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Agenda Item 4

# Air Navigation Performance Framework

## Performance in 2022

Results from the 2023 data collection exercise

(reflecting State submissions up to 15 October 2023)

EASPG/05

Paris, France

29 November – 1 December 2023





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## Executive Summary





## General Regional Performance

- Following the COVID19 related unprecedented drop in air traffic in 2020 and 2021, 2022 marked a continual recovery of air transport operations.  
Recovery varied across the EUR region in terms of total traffic share and connections. While the overall traffic numbers reached 80 - 85% of the pre-pandemic levels, there are variations across the region.  
The low-cost sector recovered quicker than the legacy carrier segment, resulting in changes to the network services.
- A further impact on the network is related to the repercussion of the Russian invasion of Ukraine resulting in a significant share of the European airspace unserviceable and constraints on air transport operations.
- The associated performance indicators for 2022 need to be evaluated in light of the recovery of air traffic.

## Air Transport / Traffic / Demand

- On average, there has been a continual recovery from the pandemic traffic levels to about 80 – 85 % in 2022. Traffic recovery showed a wave pattern and varied across States in 2022.
- Seasonal effects showed the strong demand return and culminated in a high number of passenger facilitation related delay and associated ripple effects on ATFM delay. The year 2022 also witnessed a recovery of international traffic, although pre-pandemic levels are not yet fully reached.
- The stress on the system is also seen in the total of en-route ATFM delay reaching pre-pandemic levels, including ripple effects from the military conflict in part of the EUR region.
- The overall traffic development affected the overall traffic /demand situation nationally and region-wide.



### Air Navigation Service organisation and associated performance

- The EUR region is characterised by a wide variety in the size of the airspace as well as of traffic density. Post-pandemic, traffic in 2022 continued to increase. While across the European region traffic recovered continuously, national traffic levels vary in terms of recovery and connectivity.
- 8 reporting states have 4 or more FIRs accounting for more than 40% of all FIRs. 13 states organise their service provision into 2 FIRs, while the majority of states (size-dependent) operate 1 FIR. The number of FIRs is associated with volume of airspace and number of control unit.
- The top 4 States included in the report cover 50% of the continental airspace. Two third of the continental airspace is served by a total of 8 States.
- Traffic levels varied across the EUR region. About 60% of the IFR flight hours within the continental airspace in 2022 is serviced by 7 participating States
- The overall average of serviced flight hours increased across the region to about 350k flight hours. The majority of States still serviced at or below this threshold in 2022.

- In terms of staffing/ATCO hours, there has been only a marginal change across the region. This highlights that service provision is predominantly influenced by the organization/planning accounting for the anticipated demand.  
A total of 6 States are accountable for about 60% of all en-route ATCO hours on duty in the EUR Region. Oceanic service provision is handled by a small number of States within the EUR region (i.e. 3 States reporting).
- For terminal operations, the top 10 States accounted for about 60% of all ATCOs in operations at Terminal Facilities, i.e. combined APP and Towers. The wider spread in comparison to the previous years shows that for major hubs operations have not yet reached the pre-pandemic levels, but are continuously increasing.
- The average flight hours per IFR across the European regions ranges just below 0.5 min/flight. The indicator decreased for the top reporting State in 2022 (signalling a slight modification of the overall traffic pattern of the post-pandemic traffic).  
For the other States, the average flight hours per IFR flight is broadly consistent with the previous year. This evidences that traffic patterns / recovery adhere to pre-pandemic connectivity.



- Traffic changes observed at the national airport level follow the overall traffic recovery in 2022 vs 2021. Airport IFR movements are concentrated within 13 reporting States accounting for a total of 80% of all movements.  
The average national number of IFR airport movements ranges around 350.000 while the top 4 States observed airport movement numbers of a factor of 4 - 6 more (1.400.000 – 2.000.000).

### Capacity performance

- The year 2022 is characterized by a resurgence of capacity constraints. On average, ATFM delay levels similar to the pre-pandemic peak years in 2018/2019 were observed.
- There is a strong imbalance of capacity/demand across the EUR region. About 62% of the observed ATFM delay is concentrated in 2 States, while the vast majority of States does not generate a significant number of ATFM delays. This imbalance and associated benefit pool may inform targeted prioritization of capacity enhancing measures.
- In 2022, ATFM delay at airports – similar to the en-route portion – were on the rise. In 2022, about 20 airports triggered 90% of the airport associated ATFM delay with 3 major airports contributing most. Average ATFM delay (respective delay per flight) for these airport remained constant in 2022, however, it broadly doubled for the other airports. Key drivers for the constraints at the airports was the stronger than expected recovery of traffic (associated passenger facilitation issues) and a stronger impact by weather related delays.



### Flight Efficiency and Fuel Burn Emissions

- Flight efficiency followed broadly the pattern of the previous years. While steadily increasing since 2020, the overall total achieved IFR distance observed across the EUR Region was still reduced as a function of the flights operated (i.e. lower km flown).

Given the dimensions of the EUR region and the different airspace volumes, just under 60% of the total achieved IFR distances is measured for flights within 6 States.

- These top 6 States are accountable for about 65% of all extra distances.

While the total extra IFR distance increased in comparison to 2020/2021 with increasing traffic, the overall pattern remained constant.

This shows that network inefficiencies are of systemic nature (route structure, procedure design)

- CO2 emissions reported are linked to traffic density and therefore “appear” to be concentrated in this subset of countries (servicing higher traffic numbers, larger airspace volume). These results need to be addressed from an operational efficiency perspective. However, they can serve to prioritise action.



## ATCO Productivity

- 6 States are accountable for more than 60% of all en-route ATCO hours on duty in the EUR Region. For those countries the total number of ATCO hours on duty changed marginally.  
A higher level of reduction was observed in the smaller States/airspace across the EUR region
- The data suggest that there is a variety of results in the ATCO productivity, a dozen of States perform better than the average while a dozen perform below the average. The overall spread needs to account for the varying traffic pattern serviced by the ATCO work force.

## Participation

- The participation of States and Stakeholders to the ICAO activities (e.g. workshops, meetings, reports) varies greatly. Similar to the previous years, in-person events or often combined or replaced by online interactions.



