Common Project 1 CBA

Update 2024

Final Version
delivered to EC

2022-122-SESAR Deployment Manager FPA
SGA MOVE/E3/SUB/2022-122/SI2.875834

Deliverable 2.4.4

July 2024

Authoring and approval – Control Page

Prepared by	**Antoine Hottelart** Senior Performance and CBA Manager **Franck Castelain** Performance & CBA Senior Expert **Olga Burdash** CBA Expert **Miklos Kedves** CBA Expert **Borja Martínez Fernández** CBA Expert **David Brain** Environment and Operations **Andrew Watt** Senior Advisor Infrastructure Financing & Decarbonisation	**Date** 20/06/2024	**Signature** Signed
Reviewed by	**Ralph Schwarzendahl** Head of Performance & CBA	**Date** 20/06/2024	**Signature** Signed
Approved by	**Mariagrazia La Piscopia** Executive Director	**Date** 20/06/2024	**Signature** Signed

EXECUTIVE SUMMARY

Key points for attention of the reader

- The decision to invest in PCP/CP1 deployment was made, among other, based on the original PCP CBA from 2014 and the two successive versions of the CP1 CBA:
  - CP1 CBA Ed. February 2020, released before the COVID-19 pandemic, and
  - CP1 CBA Ed. November 2020, in which the previous estimations were updated to reflect the COVID-19 impact on traffic and rate of implementation and the changes that were agreed regarding the CP1 geographic and technical scope.
- The present document is the CP1 CBA Ed. 2024 and aims at updating the previous CBAs to reflect the latest changes and, above all, include the benefits expected from the deployment of AF5 and AF6, for which only costs were estimated before. Since this is not a CBA that will be used for an invest/do not invest decision because the CP1 deployment was decided on and is regulated, no Net Present Value or discounted figures are presented in this document. Instead, the focus falls on the overview of investments that have already been committed and still need to be realised to ensure the deployment of the full scope of CP1, and on the benefits that are expected from this deployment.
- The timeframe for which the costs and benefits are presented in this document focuses on a few key dates: 2014 as a start of deployment, end 2023 to show the investments and benefits already achieved, 2030 for comparison with previous editions, but also snapshots in 2035 and 2040 to reflect the impact of AF5 and AF6, whose nature makes the 2030 timeline too short to observe their impact.

CP1 Cost and Benefits

In terms of costs, **full scope of CP1 deployment is estimated at € 4.8bn.** Most of this cost **needs to be realised before 31 December 2027, as required by the CP1 Regulation.** AF6 is the only ATM functionality for which part of the investment is to be realised post-2027 and it corresponds to the fleet equipage. Below are summarised the costs already incurred and those that still need to be deployed.

	AF1	AF2	AF3	AF4	AF5	AF6	Total
ANSPs	€ 140 m	€ 161 m	€ 1.3 bn	€ 107 m	€ 620 m	€ 268 m	**€ 2.6 bn**
Airport Operators	€ 1 m	€ 573 m	-	€ 12 m	€ 249 m	-	**€ 834 m**
Military	-	-	€ 111 m	-	€ 389 m	-	**€ 500 m**
Airspace Users	€ 7 m	€ 123 m	€ 18 m	€ 20 m	€ 144 m	€ 231 m	**€ 542 m**
Network Manager	€ 3 m	-	€ 25 m	€ 68 m	€ 107 m	€ 15 m	**€ 218 m**
CFSPs	-	-	€ 25 m	€ 12 m	€ 33 m	-	**€ 70 m**
MET Providers	-	-	-	-	€ 69 m	-	**€ 69 m**
Total	**€ 150 m**	**€ 857 m**	**€ 1.5 bn**	**€ 219 m**	**€ 1.6 bn**	**€ 514 m**	**€ 4.8 bn**

Despite the fact that almost 40% of all investments into CP1 deployment are still to be realised, it is already delivering significant benefits. **By the end of 2023, CP1 is delivering € 4.6bn worth of cumulative benefits against the do-nothing scenario** (2014-2023). This value is set to reach **€ 19.4bn by 2030, once the CP1 is fully deployed.**

To better consider the impact of AF5 and AF6 deployment, it is important to look at the results also in a longer timespan: **CP1 is expected to bring € 34.2bn worth of cumulative benefits by 2035 and € 51.8bn by 2040.**

The benefit-cost ratio (BCR) of CP1 deployment is at 1.5 in 2023, showing that **each euro invested in CP1 already brings 1.5 euros of monetizable benefits to the stakeholders.** The BCR is expected to reach 3.8 by 2030. In the table below are presented some indicators of **financial performance** of CP1 for key years.

	Already achieved			
Metric	**2023**	**2030**	**2035**	**2040**
Cumulative costs (undiscounted)	**€ 3.1bn**	€ 4.6bn	€ 4.7bn	€ 4.8bn
Cumulative benefits (undiscounted)	**€ 4.6bn**	€ 19.4bn	€ 34.2bn	€ 51.8bn
Benefit-cost ratio	**1.5**	3.8	5.9	8.0

In terms of **per-flight performance,** below is summarised the expected performance improvements brought by CP1 deployment measured against a do-nothing scenario. The values below are presented as **ECAC average values per flight**.

	Already achieved			
Metric	**2023**	**2030**	**2035**	**2040**
Minutes saved	**1.9 min**	3.2 min	3.5 min	3.7 min
Fuel kg saved	**7.0 kg**	42.3 kg	47.0 kg	47.8 kg
CO_2 kg saved	**22.1 kg**	133.2 kg	147.9 kg	150.5 kg
ANS cost efficiency	**€ 5.2**	€ 25.8	€ 38.0	€ 42.1

The need for investment for full CP1 deployment

The findings from this CP1 CBA highlight that **CP1 is a necessary step towards the achievement of a sustainable ATM-related aviation in Europe.**

To fulfil this important step, it is crucial to ensure that the full scope of CP1 is deployed within the timeframe set-out in the CP1 Regulation. To do so, it is **essential to secure the remaining € 1.7bn that are still to be invested in the upcoming years, most of it being concentrated in 2024 and 2025.** The functionalities that need of the majority of the remaining investment are AF5 (€ 903m), AF6 (€ 500m) and AF2 (€ 234m).

In terms of stakeholders, **most of the remaining investments are concentrated in ANSPs (€ 730m), Airspace Users (€ 354m), Airport Operators (€ 326m) and Military (€ 250m).** The Network Manager, MET Providers and CFSPs have a total of € 821m in remaining investments. It is to also note that in the case of Airspace Users, about 64% of the remaining investment will happen after 2027, corresponding to the forward-fit of their fleet to support AF6. To do so, **there could be the possibility of securing a mix of grant funding and loan financing to build a large initial pool of capital, that needs to be mobilised in a short period of time, to ensure the deployment of CP1 functionalities** within the timeframe foreseen in the Regulation.

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1. Introduction

This document describes the output of the latest update to the Common Project 1 (CP1) Cost Benefit Analysis (CBA), carried out by the SESAR Deployment Manager (SDM) on request of the European Commission (EC). The first CP1 CBA was conducted by SDM in 2019/2020 [1] before the Covid-19 pandemic, followed by an update conducted in November 2020[1] to consider the impact of COVID-19 and the technical and geographical changes. The latter was published in EU 116/2021 regulation in February 2021 [2].

The scope of this report is limited to the agreed scope of CP1, and its results include the revision of some of the original assumptions in terms of monetisation factors (e.g., cost of minute of delay, cost of fuel and CO_2, etc.) and traffic to match the latest European developments. Moreover, the latest status of sub-functionalities implementation was used, according to the SDM Monitoring View. Contrary to the Pilot Common Project (PCP) and the previous editions of CP1 CBA, and due to the extended timeframe of the present update, discounted values are not shown, but rather attention is driven to snapshots in some key years:

- The **results that have been achieved from 2014 until end of 2023,** to show the current situation at the time of writing of this report.
- The **results that are expected to be achieved by 2030,** which correspond to the initial CP1 CBA timeline.
- The **expected results by 2035 and 2040,** to depict especially the savings stemming from AF5 and AF6, and to be aligned with ATM Master Plan [3].

The extension of timeline with snapshots in 2035 and 2040 serves to account for the impact from AF5 and AF6 deployment, for which 2030 timeframe would be too short to observe any impact, as well as to counterbalance the effect of COVID-19, which omits at least two years of benefits due to the low volume of traffic during this period.

Since the investments in CP1 deployment already started years ago and since this CBA update does not aim at providing a tool for "go/no go" type of decision-making, it was decided that there would be no added value in showing an NPV to the investors, but rather **provide a comprehensive overview of the status of committed costs and realised benefits, as well as the expected benefits and investments within the different timeframes described above.**

The results incorporate all the learnings on costs and benefits gained from 10 years of PCP and CP1 deployment under SDM coordination: all values derive from inputs provided by the Implementation Projects' (IP) managers, the SDM experts, as well as experts from EUROCONTROL and the Network Manager (NM). **The data represents mainly average values, which overall embody a reasonable reflection of actual costs and expected benefits but are not applicable to costs and benefits of all specific local stakeholders.**

The methodology used is consistent with the validated methodology used for SESAR-related CBAs, however, all cost and benefit numbers are presented undiscounted.

This document is structured along several chapters:

- **Chapter 2 – CP1 Costs** presents the overview of the costs related to CP1 deployment. These include both the costs that have already been incurred, and those that are still to take place from 2024. The chapter presents the costs overview from different perspectives: in total, per AF, per stakeholder, per year, etc. The cost values presented in the document are undiscounted.
- **Chapter 3 – CP1 Benefits** presents the economic results of the updated assessment of CP1 deployment, focussing on the monetisation of the benefits from different AFs. All values are presented undiscounted.
- **Chapter 4 – CP1 Performance** aims at providing an overview of the expected performance of CP1 in absolute numbers. It essentially shows the benefits presented in Chapter 3 from the perspective of unitary values (i.e., not monetised) of ATM operational metrics, also providing an

[1] Common Project 1 Update of the original CP1 Proposal CBA, November 4th, 2020

overview of the performance per flight and some economic indicators. In this chapter a focus on the environmental performance is included.

- **Chapter 5 – Comparison between costs and benefits** offers an overview of the evolution of benefits of CP1 deployment in relation to its costs, as well as an assessment of its financial performance.
- **Chapter 6 – Conclusion** presents some key conclusions arising from the analysis performed during this update of CP1 CBA.

2. CP1 Costs

This chapter provides a detailed view on the evolution of CP1 costs from 2014 until 2030, and beyond. It shows an overview of the costs committed in the past, but also provides an outlook of what is remaining to be invested at this stage to ensure the deployment of the full scope of CP1.

Cost data has been derived from SDM database of projects that are continuously monitored and complemented by consultation with SDM and external experts and implementing projects. The European Defence Agency (EDA) was involved in the estimation of costs and deployment locations for Military as well as the Airspace Users regarding Airlines. There are some uncertainties in terms of costs for the future, due to different requirements based on complexity and size of deployment locations, and the values presented in the sections hereafter constitute an estimate as close as possible to the reality. All costs provided in the report are undiscounted.

2.1. Overview of costs

The **total cost for full scope of CP1 deployment is estimated at € 4.8bn,** based on calculations performed during CP1 CBA Ed. 2024 and presented in this report. The costs are distributed per AF and per stakeholder.

	AF1	AF2	AF3	AF4	AF5	AF6	Total
ANSPs	€ 140 m	€ 161 m	€ 1.3 bn	€ 107 m	€ 620 m	€ 268 m	**€ 2.6 bn**
Airport Operators	€ 1 m	€ 573 m	-	€ 12 m	€ 249 m	-	**€ 834 m**
Military	-	-	€ 111 m	-	€ 389 m	-	**€ 500 m**
Airspace Users	€ 7 m	€ 123 m	€ 18 m	€ 20 m	€ 144 m	€ 231 m	**€ 542 m**
Network Manager	€ 3 m	-	€ 25 m	€ 68 m	€ 107 m	€ 15 m	**€ 218 m**
CFSPs	-	-	€ 25 m	€ 12 m	€ 33 m	-	**€ 70 m**
MET Providers	-	-	-	-	€ 69 m	-	**€ 69 m**
Total	**€ 150 m**	**€ 857 m**	**€ 1.5 bn**	**€ 219 m**	**€ 1.6 bn**	**€ 514 m**	**€ 4.8 bn**

Table 1: Overview of CP1 costs

The values in Table 1 above show the cumulative costs arising from the adjustments performed in 2024 to the initially estimated values, to reflect the latest knowledge available and experience from existing awarded projects. These cumulative costs are spread across some key years and shown in Table 2

	2023	2030	2035	2040
AF1	€ 68 m	€ 150 m	€ 150 m	€ 150 m
AF2	€ 631 m	€ 857 m	€ 857 m	€ 857 m
AF3	€ 1.4 bn	€ 1.5 bn	€ 1.5 bn	€ 1.5 bn
AF4	€ 217 m	€ 219 m	€ 219 m	€ 219 m
AF5	€ 707 m	€ 1.6 bn	€ 1.6 bn	€ 1.6 bn
AF6	€ 14 m	€ 333 m	€ 417 m	€ 514 m
Total[2]	**€ 3.1 bn**	**€ 4.6 bn**	**€ 4.7 bn**	**€ 4.8 bn**

Table 2: Overview of cumulative CP1 cost distribution per AF in 2023, 2030, 2035 and 2040

[2] Please note that the totals for 2023 and 2030 may be slightly different due to rounded values per AF.

In Figure 1 is presented a summary of the difference between the estimated CP1 deployment costs that were presented during the CP1 CBA Ed. November 2020, and CP1 CBA Ed. 2024, as shown more in detail throughout this document.

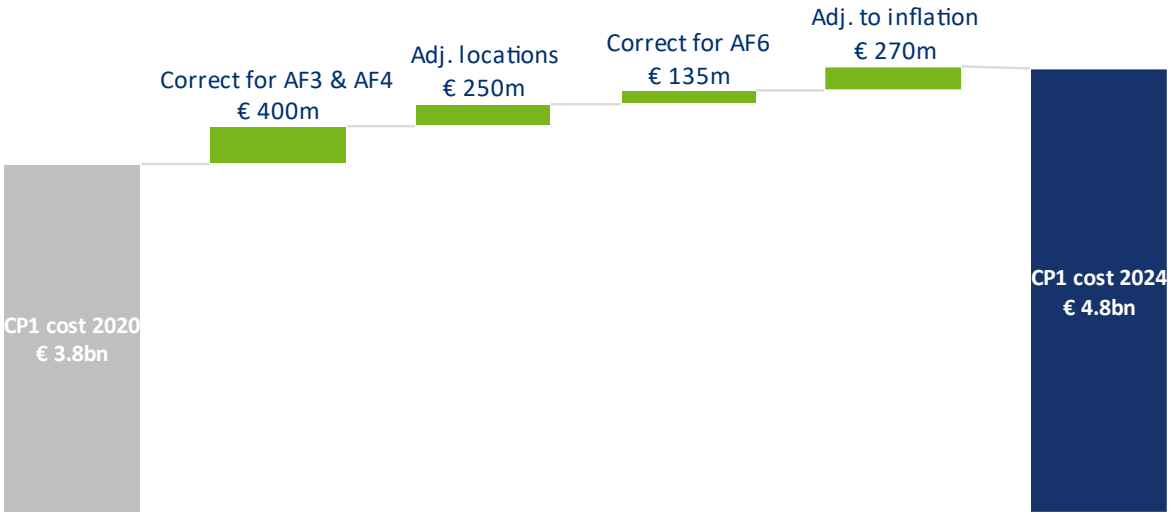

Figure 1: Overview of key cost changes between the CP1 CBA Ed. November 2020 and CP1 Ed. 2024

In relation to the estimate published in November 2020, the total CP1 cost estimate performed in 2024 update were influenced by a few key factors:

- The unit cost for AF3 and AF4 was initially underestimated according to the experts consulted. This factor has been adjusted for in the 2024 recalculation of CP1 costs and amounts to about € 400m in total costs.
- Comparing with the previous version, new deployment locations were added to CP1 scope (e.g., Zurich, Oslo, and Geneva airports for AF2 and number of locations for AF5), resulting in a change of about € 250m in total.
- AF6 costs were increased to reflect the latest cost data that was obtained from the relevant experts during the elaboration of AF6 CBA in 2023[3] [4]. This represents an increase of about € 135m for AF6.
- An adjustment to the inflation with relation to 2021 values was performed. Assuming an average inflation factor of 3%, this represents just under € 270m in CP1 deployment costs.

[3] For more details on AF6 CBA please refer to ANNEX C.

2.2. Remaining costs & investment needs

By the end of 2023, out of the total CP1 costs, just over € 3bn have already been invested, and just over € 1.7bn remain to be invested. The figure below shows an overview of the distribution of the investment that has been made until the end of 2023, as well as the distribution of the remaining investment needs, per ATM functionality, from 2024 onwards.

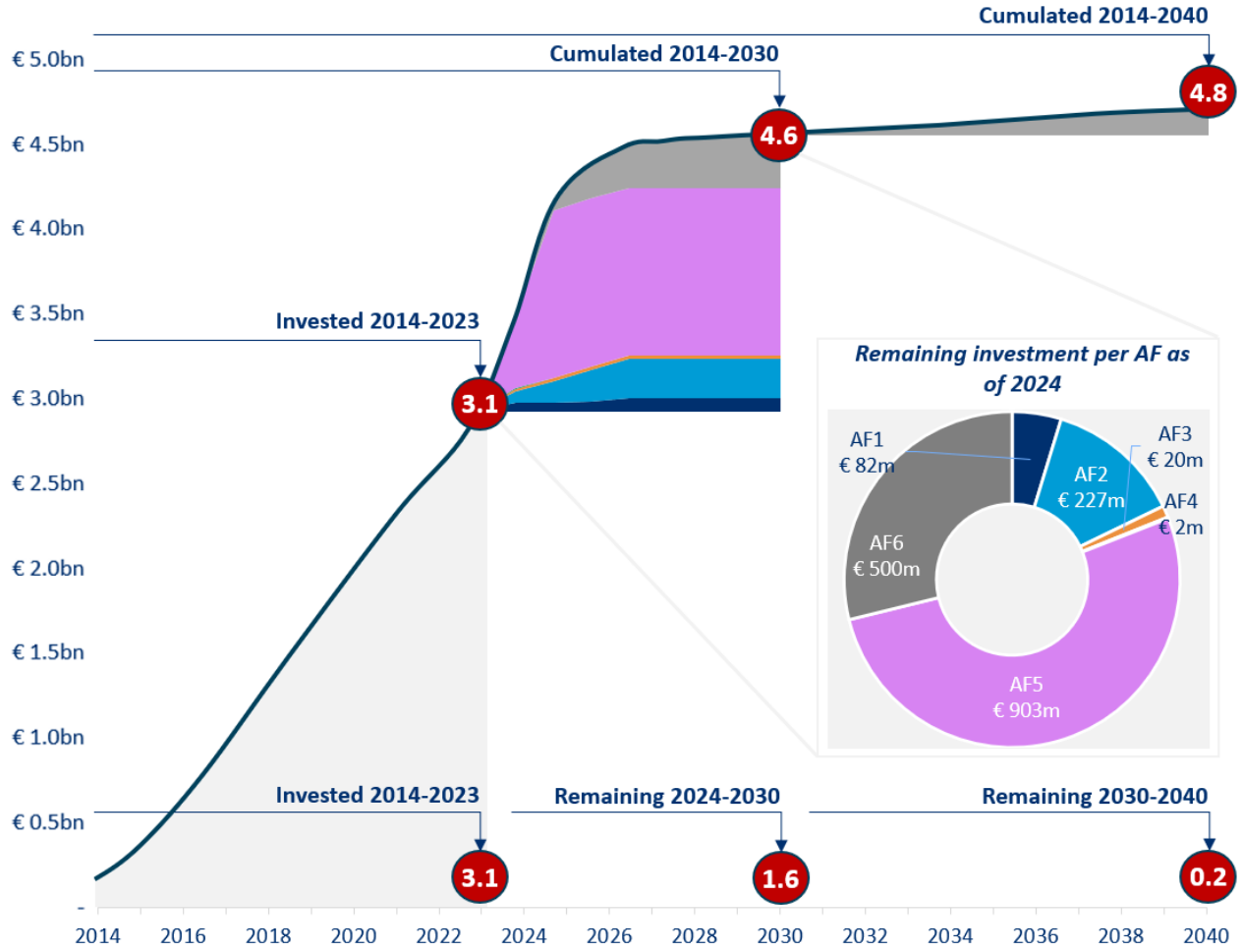

Figure 2: Overview of CP1 costs invested by end 2023 and remaining from 2024

Considering that CP1 is expected to cost € 4.8bn to be fully deployed, from 2024 € 1.7bn still remains to be invested. Out of this value, **€ 1.6bn needs to be invested before the end of 2027, in alignment with the CP1 Regulation.** And the remaining € 200m, corresponding to AF6 fleet equipage, is to be invested gradually starting from 31 December 2027.

