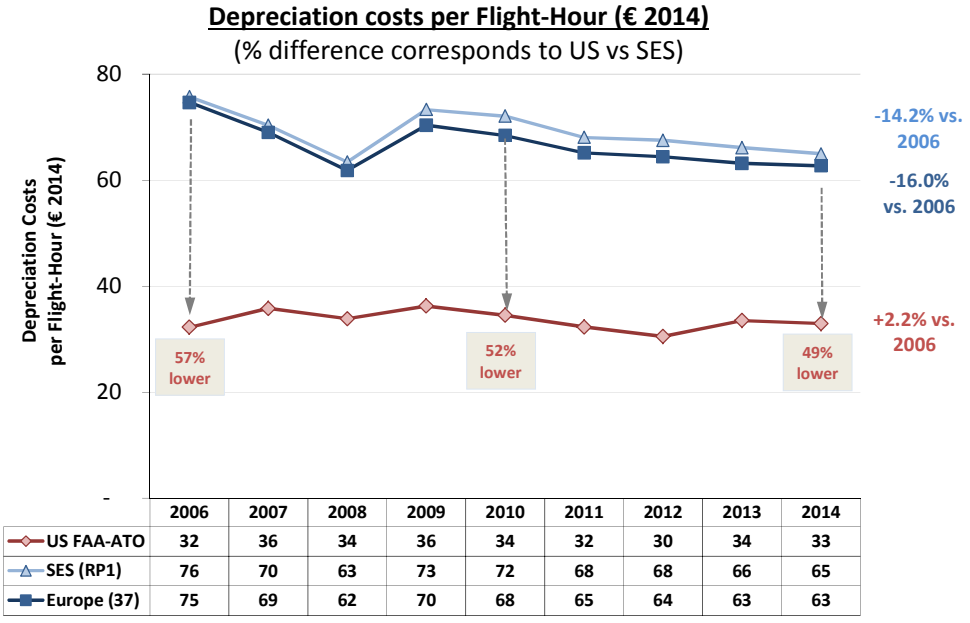
Figure 2-6: Trends in unit support costs (2006-2014)

SES States' unit support costs decreased at an average rate of -0.8% p.a. over the analysis period with an interruption in 2009 when a dip in traffic volumes raised the unit support costs by +9.5%. Between 2006 and 2014, FAA-ATO unit support costs increased at an average rate of +2.0% per year, although they have been decreasing at a moderate rate since 2011.

[8] U.S. Next Generation Air Transportation System.

As a result, the unit support cost gap between US and SES States reduced from 158.3 Euro per flight-hour in 2006 to 93.4 Euro in 2014.

Unit depreciation costs are a component of unit support costs, and the two have followed a similar pattern over the analysis period (see Figure 2-7). While the US unit depreciation cost remained relatively stable, the SES States' unit depreciation cost fell notably, resulting in a narrowing of the gap (49% lower in 2014 compared to 57% lower in 2006).



	2006	2007	2008	2009	2010	2011	2012	2013	2014
US FAA-ATO	32	36	34	36	34	32	30	34	33
SES (RP1)	76	70	63	73	72	68	68	66	65
Europe (37)	75	69	62	70	68	65	64	63	63

Figure 2-7: Trends in unit depreciation costs (2006-2014)

The SES States' unit depreciation costs decreased by -16.0% between 2006 and 2008 but, due to the decrease in traffic volume following the economic crisis, increased again in 2009. Between 2009 and 2014, unit depreciation costs decreased continuously in Europe. The US experienced a slight decrease in unit depreciation costs between 2009 and 2012 but showed an increase again in 2013/2014.

The lower depreciation costs in the US for a volume of traffic that is nearly twice as large as in Europe may arise from several factors:

- It can be an indication of an almost fully-depreciated asset base in advance of the FAA's programme of investment in NextGen;
- A rather high average remaining accounting life of assets in Europe following recent large investment programmes (but more capital expenditure (capex) is expected as a result of SESAR[9] deployment);
- Genuine differences in the accounting treatment of depreciation. FAA depreciation expenses are calculated using the straight-line method as in Europe but longer depreciation periods may be applied in the US. It should be noted that the FAA-ATO follows US Generally Accepted Accounting Principles (GAAP), while European ANSPs use either International Financial Reporting Standards (IFRS) or local GAAP; and,

[9] Single European Sky ATM Research.

- The result of a fragmented approach in capital expenditures in Europe, leading to over capitalisation, asset duplication and generally lower asset productivity.

Indeed, due to the fragmentation of ANS service provision in Europe, support costs are substantially higher than in the US, which benefits from significantly fewer operational units (ACCs+APPs) and a common ANS system.

Although the implementation of functional airspace blocks (FABs) as required by SES legislation is a good tool to address fragmentation, at present there are few short or medium plans to consolidate ANS service provision in the European Union. It is expected that the rationalisation through common procurement of ATM/CNS systems and infrastructure sharing could bring significant benefits for Europe.

2.2.4 ATCO productivity and employment costs

A detailed PRC Report [Ref. iii] on a sample of three US en-route centers in 2003 identified that, in 2001, average yearly working hours for the US controllers in those centers were some 30% higher than in their European counterparts, although this was offset by higher salaries in the US at the time of that study[10]. This was mainly due to:

- US ATCOs handling more traffic when working at their maximum throughput;
- Enhanced availability of US ATCOs to staff the operations room to match the ups and downs of traffic (more effective use of the resource through more flexible roster practices and working arrangements).