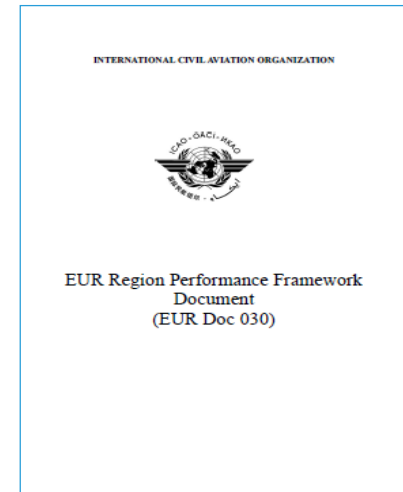
# Introduction



## ICAO EUR Region Performance Framework Document

ICAO EUR Doc 030 presents the performance Framework  
(available in English/Russian language)

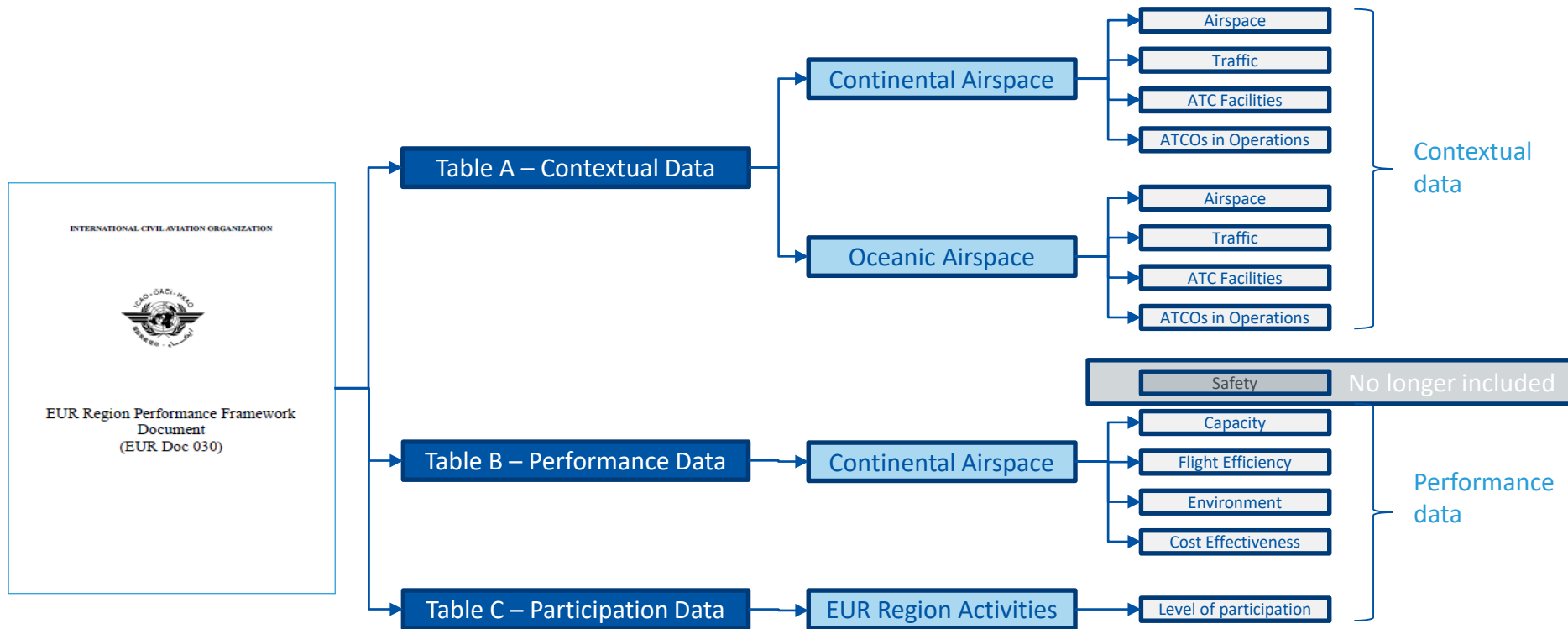
- Introduction
- Background
- Relationship with ICAO Global developments
- Relationship with the EU Performance Scheme
- Geographical scope
- Roles and responsibilities
- KPAs/KPIs/Metrics
- Monitoring and reporting at regional/national level
- Guidance material