For the deployment of the remaining functionalities post-2023, for all AFs except AF6, the investments are expected to be finalised before 2030. More specifically:

- Functionalities 1 through 5 are expected to see their deployment finalised before 2027, meaning that the corresponding investments are expected to be concentrated during this period.
- AF6 is the functionality for which it is expected that most deployment investments are finalised by end of 2027, as per Regulation. However, since AF6 relies on the fleet forward fit, there are expected some yearly CAPEX until the end of analysis period. This corresponds to the number of new aircraft deliveries every year and that will need to be equipped with AF6 as of 31 December 2027.

To ensure the timely deployment of the remaining scope of CP1, the deadline for which is set in the CP1 Regulation on 31 December 2027, it is crucial to secure the funds in a swift and timely manner. The amount concerned, totals to € 1.7bn, the majority of which needs to be deployed within the 2027 timeframe, and a small part (about € 200m) is to be used over the years until the fleet is renewed and supporting AF6.

To do so, there could be the possibility of securing a mix of grant funding and loan financing to build a large initial pool of capital, that needs to be mobilised in a short period of time, to ensure the deployment of CP1 functionalities within the timeframe foreseen in the Regulation. The SDM document on "Proposals on potential funding and financing mechanisms in support of SESAR deployment"[6] has already identified that the blending of financing and grants *"could generate substantial capital sums early in a project's lifecycle and would provide a considerable stimulus to accelerating deployment."* SDM and NM have been working with the European Investment Bank to explore the possibilities for securing such an early capital injection, and those discussions will be further pursued in the light of this report.

2.2.1. Remaining investments per functionality

CP1 investment per AF and its split between the amount that has already been invested and that still needs to be deployed after 2023 is summarised in the figure below.

The estimate of the remaining investment per ATM functionality was defined based on the latest SDM Monitoring View, including the gap closure by the end of 2023.

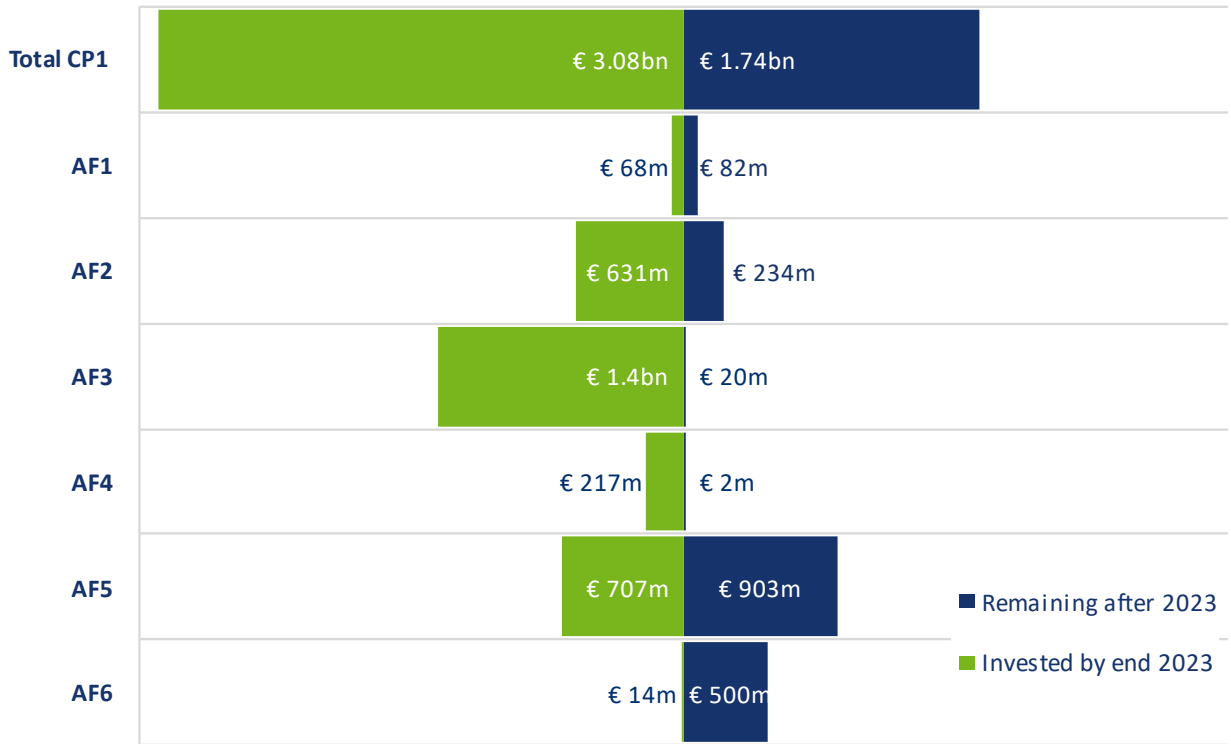

Figure 3: Overview CP1 costs already invested and the remaining to be invested per AF

It can be observed in the figure that for most functionalities, the biggest chunk of the investment has already been committed until the end of 2023.

Some exceptions are **AF1**, for which most of the investment still needs to be realised.

AF2, which still needs an investment mainly in extended AOP.

AF5, which needs a big investment mainly in sub-AF 5.2 - Stakeholders' SWIM PKI and cyber security, with € 458m and sub-AF 5.6 - Flight Information Exchange, with € 153m remaining to be invested. For the sub-AF 5.3 - Upgrade Aeronautical Information Exchange system/service, and sub-AF 5.4 - Upgrade Meteorological information exchange system/service, the remaining investment is around € 110m each.

Regarding **AF6**, the ground investment for many locations should start as soon as possible; it is also worthwhile to note that a part of the investments in this functionality are expected to be reflected in new aircraft deliveries equipment as of 31 of December 2027 and supported by Airspace Users.

The distribution of the remaining investment per functionality over years after 2023 is presented in the figure below.

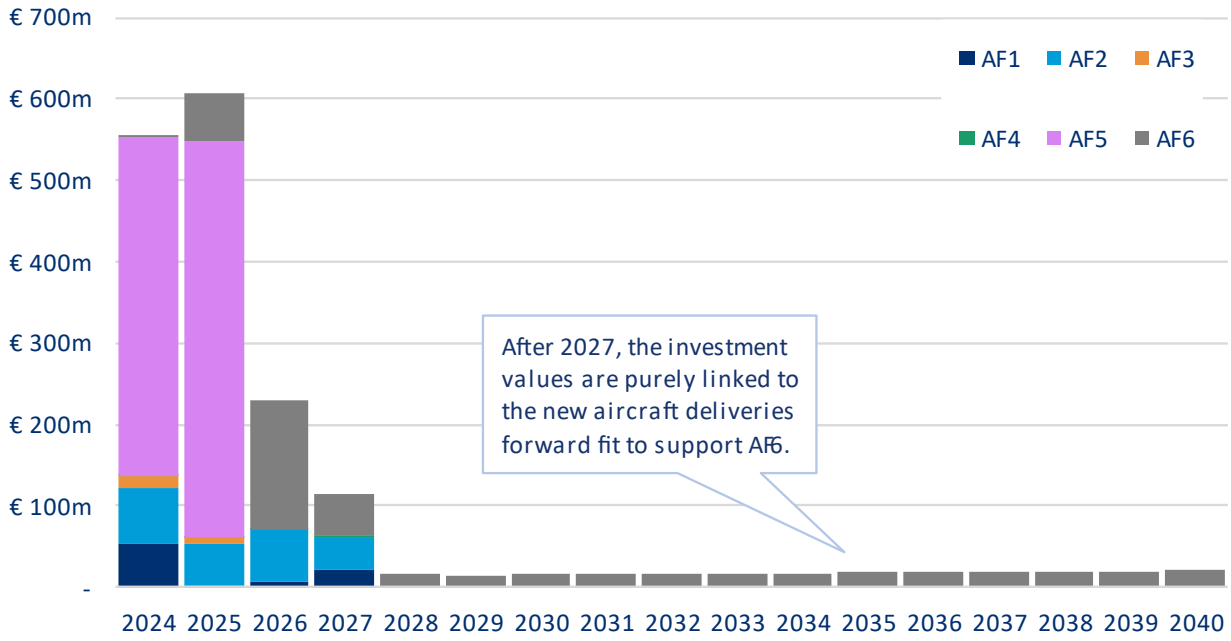

Figure 4: Distribution of investments remaining after 2023 over time and per AF

2.2.2. Remaining investments per stakeholder

Looking at the investment per stakeholder, its split between the budget that has already been invested up until the end of 2023, and the budget that is still to be invested to complete the CP1 deployment is presented in the figure below.

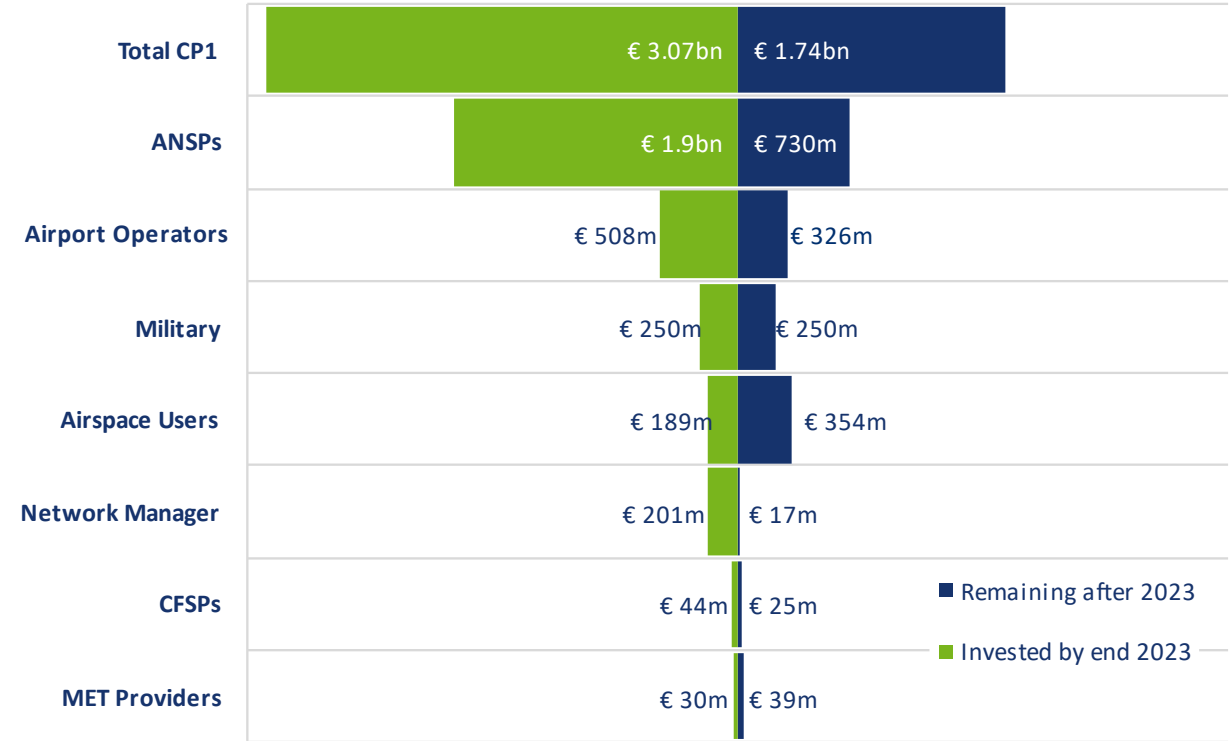

Figure 5: Overview CP1 costs already invested and the remaining to be invested per stakeholder

When looking into Figure 5, is important to note that:

- **ANSPs** need to invest about € 80m in AF1 deployment. Out of those, in 2024 the investment will concentrate on E-AMAN deployment, and until 2027 the deployment will focus on AMAN/DMAN deployment.

  Out of the € 903m left to invest in AF5, ANSPs are expected to invest more than € 350m in SWIM, and the **Military** are expected to invest € 250m before end 2025.

  For AF6, ANSPs are expected to deploy this functionality by end of 2027, with an estimated investment of € 260m.

  The last € 40m to be invested by ANSPs is distributed between AF2, AF3 and AF4.

- **Airport Operators** are expected to invest around € 180m in AF2, to fill the deployment gap of Extended AOP until end of 2027, as well as the Airport Safety Nets until end of 2025.

  Regarding AF5, € 150m will need to be invested by end of 2025 by Airport Operators.

- **Airspace Users**[4] will also need to invest, mainly in AF6. This value is expected to round € 18m per year, to equip the new aircraft deliveries starting from 31 December 2027, assuming an equipment of almost 400 aircraft per year until 2040.

  Airspace Users will also need to invest about € 90m in AF5. This investment will be required to be performed by the end of 2025.

  The last € 35m to be invested by AUs is on AF2.

[4] The costs of CP1 functionalities are allocated to European Scheduled Airlines, which represent about 80% of total scheduled flights in Europe. Nonetheless, it is to note that non-SES2+2 Airlines may also face some costs to comply with CP1 regulation.

- **Met Providers** and **CFSPs** will also need to invest in AF5 before end of 2025.
- **Network Manager** investment is mainly in AF6 and a small part on AF5 to close the gap.

Zooming into the investment that still needs to be deployed from 2024, its distribution across time is presented in the figure below.

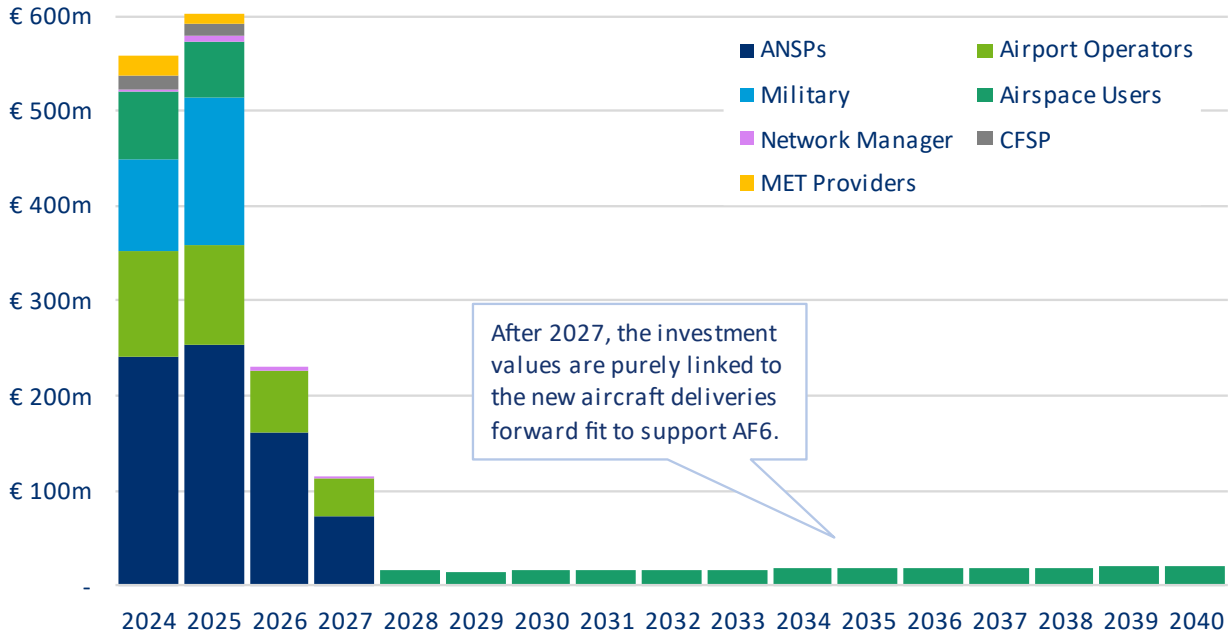

Figure 6: Distribution of investments remaining after 2023 over time and per stakeholder

3. CP1 Benefits

The sections hereafter provide an overview of the expected undiscounted monetised benefits from CP1 deployment. These benefits were estimated using the expertise of SDM, Network Manager and other units of EUROCONTROL. The methodology behind the benefit estimation is available in SDM library and is summarised in ANNEX A.

3.1. Overview of benefits

In total, the **CP1 deployment is expected to bring over € 19.4bn between 2014 and 2030** in monetised undiscounted benefits. The distribution of these benefits per Key Performance Area (KPA), and the overview of the expected benefit ramp-up over the same period (i.e., 2014-2030) is presented in Figure 7.