In the meantime, the gap in average working hours between Europe and the US has further widened. In 2014, the average annual working hours per ATCO in OPS in the US (1 824 hours[11]) were 41% higher than in SES States (1 296 hours).

As shown in Figure 2-8, US ATCOs were handling 0.97 flight-hours per ATCO-hour in 2014, while European ATCOs were handling 0.66 flight-hours per hour.

Despite a notable closure of the productivity gap between 2006 and 2014, ATCO productivity in the US remains considerably higher than in SES States, with each US ATCO still handling some +46% more volume of traffic than their counterparts in SES States.

In Europe, the level of overall productivity may also be influenced by the level of fragmentation with on average smaller en-route facilities which requires more handovers and interactions.

In SES States (with the exception of 2009) continuous productivity gains could be achieved over the analysis period (+1.8% p.a. on average) due to the increase in traffic levels and improved rostering. At the same time, US productivity fell by -2.3% p.a. on average due to

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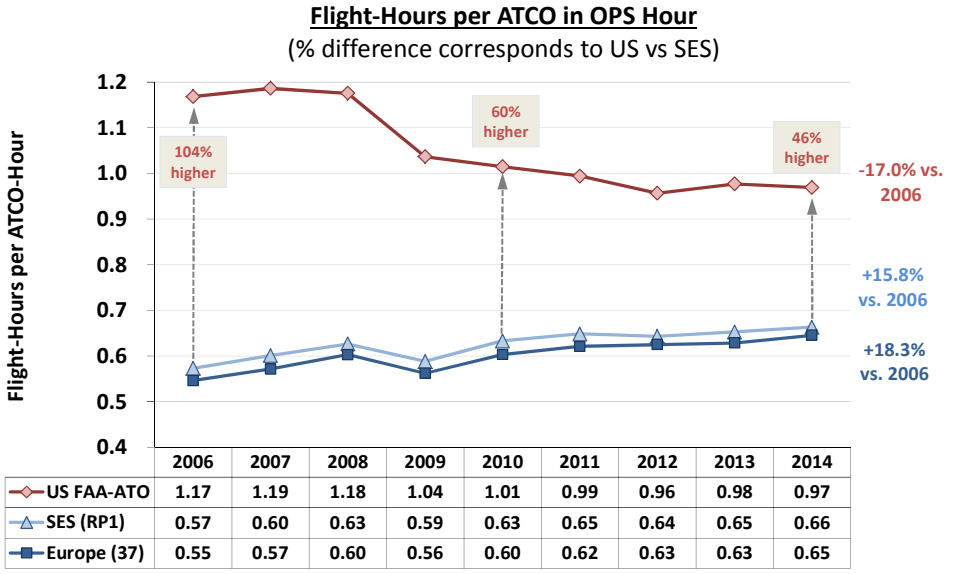
[10] In the 2003 comparison the exchange rate was 1€ to US$0.9. Using the 2006-2014 average exchange rate would bring the average ATCO costs much closer to the European level because of the appreciation of the EURO during that time.

[11] Average annual working hours reported by the FAA-ATO represent actual hours worked including time worked outside of the scheduled shift, less leave, as collected through Labour Distribution Reporting.

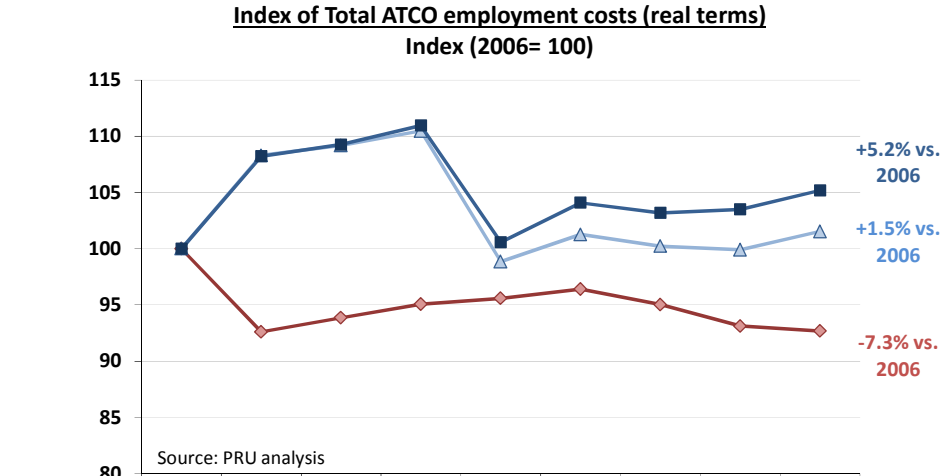
several factors, which include a drop in traffic levels and an ongoing change in the mix of ATCOs, which can impact the average annual working hours.



	2006	2007	2008	2009	2010	2011	2012	2013	2014
US FAA-ATO	1.17	1.19	1.18	1.04	1.01	0.99	0.96	0.98	0.97
SES (RP1)	0.57	0.60	0.63	0.59	0.63	0.65	0.64	0.65	0.66
Europe (37)	0.55	0.57	0.60	0.56	0.60	0.62	0.63	0.63	0.65

Figure 2-8: Trends in ATCO-hour productivity (2006-2014)

Figure 2-9 shows the total ATCO employment costs in real terms between 2006 and 2014. Overall total ATCO employment costs in the US decreased by -7.3% compared to 2006 whereas in the SES States total ATCO employment costs increased by +1.5% vs. 2006 (Europe +5.2%).