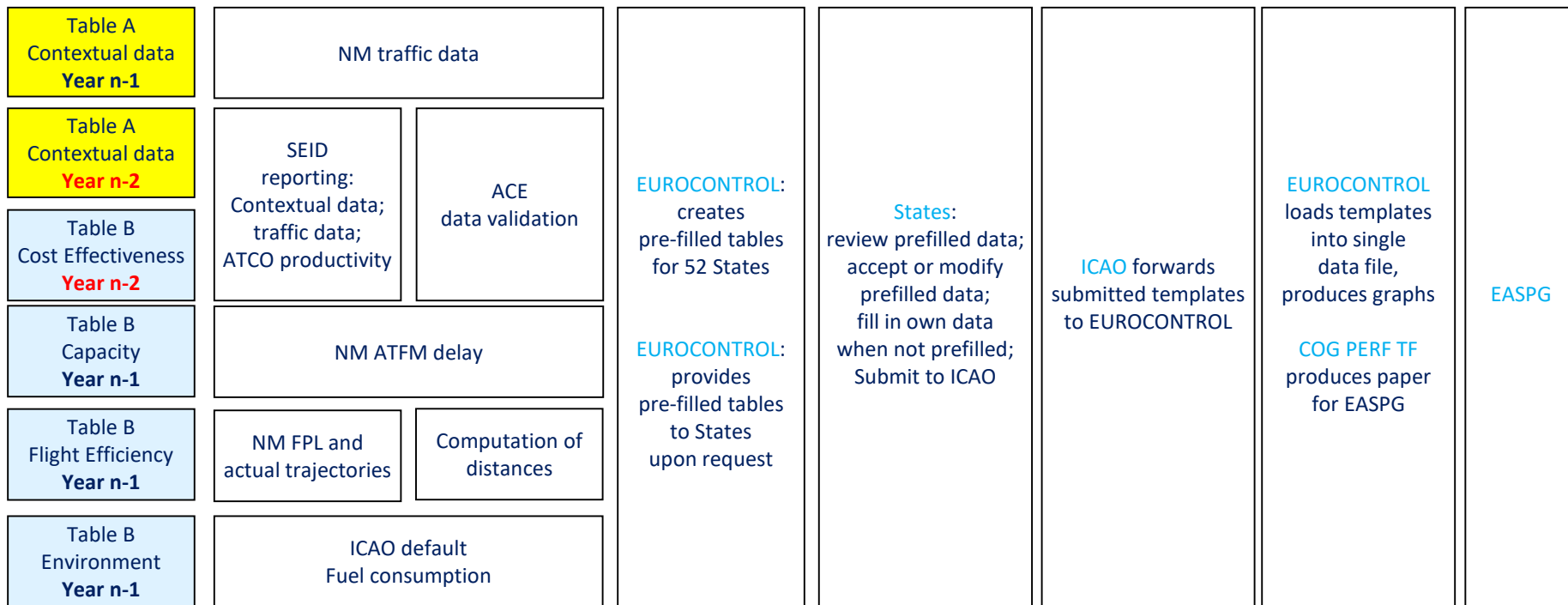


KPA	OBJECTIVES	FOCUS AREAS	INDICATORS
SAFETY	Ensure safety continuous improvement through reduction of ATM related safety occurrences and implementation of uniform safety standards		Effectiveness of Safety Management (Safety Maturity Questionnaire)
			Level of State Safety Culture (Safety Culture Questionnaire)
			Adoption of harmonized occurrences severity classification methodology
CAPACITY	Capacity meets demand for en-route and at airports	En-route ATFM Delay	Average en-route ATFM delay generated by airspace volume
		Airport ATFM Delay	Average ATFM delay per flight in the main airports (to be identified by States)
EFFICIENCY	Ensure users may use most efficient routes	Horizontal Flight Efficiency	Average horizontal en route flight efficiency (length of the en route part of the actual trajectory/last flight planned route vs great circle)
ENVIRONMENT	Contribute to the protection of environment (fuel/CO2 emissions reduction)		CO2 emissions related to inefficiencies in route extension
COST EFFECTIVENESS	Contribute to optimization of costs for ANS	ATCO Productivity	IFR Flights (en-route) per ATCO hour duty
			IFR flight hours per ATCO hour on duty
			IFR movements per ATCO hour on duty
PARTICIPATION BY ATM COMMUNITY	Ensure States' participation to Regional planning and implementation activities		Level of participation to meetings
			Level of responses to planning activities
			Level of provision of performance results

No longer Doc 030  
Regional Safety reporting









ICAO EUR/NAT Office accreditation (56 States)

ICAO EUR Region (55 States)

ECAC (44) – Iceland (1) = 43 States

EUROCONTROL (41 States)

SES Performance Scheme RP3 (30 States)

EU (27 States)

MUAC	Austria	Italy	Norway	Albania	Azerbaijan	Algeria	Iceland
	Belgium	Latvia	Switzerland	Armenia	San Marino	Andorra	
	Bulgaria	Lithuania		Bosnia and Herzegovina		Belarus	
	Croatia	Luxembourg		Georgia		Israel	
	Cyprus	Malta		North Macedonia		Kazakhstan	
	Czech Republic	Netherlands		Republic of Moldova		Kyrgyzstan	
	Denmark	Poland		Monaco		Morocco	
	Estonia	Portugal		Montenegro		Russian Federation	
	Finland	Romania		Serbia		Tajikistan	
	France	Slovakia		Turkey		Tunisia	
	Germany	Slovenia		Ukraine		Turkmenistan	
	Greece	Spain		United Kingdom		Uzbekistan	
	Hungary	Sweden					
	Ireland						

ECAA Member

Pre-filled template available,  
No support requested

Support requested,  
Pre-filled template provided



ACE data available



Template submitted





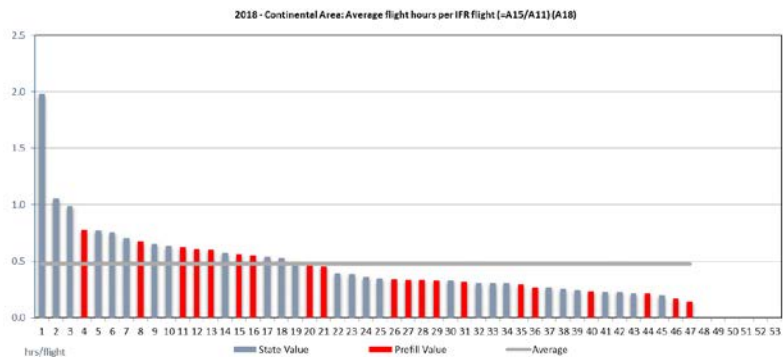
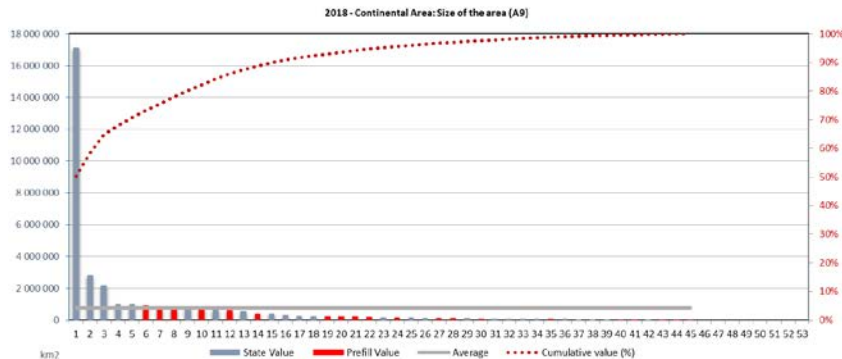
- Participation varied over the past years
  - organisational changes during pandemic with ripple effects on staffing levels / priorities in post-pandemic setup
  - SES process for EU Member States
- 2023 participation: 29 submissions
- States actively benefitting from support through prefilling (e.g. reduction of replication, consistency, quicker turnaround) → «thank you»
- Potential to increase participation through targeting non-reporting States

# Processing and presentation of results

- Data is collected in one Excel reporting template per State
- Data of individual States is collated into a single data set
  - Basis for graphical representation of results
    - Combination of prefilled and submitted data
      - Grey bars: data as submitted by the State
      - Red bars: prefilled data where available, for States which did not submit a template
      - In some cases the number of States in the graphs is smaller than the number of pre-filled + submitted templates. Reason: for some States the template is only partially filled.
  - Results are anonymised
    - But each State can see where it stands in comparison to all States in the Region
      - Each State knows its own values and can therefore position itself in the graphs

# Explanation of graphs

- **Title**
  - Identifies the data: year, scope (geographical and/or KPA), name of the data item, identifier code in the template
- **X-axis**
  - The list of anonymised States for the State- and ANSP-based data items (MUAC included as an ANSP), and the list of anonymised airports for the airport-based data items ( $\pm 180$  airports). Note that the labels are ranking numbers, not State/airport identifiers: in principle the mapping between numbers and States/airports is different for each graph.
- **Left y-axis**
  - The value of the data item, with the measurement units in the bottom left corner (blank means it is simply a count).
- **Grey line**
  - The average value (arithmetic mean), based on the number of States/ANSPs for which results are available for this data item (the length of the line indicates for how many States/ANSPs data is available). This value is a proxy for the regional average: it will change as data for more States/ANSPs is available.
- **A series of grey and/or red bars**
  - The profile of individual State/ANSP/airport values in descending order. This provides a good picture of the differences within the region. The bars do not show the difference between a reported value of zero and the value not being reported, but this can be deduced from the brown line (absence of a bar below the grey line means value zero or a value too small to be visible in the graph).
- **A red dotted line**
  - For data items which are aggregatable over States/ANSPs/airports: the cumulative profile of the blue bars in percent (see right-hand axis).