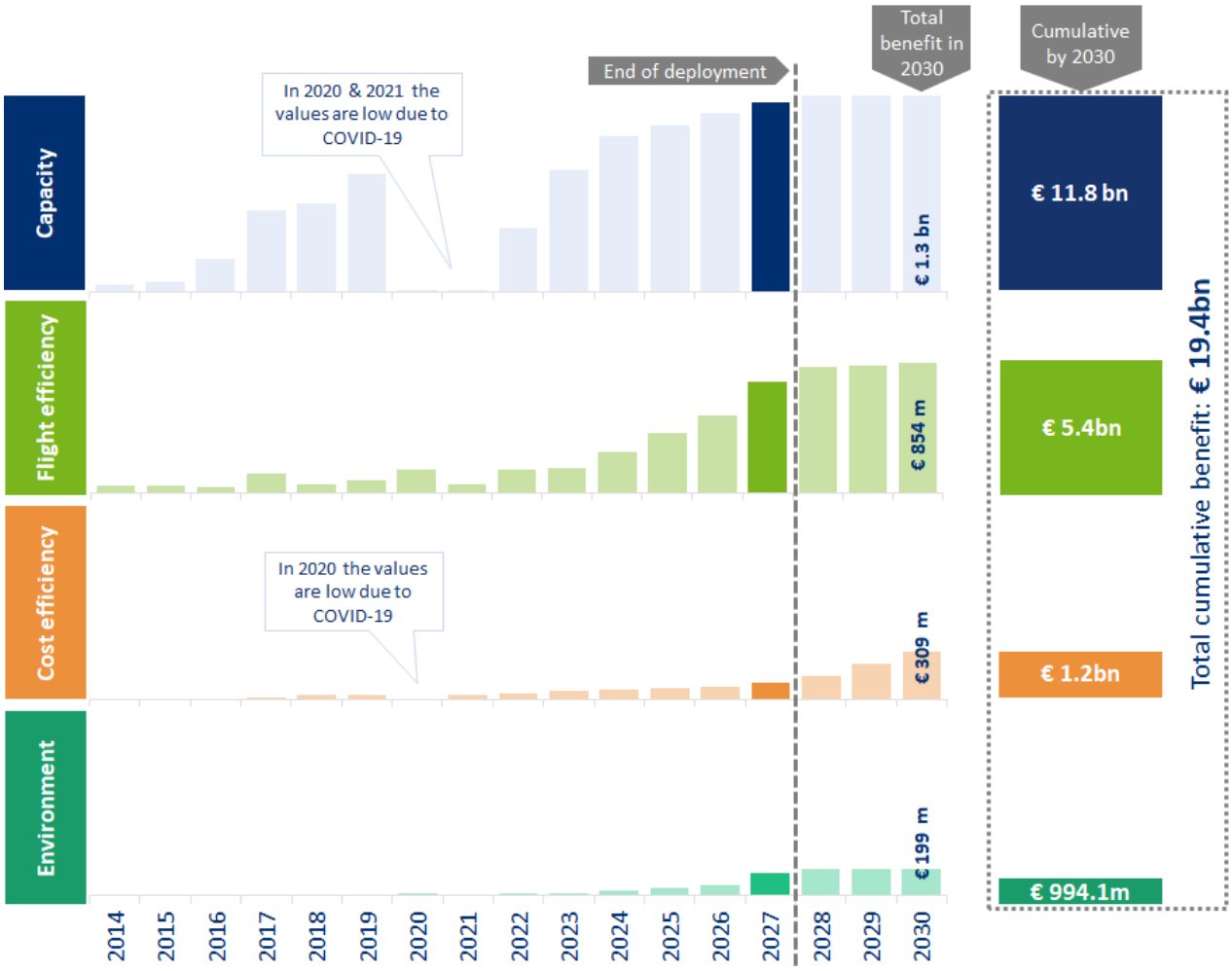

Figure 7: Monetised benefit distribution per KPA

It can be observed in the figure that as of 2027, the year by the end of which all stakeholders involved are expected to have implemented the CP1 functionalities, the benefits are expected to reach their maximum of the fast ramp-up, after which they would increase at a steady pace, mainly following the traffic dynamic. In the case of some AFs, however, the main chunk of benefits will be visible some years after the end of deployment, because they either serve as enhancers to other solutions, as is the case of AF5, or they depend on the progressing fleet equipage, as happens with AF6. The fact that some benefits will only be realisable sometime after end of 2027 highlights the **importance of ensuring the investment in the deployment of the functionalities that have not yet been implemented**.

Looking into the performance of the different KPAs, capacity is expected to benefit the most from CP1 deployment, followed by flight efficiency. However, cost efficiency, and the environment are also expected to greatly improve, particularly when the CP1 full operating capability is achieved (i.e., after 2027). A more in-depth analysis of the environmental performance is provided in section 4.3.

While significant benefits from CP1 deployment are expected already by 2030, this only represents a 3-year timeframe for observation of full-scale benefits (i.e., three years after the full operating capability is achieved). To have a better understanding of the full scale of benefits that CP1 is expected to bring, it is interesting to look into the forecast further in time. In this respect, Figure 8 shows the snapshots of the expected benefits for the years 2023, 2030, 2035 and 2040, as well as the cumulative values at the end of each year (i.e., for 2023 the benefits that have been achieved by the time of writing of this report[5]).

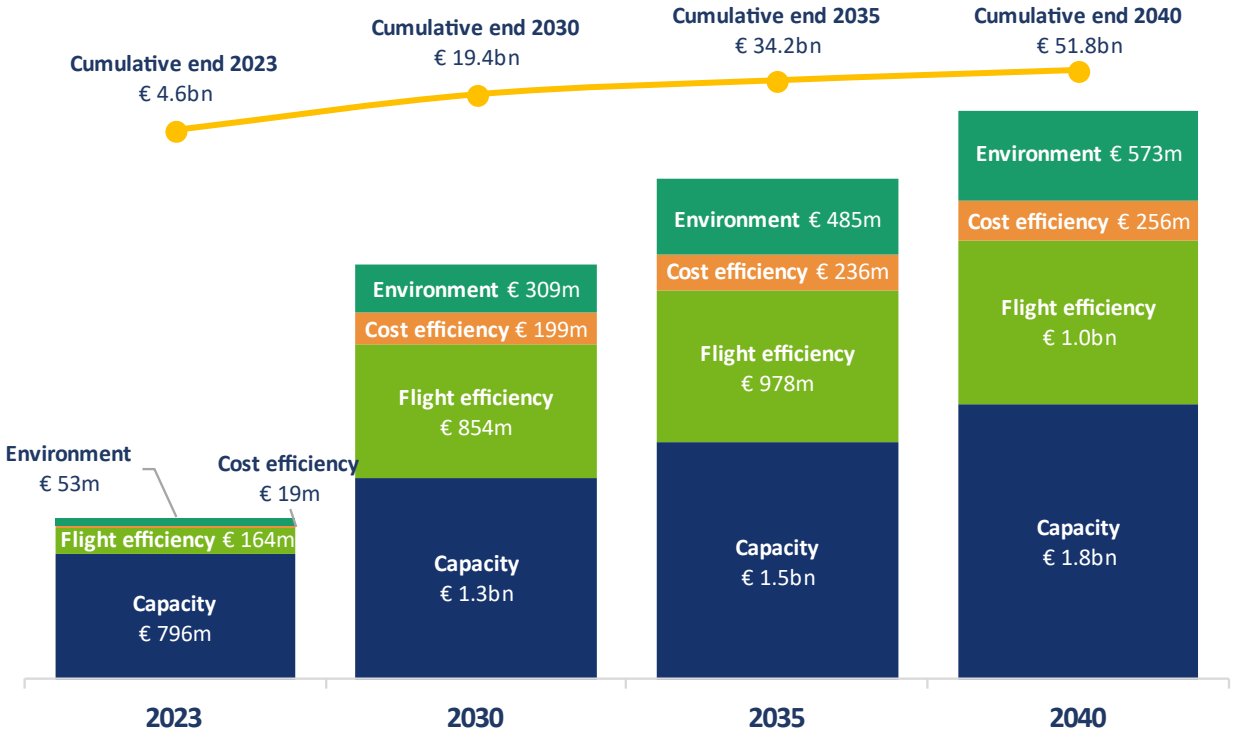

Figure 8: Benefit snapshots in 2023, 2030, 2035 and 2040 and cumulative values

As shown in Figure 8, in 10-year period, **between 2030 and 2040, the total cumulative benefits more than double, growing from € 19.4bn to € 51.8bn (+167%), while in the five years between 2030 and 2035 they increase by more than 75%.** This highlights the importance of long-term analysis and the weight of some functionalities (e.g., AF5 and AF6) on the global CP1 picture.

Furthermore, the yearly benefits, both in total and per KPA, also increase over the years, showing that, in the long term, this important investment will benefit the relevant stakeholders in accordance with the traffic changes. For per flight impacts please refer to Chapter 0.

[5] Note that benefits shown here (€4.6bn for the CP1 at end 2023) are not comparable to the SDM factsheet value of €9.6bn until 2030 for the 293 projects already completed in March 2024.

3.2. Benefits per functionality

Figure 9 shows the distribution of cumulative benefits from CP1 deployment per AF at the end of 2030.

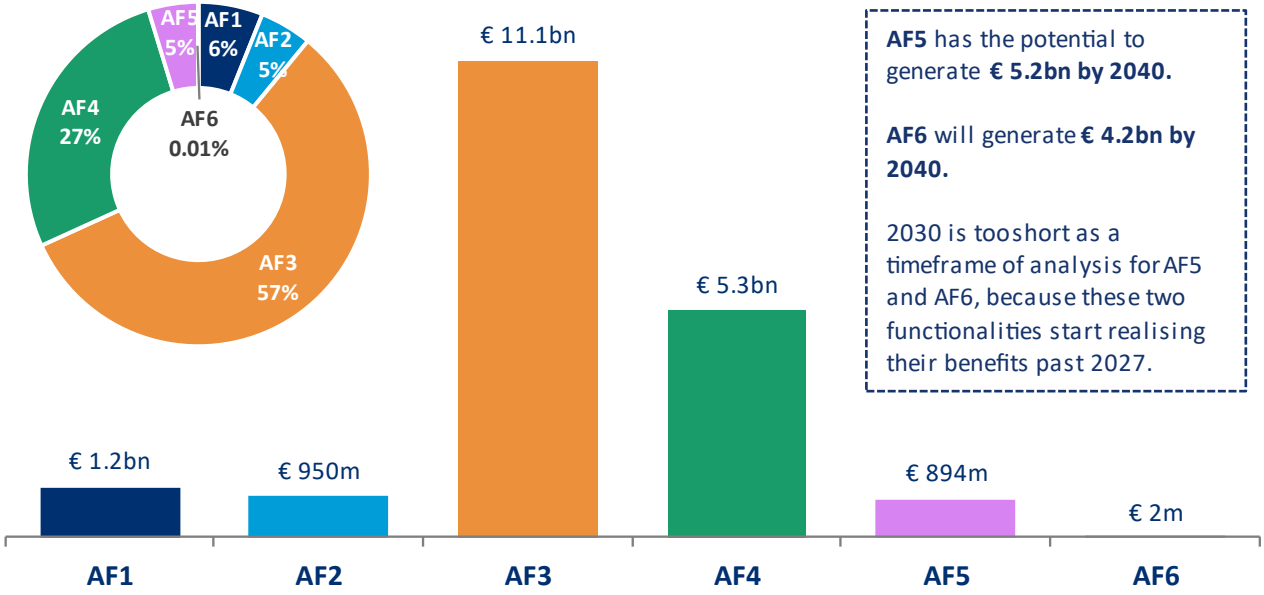

Figure 9: Cumulative benefit distribution per AF by 2030

AF3 contributes the most to CP1 performance in terms of monetised benefits, followed by AF4. While AF6, in the 2030 timeframe, is the functionality that brings the least relative benefits. It is, however, important to note, that these **differences are linked to the rather short timeframe of analysis: there are only three years between the end of CP1 deployment (i.e., end of 2027) and the end of analysis period.** To obtain a fuller picture of relative benefits from each ATM functionality, Figure 10 presents the expected benefits per AF for a more extended period. These are presented as cumulative values for 2030, 2035 and 2040.

As explained above, it must be underpinned that AF6 is one of most promising functionalities in the future, especially when additional follow up functionalities (full TBO) are increasing the benefits, significantly to the solely scope of CP1, which is presented in this document.

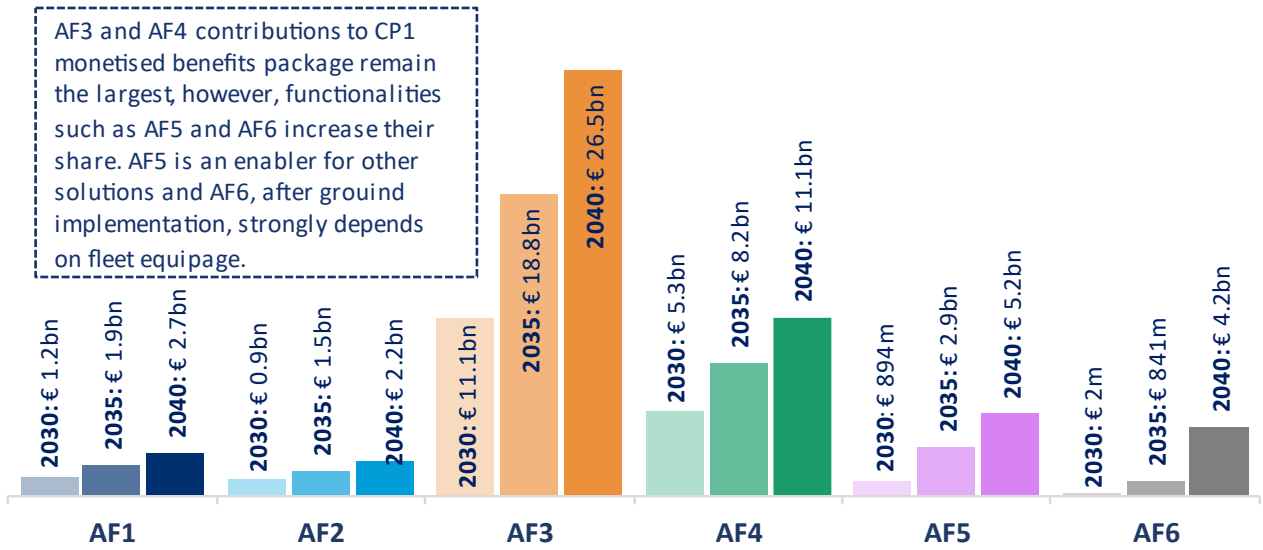

Figure 10: Cumulative benefit distribution per AF by 2030, 2035 and 2040

From Figure 10 it becomes clear that, although the biggest contributors in terms of monetised benefits remain AF3 and AF4, the relative contribution of AF5 and AF6 increase over time.

In the case of AF5 this is linked to the fact this functionality represents an enabler and enhancer for other solutions, which means that it typically takes time before the impacts from AF5 deployment are felt. Also,

because AF5 is expected to bring staff costs savings, which for obvious reasons cannot materialise immediately after deployment.

When it comes to AF6, this functionality strongly relies on the fleet equipage rate. Since the CP1 Regulation states that all the aircraft certified as of 31 December 2027 are to be forward fit to support AF6, the benefits from this functionality are only realised after sufficient time has passed to equip enough aircraft and the corresponding flights are using AF6.

For more detailed information on AF5 and AF6 CBAs please refer to ANNEX B and ANNEX C respectively.

All the remaining functionalities maintain their relative contributions over time. However, their total benefits are also seen to increase as the time progresses, showing that in any case, **all functionalities continue generating benefits over the years in accordance with the flights that use them.**

4. CP1 Performance

The improvement of performance is a cornerstone of the CP1 regulation. Besides the necessary capacity improvements, a reduction of CO_2 emissions is becoming increasingly important. When it comes to CO_2 reduction, the targets of the Green Deal [7] are ambitious and can only be reached by focussing on the improved performance, which requires efforts from all stakeholders involved. Thus, CP1 is an important step to modernize the European ATM system, framed by the ATM Master Plan, but also to contribute to key EU policies, as is the case of the Green Deal. Therefore, the sections below present the performance of CP1 deployment in terms of some key metrics assessed, with a focus on the environmental impact.

4.1. Overview of Performance

Table 3 provides an overview of CP1 performance in 2030. It is presented split per flight phase, first as total cumulative impact (e.g., total minutes saved) between 2014 and 2030, and then in the year 2030 only. **The values per flight represent the ECAC average values** for the specific year.

Metric	Cumulative 2014-2030	Per ECAC flight in 2030
Minutes saved	**340.6 million**	**3.2 min**
Departure delay[6]	*270.8 million*	*2.4 min*
Taxi	*14.8 million*	*0.1 min*
En-route	*41.4 million*	*0.6 min*
TMA	*13.6 million*	*0.1 min*
Fuel saved	**3.2 million tons**	**42.3 kg**
Taxi	*0.1 million*	*1.4 kg*
En-route	*2.5 million*	*36.0 kg*
TMA	*0.5 million*	*5.0 kg*
CO_2 saved	**10.0 million tons**	**133.2 kg**
Taxi	*0.5 million*	*4.5 kg*
En-route	*7.8 million*	*113.3 kg*
TMA	*1.7 million*	*15.6 kg*
Cancellations avoided	**6,185**	**n/a**
ANS cost efficiency	**€ 1.2 billion**	**€ 25.8**

Table 3: CP1 performance by 2030 – total and per ECAC flight

As mentioned earlier in the report, the 2030 timeframe is limited in its capability to showcase the impact of some of the functionalities. Thus, hereafter is presented the forecast impact per flight for some key analysis years, namely 2023, 2030, 2035 and 2040, for completeness of the analysis. In particular, the impact of AF5 and AF6 will be higher in the total numbers when observed over a longer period.

In Table 4, the first column shows the benefits that have already been achieved in 2023[7] due to the CP1 investments already made. The year 2030, as it is the final date of the CP1 regulation, is important because it is the starting point of saving for future solutions.

The snapshots of 2035 and 2040 show the evolution of continuous improvements and the contribution of AF5 and AF6. Due to the impact of COVID-19, estimates published in the previous CP1 CBA Edition Feb. 2020 are difficult to achieve, and these two additional columns are counterbalancing that impact.

The values in the table below were measured with relation to a "do nothing" scenario, in which it also includes intangible savings. The minutes, fuel and CO_2 saved, as well as ANS cost efficiency represent average values per ECAC flight in each year.

[6] Departure delay includes airport ATFM delay, ATC delay and en-route ATFM delay.

[7] Please note that for per-flight performance only year-on-year values are used and not cumulative.

	Already achieved			
Metric	**2023**	**2030**	**2035**	**2040**
Minutes saved	**1.9 min**	3.2 min	3.5 min	3.7 min
Fuel kg saved	**7.0 kg**	42.3 kg	47.0 kg	47.8 kg
CO_2 kg saved	**22.1 kg**	133.2 kg	147.9 kg	150.5 kg
ANS cost efficiency	**€ 5.2**	€ 25.8	€ 38.0	€ 42.1

Table 4: CP1 performance per average ECAC flight in 2023, 2030, 2035 and 2040[8]

As shown in the table above, with the investments performed until 2023, CP1 has delivered significant benefits. However, these **benefits are expected to substantially improve by 2030 and even more by 2035, assuming that the remaining investments are realised and CP1 functionalities are deployed until the target date** (i.e., end of 2027).

This highlights, once again the role that the **synchronized deployment** of the remaining CP1 functionalities within the defined scope plays in achieving the expected benefits and in improving the performance of ATM in Europe.

4.1.1. Performance per flight concerned

While the performance shown in Table 4 represents CP1 performance in terms of an ECAC average flight, **Table 5 below shows a zoom-in into the CP1 flight efficiency performance in terms of fuel and time, at sub-AF level[9] with a focus on the specific flights concerned by each sub-AF deployed as per CP1 Implementing Rule.**

The aim of this view is to highlight the differences in performance between the different functionalities when looking only at the flights concerned by this functionality according to the CP1 Implementing Rule.

This means, for example, that once a certain functionality is deployed in a determined airport, the zoomed-in performance per flight is calculated purely for the flights departing or arriving from or to that location. Due to the local differences, the result is given within a range.

Sub-AF[10]	Fuel saving per flight concerned	Time saving per flight concerned	% of ECAC flights concerned	Flight phase concerned
Sub-AF 1.1	[17.4 – 26.4 kg]	[0.2 – 0.5 min]	30%	Arrival phase
Sub-AF 1.2	[7.9 – 8.7 kg]	[0.3 – 0.4 min]	15%	Taxiing phase Arrival phase
Sub-AF 2.1	[2.9 – 10 kg]	[0.5 – 1 min]	30%	Taxiing phase
Sub-AF 2.2	[0.4 – 0.8 kg]	[0.1 – 0.1 min]	70%	Taxiing phase
Sub-AF 2.3	[0.1 – 3.1 kg]	[0.01 – 0.01 min]	30%	Taxiing phase
Sub-AF 3.1	[8 – 41.7 kg]	[0.15 – 0.55 min]	10%	Cruising phase
Sub-AF 3.2	[35 – 58 kg]	[1 – 2 min]	75%	Cruising phase
Sub-AF 4.1	n/a	[0.3 – 0.4 min]	5%	Pre departure phase
Sub-AF 4.2	n/a	[0.2 – 0.3 min]	50%	Pre departure phase
Sub-AF 4.3	n/a	[0.1 – 0.2 min]	70%	Pre departure phase
AF6	[8 – 12 kg]	[0.05 – 0.1 min]	90%	Cruising phase

Table 5: Zoom-in CP1 flight efficiency in terms of fuel and time per sub-AF for specific flights concerned

The values presented above are calculated based on projects already implemented within the CP1 scope, and the savings depend on the location where the sub-functionality is deployed. These estimations have

[8] Please note that the values in this table represent the average values at ECAC level and should not be compared to other SDM material that investigates specific environments.