	2006	2007	2008	2009	2010	2011	2012	2013	2014
US FAA-ATO	100.0	92.6	93.9	95.1	95.6	96.4	95.0	93.1	92.7
SES (RP1)	100.0	108.3	109.2	110.5	98.9	101.3	100.2	99.9	101.5
Europe (37)	100.0	108.2	109.3	111.0	100.6	104.1	103.2	103.5	105.2

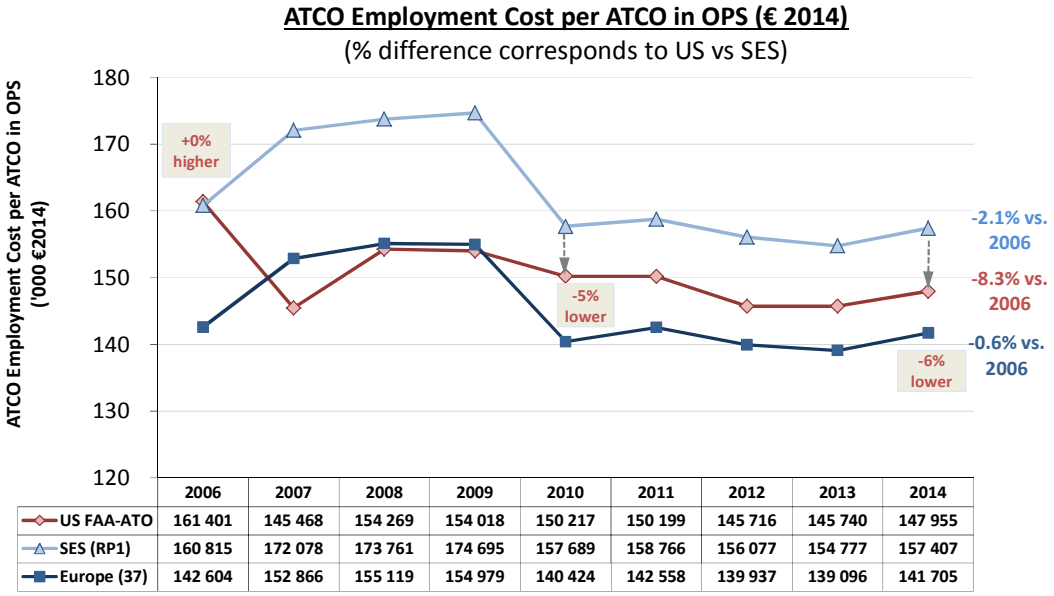
Figure 2-9: Trends in total ATCO employment costs (2006-2014)

Whereas ATCO employment costs in the US decreased slightly over time, there was a notable increase in Europe between 2006 and 2009. This increase in Europe was due to a number of factors which were thoroughly documented in the EUROCONTROL annual ACE Benchmarking Reports [Ref. ix], including:

- Large increases in employment costs in Spain;
- Upward pressure on salaries experienced by several Central and Eastern European countries following their accession to the EU; and,
- Additional pension costs which were previously not recognised; ANSPs have dealt with this in a variety of ways, including increased contributions and one-off payments.

The average employment costs per ATCO in Europe decreased significantly in 2010, mainly as a result of the introduction of Law 09/2010 in Spain which had a significant impact on ATCO contractual working hours and overtime hours leading to a substantial reduction in employment costs.

Figure 2-10 shows the evolution of the ATCO employment costs[12] per ATCO in OPS between 2006 and 2014. It is important to point out that the comparison of employment costs is influenced by the exchange rate used (see Figure 1-4). For example, using the 2015 exchange rate of 1€ to US1.11 (€ depreciated against the US$) would increase US costs and shift the US curve upwards in Figure 2-10, all else equal.