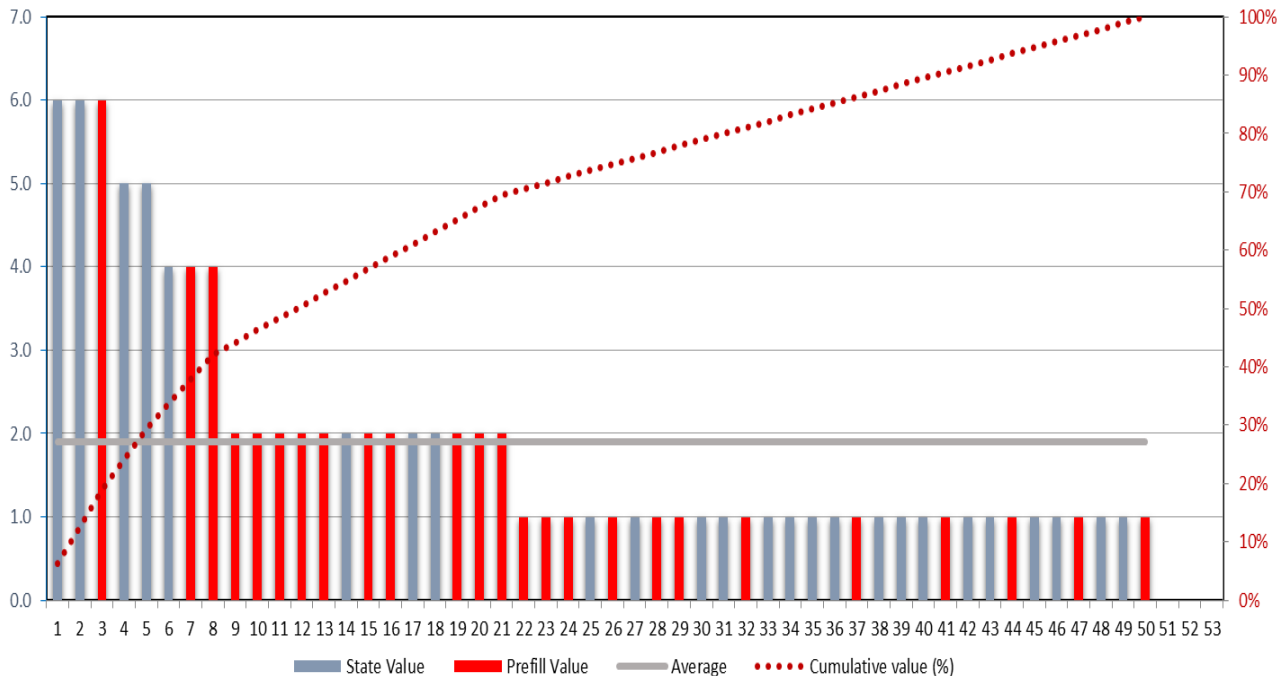
## Contextual data (Table A)



Continental Area		
	Airspace	
A8	Number of FIRs	Number
A9	Size of the area	km <sup>2</sup>
A10	Radar Surveillance Coverage at FL 290	km <sup>2</sup>
	Traffic	
A11	Total number of IFR flights controlled (=A12+A13+A14)	Flights/year
A12	Number of domestic IFR flights controlled	Flights/year
A13	Number of international IFR flights controlled	Flights/year
A14	Number of IFR overflights controlled	Flights/year
A11b	Total number of IFR flights controlled (use only if A12+A13+A14 not available)	Flights/year
A15	Number of IFR flight-hours controlled	hrs/year
A16	Number of IFR airport movements controlled (departures+arrivals)	Mov/year
A17	Number of VFR airport movements controlled (departures+arrivals)	Mov/year
A18	Average flight hours per IFR flight (=A15/A11)	hrs/flight
A19	Average IFR traffic density (=A15/A9)	hrs/km <sup>2</sup> /year
	ATC facilities	
A20	Number of ACCs	Number
A21	Number of co-located ACC/Approach Facilities	Number
A22	Number of Approach Control Facilities	Number
A23	Number of co-located Tower/Approach Facilities	Number
A24	Number of stand-alone Towers	Number
A25	Number of co-located ACC/Tower/Approach Facilities	Number
	ATCOs in operations	
A26	Number of ATCOs in operations at ACCs	FTE
A27	Number of ATCOs in operations at Terminal Facilities (APP+TWRs)	FTE