[9] For a full list of sub-AFs and their names please refer to ANNEX A.

[10] For the full list and description of cub-AFs please refer to ANNEX A.

been confirmed by an ad-hoc study ran with EUROCONTROL Sustainability Unit in 2023. In cases when a sub-AF is not yet implemented (e.g., AMAN/DMAN), expert judgment was used to estimate the performance.

Furthermore, as described in ANNEX B, the deployment of **AF5 is expected to add an increase to the performance estimated for AF1 through AF3 by 5 to 10%.**

4.2. Qualitative benefits

On top of the operational benefits that CP1 is expected to bring and that have been quantified in the frame of this CBA update, there is a set of qualitative benefits to which CP1 is expected to contribute to the frame of its improvement of the SES and ATM scene in Europe, and that are summarised hereafter.

Safety improvement is one of the key non-monetizable benefits brought by the CP1 deployment. The different CP1 functionalities contribute to a different extent and in a different way to safety enhancement:

- AF2 shall help to prevent runway incursions, ground collisions and deviation of taxiing procedures that commonly result in a high number of ATM/ANS related incidents and accidents.
- AF3 and AF1 are addressing airborne collisions (one of the key priority safety areas defined by EASA) in Free Route Airspace (FRA) caused by separation minima infringements and unauthorized penetration of segregated airspace as well as in TMA.
- AF4 can improve safety by reducing tactical interventions by ATCOs and improve de-confliction of aircraft. This is expected to prevent ATCOs' overloads, contributing to the improvement of safety.
- AF5 is expected to improve the safety aspect by contributing to the integration of different information systems with SWIM, which will lower the complexity with a reduced risk of system outages during operations, providing ATCOs with more accurate information and leading to better situational awareness.
- With AF6, the ATS B2 ADS-C trajectory is downlinked directly from the active flight plan in the Flight Management System (FMS) including latest updates by the flight crew in a TBO environment. The trajectory ideally provides vertical-, horizontal-profile and time/speed information about the aircraft. This information can provide reliable data regarding the trajectory that the aircraft will follow, allowing for a safety enhancement through better awareness of the ground about the aircraft's flight profile.

Improved predictability: by deploying, among other, different aspects of information exchange between the aircraft and ATCOs, the automatic trajectory downlink and trajectory-based operations, as well as coordination at arrival and departure between the stakeholders involved, CP1 is expected to bring improvements to the predictability aspect of ATC. Predictability improvements stem from different CP1 functionalities, namely:

- AF1 improves predictability through better coordination between en-route and approach ATC units and airports by deploying AMAN/DMAN, which can minimise unexpected changes to the aircraft arrival and departure times.
- AF2, by enhancing the airport operations and seamless information exchange also contributes to the improvement in predictability of operations both at the airport and at the network level though information exchange.
- AF5 and AF6 are expected to contribute to predictability improvement by enabling real-time communication between the aircraft and the ATCO, and trajectory downlink from the aircraft, providing both parties with the most recent and accurate information.

By guaranteeing the deployment of numerous ATCO support tools, CP1 is expected to greatly contribute to the **improvement of situational awareness** by ATCOs but also by airport actors, etc. It is expected that the deployment of automatic trajectory downlink will improve the real awareness of the ATCOs about the flight position and trajectory. An improved ATCO situational awareness is expected to further improve the safety of ATC.

With improved predictability, situational awareness and better data exchange, there is also room for **efficiency improvement** along the entire flight: at the airport, the efficient and timely communications between all the actors involved will improve the efficiency of ground handling operations and contribute

to the timely departure of aircraft; AMAN/DMAN integration is expected to contribute to the efficiency of sequencing and management of departures and arrivals, optimising the capacity at airports; free route airspace is expected to improve the flight efficiency, particularly from the point of view of the Airspace Users, allowing them to fly their most efficient routes when possible; the information sharing across the network will enhance local awareness; SWIM and TBO will improve the real-time communications between the stakeholders involved, supporting their respective activities and, optimising the information flows to better suit everyone's needs.

4.3. Focus on Environment

CP1 Regulation was launched with the view to improve the capacity issues, which is expressed in en-route ATFM delay reduction. However, since there is a clear link between capacity and flight efficiency, the latter one is influenced by Route Availability Document (RAD) restrictions in case of capacity restrictions, making capacity a key enabler for efficient flight paths.

Following the logical chain, an **improved flight efficiency leads to reduction in fuel burn rate per flight, which, in turn, leads to an improvement in CO_2 emissions per flight due to CP1.**

The work performed by SDM clearly shows, on selected local spots, that the **use of CP1 functionalities already now allows a significant reduction of CO_2 emissions.** Keeping in mind that these results correspond to average savings across a number of flights, they clearly indicate the potential of CP1 functionalities in terms of environmental impact.

ATM functionality	Cumulative CO_2 saving 2014-2030	CO_2 saving per ECAC flight in 2030
AF1	1,641,650 tons	14.3 kg
AF2	420,631 tons	3.8 kg
AF3	7,554,808 tons	107.5 kg
AF4	0	0
AF5	377,468 tons	7.6 kg
AF6	1,161 tons	0.1 kg
Total	**9,995,718**	**133.2 kg**

Table 6: CO_2 savings per AF by 2030

Table 6 breaks down the cumulative CO_2 savings by 2030 and the average CO_2 savings per ECAC flight in 2030 according to the updated CP1 calculations based on expected CP1 deployment per ATM functionality. By 2030 **AF3 is expected to provide the highest amount of CO_2 savings,** principally through Cross-border Free Route Airspace and enhanced Airspace Management (ASM) processes such as advanced Flexible Use of Airspace (FUA). Primarily, **these benefits are expected to be realised in the en-route phase of flight through more direct routings and enhanced accessibility to temporary restricted areas.** After 2030, optimised routings for cruising traffic - such as new Zero Emission market segments that are expected to cruise at lower levels – may be supported if FRA is extended to lower airspace.

In the descent / arrival phase, **AF1 will provide CO_2 savings primarily through the implementation of extended or cross-border Arrival Manager (XMAN).** The sharing of data from arriving aircraft enabled by XMAN through a larger horizon (up to 400 NM) enables flights to absorb delay in the en-route phase, at a higher altitude where the aircraft operates more efficiently.

On the ground, **AF2 can contribute to CO_2 savings with the integration of Departure Manager (DMAN) and through the deployment of ATC Safety Nets** such as A-SMGCS (Advanced Surface Movement Guidance and Control System) where the provision of ground guidance can help to optimise taxi procedures especially during peak hours, Low Visibility procedures (LVPs) and at night.

Whilst, according to the Network Manager partition model (see A.4 for more details), **AF4** brings no CO_2 savings (as it impacts only departure delays where engine is off), the **benefits of AF5 are primarily linked to other AFs** as this functionality represents an enabler and enhancer for other solutions.[11]

For **AF6,** the trajectory management concept entails the systematic sharing of aircraft trajectory between operational stakeholders. Initial benefits are exemplified by the Extended Projected profile (EPP) concept where downlinked data such as ToC or ToD points shared with ATC can support **optimised vertical flight paths to assist in both ensuring separation and reducing inefficiency linked to an early descent**

[11] For more details on the distribution of AF5 benefits please refer to ANNEX B.

instruction respectively (i.e., optimising both climb and descent flight phases).[12] Benefits from AF6 are expected to ramp up after 2030. The new FF-ICE (Flight and Flow Information for a Collaborative Environment) flight plan will also enable the flight planning of a more efficient trajectory both for the horizontal trajectory and vertical trajectory (e.g., by the sharing of an optimal ToD point as opposed to start of descent being flight planned upon entry to FRA).

Table 6 above details the average CO_2 savings per ECAC flight in 2030 according to the updated CP1 calculations based on expected CP1 deployment per ATM functionality and is measured as an average value across all ECAC flight in the year. However, as some CP1 concepts may only be expected to contribute to reduced emissions after the CP1 timeframe (i.e., towards 2040), Table 7 below details the total CO_2 savings that could be expected should all CP1 sub-AF concepts be deployed in the future ATM system with all technologies mature and realising their full benefits. The values in the table below represent an order of magnitude of CO_2 savings that can be expected from different sub-functionalities, and which highly depend on the specific conditions of the flight.

Sub-AF	CO_2 saving per flight concerned	Flight phase concerned
Sub-AF 1.1 - eAMAN / XMAN	55.6 – 83.4 kg	Arrival phase
Sub-AF 1.2 - AMAN / DMAN integration	24.9 – 27.5 kg	Taxiing phase Arrival phase
Sub-AF 2.1 - DMAN	9.2 – 31.6 kg	Taxiing phase
Sub-AF 2.2 – iAOP / eAOP	1.3 – 2.5 kg	Taxiing phase
Sub-AF 2.3 - Airport Safety Nets – A-SMGCS	0.3 – 9.8 kg	Taxiing phase
Sub-AF 3.1 - ASM / FUA	25.3 – 131.8 kg	Cruising phase
Sub-AF 3.2 - iFRA / eFRA	110.6 – 183.3 kg	Cruising phase
AF6 - i4DT	25.3 – 37.9 kg	Cruising phase
Total	**253 – 517 kg**	

Table 7: CO_2 savings per sub-AF expected from the deployment of all concepts realising their full benefits on a specific flight

[12] For more details on AF6 benefits please refer to ANNEX C.

The figure below demonstrates how and in which flight phases CP1 concepts are expected to deliver environmental savings. The values presented in this figure represent the impact from CP1 functionalities on a theoretical flight that could benefits from all functionalities at different flight phases. These values are different from the ones presented earlier in this report, since the previous numbers refer to average values at ECAC level or performance interval expected from CP1. As can be observed in the figure, **65% of CP1 CO_2 savings are expected to be found in the cruise phase, 25% in the descent phase and 10% in the taxi-out phase.**

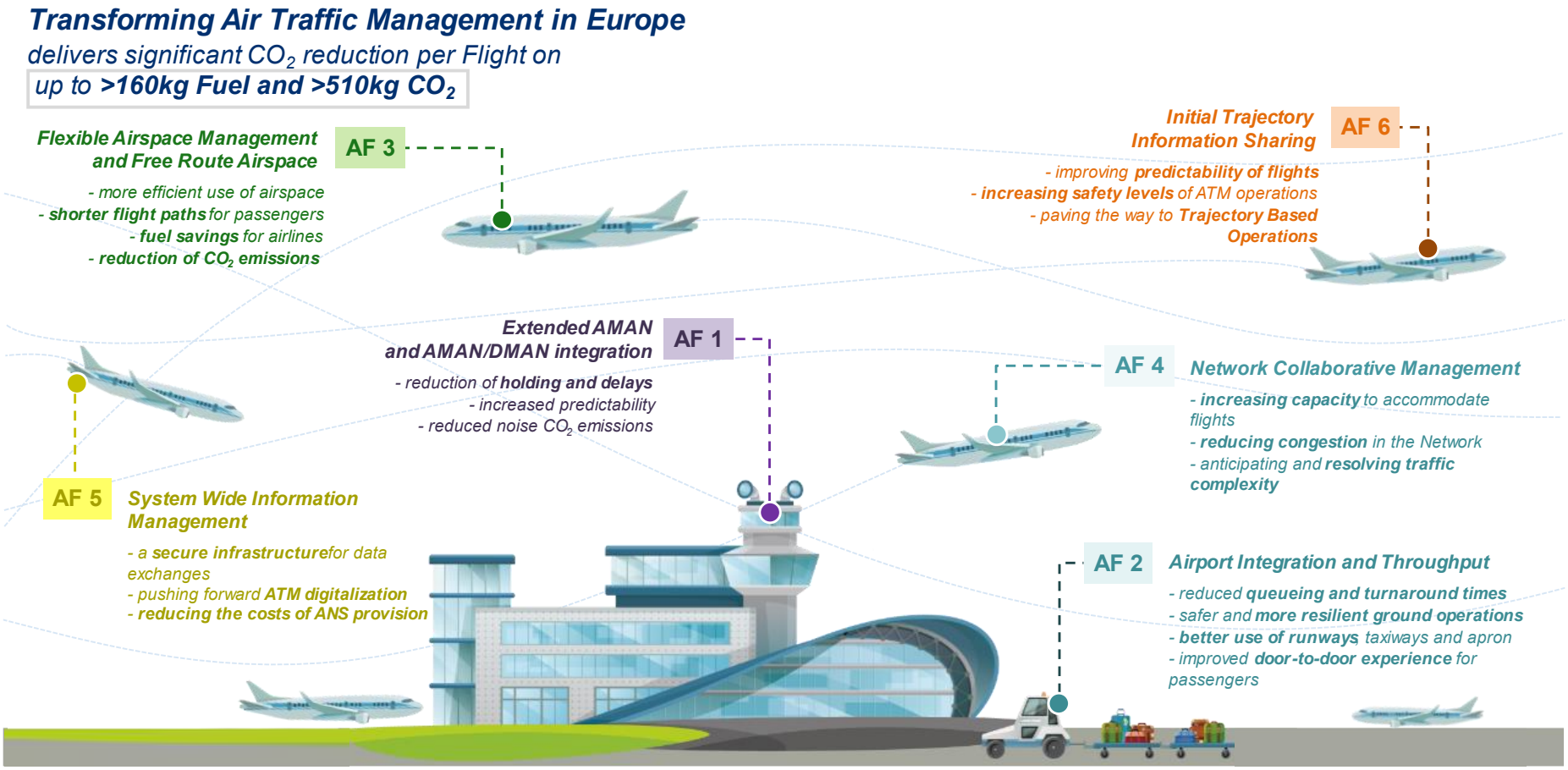

Figure 11: How and in which phases of flight CP1 concepts are expected to deliver environmental benefits

5. Comparison between costs and benefits

The figure below presents a summary of **yearly undiscounted costs and benefits** over the entire CP1 CBA timeline (i.e., 2014 -2040).

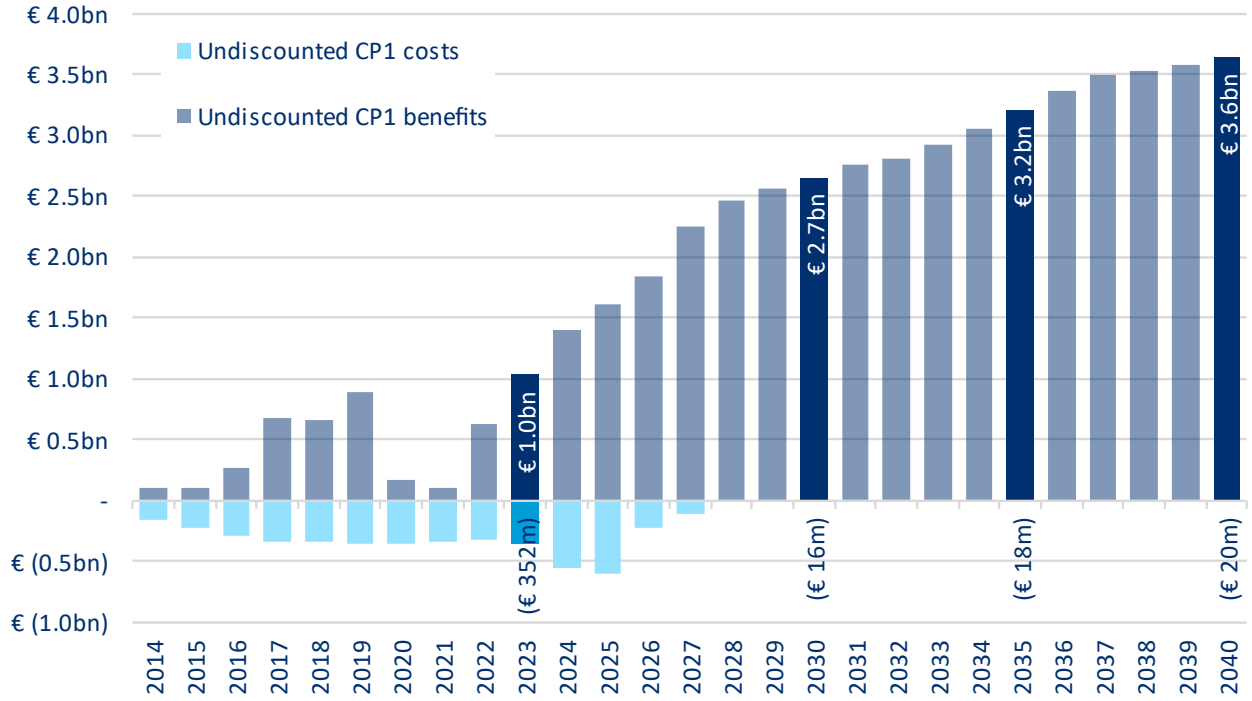

Figure 12: Comparison of the evolution of CP1 undiscounted costs and benefits over the CP1 timeline

It can be observed in the figure above that, once the main investments in the **CP1 deployment have been realised, its benefits greatly overcome the costs**. This is already the case prior to 2024: **the benefits start overcoming the costs as early as 2017,** with a decrease in 2020 and 2021 due to COVID-19, and in 2022, as soon as the traffic starts recovering, the yearly benefits generated by CP1 outgrow the yearly costs again.

Moreover, it is to note that the relation between costs and benefits is the greatest after 2027, when the costs are reduced to the minimum (i.e., the only costs foreseen after 2027 are those related to aircraft forward fit to support AF6) and the benefits are reaching their maximum, considering the share of fleet equipped with AF6. In the table below are presented some indicators of financial and environmental performance of CP1 for key years.

	Already achieved			
Metric	**2023**	**2030**	**2035**	**2040**
Benefit-cost ratio[13]	**1.5**	3.8	5.9	8.0
CO_2 kg saved per € invested[14]	**0.6**	2.2	4.0	6.0

Table 8: Financial and environmental performance of CP1

The benefit-cost ratio (BCR) of the investment in CP1 shows the value of the investment by comparing the costs of a project with the benefit that it generates. In this case, it is shown that **every euro invested into CP1 deployment brings 1.5 euros in 2023, and 3.8 euros in 2030 to the stakeholders** in terms of monetizable benefits.

[13] Benefit-cost ratio is a metric that compares the present value of benefits and costs of an investment project, showing the profitability of the project itself in a determined timeframe.

[14] Kilograms of CO_2 saved with each euro spent on CP1 deployment.

Furthermore, it is also visible in the table that with **every euro invested in CP1**, about 0.6 kg of **CO_2 savings** were generated in 2023. This value is expected to reach 2.2 and 4.0 in 2030 and 2035 respectively.

6. Conclusion

The analysis performed during the elaboration of this update to CP1 CBA allows to **highlight the important role that CP1 plays in the improvement of the air traffic management across Europe**. It shows the evolution of the costs and benefits related to a synchronised deployment of all CP1 functionalities and the corresponding families.

It has once more underlined that the deployment of CP1 functionalities as stipulated in the **CP1 Regulation will bring significant improvements in terms of delay reduction, improvement of flight efficiency, improvement of cost efficiency, avoidance of cancellations and a reduction of the environmental footprint**.