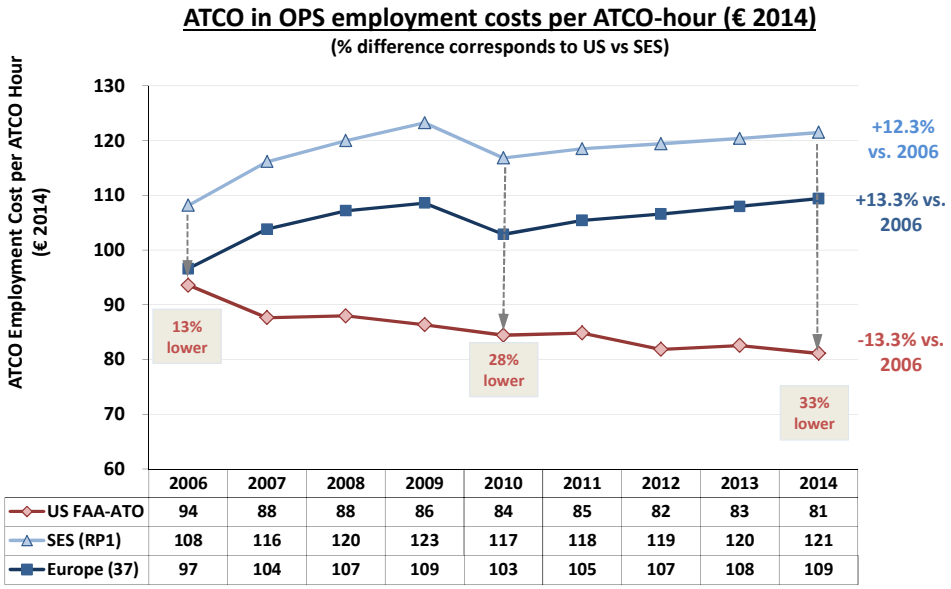


	2006	2007	2008	2009	2010	2011	2012	2013	2014
US FAA-ATO	161 401	145 468	154 269	154 018	150 217	150 199	145 716	145 740	147 955
SES (RP1)	160 815	172 078	173 761	174 695	157 689	158 766	156 077	154 777	157 407
Europe (37)	142 604	152 866	155 119	154 979	140 424	142 558	139 937	139 096	141 705

Figure 2-10: Employment costs per ATCO in OPS (2006-2014)

Taking into account differences in average working hours, the US has notably lower ATCO employment costs per ATCO-hour than Europe (see Figure 2-11). This gap in unit employment costs continuously widened from 13% lower costs in the US in 2006 to 33% lower costs per ATCO hour in 2014.

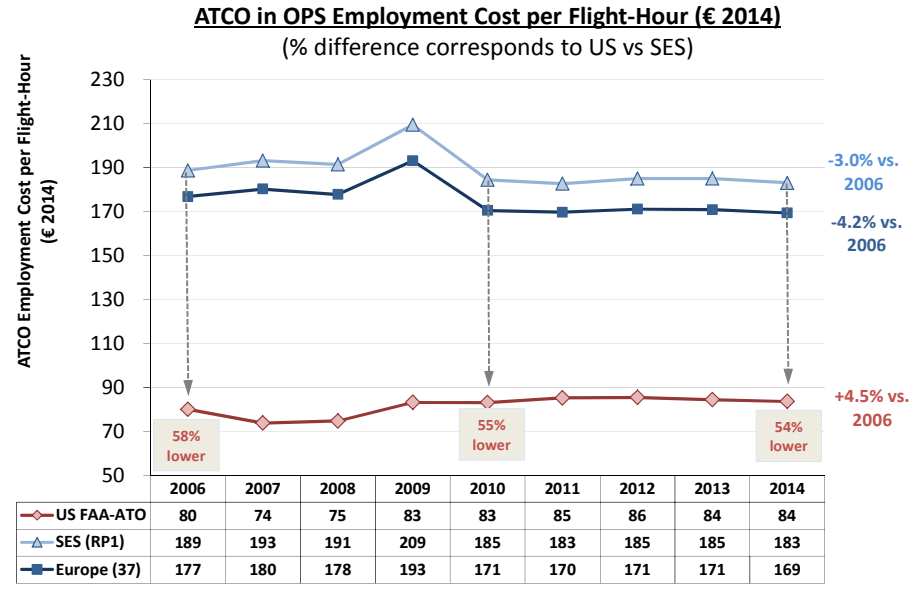
[12] The employment costs include both compensation (e.g. wages and salaries) and benefits (e.g. employer contribution to social security, staff pensions).



	2006	2007	2008	2009	2010	2011	2012	2013	2014
US FAA-ATO	94	88	88	86	84	85	82	83	81
SES (RP1)	108	116	120	123	117	118	119	120	121
Europe (37)	97	104	107	109	103	105	107	108	109

Figure 2-11: ATCO employment costs per ATCO-hour (2006-2014)

When combining the ATCO employment costs and the output in terms of controlled flight hours (see analytical framework in Figure 1-3) the resulting ATCO in OPS employment costs per flight-hour were around 54% lower in the US than in SES States in 2014 (Figure 2-12).



	2006	2007	2008	2009	2010	2011	2012	2013	2014
US FAA-ATO	80	74	75	83	83	85	86	84	84
SES (RP1)	189	193	191	209	185	183	185	185	183
Europe (37)	177	180	178	193	171	170	171	171	169

Figure 2-12: ATCO employment costs per flight-hour (2006-2014)

This reflects the significantly higher productivity in the US (see Figure 2-8), whereby each US ATCO handles some 46% more flight-hours than their average European counterparts, while the employment costs per ATCO in OPS are about 5% lower than in SES States (see Figure 2-10).

3 Summary of the main results and conclusions

Given the characteristics of the airspace, the FAA-ATO is a realistic comparator for the European ANS system. It is however acknowledged that, even though many similarities exist, there are different legal/regulatory, economic, social, and operational environments which may affect the observed differences in performance.

Overall, the FAA-ATO continues to provide a comparable quality of service at notably lower ATM/CNS unit costs in 2014, although there has been a considerable reduction of the performance gap between the US and Europe over the past eight years.

The observed reduction of the cost-efficiency gap has been driven by opposing traffic and ATM/CNS cost trends on both sides of the Atlantic over the analysis period (2006-2014).

Evolution of cost-efficiency drivers

To ensure comparability and consistency over time, the analyses of the cost efficiency trends has been based on the key metrics from the well-established performance framework used throughout the report.

Figure 3-1 shows the trends for the main drivers affecting ATM/CNS unit cost changes between 2006 and 2014 for the US FAA-ATO (red) and SES RP1 States (blue).