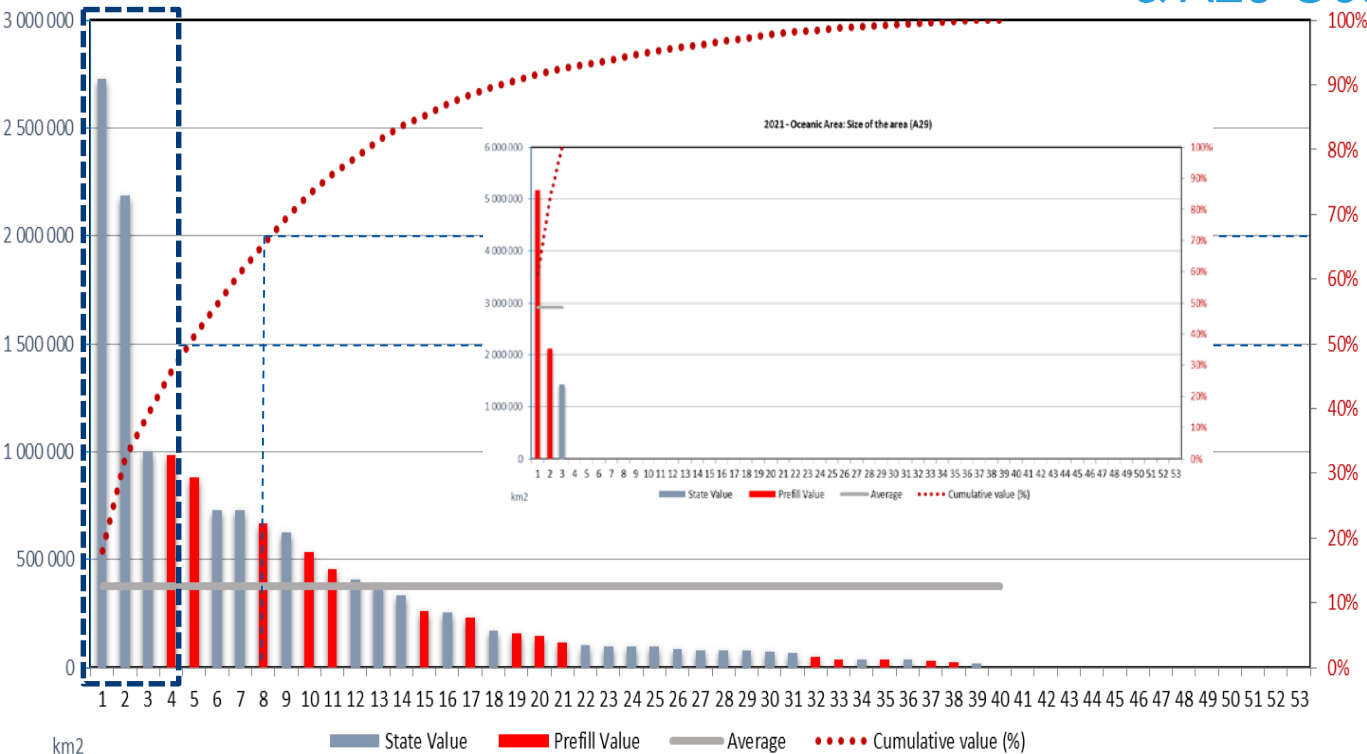
Oceanic Area (for States having an Oceanic Area)		
	Airspace	
A28	Number of FIRs	Number
A29	Size of the area	km <sup>2</sup>
A30	Radar Surveillance Coverage at FL 290	km <sup>2</sup>
	Traffic	
A31	Number of IFR flights controlled (=A32+A33+A34)	Flights/year
A32	Number of domestic IFR flights controlled	Flights/year
A33	Number of international IFR flights controlled	Flights/year
A34	Number of IFR overflights controlled	Flights/year
A31b	Number of IFR flights controlled (use only if A32+A33+A34 not available)	Flights/year
A35	Number of IFR flight-hours controlled	hrs/year
A36	Average flight hours per IFR flight (=A35/A31)	hrs/flight
A37	Average IFR traffic density (=A35/A29)	hrs/km <sup>2</sup> /year
	ATC facilities	
A38	Number of OACs	Number
	ATCOs in operations	
A39	Number of ATCOs in operations at OACs	FTE

2022 - Continental Area: Number of FIRs (A8)



- Continental airspace in the EUR region varies widely, including the organisation of service provision in terms of FIRs.
- Smaller States / airspaces organise their air navigation service regions as a single FIR while larger nations (and associated airspace) is structured in a multitude of FIRs.
- 8 reporting states have 4 or more FIRs accounting for more than 40% of all FIRs.
- 13 states organise their service provision into 2 FIRs, while the majority of states (size-dependent) operate 1 FIR

# Data items A9 Continental Airspace Size & A29 Oceanic Area Size



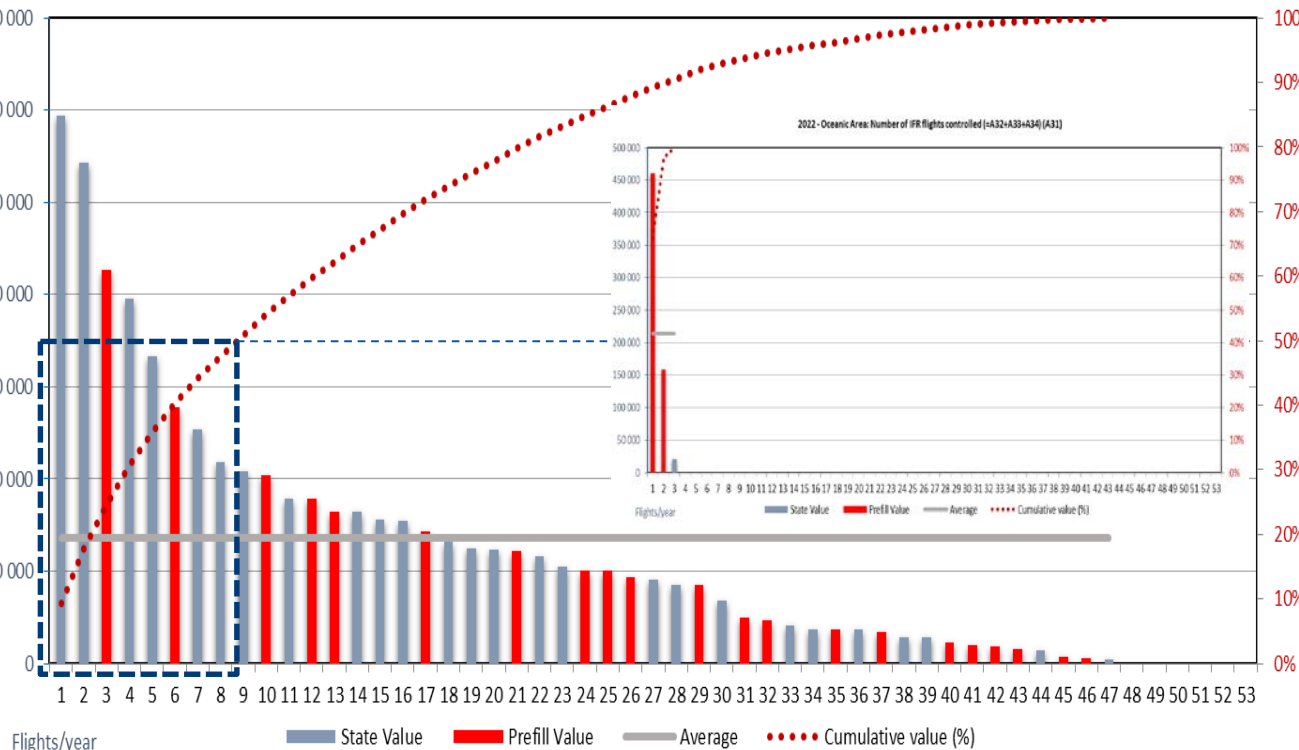
- The EUR region is characterised by a wide variety in the size of the continental airspace. Oceanic airspace and service provision is largely concentrated in a small number of States.
- The top 4 States included in the report cover just under 50% of the continental airspace. Two third of the continental airspace is served by a total of 8 States.
- With 50% of the States, 95% of the continental airspace is covered. Oceanic traffic is served by 3 States.