With a total expected investment to complete the deployment of CP1 of about € 4.8bn, **CP1 is expected to bring benefits worth of € 19.4bn and € 51.8bn by the end of 2030 and 2040 respectively.** Furthermore, on top of the monetized benefits, it is important to highlight that **CP1 is a key contributor to the modernisation of ATM in Europe and to the achievement of performance goals that are set to the industry for the upcoming decades.**

At the end of 2023, CP1 is already delivering significant benefits, even if the deployment status sets it at 42% of the deployment scope achieved (or corresponding to 63% of all expected investments). From the financial point of view, the values are also positive: **a benefit-cost ratio of 3.8 in 2030 shows that for each euro invested in CP1, the return for the stakeholders will represent 3.8 euros.** Furthermore, this metric is already at 1.5 in 2023, despite a deployment that is not yet complete. This performance is expected to further improve by 2035, since it will also reflect the contribution from AF5 and AF6 deployment, which shows a positive dynamic.

About 37% of all investments are still to be realised by the end of CP1 timeframe. **It is critical that most of this investment happens in the upcoming years, to ensure a timely CP1 deployment, by end of 2027,** as stipulated in the CP1 Regulation. Although the cost estimation has increased since the last CP1 CBA Ed. November 2020, mainly due to corrections of unit cost underestimation in the previous assessments, adjustments of AF5 and AF6 costs, as well as due to the inflation. In terms of means to secure the necessary investment, there are some financial mechanisms that could potentially be leveraged, to secure a mix of grant funding and loan financing and to ensure full CP1 deployment within the 2027 timeframe.

7. Acronyms

ACC	Area Control Centre
Adj.	Adjusted
ADS-C	Automatic Dependent Surveillance - Contract
AMAN	Arrival Management
ANSP	Air Navigation Service Provider
AOP	Airport Operations Plan
ASMA	Arrival Sequencing and Metering Area
A-SMGCS	Advanced Surface Movement Guidance and Control System
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATFM	Air Traffic and Flow Management
ATM	Air Traffic Management
ATS	Air Traffic Service
AU	Airspace User
BCR	Benefit-Cost Ratio
CAPEX	Capital Expenditure
CD/R	Conflict Detection and Resolution
CFSP	Computerised Flight Plan Service Provider
CINEA	European Climate, Infrastructure and Environment Executive Agency
CP1	Common Project 1
CPDLC	Controller Pilot Data Link Communications
EDA	European Defence Agency
EPP	Extended Projected Profile
FMS	Flight Management System
i4D	Initial Trajectory Information Sharing
IP	Implementation Project
IRR	Internal Rate of Return
KPA	Key Performance Area
KPI	Key Performance Indicators
LVO	Low Visibility Operations
MP	Master Plan
NM	Network Manager
NOP	Network Operations Plan
OPEX	Operating Expense
RAD	Route Availability Document
SDM	SESAR Deployment Manager
SES	Single European Sky
SESAR	Single European Sky ATM Research
TBO	Trajectory-Based Operations
TMA	Terminal Manoeuvring Area
ToC	Top of Climb
ToD	Top of Descent
XMAN	Cross-Border Arrival Management

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[2] CP1 Regulation. Commission Implementing Regulation (EU) 2021/116 of 1 February 2021 on the establishment of the Common Project One supporting the implementation of the European Air Traffic Management Master Plan provided for in Regulation (EC) No 550/2004 of the European Parliament and of the Council, amending Commission Implementing Regulation (EU) No 409/2013 and repealing Commission Implementing Regulation (EU) No 716/2014 (Text with EEA relevance). Available at: http://data.europa.eu/eli/reg_impl/2021/116/oj

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[4] AF6 Business Case. Initial Trajectory Information Sharing. Release 1.02, December 2023

[5] EUROCONTROL Standard Inputs for Economic Analyses Release 10.0.3. Available at: https://ansperformance.eu/economics/cba/standard-inputs/

[6] 2022-122-SESAR Deployment Manager FPA SGA MOVE/E3/SUB/2022-122/S12.875834, Deliverable 4.1.1, 11.07.2023

[7] EU Commission: European Green Deal Initiative. Link: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

[8] SESAR Deployment Programme 2022. Available at https://www.sesardeploymentmanager.eu/publications/deployment-programme

ANNEX A Scope of CP1 CBA update

A.1 CP1 deployment status

In the figure below is presented an overview of the CP1 deployment roadmap, per family.

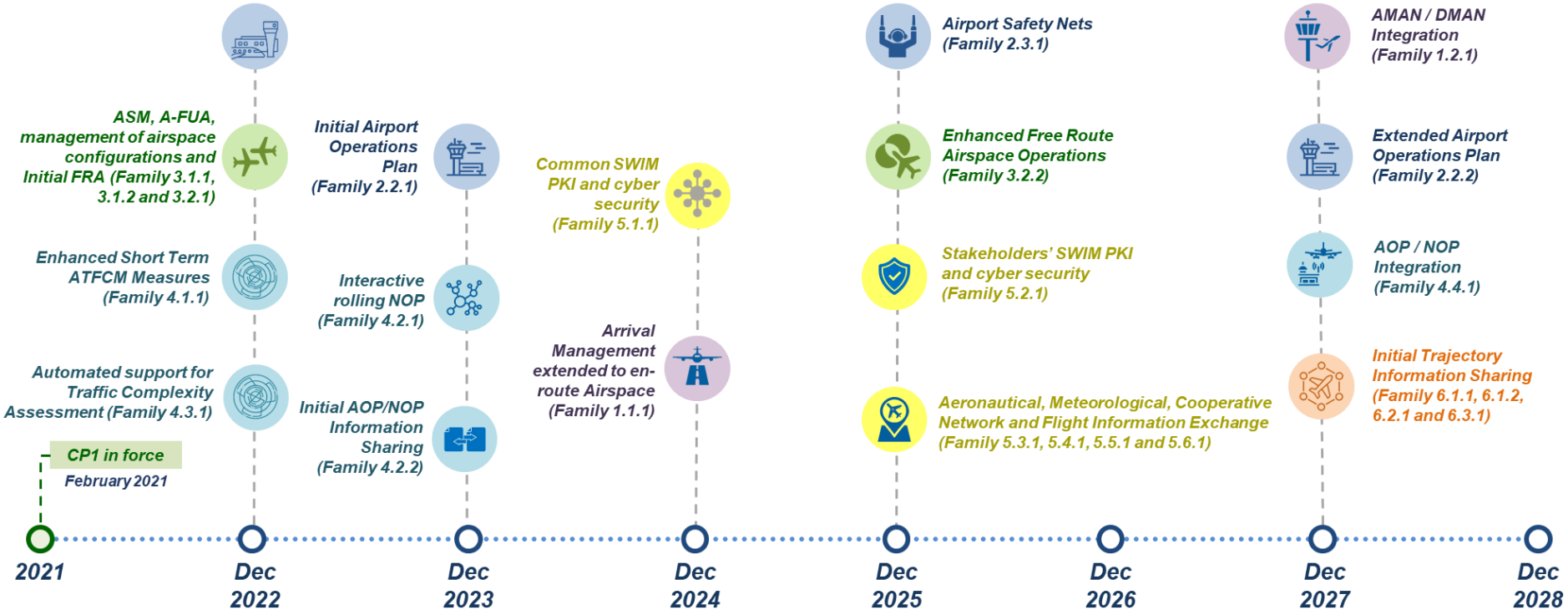

Figure 13: Overview of CP1 deployment roadmap

In the table below is presented an overview of CP1 functionalities for which costs and benefits were calculated in the scope of this document, as well as the percentage completion of their deployment as reported in the SDP Monitoring View at the end of 2023, and the defined end of deployment deadline.

ATM Functionality	Sub-Functionality / Family	% of completed and ongoing by end 2023[15]	Deployment deadline
AF 1 - Extended AMAN and Integrated AMAN/DMAN in the high-density TMA	Sub-AF 1.1 - Arrival Manager extended to en-route airspace	57%	DEC 2024
	Sub-AF 1.2 - AMAN/DMAN Integration	0%	DEC 2027
AF2 - Airport Integration Throughput	Sub-AF 2.1 – Departure Management Synchronised with Pre-Departure Sequencing	98%	DEC 2022
	Sub-AF 2.2 / Family 2.2.1 – Initial AOP	99%	DEC 2023
	Sub-AF 2.2 / Family 2.2.2 - Extended AOP	26%	DEC 2027
	Sub-AF 2.3 – Airport Safety Nets	70%	DEC 2025
AF3 - Flexible Airspace Management and Free Route Airspace	Sub-AF 3.1 Airspace management and advanced flexible use of airspace	100%	DEC 2022
	Sub-AF 3.2 / Family 3.2.1 – Initial FRA	100%	DEC 2022
	Sub-AF 3.2 / Family 3.2.2 – Enhanced Free Route Airspace Operations	90%	DEC 2025
AF4 - Network Collaborative Management	Sub-AF 4.1 – Enhanced Short Term ATFCM Measures	100%	DEC 2022
	Sub-AF 4.2 Collaborative NOP	96%	DEC 2023
	Sub-AF 4.3 – Automated Support for Traffic Complexity Assessment and Flight Planning Interfaces	100%	DEC 2022
	Sub-AF 4.4 – AOP/NOP Integration	30%	DEC 2027
AF5 – SWIM	Sub-AF 5.1 – Common SWIM PKI and cybersecurity	75%	DEC 2024
	Sub-AF 5.2 – Stakeholders' SWIM PKI and cybersecurity	36%	DEC 2025
	Sub-AF 5.3 – Upgrade Aeronautical Information Exchange system / service	63%	DEC 2025
	Sub-AF 5.4 – Upgrade Meteorological Information Exchange system / service	43%	DEC 2025
	Sub-AF 5.5 – Upgrade / Implement Cooperative Network Information Exchange system / service	36%	DEC 2025
	Sub-AF 5.6 – Flight Information Exchange	12%	DEC 2025
AF6 - Initial Trajectory Information Sharing[16]	Sub-AF 6.1 – Initial air-ground Trajectory Information Sharing	2%	DEC 2027
	Sub-AF 6.2 – Network Manager Trajectory Information Enhancement	20%	DEC 2027
	Sub-AF 6.3 – Initial Trajectory Information Sharing Ground Distribution	20%	DEC 2027

Table 9: Overview of CP1 families and their completion status

[15] Average sum of % of "completed" and "ongoing" by end 2023 (according to SDP Monitoring View).

[16] Note: Due to information availability, the AF6 CBA was not split per family, but the results were calculated at AF level.

A.2 Assumptions

Costs

When referring to the costs that were already deployed: for each sub-AF, the identification of investment needs was performed per category of stakeholder, based on the Deployment Programme Planning View. The unit cost per sub-AF is identified by benchmarking the projects with CINEA funding. The results of the benchmarking were challenged with the help of internal and external experts. Cost drivers and multipliers were identified as well. The result is the average cost expectation per multiplier.

In what regards the remaining costs: it is assumed, in this report, that the percentage of costs already committed corresponds to the percentage of AF and sub-AF already considered by the SDP Monitoring View as "completed" and "ongoing" by end of year 2023. The remaining costs were then estimated based on this information, coupled with the information regarding total CP1 costs and the costs already deployed, as mentioned above.

Benefits

The benefit estimates are updated with the latest traffic figures at the time of the document preparation[17].

The general methodology for benefits assessment (Key Performance Areas, Key Performance Indicators, monetisation factors…) have been recalled in some of the paragraphs below. An increased alignment with EUROCONTROL and SJU is reached by using the latest EUROCONTROL Standard Input (version 10). Fuel and CO_2 prices are adjusted on a yearly basis, to allow a realistic view on the savings. The specific methodology for benefits assessment of AF1/2/3/4 is described in A.4. The specific methodology for AF5 can be found in Annex B.

It is important to recall that all benefits in this document are estimated against a do-nothing scenario ("without CP1"). In particular, the CP1 impact in terms of capacity (i.e., ATFM delays) is measured against the delay forecast by the Network Manager where delays would strongly increase in case no investments are made. This means that the results show the **avoided delays** due to CP1 deployment.

Geographical scope

The geographical scope of CP1 CBA update varies depending on the functionality, but it reflects the scope defined in the Commission Implementing Regulation (EU) 2021/116.

For unit costs allocation, the typology of deployment locations used is presented hereunder:

[17] STATFOR October 2023 (base scenario)

Country	Complexity	Air Traffic Control Centre >FL285	Military (ACC/CRC)	Airports	Type of airport
Austria	High	Wien ACC	1 ACC / 1 CRC	Vienna Schwechat	Medium
Belgium	Very High		1 ACC / 1 CRC	Brussels National	Medium
Bulgaria	Medium	Sofia ACC	1 CRC		
Croatia	High	Zagreb ACC	1 CRC		
Cyprus	Medium	Nicosia ACC			
Czech Republic	High	Praha ACC	1 CRC	Prague Václav Havel	Small
Denmark	Medium	København ACC	1 ACC / 1 CRC	Copenhagen Kastrup	Medium
Estonia	Low	Tallinn ACC			
Finland	Low	Helsingin APP Tampereen ACC	1 CRC	Helsinki Vantaa	Small
France	High	Bordeaux ACC Brest ACC Marseille ACC Paris ACC Reims ACC	5 ACC / 3 CRC	Lyon Saint-Exupéry	Small
				Nice Côte D'Azur	Small
				Paris Charles de Gaulle	Very Large
				Paris Orly	Medium
Germany	Very High	Bremen ACC Karlsruhe UAC München ACC	4 CRC	Berlin Brandenburg (International)	Medium
				Düsseldorf Airport	Medium
				Frankfurt am Main	Very Large
				Hamburg Airport	Small
				Munich Franz Josef Strauss	Large
				Stuttgart Airport	Small
Greece	Medium	Athinai ACC Makedonia ACC	2 CRC	Athens Eleftherios Venizelos	Medium
Hungary	High	Budapest ACC	1 CRC		
Ireland	Low	Shannon ATS	1 ACC / 0	Dublin Airport	Large
Italy	High	Brindisi ACC Milano ACC Padova ACC Roma ACC	4 ACC /2 CRC	Milan Linate	Small
				Milan Malpensa	Medium
				Rome Fiumicino	Large
Latvia	Low	Riga ACC	1 CRC		
Lithuania	Low	Vilnius ACC			
Luxembourg	Low				
Maastricht	Very High	Maastricht UAC			
Malta	Low	Malta ACC			
Netherlands	High		1 ACC / 1 CRC	Amsterdam Schiphol	Very Large

Norway	Low	Norway ACC (Bodø) Norway ACC (Oslo-Stavanger)	5 CRC	Oslo Gardermoen	Medium
Poland	Medium	Gdańsk APP Kraków APP Warszawa ACC	4 CRC	Warsaw Chopin Airport	Medium
Portugal	Medium	Lisboa ACC Santa Maria OAC Santa Maria APP	1 ACC / 2 CRC	Lisbon Humberto Delgado	Medium
Romania	Medium	București ACC	4 ACC / 2 CRC		
Slovak Republic	High	Bratislava ACC	1 ACC / 1 CRC		
Slovenia	High	Ljubljana ACC			
Spain	High	Barcelona ACC Canarias ACC Madrid ACC	4 ACC / 4 CRC	Barcelona El Prat	Large
				Madrid Barajas	Very Large
				Málaga Costa del Sol	Small
				Palma de Mallorca Son Sant Joan	Medium
Sweden	Medium	Malmö ACC Stockholm ACC	5 CRC	Stockholm Arlanda	Medium
Switzerland	Very High	Geneva ACC Zurich ACC	1 ACC / 1 CRC	Geneva Airport	Medium
				Zürich Kloten	Large
TOTALS					
30	**4 Very High 10 High 8 Medium 8 Low**	**47**	**25 Mil. ACCs 45 CRC**	**31**	**4 Very Large 5 Large 14 Medium 8 Small**

Table 10: Detailed overview of CP1 geographical scope

Traffic

In the CBA, the STATFOR medium-term traffic forecast Base scenario, dating from October 2023 was used[18]. Since STATFOR only provides traffic forecast until 2029, after that date, a yearly growth of 1.3% was applied. The table below provides a snapshot of the traffic figures for a few years.

	2024	2025	2030	2035	2040
STATFOR ECAC traffic	10.9m	11.1m	11.9m	12.8m	13.6m

Table 11: Traffic assumptions used in CP1 CBA

For AF1 and AF2 families that focus on the airport performance, the STATFOR airport traffic forecast Base scenario is used. This traffic being specific to each airport, benefits and costs calculations are consistent. For AF3 and AF4, the impact of Turkey on benefits is not counted. Isolating the savings from other non-SES flights (UK, Western Balkans, etc.) is not possible as per the Network approach applied by NM in its simulation. However, the extra accounted benefits are not significant compared to the margin of error of the overall calculation, also knowing that existing UK projects from the PCP will contribute to the overall Network approach.

Performance indicators assessed

Below is presented a summary of the performance indicators that were measured and monetized in the frame of this CBA. These were used as indicators for benefits from CP1 deployment.

[18] Source: EUROCONTROL Forecast 2023-2029. Update - Autumn 2023. Available at https://www.eurocontrol.int/publication/eurocontrol-forecast-update-2023-2029-autumn-2023

KPA	Monetised KPI	Related KPI definition
Capacity	Airport ATFM delay	ATFM delay per flight attributable to terminal and airport air navigation services and caused by landing restrictions at the destination airport.
	ATC delay	Delays in start-up due to air traffic control constraints when the aircraft is ready to leave the departure stand.
	En-route ATFM delay	Minutes of en-route ATFM delay per flight attributable to air navigation services.
	Cancellations	Number of cancellations avoided.
Cost efficiency	ANS productivity	Increase in number of flights per ATCO hour on duty
Flight efficiency (time and fuel)	ASMA time	ASMA time is split in two: Unimpeded ASMA time is the ASMA transit time in non-congested conditions at arrival airports. Additional ASMA time is a proxy for airport inefficiencies in the approach phase, the average arrival runway queuing time on the inbound traffic flow, during congestion periods at airports. A more efficient management of arrival flow will also result in fuel savings for the aircraft operators since they will avoid hold time.
	Taxi-out time	Taxi-out time is split in two: Unimpeded taxi-out time, which is the actual taxi-out time of a flight (i.e., the time elapsed between the off-block time of this flight and its take-off time). The unimpeded taxi-out time is the taxi-out time in non- congested conditions at airports. Additional taxi-out time is a proxy for the average departure runway queuing time on the outbound traffic flow, during congestion periods at airports. Taxi-out time includes possible push-back delay, possible remote de-icing time, and departure runway occupancy time. This will also be translated into fuel savings due to reduction of engine-on time of the aircraft.
	Nautical miles	Minutes and fuel saved due to a more efficiency horizontal or vertical flight profile.
Environment	CO_2 saving	CO_2 tons saved linked to the of flight efficiency metrics described above.

Table 12: Performance indicators assessed in CP1 CBA

Monetisation factors

The monetisation factors used to transform the expected performance into monetary values are presented below. They are a result of SDM considerations and EUROCONTROL Standard Inputs for Economic Analyses Release 10.0.3. The values were updated in early 2024 to reflect the updates in the source documents.

KPI	Monetisation factor until 2023	Monetisation factor after 2023
Airport ATFM delay – €/min	€ 38	€ 45
En-route ATFM delay – €/min	€ 38	€ 45
ATC delay – €/min	€ 38	€ 45
ASMA time (unimpeded) – €/min	€ 37	€ 41
ASMA time (additional) – €/min	€ 45	€ 52
Taxi-out time (unimpeded) – €/min	€ 37	€ 41
Taxi-out time (additional) – €/min	€ 45	€ 52
Flight time – €/min	€ 37	€ 41
Cancellations – €/cancellation	€ 17,650	€ 20,930

Table 13: Monetisation factors used in CP1 CBA

For each KPI, improvements can be monetised by multiplying the savings (expressed in their respective unit) by a valorisation factor: euros per minute, euros per ton of fuel or ton of CO_2 etc. The table below provides an overview of the valorisation factors used in this CBA update for the performance monetisation.