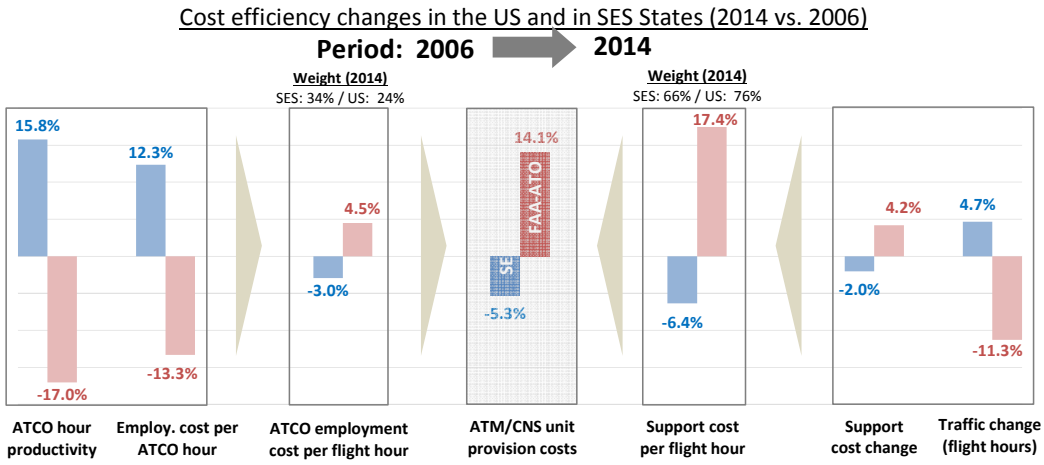


Figure 3-1: Changes in the cost-efficiency indicator (2006-2014)

Compared to 2006, ATM/CNS unit costs were +14.1% higher in the US in 2014 but decreased by -5.3% in SES States (RP1). The change in the US was mainly driven by an increase in support costs (+4.2% vs. 2006) combined with a substantial reduction in traffic volume (-11.3% vs. 2006) which also resulted in a notable reduction of ATCO hour productivity in the US (-17% vs. 2006). The reduction of employment cost per ATCO hour by -13.3% compared to 2006 could not compensate for the aforementioned effects and therefore resulted in notably higher ATM/CNS unit costs in the US in 2014.

In the SES States the trends were opposite between 2006 and 2014 with total support costs reducing by -2.0%, flight hours increasing by +4.7% and an ATCO productivity increase by +15.8% compared to 2006. Although employment costs per ATCO hour

increased by +12.3%, they were more than compensated by an increase in traffic, which resulted in overall ATM/CNS unit costs decreasing by -5.3% compared to 2006.

However, the longer term analysis between 2006 and 2014 to some extent masks the trends in two notably different time periods. In the US, ATM/CNS provision costs increased at a higher rate than in Europe between 2006 and 2009 but both systems were able to significantly cut costs following the economic crisis starting towards the end of 2008 and the resulting decrease of traffic. While traffic in Europe started to grow again in 2010, US traffic levels continued to decrease and only stabilised in 2014.

For a better understanding of the overall trend (2006 and 2014) the analysis was further broken down into the period from 2006 to 2009 (before and just after the start of the economic crisis) and from 2009 onwards.

Figure 3-2 shows a breakdown of the main cost-efficiency performance drivers between 2006 and 2009 for the US FAA-ATO and the SES States (RP1). For the US, the trends are exactly the same as for the 2006 to 2014 period but with a more prominent increase in unit support costs (+22.3% vs. 2006), mainly driven by a +20% increase in other operating costs (see Figure 2-5), and hence ATM/CNS unit costs (+17.6%).

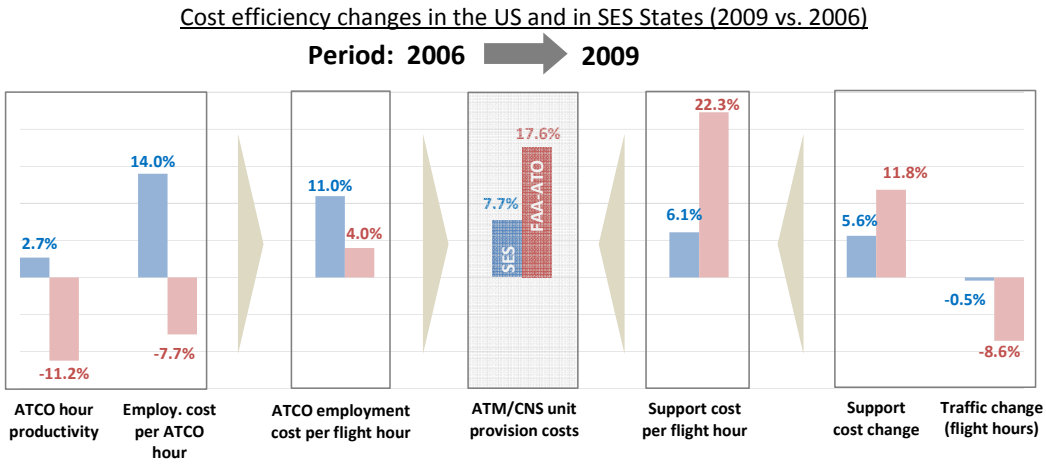


Figure 3-2: Changes in the cost-efficiency indicator (2006-2009)

Between 2006 and 2009, the SES States (RP1) in Europe also showed an increase in support costs (+5.6%) and ATM/CNS unit costs (+7.7%) but benefited from a more moderate traffic reduction than observed for the US during that time.