# Data items A11 Total Number of IFR flights

## & A31 Oceanic IFR flights controlled

2022 - Continental Area: Total number of IFR flights controlled (=A12+A13+A14+A11)

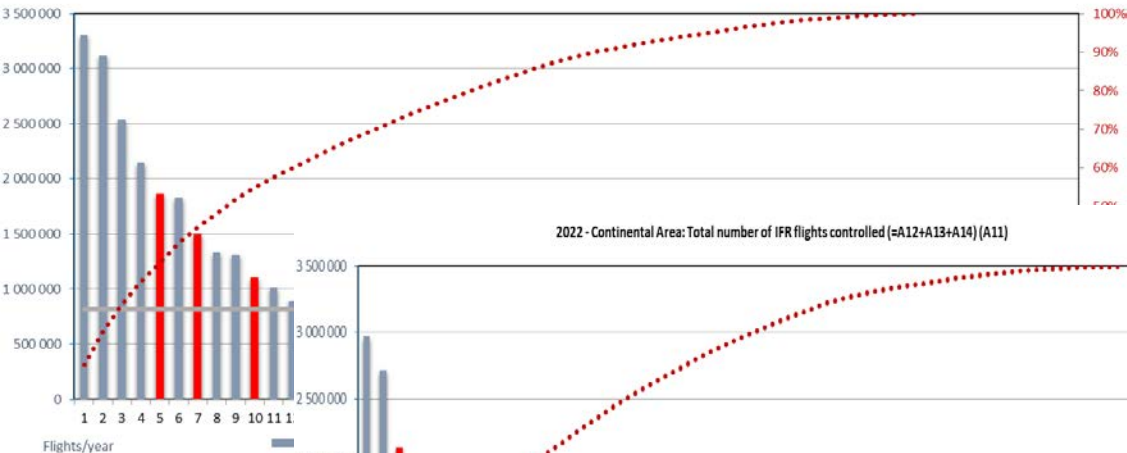


- Post-pandemic, traffic in 2022 continued to increase. While across the European region traffic recovered continuously, national traffic levels vary in terms of recovery and connectivity.
- About 50% of the total IFR flight hours are accrued by 8 States.
- Similar to the overall traffic share across the region, the share of the recovery is heavily dependent on the size of the continental airspace serviced by the State.
- On average, the total annual traffic (controlled IFR flights varied between 50-85% of pre-pandemic levels. Oceanic traffic (primarily long-range) international traffic continuously increased in 2022.

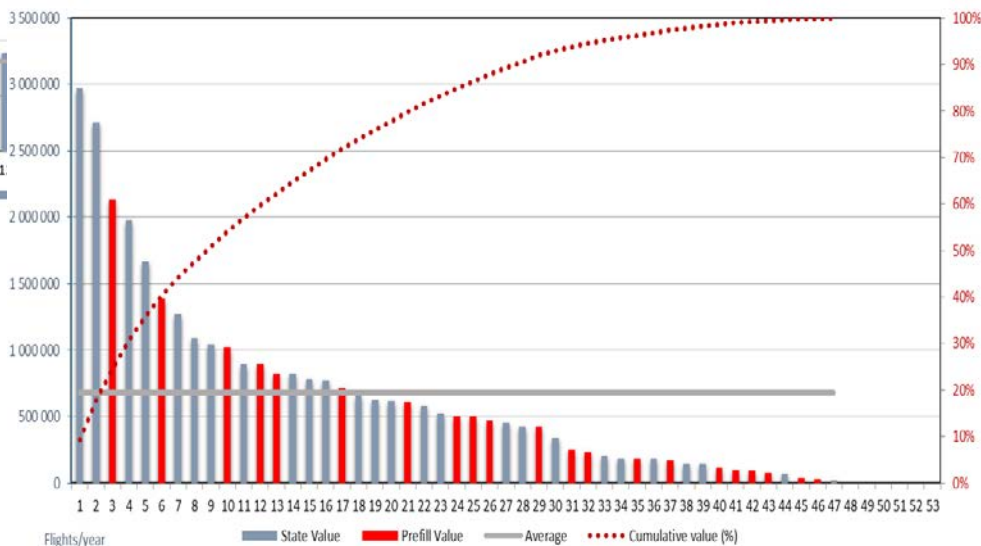




2019 - Continental Area: Total number of IFR flights controlled (=A12+A13+A14) (A11)

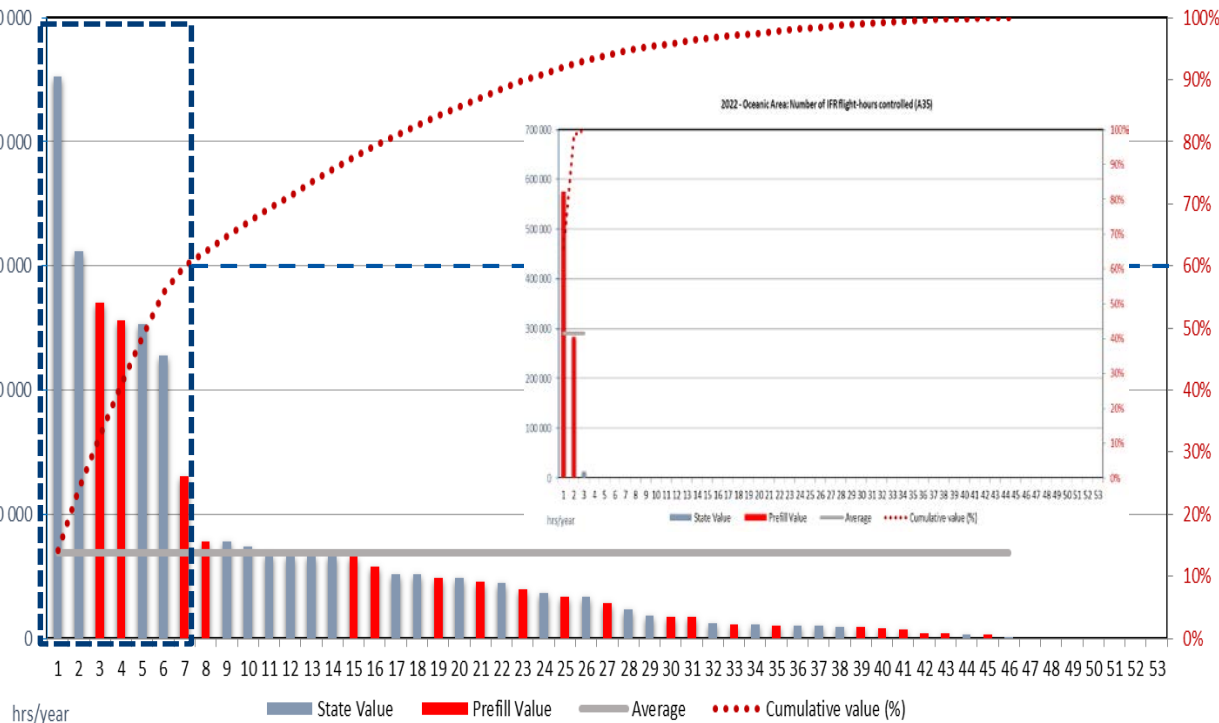


2022 - Continental Area: Total number of IFR flights controlled (=A12+A13+A14) (A11)