Metric	Unit	Valorisation factor
Fuel to CO_2 ratio	n/a	3.15
Fuel consumption – ASMA time	Kg/min	40
Fuel consumption – Taxi-out time	Kg/min	10
Fuel consumption – Horizontal flight time	Kg/min	60
Nautical miles flown per minute	NM/min	7.3

Table 14: Valorisation factors used in CP1 CBA

Fuel price and cost of CO_2 emissions

Thus, the assumptions used in this CBA update for fuel price and CO_2 cost are as follows:

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023-2026	2027-2040
Jet fuel price (€/tonne)	€ 698	€ 487	€ 370	€ 458	€ 571	€ 560	€ 332	€ 543	€ 1,040	€ 819	€ 819
CO_2 allowance (€/tonne)	€ 7.2	€ 8.2	€ 6.6	€ 8.1	€ 24.6	€ 21.7	€ 32	€ 53	€ 82	€ 83	€ 125

Table 15: Costs of fuel and CO_2 used in CP1

A.3 Detailed cost per sub-functionality

CP1 costs were identified at the sub-AF level and for each key stakeholder. This section contains the cost inputs used in this report to calculate the investments (undiscounted values). It includes the unit investment per deployment location, as well as the number of deployment locations for each sub-AF.

The table below lists the key stakeholders, their number, and the AFs they have to invest in.

Stakeholder	Key Investment	Number of Stakeholders
ANSPs	All AFs	Typically, 20 ANSPs, 30 countries (varies per sub-AF)
Airports	AF1, AF2, AF4, AF5	Typically, 20 airports, varies per sub-AF
Military	AF3 and AF5	25 militaries ACCs, 45 CRCs, 30 countries (depending on sub-AF)
MET providers	AF5	1 provider (for framework) 30 providers (30 countries)
Airspace Users	All AFs[19]	5 major airlines with more than 1 000 flights per day, 30 airlines with more than 100 flights per day.[20] They represent around 80% of total Scheduled Aviation flights. Overall fleet of 7200 aircraft and 4900 FF until 2040
CFSPs	AF3, AF4, AF5	5 CFSP – 2 used by major airlines, 3 used by other airlines
Network Manager	AF1, AF3, AF4, AF5, AF6	1 NMOC

Table 16: Number of Stakeholders considered

[19] Please note that for Sub-AF 1.1, 2.1, 2.2, 2.3, 5.4, there are no deployment milestones outlined for the Airspace Users in the SESAR Deployment Programme. However, several investments have already been undertaken by the Airlines in the frame of these Sub-AFs. Therefore, their costs are considered in this CBA for completeness purposes.

[20] Due to the scope of the document, only Airspace Users from the EU are considered in the assessment.

The below costs are based on information available in the STAR portal on CINEA funded projects and additional input as received during discussions with SDM subject matter experts.

Sub-AF/Family	Stakeholder	Unit cost ('000 €)	Deployment unit	Deployment locations	Total costs ('000 €)	Comment
Sub-AF 1.1 – Arrival Management extended to en-route airspace	ANSPs	1,654	Airport	20	110,268	For each affected airport, on average 7 neighbouring ACCs also need to invest.
		551	ACC	140		
	Airports	33	Airport	20	662	
	Military	-	-	-	-	
	MET providers	-	-	-	-	
	Airspace Users	220	Airline	30	6,616	Airline IT system costs necessary for airside integration.
	CFSPs	-	-	-	-	
	Network Manager	2,757	NMOC	1	2,757	
Total costs Sub-AF 1.1:					**120,303**	
Sub-AF 1.2 - AMAN/DMAN Integration	ANSPs	4,945	TMA	6	29,668	Costs obtained from initial CP2 CBA.
	Airports	-	-	-	-	
	Military	-	-	-	-	
	MET providers	-	-	-	-	
	Airspace Users	-	-	-	-	
	CFSPs	-	-	-	-	
	Network Manager	-	-	-	-	
Total costs Sub-AF 1.2:					**29,668**	
Sub-AF 2.1 - Departure Management Synchronised with Pre-departure sequencing	ANSPs	4,525	Very large and large airport	9	88,793	Costs are for implementing the DMAN in Airport Systems, creating an IT connection between the airport operator's system and airport stakeholders, implementing the information sharing platform. ANSPs costs related to operational validation, specification, development, and technical verification of changes for EFS based on lists
		4,374	Medium airport	10		
		4,324	Small airport	1		
	Airports	9,249	Very large and large airport	9	167,889	Costs are for implementing the DMAN in Airport Systems, creating an IT connection between the airport operator's system and airport stakeholders, implementing the information sharing platform. Computer Systems of the airport need to be set-up to enable A-CDM.
		7,741	Medium airport	10		
		7,238	Small airport	1		
	Military	-	-	-	-	
	MET providers	-	-	-	-	

Sub-AF/Family	Stakeholder	Unit cost ('000 €)	Deployment unit	Deployment locations	Total costs ('000 €)	Comment
	Airspace Users	1.47	Employee	1,575	4,837	Test and Implement an A-CDM platform, train employees to use it
		502	System	5		
	CFSPs	-	-	-	-	
	Network Manager	-	-	-	-	
				Total costs Sub-AF 2.1:	**261,520**	
Sub-AF 2.2 - Initial AOP / Extended AOP	ANSPs	-	-	-	-	
	Airports (iAOP)	7,521	Airport	19	142,899	Implement different system modules to extend Airport's Operational Database. OSL does not implement iAOP.
	Airports (eAOP)	2,930	Very large airport	4	214,511	
		8,205	Large and medium airport	19		
		5,861	Small airport	8		
	Military	-	-	-	-	
	MET providers	-	-	-	-	
	Airspace Users	175	Airport	19	3,334	Implement data collection systems for the airports (OSL do not applied)
	CFSPs	-	-	-	-	
	Network Manager	-	-	-	-	
				Total costs Sub-AF 2.2:	**360,744**	
Sub-AF 2.3	ANSPs	4,498	Very large and large airport	9	72,289	ATCO training, system design and implementation
		2,892	Medium and small airport	11		
	Airports	2,891	Very large airport	4	47,539	Analysis phase, system design, safety and risk assessment, training, integration, and testing, and go-live
		2,248	Other airports	16		
	Military	-	-	-	-	
	MET providers	-	-	-	-	
	Airspace Users	16	Aircraft	7,177	115,226	
	CFSPs	-	-	-	-	
	Network Manager	-	-	-	-	
				Total costs Sub-AF 2.3:	**235,055**	

Sub-AF/Family	Stakeholder	Unit cost ('000 €)	Deployment unit	Deployment locations	Total costs ('000 €)	Comment
Sub-AF 3.1 - Airspace management and advanced flexible use of airspace	ANSPs	11,629	High complexity ANSPs	14	310,640	Includes costs for VoIP Implementation
		9,240	Medium complexity ANSP	16		
	Airports	-	-	-	-	
	Military	442	Country	30	13,274	Cost based on LARA project. Actual LARA French project cost € 0.5m. A correction factor of 1,13 is applied to French prices to adjust at EU value level
	MET providers	-	-	-	-	
	Airspace Users	1,177	Airline	5	5,885	Major Airlines will adapt their internal IT-tools. The other airlines will use the NM systems (B2B).
	CFSPs	3,500	CFSP	5	17,500	
	Network Manager	14,662	NMOC	1	14,662	
Total costs Sub-AF 3.1:					**361,961**	
Sub-AF 3.2 - Initial FRA and Enhanced Free Route Airspace Operations	ANSPs	46,821 for high complexity ANSPs 19,950 for medium complexity ANSPs	ANSP	14 high complexity ANSPs 16 medium complexity ANSPs	974,690	
	Airports	-	-	-	-	
	Military	1,770 per CRC 724 per military ACCs	CRC Mil. ACCs	45 CRCs 25 militaries ACCs	97,758	
	MET providers	-	-	-	-	
	Airspace Users	955 per major airline 281 for others	Airline	30 airlines, incl. 5 major	11,797	
	CFSPs	1,500	CFSP	5	7,500	
	Network Manager	10,263	NMOC	1	10,263	
Total costs Sub-AF 3.2:					**1,102,009**	
Sub-AF 4.1 - Enhanced Short	ANSPs	2,000	Country	30	60,000	Costs relate to STAM Tool implementation (France, MUAC, Poland & Switzerland)
	Airports	-	-	-	-	

Sub-AF/Family	Stakeholder	Unit cost ('000 €)	Deployment unit	Deployment locations	Total costs ('000 €)	Comment
Terms ATFCM Measures	Military	-	-	-	-	
	MET providers	-	-	-	-	
	Airspace Users	1,241	Major airline	5	6,205	Major Airlines AF4.1 + AF 4.3 Major Airlines will adapt their internal IT-tools. The other airlines will use the NM systems (B2B).
	CFSPs	1,750	Major CFSP	2	3,500	CFSP of Major Airlines
	Network Manager	9,123	NMOC	1	9,123	
Total costs Sub-AF 4.1:					**78,828**	
Sub-AF 4.2 - Collaborative NOP	ANSPs	100	country	30	3,004	
	Airports	613		19	11,648	Those costs cover all Sub AF4.2 NOP for AO
	Military	-	-	-	-	
	MET providers	-	-	-	-	
	Airspace Users	1,802 for Major 200 for other airline	Airline	5 major airlines, 25 other	14,022	Development costs for tools for airspace users
	CFSPs	1,683	CFSP	5	8,413	
	Network Manager	46,591	NMOC	1	46,591	
Total costs Sub-AF 4.2:					**83,679**	
Sub-AF 4.3 - Automated Support for Traffic Complexity Assessment and Flight Planning Interfaces	ANSPs	2,002 for high complexity 1,001 for medium complexity	ANSP	14 high complexity 16 medium complexity	44,047	
	Airports	-	-	-	-	
	Military	-	-	-	-	
	MET providers	-	-	-	-	
	Airspace Users	-	-	-	-	
	CFSPs	-	-	-	-	
	Network Manager	10,919	NMOC	1	10,919	
Total costs Sub-AF 4.3:					**54,966**	
Sub-AF 4.4 - AOP/NOP integration	ANSPs	-	-	-	-	ANSP costs correspond to small investments in ANSP systems made by the ANSPs/Airports (depending on system ownership) at the small and medium sized airports where this functionality will be deployed
	Airports	-	-	-	-	

Sub-AF/Family	Stakeholder	Unit cost ('000 €)	Deployment unit	Deployment locations	Total costs ('000 €)	Comment
	Military	-	-	-	-	
	MET providers	-	-	-	-	
	Airspace Users	-	-	-	-	
	CFSPs	-	-	-	-	
	Network Manager	1,213	NMOC	1	1,213	
Total costs Sub-AF 4.4:					**1,213**	
Sub-AF 5.1 - Common SWIM PKI and Cybersecurity	ANSPs	294	country	30	8,811	
	Airports	-	-	-	-	No need according to Experts
	Military	-	-	-	-	
	MET providers	87 for EUMETNET 1 for each country	country	1 MET provider 30 countries	117	
	Airspace Users	10 per consulting engagement	Airline	30	289	
	CFSPs	-	-	-	-	
	Network Manager	26,393	NMOC	1	26,393	Initial Info from NM Costs estimation covering all stakeholders
Total costs Sub-AF 5.1:					**35,611**	
Sub-AF 5.2 - Stakeholders' SWIM PKI and cyber security	ANSPs	7,802	Country	30	234,075	
	Airports	2,302 230	Airport	31 airports 93 airports	92,758	
	Military	2,281 per ACC 7,379per CRC	Mil ACC CRC	25 ACCs 45 CRCs	389,072	VOICE, PATRUS, IP compliance and Gateway Upgrade for 4Flight compliance NATO CAOC centres (ES, PT, DE, GR, IT) are counted as national CRCs
	MET provider	-	-	-	-	
	Airspace Users	285	Airline	6	1,712	- if Airlines have already ISMS in place, then no additional cost will occur. - to be conservative, we could consider that 20% of Airlines will have to invest, meaning in total 6 airlines. OPEX costs are not considered in this CBA update
	CFSPs	-	-	-	-	
	Network Manager	9,743m	NMOC	1	9,743	

Sub-AF/Family	Stakeholder	Unit cost ('000 €)	Deployment unit	Deployment locations	Total costs ('000 €)	Comment
				Total costs Sub-AF 5.2:	**727,360**	
Sub-AF 5.3 – Upgrade Aeronautical Information Exchange system / service	ANSPs	6,964m	Country	30	208,926	
	Airports	1,850m	airport	31	57,346	
	Military	-	-	-	-	
	MET provider	-	-	-	-	
	Airspace Users	1,757	Airline	30	52,705	
	CFSPs	1,088	CFSP	5	5,441	
	Network Manager	20,751	NMOC	1	20,751	
				Total costs Sub-AF 5.3:	**345,168**	
Sub-AF 5.4 - Upgrade Meteorological information exchange system / service	ANSPs	1,210m	Country	30	36,309	
	Airports	1,135m	Airport	31	35,175	
	Military	-	-	-	-	
	MET providers	1,018 EUMETNET 2,269 other providers	Country	1 30	69,097	
	Airspace Users	951	Airline	30	28,531	
	CFSPs	397	CFSP	5	1,986	
	Network Manager	2,739	NMOC	1	2,739	
				Total costs Sub-AF 5.4:	**173,837**	
Sub-AF 5.5 - Upgrade / Implement Cooperative network information exchange	ANSPs	2,455	country	30	73,650	
	Airports	575 173	airport	31 airports (very large/large/medium/small) 93 (other)	33,890	
	Military	-	-	-	-	
	MET providers	-	-	-	-	
	Airspace Users	-	-	-	-	
	CFSPs	-	-	-	-	
	Network Manager	31,058	NMOC	1	31,058	
				Total costs Sub-AF 5.5:	**138,598**	
Sub-AF 5.6 - Flight Information Exchange	ANSPs	1,932	country	30	57,970	ANSP plus connecting/consuming costs on the airport side
	Airports	966	airport	31	29,951	

Sub-AF/Family	Stakeholder	Unit cost ('000 €)	Deployment unit	Deployment locations	Total costs ('000 €)	Comment
	Military	-	-	-	-	
	MET providers	-	-	-	-	
	Airspace Users	2,013 per airline	airline	30	60,386	
	CFSPs	5,072	CFSP	5	25,362	
	Network Manager	€ 16,695m	NMOC	1	16,695	
				Total costs Sub-AF 5.6	**190,365**	
Sub-AF 6.1 - Initial Air-Ground Trajectory Information Sharing	ANSPs	5,700	ACCs	47	267,900	+0PEX to be considered (see annex C). Include Sub-AF6.3: Initial Trajectory Information Sharing ground.
	Airports	-	-	-	-	
	Military	56	Forward Fit (transport aircraft and tanker only)	btw 100-200	0	No cost for Military at this stage, according to EDA no cost for Military, however in case of modification we already insert some numbers: the unit costs for forward fitting of aircraft are somewhat similar to the costs for the commercial aircraft (15-20% more due to potential more security/cybersecurity and IoP complexity)
	MET providers	-	-	-	-	
	Airspace Users	47	Forward Fit	4,912	230,864	Until 2040
	CFSPs	-	-	-	-	
	Network Manager	-	-	-	-	
				Total costs Sub-AF 6.1 cost:	**498,764**	
Sub-AF 6.2 - Network Manager Trajectory Information Enhancement	ANSPs	-	-	-	-	
	Airports	-	-	-	-	
	Military	-	-	-	-	
	MET providers	-	-	-	-	
	Airspace Users	-	-	-	-	
	CFSPs	-	-	-	-	
	Network Manager	15,000	NMOC	1	15,000	Include Sub-AF6.3: Initial Trajectory Information Sharing ground.
				Total costs Sub-AF 6.2:		**15,000**

Table 17: Detailed overview of CP1 costs

A.4 Detailed benefits per functionality

Top-down table used to assess the benefits of AF1 and AF2

The percentage of expected KPI improvements associated with each sub-AF of AF1 and AF2 was estimated based on available data such as SESAR documentation, flight reports, PRU data and expert judgement. When improvements concern only a portion of flights, a correction factor is applied (e.g., if only arrival flights are concerned then a correction factor of 50% of the total flights of the airport is applied). Other example, if a functionality is bringing benefits only during Low Visibility Operations (LVO), a percentage is applied (estimation of LVO period for an airport). These are summarised in the tables below.

Top-Down model AF1/AF2	1.1.1	1.2.1	2.1.1	2.2.1	2.2.2	2.3.1
Airport ATFM Delay	1.0%	0.1%		0.1%	0.01%	
ATC Delay		0.3%	3.0%	0.1%	0.01%	25.0%
ASMA Time (unimpeded)	3.0%					
ASMA Time (additional)	1.0%					
Taxi-out Time (unimpeded)						
Taxi-out Time (additional)		2.0%	7.0%	1.2%	0.1%	10.0%
Cancellations			22.5%	18.4%		

Table 18: Top-down model used for estimation of AF1 and AF2 benefits

Correction factors	1.1.1	1.2.1	2.1.1	2.2.1	2.2.2	2.3.1
Airport ATFM Delay	50%	50%		50%	50%	
ATC Delay		50%	50%	50%	50%	4%
ASMA Time (unimpeded)		50%				
ASMA Time (additional)		50%				
Taxi-out Time (unimpeded)		50%	50%			
Taxi-out Time (additional)		50%	50%	50%	50%	4%
Cancellations			1.55%	1.55%		

Table 19: Correction factors to the AF1/AF2 Top-down model

Methodology used for AF3 and AF4 benefit estimation

Please refer to the methodology description in the CP1 CBA Edition February 2020[21] where savings in ATFM delays and Nautical Miles were calculated by the Network Manager based on simulation tools. These initial estimations are represented by the blue curve in the figures below.

The CP1 CBA Edition November 2020 provided updated values for the savings in ATFM delays and Nautical Miles. They were derived from the initial (pre-COVID) values, by using elasticity factors (correlation between traffic volume and capacity or flight efficiency) to model the benefits deviations caused by traffic decrease. These elasticity factors (3 for ATFM delays and 1 for Nautical Miles) were used for the years 2021 and beyond, whereas for the year 2020 it was considered they were not significant enough, given the extremely low level of traffic: instead, a conservative assumption was made to consider that no benefits had to be counted for CP1 in 2020. These estimations are represented by the dotted orange curve in the figures below.

In the current report, the updated savings for AF3 and AF4 are represented by the orange curve in the figures below and were assessed with the following methodology:

ATFM Delay Savings

Actuals

[21] FPA MOVE/E2/2014-717/SESAR FPA Deliverable D3.5.1

It must be noted that the initial (pre-COVID) values of delay savings (or "avoided delays" as savings are measured against a do-nothing scenario) were calculated by The Network Manager with the principle that they would allow to meet the assigned target in the Performance Scheme (0.5 minute per flight).

Therefore, for the period 2014-2019 the actual values of ATFM delays as published by the Network Manager are used to calculate an "excess delay per flight" ("excess" meaning "above the target"). It is assumed that CP1 contributes only partially to this excess delay, with a percentage of contribution varying over the years to reflect the ramp-up of CP1 deployment (from 20% in 2014 to 70% in 2018 and 2019). For each year, this excess delay per flight attributed to CP1 is multiplied by the number of flights and the result is retrieved from the initial simulation.