Figure 3-3 shows the breakdown for the period 2009 to 2014 when traffic started to recover in Europe (+5.1% vs. 2009) but continued to decline in the US until 2014 when it stabilised (-3.0% vs. 2009).

Between 2009 and 2014, the US FAA ATO clearly adjusted to the reduction in traffic levels which consequently resulted in a -3.0% reduction of ATM/CNS unit costs during that time.

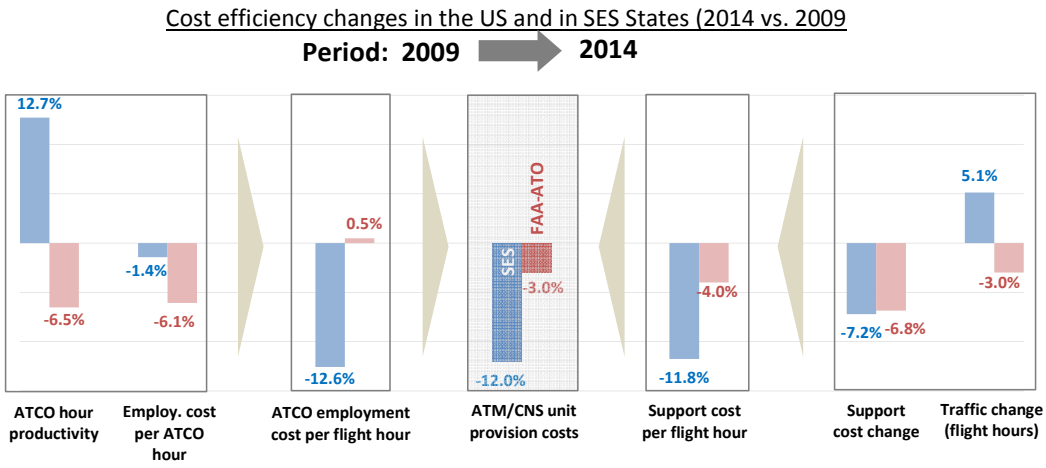


Figure 3-3: Changes in the cost-efficiency indicator (2009-2014)

In Europe the observed gradual recovery of traffic, the cost containment measures implemented by a majority of service providers in the wake of the sharp traffic decrease in 2009, and the implementation of the SES performance scheme (2012-2014) with binding targets and incentive mechanisms contributed to a change in economic behaviour and a notable reduction in ATM/CNS unit provision costs in Europe (-12.0% vs. 2009).

Results of main cost-efficiency metrics in 2014

Figure 3-4 provides a comparison of performance between the US FAA-ATO and the SES States (RP1) in 2014.

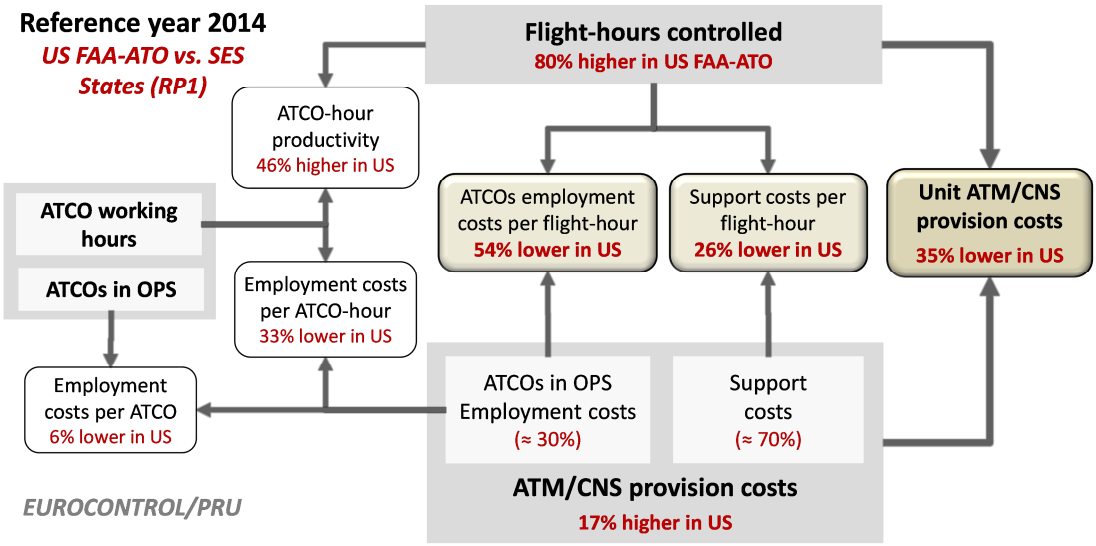


Figure 3-4: Summary of the main results (2014)

As pointed out before, despite the notable reduction of the performance gap over the past eight years, ATM/CNS unit costs were still 35% lower in the US in 2014 (46% in 2006).

The lower ATM/CNS unit cost in the US is due to lower support costs (-26% vs. SES States) and ATCO employment costs (-54% vs. SES States) per flight hour.

Indeed, despite substantial productivity improvements in Europe between 2006 and 2014, the productivity of US ATCOs remained 46% higher in the US in 2014. ATCOs in the US have higher annual working hours and more flexible working arrangements, which allow the FAA-ATO to accommodate changes in demand more easily than European ANSPs.