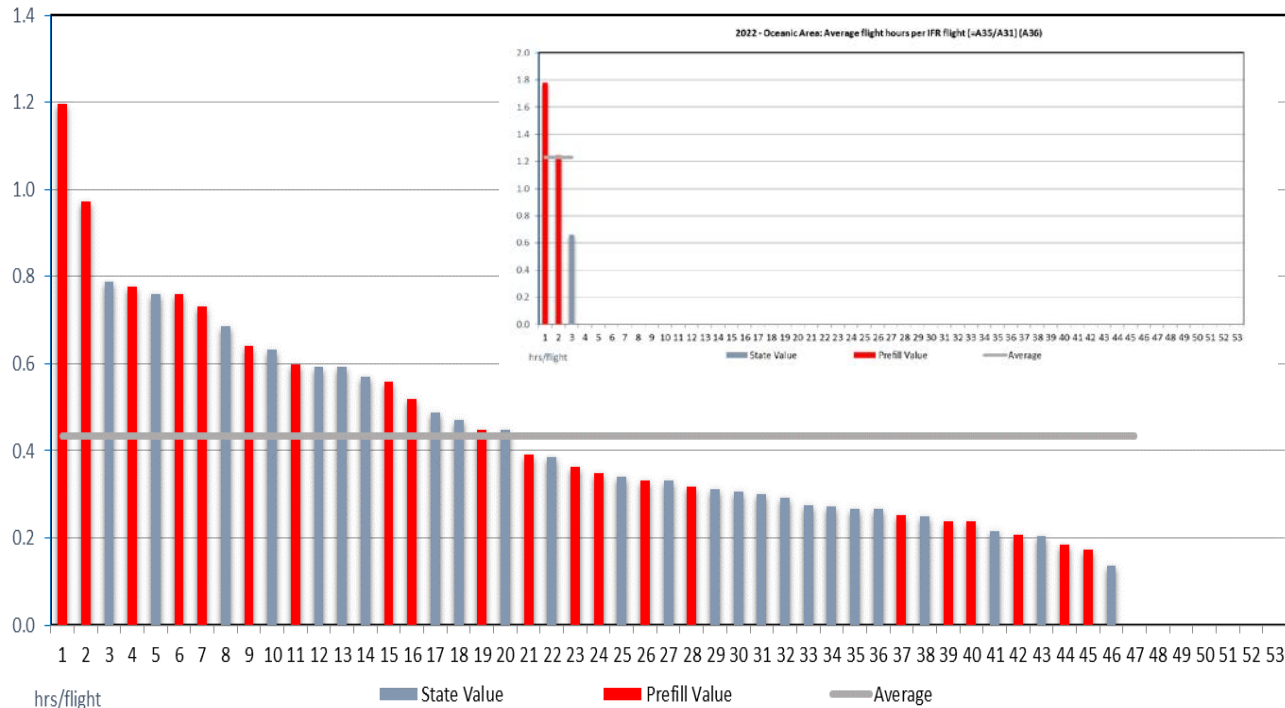
- Comparing traffic levels in 2019 vs 2022, a continual recovery across the European region can be observed.
- While in 2019 traffic ranged from just under 3.4 million flights to under 100,000 flights; the level per State increased following the pandemic decline in 2021 and 2022.
- Total annual traffic ranged on average 55-85% across the region.

2022 - Continental Area: Number of IFR flight-hours controlled (A15)



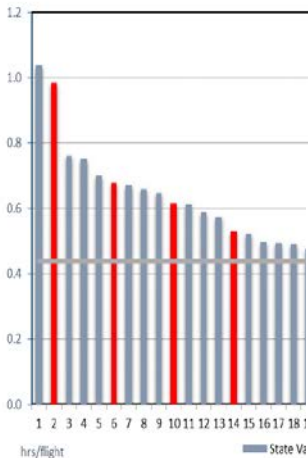
- About 60% of the IFR flight hours within the continental airspace in 2022 is serviced by 7 participating States.
- The overall average of serviced flight hours increased across the region to about 350k flight hours. The majority of States serviced at or below this threshold in 2022.
- IFR hours are associated with the overall IFR traffic accounted by the States and the associated airspace (FIR) size
- The oceanic traffic is served by 3 States and primarily handled by 2 of the participating States. In comparison to 2021 oceanic traffic doubled showing the steady post-pandemic recovery of international air traffic.

2022 - Continental Area: Average flight hours per IFR flight (=A15/A11) (A18)

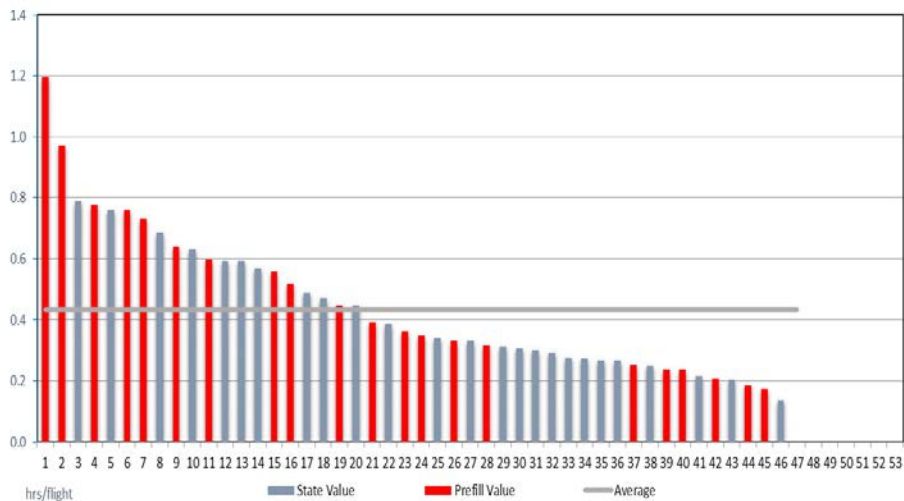


- The average flight hours per IFR flight decreased for the top reporting State in 2022 (signalling a slight modification of the overall traffic pattern of the post-pandemic traffic).
- For the other States, the average flight hours per IFR flight is broadly consistent with the previous year. This evidences that traffic patterns / recovery adhere to pre-pandemic connectivity.
- The average flight hour per IFR flight remained constant in comparison to the previous reporting years and ranges now at just under 0.45 min per flight.
- About half of the participating States range below the average value. This is strongly correlated with the size of the national airspace volume.
- Oceanic traffic pattern show a constant flight duration in comparison to the previous years

2019 - Continental Area: Average flight hours per IFR flight (=A15/A11) (A18)