For the year 2020, it is still assumed that there is no ATFM delay savings, given the extremely low volume of traffic.

For the period 2021-2023, it is assumed that the methodology used for 2014-2019 is not applicable because the actual values of ATFM delays as published by the Network Manager are still impacted by the low volume of traffic due to COVID. Therefore, the updated values of delay savings are calculated based on the initial values and the elasticity factor of 3.

Future values

For the remaining years (2024-2040), the updated values of delay savings are also calculated based on the initial values and the elasticity factor of 3. As traffic recovers, they progressively reach the figures provided in the initial Network Manager simulation.

This results in the values represented on the orange curve in the graph below. It is worth noting that these calculations made by SDM and the methodology itself are commonly agreed with the Network Manager, owner of the initial simulation.

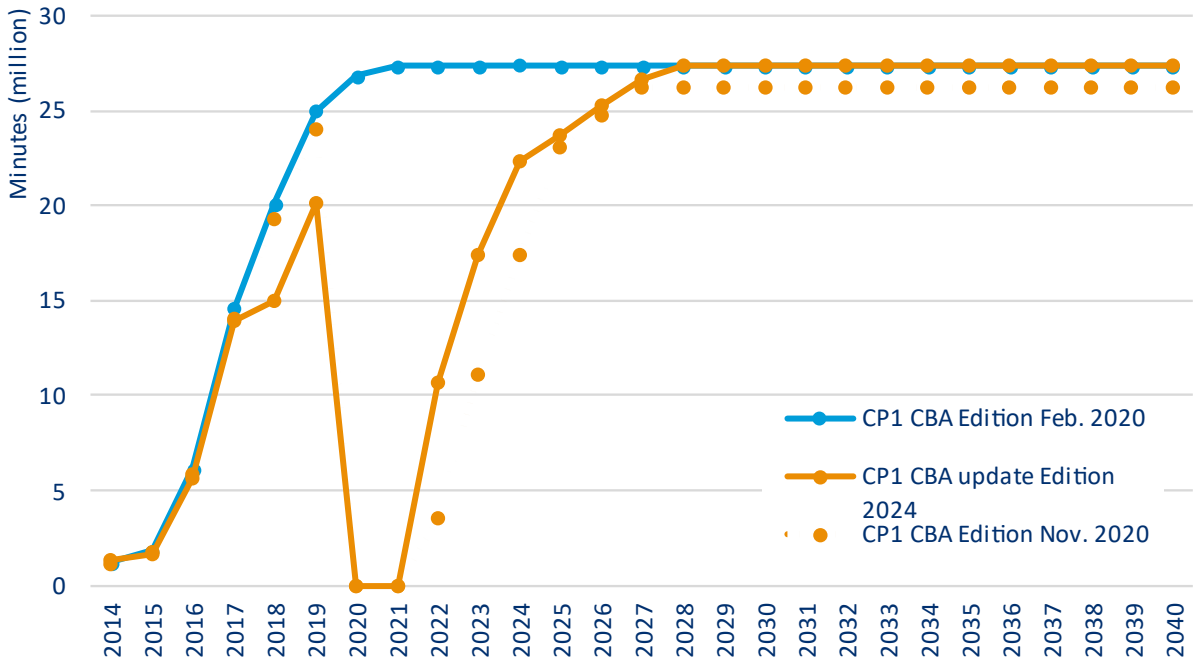

Figure 14: ATFM delay savings for AF3 and AF4

Nautical Miles Savings

Actuals

For the period 2014-2023, the values are provided by the Network Manager reflecting all savings from CP1 deployment, considering airspace design, KEP savings and KEA savings. It should be noted that actuals in Nautical Miles savings are well below the initial estimation, which is explained firstly by the lower volume of traffic, then by some postponements (France) or airspace restrictions (Spain) in the core area and also by external factors, most importantly the war in Ukraine and its impact in terms of flight paths due to the "no flying zone" that was implemented.

Future values

The updated values of Nautical Miles savings are calculated based on the initial values and the elasticity factor of 1. As traffic recovers, they progressively reach the figures provided in the initial Network Manager simulation.

The assumption for the period 2024-2027, as also agreed with the Network Manager, is that the impact of the war in Ukraine will progressively decrease. Compared with the CP1 CBA Edition November 2020, the savings are therefore postponed.

This results in the values represented on the orange curve on the graph below. It is worth noting that these calculations made by SDM and the methodology itself are commonly agreed with the Network Manager, owner of the initial simulation.

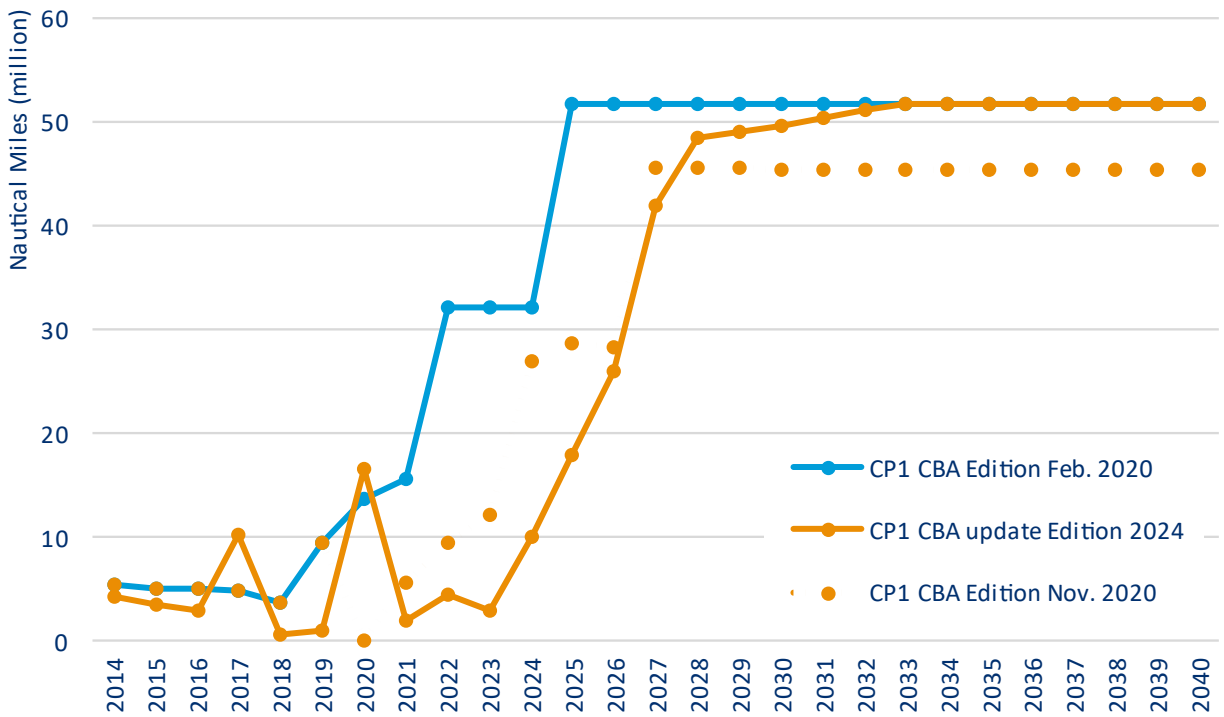

Figure 15: Nautical Miles savings for AF3

Partition per family

The NM established that the AF3 and AF4 benefits should be split between families according to the Table below.

Family name	Part for ER ATFM delays	Part for Nautical Miles
3.1.1 - ASM and A-FUA	8%	7%
3.1.2 - Management of Predefined Airspace Configurations	12%	3%
3.2.1 - Initial FRA	20%	35%
3.2.2 - Enhanced Free Route Airspace Operations	20%	55%
4.1.1 - Enhanced Short Terms ATFCM Measures	15%	0%
4.2.1 - Interactive Rolling NOP	10%	0%
4.2.2 - Initial AOP/NOP Information sharing	5%	0%
4.3.1 - Automated Support for Traffic Complexity Assessment and Flight Planning Interfaces	5%	0%
4.4.1 - AOP/NOP integration	5%	0%

Table 20: Split of AF3 and AF4 benefits between families

ANNEX B AF5 calculations

B.1 Overview

System-Wide Information Management (SWIM) enhances sharing information and supports a transition towards a more digitalised ATM system. Currently, information sharing in the ATM system relies mostly on an outdated architecture, which combines various systems and standards used by different stakeholders. SWIM is a global common standard that lets users and providers exchange data easily without needing different interfaces or protocols.

In the original CP1 CBA from 2020, only AF5 costs were calculated in terms of investment requirements, the benefits, however, were only described qualitatively. SDM found it difficult to properly estimate AF5 benefits and AF5 was described as a pure enabler for the other functionalities.

In this update, SDM created a model using input from AF5 experts, the Network Manager and Air Navigation Service Providers. As the model heavily relies on expert judgement, **it will benefit from feedback received during the consultation for further improvement**.

B.2 Methodology and assumptions

System-Wide Information Management (SWIM) is recognised as one of the key enablers of SESAR. Its implementation is transversal across all ATM systems, data domains and business trajectory phases (planning, execution, post-execution), involving a wide range of ATM stakeholders. SWIM covers all information exchange relevant to ATM, including trajectories, surveillance data, all types of aeronautical information and meteorological data.

In comparison to the current private, one-to-one, point-to-point communications, where other parties who might be affected are not involved in immediate decisions, SWIM services offer several advantages:

- Reduced number of interfaces,
- Standardisation, assuring overall consistency,
- Shared data and services by providing transparent access to ATM services, which are likely to be geographically distributed,
- Improved collaborations and informed decisions by supporting flexible and modular sharing of information, as opposed to one-to-one interfaces.

To create the AF5 benefits model, SDM conducted a series of meetings with experts and these expert analyses suggested that AF5 benefits would result from:

- Enhancements of operational benefits from other CP1 ATM Functionalities (AFs), resulting in time/fuel/CO_2 savings, and
- Reductions in operational costs, including staff and non-staff costs (such as energy, communication, maintenance, cybersecurity and other).

A further analysis with AF5 experts and the Network Manager helped identify three categories of CP1 families:

- Category 1 includes CP1 families where SWIM will not provide any extra benefits.
- Category 2 comprises CP1 families where SWIM is a necessary enabler (these families cannot be implemented without SWIM).
- Category 3 includes CP1 families that could be implemented without SWIM, but where SWIM will either enhance the operational impact, generate cost savings, or both.

The main aim of this classification is to model AF5 impacts across various AF1/2/3/4/6 families where AF5 could generate an impact on benefits:

- For families in Category 1, AF5 will not bring any additional benefits.
- For families in Category 2, benefits are already included in AF1/2/3/4/6 calculations. To avoid double counting, it is assumed that AF5 additional benefits are equal to zero.
- For families in Category 3, SWIM will provide additional benefits, which will be included as operational benefits, cost savings, or both.

Following the categorisation described above, the families have been grouped as follows:

- Category 1: No benefit from SWIM
  - Family 1.2.1 (AMAN/DMAN integration): There are no specific SWIM service specification available to support this service.[22]
  - Family 2.3.1 (Airport Safety Nets)
- Category 2: No additional benefits as SWIM is a necessary enabler
  - All AF4 families (Network Collaborative Management): Each AF4 service relies on various other services and requires the implementation of SWIM services for data exchange.
  - All AF6 families (Initial Trajectory Information Sharing): as AF5 and AF6 are heavily linked together through the FF-ICE services, it is considered in this document that AF5 benefits to AF6 are already counted in the AF6 CBA, described in Annex C below.
- Category 3: Operational benefits, cost savings, or both
  - Family 1.1.1 (E-AMAN): This ATM Functionality is mainly connected to AF 5.6.1 "Extended AMAN" SWIM service. When implemented, this service will facilitate efficient, secure, reliable, and cost-efficient data exchange among E-AMAN partners.
  - Family 2.1.1 (Departure Management Synchronised with Pre-departure Sequencing): The information exchanged over SWIM as a result of A-CDM procedures will improve their efficiency.
  - Family 2.2.1 (Initial AOP)
  - Family 2.2.2 (Extended AOP)
  - Family 3.1.1 (ASM and advanced flexible use of airspace): The exchange of aeronautical information (AF 5.3.1) will improve the Flexible Use of Airspace, potentially leading to operational benefits and increased cost efficiency.
  - Family 3.1.2 (Management of predefined airspace configuration): Aeronautical information exchange (AF 5.3.1) will enhance the management of predefined airspace configurations, possibly with operational benefits and increased cost efficiency.
  - Family 3.2.1 (Initial FRA)
  - Family 3.2.2 (Enhanced Free Route Airspace Operations)

Following this classification, Table 21 below shows the **proposed percentages of impact (additional operational savings)** across the different AF1 to AF4 families from expert judgement.

[22] However, using the SWIM specification for data exchange in A-CDM would be advantageous.

Family	5.1.1 Common SWIM PKI and cyber-security	5.2.1 Stakeholders' SWIM PKI and cyber-security	5.3.1 Aeronautical Information Exchange	5.4.1 Met. information Exchange	5.5.1 Cooperative network information Exchange	5.6.1 Flight Information Exchange	Total AF5
1.1.1 - Arrival Management extended to en-route airspace				5%		10%	**15%**
1.2.1 - AMAN/DMAN Integration							**0%**
2.1.1 - Departure management synchronised with pre-departure sequencing					5%		**5%**
2.2.1 - Initial AOP					5%		**5%**
2.2.2 - Extended AOP					5%		**5%**
2.3.1 - Airport Safety Nets							**0%**
3.1.1 - ASM and Advanced Flexible Use of Airspace			5%			1%	**6%**
3.1.2 - Management of Predefined Airspace Configurations			5%			1%	**6%**
3.2.1 - Initial FRA			2%	1%		2%	**5%**
3.2.2 - Enhanced Free Route Airspace Operations			2%	1%		2%	**5%**
4.1.1 - Enhanced Short Terms ATFCM Measures					0%		**0%**
4.2.1 - Interactive Rolling NOP					0%		**0%**
4.2.2 - Initial AOP/NOP Information sharing					0%		**0%**
4.3.1 - Automated support for traffic complexity assessment and flight planning interfaces					0%		**0%**
4.4.1 - AOP/NOP integration					0%		**0%**

Table 21: AF5 operational impact on AF1/2/3/4

Table 22 shows the proposed percentages of cost savings across the different costs categories. At this stage, only ANSP costs were considered.

Description	5.1.1 Common SWIM PKI and cyber-security	5.2.1 Stakeholders' SWIM PKI and cyber-security	5.3.1 Aeronautical Information Exchange	5.4.1 Met. information Exchange	5.5.1 Cooperative network information Exchange	5.6.1 Flight Information Exchange	Total AF5
ATCO	0.0%	0.0%	0.7%	0.4%	0.8%	0.7%	**2.5%**
Non-ATCO	0.0%	0.0%	1.2%	0.6%	1.5%	1.2%	**4.5%**
Non-staff (energy, communication, maintenance, cybersecurity, etc.)	2.5%	2.5%	0.0%	0.0%	0.0%	0.0%	**5.0%**

Table 22: AF5 impact on ANSP cost savings

Table 23 below outlines the assumptions for the **ramp-up of operational savings and cost savings**. Operational savings are expected to start to materialise already in 2025, as investments have been carried out for a couple of years and the implementation deadline is end of 2025[23]. Cost savings might require longer time to be achieved, as indicated by the conservative estimate in the table.

Year	Operational savings	Cost savings
2025	25%	0%
2026	60%	0%
2027	80%	10%
2028	100%	25%
2029	100%	50%
2030	100%	75%
2031 and beyond	100%	100%

Table 23: Ramp-up of operational and cost savings

B.3 Expected costs of AF5

The total undiscounted costs of AF5 are approximately € 1.7bn in the 2014-2025 period. Table 24 below shows the breakdown of costs per category of stakeholders. All details of the cost calculation (unit costs and number of units) can be found in the tables of section A.3 Detailed cost per sub-functionality above.

Cost category	Total costs (2014-2025)
ANSPs	€ 620m
AOs	€ 249m
Militaries	€ 389m
Met	€ 69m
Airspace Users	€ 271m
CFSP	€ 33m
NM	€ 107m
Total undiscounted costs	**€ 1,738m**

Table 24: AF5 costs per stakeholder category, 2014-2025

[23] This document refers strictly to the CP1 Regulation, with 2025 being the mandatory deployment date. An alternative scenario in which the AF5 implementation is postponed could be assessed separately.

B.4 Expected benefits of AF5

Table 25 below summarises cumulated AF5 benefits from 2025 till the end of 2030, 2035 and 2040.

Benefit	2030 (cumulated)	2035 (cumulated)	2040 (cumulated)
Operational savings	€ 433m	€ 947m	€ 1,472m
Cost savings (staff)	€ 333m	€ 1,427m	€ 2,597m
Cost savings (non-staff)	€ 128m	€ 577m	€ 1,097m
Total	**€ 894m**	**€ 2,951m**	**€ 5,166m**

Table 25: AF5 cumulative monetized benefits

Table 26 below shows the impact per average ECAC flight in the years 2030, 2035 and 2040.

Operational savings per flight	2030	2035	2040
Minutes saved	0.12 min	0.12 min	0.11 min
Fuel kg saved	2.4 kg	2.4 kg	2.3 kg
CO_2 kg saved	7.6 kg	7.5 kg	7.1 kg
ANS cost efficiency	€ 18.3	€ 25.1	€ 25.8

Table 26: AF5 benefits per average flight (in units)

B.5 Results of AF5 CBA

The figure below shows the cash flows of AF5 starting from 2014 (the first year with costs). The Cumulative Cash Flow line (CCF) displays the sum of all costs and benefits discounted to the year when the first cost occurred, 2014, using a 4% discount rate[24].

The ramp-up of costs starts in 2014 and reaches 100% in 2025, when AF5 has to be fully implemented by regulation. The ramp-up of benefits starts in 2025 and it reaches 100% in 2031. Thereafter, benefits continue increasing mostly in line with the traffic increase.