Although the gap in unit support costs (which account for some 70% of total ATM/CNS unit provision costs in Europe) also notably narrowed between the FAA-ATO and SES States over the past eight years (from -41% in 2006 to -26% in 2014) the difference which is linked to the higher level of fragmentation of services in Europe is still significant. This suggests scope for further cost reductions in Europe in the medium to longer term through consolidation of service provision, common procurement of ATM/CNS systems, and infrastructure sharing.

Outlook

For the second reference period (RP2) from 2015 to 2019, there are already agreed EU-wide and national targets in place which will drive a further 3.3% annual cost efficiency improvement in Europe until 2019. As a result, all else equal, this mandated performance improvement in Europe is likely to further reduce the gap between the US and Europe.

With a view to the target setting for the third reference period of the SES PS in Europe at the end of 2018, it will be worthwhile to envisage another update of this report to monitor the evolution between 2014 and 2017 in support of the EU target setting discussions for the third reference period (RP3) of the SES PS (RP3: 2020-2024).

4 Annex I – Summary of key data

U.S. FAA-ATO		2006	2007	2008	2009	2010	2011	2012	2013	2014
Flight Hours		25.8 M	25.9 M	26.0 M	23.6 M	23.8 M	23.4 M	23.0 M	22.8 M	22.9 M
ATCOs in OPS		12 817	13 169	12 587	12 769	13 164	13 279	13 492	13 218	12 959
Other Staff		20 821	18 763	19 932	20 772	20 890	20 547	19 969	19 627	18 542
Total staff		33 638	31 932	32 519	33 541	34 054	33 826	33 461	32 845	31 501
Total ATM/CNS provision cost	nominal	9211 M $	9407 M $	10296 M $	10535 M $	11062 M $	11236 M $	10935 M $	10774 M $	10949 M $
US Inflation rate (EUROSTAT)		3.20	2.90	3.80	-0.40	1.60	3.20	2.10	1.50	1.60
Total ATM/CNS provision cost	$ 2014	10818 M $	10737 M $	11321 M $	11630 M $	12020 M $	11830 M $	11277 M $	10946 M $	10949 M $
€/US$ exchange rates (EUROSTAT)		1.26	1.37	1.47	1.39	1.33	1.39	1.28	1.33	1.33
2014 prices using avg. €/US$ exchange rate of 1.35										
Total ATM/CNS provision cost	€ 2014	8013 M	7953 M	8385 M	8614 M	8903 M	8763 M	8352 M	8108 M	8110 M
per flight hour		310	307	323	365	375	375	363	356	354
Total support cost	€ 2014	5944 M	6037 M	6443 M	6648 M	6926 M	6768 M	6386 M	6182 M	6193 M
per flight hour		230	233	248	281	291	290	278	271	270
ATCO employment cost	€ 2014	2069 M	1916 M	1942 M	1967 M	1977 M	1994 M	1966 M	1926 M	1917 M
per flight hour		80	74	75	83	83	85	86	84	84
2014 prices using PPS conversion rate of 1.3										
Total ATM/CNS provision cost	PPS	8064 M	8004 M	8439 M	8670 M	8961 M	8819 M	8406 M	8160 M	8162 M
per flight hour		312	309	325	367	377	377	366	358	356
Total support cost	PPS	5982 M	6076 M	6485 M	6691 M	6970 M	6812 M	6428 M	6221 M	6232 M
per flight hour		232	234	250	283	293	291	280	273	272
ATCO employment cost	PPS	2082 M	1928 M	1954 M	1979 M	1990 M	2007 M	1979 M	1939 M	1930 M
per flight hour		81	74	75	84	84	86	86	85	84

EUROPE (37 ANSPs)		2006	2007	2008	2009	2010	2011	2012	2013	2014
Flight Hours		13.3 M	14.2 M	14.5 M	13.6 M	13.9 M	14.5 M	14.2 M	14.3 M	14.6 M
ATCOs in OPS		16 544	16 702	16 618	16 891	16 898	17 227	17 397	17 554	17 513
Other Staff		39 700	40 117	40 906	40 983	41 156	40 759	40 666	39 977	38 790
Total staff		56 244	56 819	57 523	57 874	58 054	57 986	58 063	57 531	56 303
Total ATM/CNS provision cost	€ 2014	7456 M	7854 M	7888 M	8023 M	7679 M	7711 M	7741 M	7597 M	7616 M
per flight hour		559	555	544	592	552	533	544	532	520
Total support cost	€ 2014	5096 M	5301 M	5311 M	5405 M	5306 M	5255 M	5306 M	5156 M	5134 M
per flight hour		382	374	366	399	381	363	373	361	351
ATCO employment cost	€ 2014	2359 M	2553 M	2578 M	2618 M	2373 M	2456 M	2434 M	2442 M	2482 M
per flight hour		177	180	178	193	171	170	171	171	169
Total ATM/CNS provision cost	PPS	8129 M	8484 M	8591 M	8754 M	8364 M	8485 M	8552 M	8408 M	8474 M
per flight hour		610	599	593	646	601	586	601	589	579
Total support cost	PPS	5618 M	5774 M	5842 M	5970 M	5843 M	5848 M	5939 M	5767 M	5787 M
per flight hour		421	408	403	440	420	404	418	404	395
ATCO employment cost	PPS	2511 M	2710 M	2749 M	2785 M	2521 M	2637 M	2613 M	2641 M	2686 M
per flight hour		188	191	190	205	181	182	184	185	183