[24] Standard discount rate based on EUROCONTROL Standard Inputs for Economic Analyses, which, in turn, is based on the data provided in Commission Delegated Regulation (EU) No 480/2014. European Commission (2014), Commission Delegated Regulation (EU) No 480/2014, Article 19 (Discounting of Cash Flow)

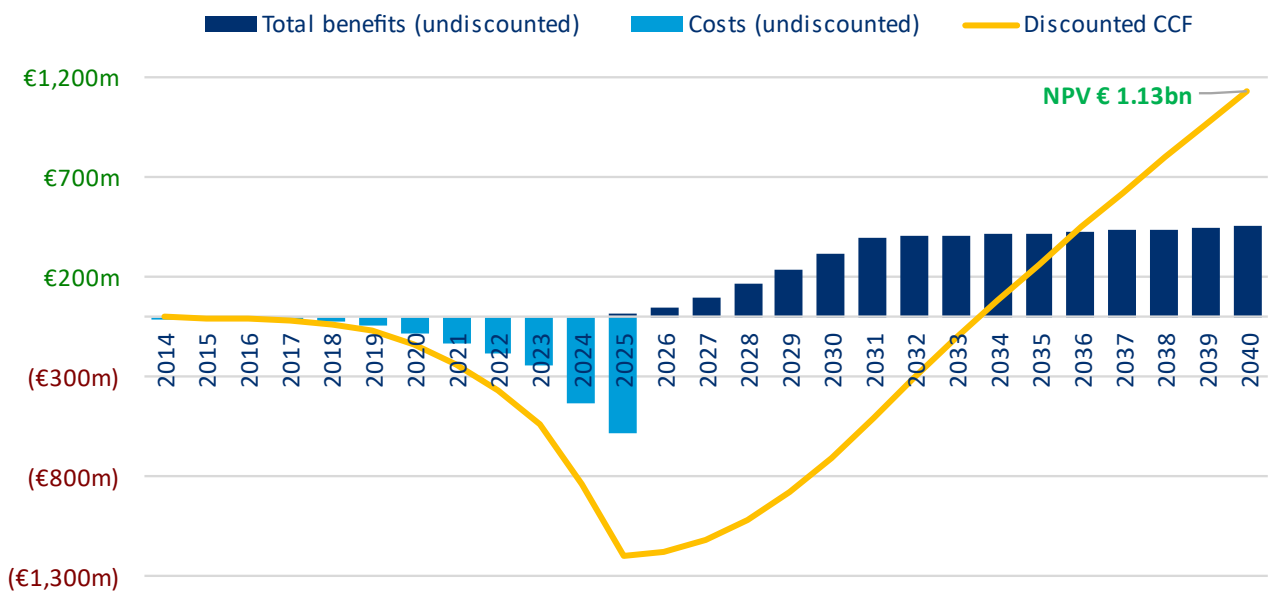

Figure 16: Evolution of AF5 cash flows

In the 2014-2040 period, the net present value (NPV) is estimated to be € 1.13bn, so the deployment of AF5 is expected to have a positive return on investment. The payback year, when the benefits are going to fully cover the costs, is 2034. The benefit-cost ratio of 1.9 means that each euro invested is expected to bring a 1.9-euro benefit.

CBA results (2014-2040)	
NPV	€ 1.13bn
IRR	10.8%
BCR	1.9
Payback year	2034
Discounted results (4%)	
Benefits	€ 2.3bn
Costs	(€ 1.2bn)
Undiscounted results	
Benefits	€ 5.2bn
Costs	(€ 1.7bn)

ANNEX C AF6 calculations

The **Initial Trajectory Information Sharing** is the first step of the 4D Trajectory and key element of ATM operating concept. One of the pillars of SESAR is the management of aircraft trajectories from planning through execution gate-to-gate. Trajectories will be expressed in all 4 dimensions (4D) and flown with significantly higher accuracy than today. The Trajectory Management concept entails the **systematic sharing of aircraft trajectory between various participants** in the ATM process to ensure that **all partners have a common view of a flight and have access to the most up-to-date data available to perform their tasks**.

Besides other operational and environmentally friendly initiatives, AF6 will play a key role in ATM modernization as it includes the first steps towards improved precision and predictability of aircraft trajectories at both network and local level, through an improved use of trajectory information, facilitating more efficient business trajectories.

The ATS B2 ADS-C trajectory is downlinked directly from the active flight plan in the FMS, including latest updates by the flight crew or by ATC. The trajectory provides vertical, horizontal and time/speed dimensions. **Situational awareness and predictability are, therefore, progressively improved thanks to the exchange of reliable information regarding the trajectory that the aircraft will follow.** AF6 will thus improve de-confliction and reduce tactical interventions, allowing the aircraft **to fly as much as possible the preferred, optimum and efficient trajectory.**

C.1 Assumptions

Below are exposed the main assumptions that were used for the elaboration of AF6 CBA.

Assumption	Value	Rationale
CBA timeframe[25]	2024-2040	The CBA start date is set at the beginning of the year following the elaboration of the CBA but before the expected start of deployment, to allow for estimation of start of deployment by ATS providers and Network Manager before 2027. The CBA is calculated until 2040 to allow for sufficient time (i.e., over 10 years) between the date of mandatory start of deployment (2028) and the end of analysis, to assess the benefits.
Number of ACCs concerned	47	According to CP1 Regulation, AF6 should be implemented above flight level 285, which is controlled by about 47 ATSUs.
Aircraft equipped in 2027	5.5%	The working assumption is that before the official date stipulated in CP1 Regulation as the starting point for new aircraft deliveries to be equipped to support AF6, there is approximately 300 aircraft already equipped with ADS-C EPP, which represents about 5.5% of total fleet.
Share of new aircraft equipped per year	100%	Assuming a linear yearly forward-fit rate, this is the target rate by 2040 to ensure that all aircraft with certificate of airworthiness issued on or after 31 December 2027 will be equipped to support AF6.
Discount rate	4%	Standard discount rate based on EUROCONTROL Standard Inputs for Economic Analyses, which, in turn, is based on the data provided in Commission Delegated Regulation (EU) No 480/2014[26].

Table 27: Assumptions used in AF6 CBA

[25] This document refers strictly to the CP1 Regulation, with 2027 being the mandatory deployment date. An *ad hoc* document (AF6 Business Case Initial Trajectory Information Sharing Release 1.02) was delivered to the European Commission in December 2023, that includes an assessment of a scenario in which the AF6 implementation is postponed.

[26] European Commission (2014), Commission Delegated Regulation (EU) No 480/2014, Article 19

Traffic

Scheduled traffic, based on STATFOR long-term forecast - Base scenario[27]. Assumed that scheduled traffic constitutes 87.1% of all traffic, according to EUROCONTROL Standard Inputs for Economic Analyses. Thus, the traffic figures are considered, for key years, as follows.

	2024	2025	2030	2035	2040
STATFOR ECAC traffic	10.9m	11.1m	12.0m	12.8m	13.6m
Scheduled traffic (%)	87.1%	87.1%	87.1%	87.1%	87.1%
Scheduled Aviation traffic	9.5m	9.6m	10.4m	11.1m	11.9m

Table 28: Traffic forecast used in AF6 CBA

Only Scheduled Airlines (i.e., Mainline and Regional) equipped aircraft are considered. They represent 87% of ECAC traffic[28].

	Part of Total ECAC flights	Narrow body (jet) part of total ECAC flight	Wide body part of total ECAC flights
Mainline	73%	56.4%	13.4%
Regional	14%	6.3%	n/a
Scheduled Airlines (total)	87%	63%	13%
Business Aviation and other	13%	n/a	n/a

Table 29: Fleet assumptions used in AF6 CBA

Aircraft fleet equipage

CP1 Regulation states that "aircraft operators must ensure that aircraft operating flights with an individual certificate of airworthiness first issued on or after 31 December 2027 are equipped with ADS-C EPP as part of ATS B2 capability, in accordance with the applicable standards in order to downlink aircraft trajectory". According to this, it is considered that, as of 31 December 2027, all new aircraft will be equipped with ADS-C EPP, which is an enabler for AF6 deployment. It is to note that, according to the industry experts, at the time of the writing of AF6 CBA report, there are about 300 aircraft equipped to support AF6. Thus, it was decided to consider them in the total fleet equipped by 2028, to ensure that the currently equipped fleet will also benefit from the AF6 capability. This corresponds to the following cumulative aircraft equipped:

	2024	2028	2030	2035	2040
Cumulative aircraft equipped	299	620	1,288	3,121	5,211
Share of total aircraft fleet equipped (excluding Turboprop)	6%	10%	20%	43%	63%
Share of flights with ADS-C EPP	13%	23%	41%	73%	90%

Table 30: Fleet equipage assumptions used in AF6 CBA

C.2 Expected costs of AF6

AF6 benefits depend on ground and airborne equipment and their connection. Thus, the delivery of these benefits depends not only on the equipage of aircraft and the deployment of ground equipment by ANSPs, but also on the flight crew's effort to start the services (e.g., logon via Controller Pilot Data Linck Communications (CPDLC) where required). **Delays on the side of either group of stakeholders would reduce drastically the benefits for the industry**.

Datalink is promoted to support the use of airborne trajectories in the ground systems. It is worth to be noted that AF6 depends critically on the implementation of datalink communications systems, both on the ground and airborne, as it is intended to support CPDLC and ADS-C, including the provisions for i4D,

[27] EUROCONTROL STATFOR, (2022). "EUROCONTROL Aviation Outlook 2050"

[28] The numbers are derived from based on EUROCONTROL Standard inputs for Economic Analyses, release 10.0.3

as defined in the "ATN Baseline 2" standard, enabling a downlink of the aircraft trajectory using Extended Projected Profile (EPP) and globally, supporting sharing of information between aircraft and ATC.

ATC systems need to be adapted to generate full benefits of downlinked trajectories. To comply with CP1, Controller Working Position they shall implement monitoring of trajectory adherence to the flight plan, generating improved situational awareness of the ATCO safety as enabler of full Trajectory Based Operation (TBO) together with the CPDLC component of the ATS B2.

The table below summarises the quantified undiscounted costs used in this CBA (timeframe 2024-2040) for the three main stakeholders considered (i.e., ANSPs, Airspace Users and the Network Manager).

Cost category	Unit cost	Number of units	Total cost
ANSPs (CAPEX)	€ 5.7m	47 ATSUs	€ 268m
ANSPs (OPEX)	€ 0.3m/year	47 ATSUs	€ 197m
NM	€ 15m	1	€ 15m
AUs – Forward-fit	€ 47k	4,912 aircraft	€ 231m
Total (undiscounted)	**n/a**	**n/a**	**€ 711m (€ 514m CAPEX)**

Table 31: Summary of costs used in AF6 CBA

Regarding airborne equipment, the assessment considers a flat cost € 47k per aircraft to forward-fit ADS-C EPP capabilities (independently of whether the aircraft is an Airbus or Boeing model), including a modification of the Flight Management System (FMS) and communication routers. Nevertheless, this hypothesis should be monitored and reviewed in future.

C.3 Expected benefits of AF6

Air/ground integration towards i4D is expected **to improve predictability of aircraft trajectory for the benefit of airspace users, Network Manager and ANSPs,** implying less tactical interventions and improved de-confliction situation and a more effective avoidance of conflicts.

The expected benefits from AF6 deployment are an **increase in en-route capacity** (with no detrimental impact on safety), an **increase in ANSP cost efficiency** (ATCO productivity), an **increase in fuel efficiency,** as well as **reduced flight time and track miles, and the consequent environmental improvements** (e.g., reduction of CO_2 emissions).

The new Conflict Detection and Resolution (CD/R) tools support the ATCO tasks and reduce their workload to manage the same traffic amount, which can be translated operationally into en-route airspace capacity, and ATCO productivity.

ADS-C EPP allows for earlier and more optimal clearances, fewer re-routings so aircraft fly closer to their optimal flight trajectories, which translates into fuel savings and flight time savings.

Given this, ADS-C EPP has a potential flight efficiency improvement in time and fuel, and consequently in CO_2 emissions.

In the table below are summarised the quantitative benefits from AF6 that were used as inputs for the CBA (based on SESAR research PJ.18, 31 and 38, Very Large-Scale Demonstrations in MUAC and flight trials from Airlines).29 Please note that these benefit areas were used specifically for AF6 CBA and were later on translated into the KPIs used by SDM for the purpose of CP1 CBA benefit calculation.

Benefit area	% change	Time	Fuel	CO_2
En-route airspace capacity	2.72%			
ATCO productivity	2.86%			
Flight Efficiency - ToD			5.4 kg/flight	17 kg/flight
Flight efficiency – ATC shortcuts		0.07 min/flight	2.7 kg/flight	8.4 kg/flight
Fuel efficiency – Optimal FL			0.9 kg/flight	2.8 kg/flight

[29] Please refer to AF6_Business Case Release 1_Ed.2023 for further details.

Benefit area	% change	Time	Fuel	CO_2
Fuel efficiency – Climb			0.5 kg/flight	1.7 kg/flight
Fuel efficiency – Delay absorption			0.1 kg/flight	0.4 kg/flight
Total OPS benefits per flight		**0.07 min/flight**	**9.6 kg/flight**	**30.3 kg/flight**
Total cumulative			**0.7m tonnes**	**2.2m tonnes**

Table 32: Summary of per-flight benefits used in AF6 CBA

Below is presented a summary of the undiscounted benefits from AF6 deployment CBA. Please note that these benefits were estimated at the ECAC level based on the per-flight benefits presented above. The cumulative benefits are presented for the entire CBA timeline (i.e., 2024-2040).

Benefit area	Cumulative benefits (units)	Cumulative benefits (€)	Benefits in 2040 (units)	Benefits in 2040 (€)
En-route airspace capacity	54.3m min	€ 2,400m	10.4m min	€ 459m
ATCO productivity	4.9m hours	€ 698m	0.8m hours	€ 118m
Fuel	686m kg	€ 562m	113m kg	€ 93m
CO_2	2,162m kg	€ 270m	357m kg	€ 45m
Flight time	5.1m min	€ 183m	0.8m min	€ 30m
Total cumulative	**n/a**	**€ 4,114m**	**n/a**	**€ 744m**

Table 33: Total benefits from AF6 CBA

C.4 Results of AF6 CBA

The Cost Benefit Analysis found that the **Initial Trajectory Information Sharing (AF6) would lead to a positive NPV of over € 1.8bn by 2040,** considering the deployment of the basic requirements traced in CP1 Regulation.

In terms of benefits, these would comprise ANS Productivity gains (~3%), **fuel savings** (reduction of ~10kg/flight ECAC-wide) and **CO_2 savings (reduction of ~30kg/flight ECAC wide).**

In 2040, the **yearly benefits would reach over € 744m in ECAC**, including a **saving of more than 357k tonnes of CO_2** per year. It is expected that, after 2040, these benefits will increase proportionally to the flights using AF6.

CBA results	
NPV	€ 1.8bn
IRR	24%
BCR	4.4
Payback year	2035
Discounted results (4%)	
Benefits	€ 2.4bn
Costs	(€ 534m)
Undiscounted results	
Benefits	€ 4.1bn
CAPEX	(€ 514m)
OPEX	(€ 197m)

Net Present Value (NPV) represents the value of all future cashflows resulting from an investment, discounted to Today's money. It shows the final discounted net result from this investment (i.e., including both, the expected benefits, and costs).

In the table hereafter is presented a summary of the main outcomes from the CBA for all stakeholders.

It can be observed that at the end of the CBA timeline (i.e., 2040) and considering a 4% discount rate, the **NPV is expected to reach € 1.8bn,** with an Internal Rate of Return (IRR) of 24% and a 4.4 benefit-cost ratio (BCR). From a cost-benefit analysis perspective, an IRR of 24% indicates that the deployment of AF6 is expected to generate a positive return on investment, while the BCR of 4.4 suggests that for each euro invested into AF6 implementation, a return of 4.4 euros is expected in terms of monetizable performance benefits. All in all, it indicates that **the deployment of AF6 is a positive investment in terms of its returns to the stakeholders.**

The **payback year being 2035** indicates the year by which the benefits from AF6 are expected to fully cover the costs, generating a positive cumulative net benefit.

The figure below shows the evolution of cashflows over the entire CBA timeline (i.e., 2024-2040). It can be observed in the figure that the costs are spread across the entire timeline, reflecting the equipment of the new aircraft deliveries with ADS-C EPP starting from 2028 and up until 2040. Between 2024 and 2027, the costs represent purely the investment on the side of the NM and the ANSPs to make available all the necessary systems to support AF6 as of 31 December 2027, as per CP1 Regulation.

Although not clearly visible in the figure, the **benefits start being generated as of 2028,** however these remain relatively low due to the low fleet equipage in the first years.

The negative NPV during the first years is expected to level out once the majority of investments have happened and there is sufficient fleet equipped to justify the investment, which is expected to happen by 2035.[30]

[30] CCF stands for Cumulated Cash Flows

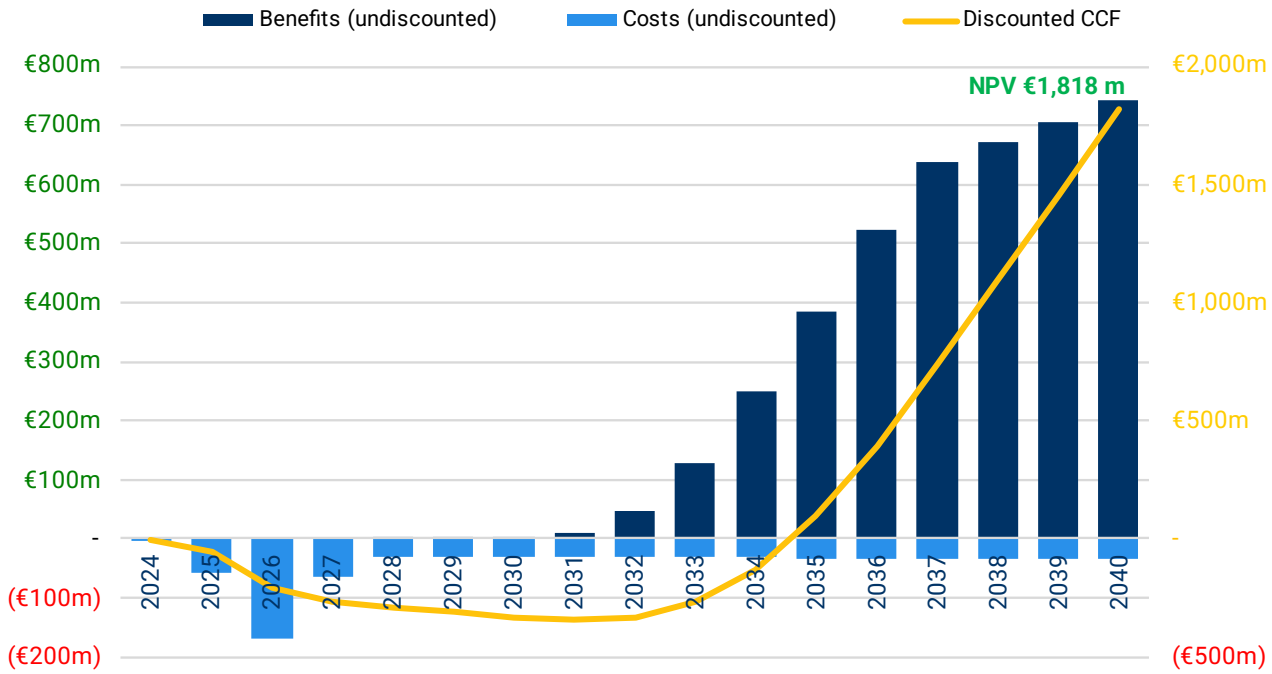

Figure 17: Evolution of AF6 costs, benefits and cumulative cashflows

There is evidence that ATM Functionality 6, ADS-C EPP will bring benefits to the European en-route airspace in safety, capacity, environment, and flight efficiency, as described hereunder:

Capacity/Predictability – the trajectory of the aircraft is defined in detail and known in advance, considering local conditions and other airspace users. This means that pilots and service providers have far more time to plan their respective operations and assets and make manoeuvres, making flight paths smoother and ensuring that air travel departures and arrivals are more predictable and efficient.

Safety – the position of every aircraft in the sky above FL285 is known for each moment in time by all the interested parties. Greater automation of ATM means that air traffic controllers and pilots will have more capacity for monitoring safety aspects.

Efficiency – knowing the exact trajectory and timing for each flight means that ATC can optimise an aircraft's routing and fuel usage. Smooth ascent and descent paths consume less fuel than the stepwise adjustments that are currently necessary.

Environmental positive impact – in turn, optimal routing and lower fuel usage reduces emissions of CO_2 and therefore the impact on climate change. In addition, trajectories can consider local needs in terms of noise and other pollution and avoid unnecessary over-flights. Greater predictability of aircraft operations means a further optimisation of resources at airports, for example, which will reduce the CO_2 emissions related to the operation of airport services. Data instead of voice communications between ATCOs and pilots can significantly reduce the use of lengthy traditional VHF radio transmissions which have much higher energy consumption than VHF Data radios which communicate in short bursts.