Single European Sky States (RP1)		2006	2007	2008	2009	2010	2011	2012	2013	2014
Flight Hours		12.1 M	12.8 M	13.1 M	12.1 M	12.3 M	12.7 M	12.4 M	12.4 M	12.7 M
ATCOs in OPS		14 238	14 410	14 388	14 480	14 355	14 605	14 706	14 779	14 771
Other Staff		29 540	29 698	29 917	29 488	29 574	29 088	28 856	28 175	27 356
Total staff		43 778	44 108	44 304	43 968	43 929	43 692	43 562	42 954	42 127
Total ATM/CNS provision cost	€ 2014	7001 M	7390 M	7415 M	7506 M	7153 M	7097 M	7106 M	6936 M	6942 M
per flight hour		577	576	568	622	583	559	573	561	547
Total support cost	€ 2014	4712 M	4910 M	4915 M	4976 M	4889 M	4778 M	4810 M	4648 M	4617 M
per flight hour		388	383	376	412	399	377	388	376	364
ATCO employment cost	€ 2014	2290 M	2480 M	2500 M	2530 M	2264 M	2319 M	2295 M	2287 M	2325 M
per flight hour		189	193	191	209	185	183	185	185	183
Total ATM/CNS provision cost	PPS	7209 M	7531 M	7616 M	7691 M	7282 M	7230 M	7240 M	7037 M	7095 M
per flight hour		594	587	583	637	594	570	584	569	559
Total support cost	PPS	4840 M	4970 M	5024 M	5083 M	4985 M	4870 M	4912 M	4711 M	4724 M
per flight hour		399	387	385	421	406	384	396	381	372
ATCO employment cost	PPS	2369 M	2561 M	2593 M	2608 M	2297 M	2360 M	2328 M	2326 M	2371 M
per flight hour		195	200	199	216	187	186	188	188	187

5 Glossary

ACC	Area Control Centre
ACE	ATM cost-effectiveness (ACE) benchmarking reports commissioned by the Performance Review Commission
ANS	Air Navigation Services
ANSP	Air Navigation Service Provider
APP	Approach control units
ARTCC	Air Route Traffic Control Center
ATCO	Air Traffic Controller
ATCSCC	Air Traffic Control System Command Center
ATM	Air Traffic Management
ATO	U.S. Air Traffic Organization
CANSO	Civil Air Navigation Services Organization.
Capex	Capital expenditure
CFMU	EUROCONTROL Central Flow Management Unit
CNS	Communication, Navigation and Surveillance
CPI	Consumer Price Index
FAA	U.S. Federal Aviation Administration
FCT	Federal Contracted Towers
GAAP	U.S. Generally Accepted Accounting Principles
NextGen	U.S. Next Generation Air Transportation System
PRB	Performance Review Body
PRC	EUROCONTROL Performance Review Commission
RP1	First Reference Period 1 of the Single European Sky (SES) performance scheme (2012-2014)
SES	Single European Sky
SES States	Single European Sky (SES) States (EU27 plus Norway and Switzerland)
SESAR	Single European Sky ATM Research
TRACON	Terminal Radar Approach Control Facilities
UAC	Upper Area Control Centre
US CONUS	The 48 contiguous States located on the North American continent south of the border with Canada, plus the District of Columbia, excluding Alaska, Hawaii, Puerto Rico and oceanic areas.

i EUROCONTROL Performance Review Commission, "U.S./Europe continental comparison of ANS cost-efficiency trends 2002-2011", (November 2013).

ii US President Executive Order EO13180, December 7, 2000.

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iv Performance Review Commission and FAA-ATO, "U.S./ Europe Comparison of ATM-related Operational performance 2015", (August 2016).

v PRB Report 'Proposed EU-wide performance targets for the period 2012-2014 (Appendix A).' Available at: http://www.eurocontrol.int/articles/ses-performance-scheme-reference-period-1-2012-2014.

vi Regulation (EC) No 549/2004 of the European Parliament and of the Council laying down the framework for the creation of the Single European Sky. OJ L 96, 31.3.2004, p. 1.

vii Commission Regulation (EC) No 691/2010 of 29 July 2010 laying down a performance scheme for air navigation services and network functions. OJ L 201, 3.8.2010, p.1.

viii Commission Implementing Regulation (EU) No 390/2013 of 3 May 2013 laying down a performance scheme for air navigation services and network functions, OJ L 128, 9.5.2013, p.1.

ix ATM Cost-effectiveness (ACE) 2014 Benchmarking Report, EUROCONTROL, Performance Review Commission, May 2016.

x EUROCONTROL Specification for Economic Information Disclosure, v3.0. Available at http://www.eurocontrol.int/documents/economic-information-disclosure-specification.

xi CANSO Global Air Navigation Services Performance Report 2015, 2010 – 2014 ANSP Performance Results, (December 2015).

xii A Plan for the Future - 10-Year Strategy for the Air Traffic Control Workforce 2012 – 2021, U.S. Department of Transportation, Federal Aviation Administration (FAA), 2012, http://www.faa.gov/air_traffic/publications/controller_staffing/media/CWP_2012.pdf.

xiii http://www.innovata-llc.com/

xiv Consolidated Statement of Net Cost, FAA Performance and Accountability Report FY2012.

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