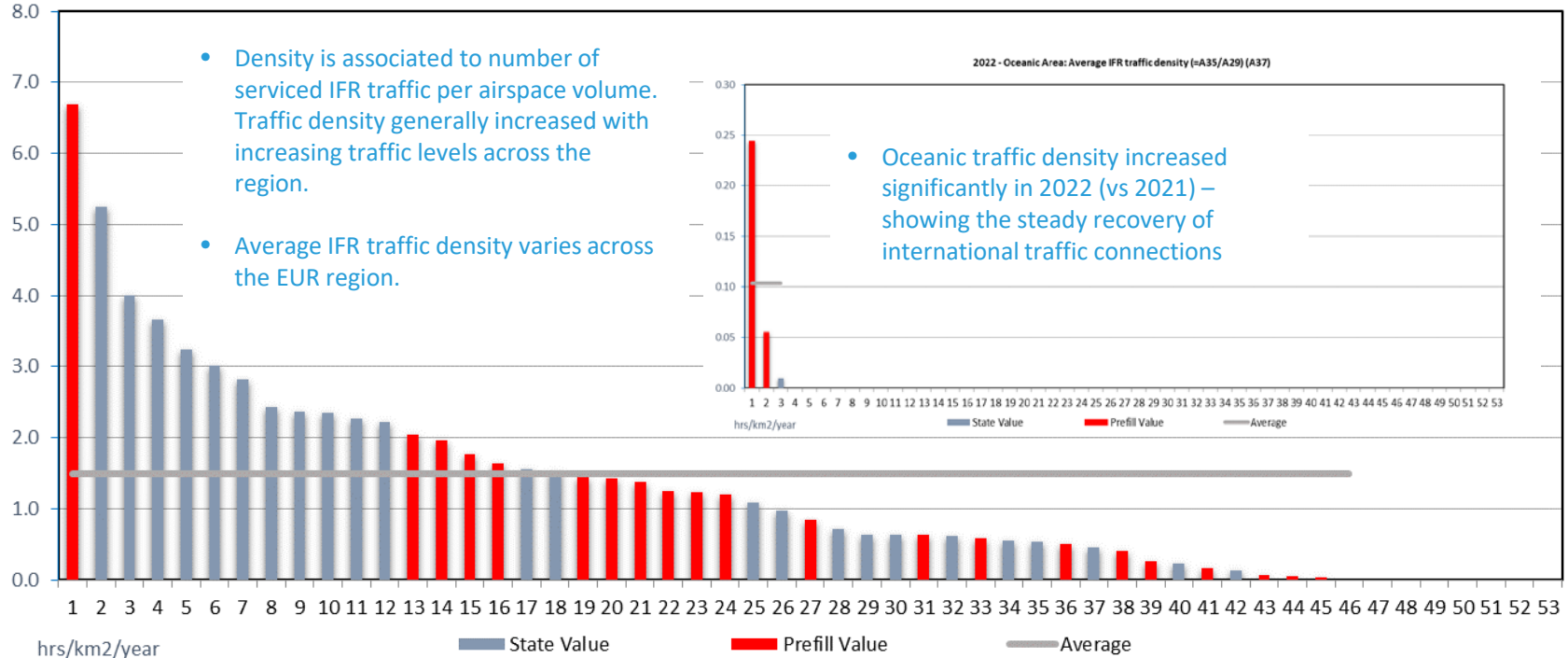


2022 - Continental Area: Average flight hours per IFR flight (=A15/A11) (A18)

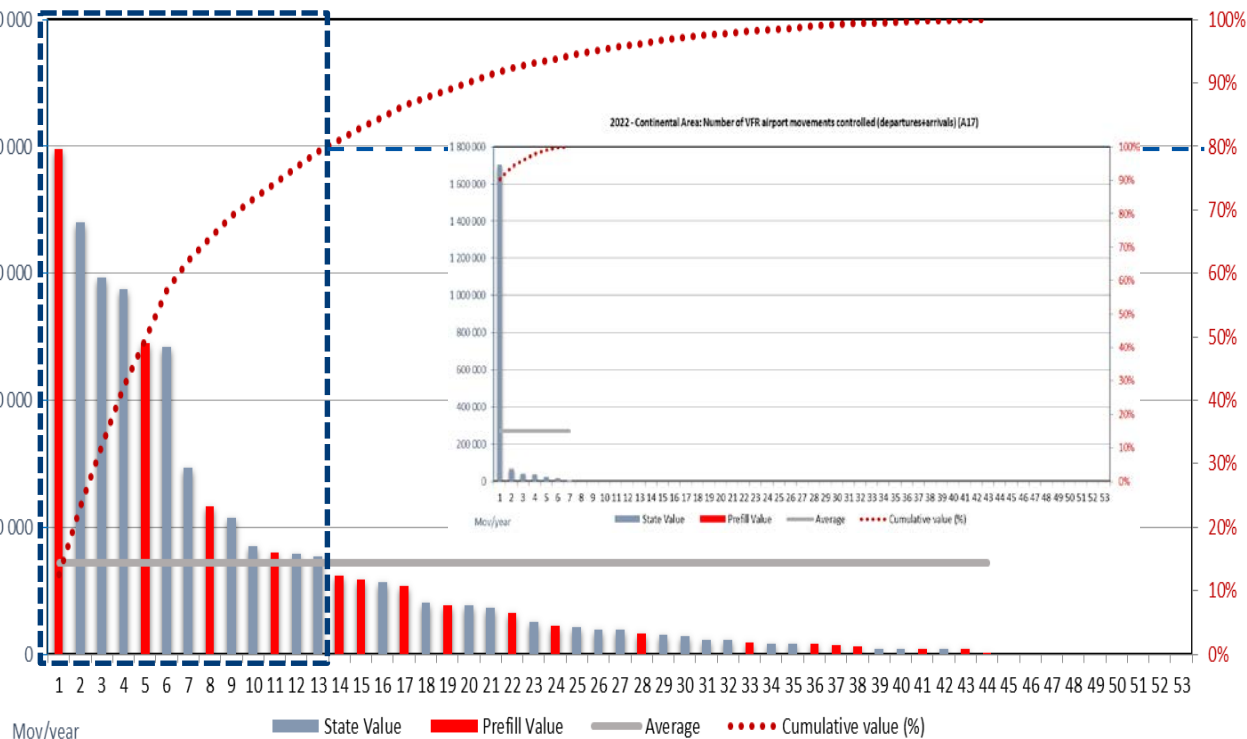


- Comparing average flight hours per IFR flight in 2019 vs 2022 – and excluding the top 2 States in both years – average flight hours are consistent with the pre-pandemic years.
- On average the average flight hour per IFR flight ranges just under 0.45 min/flight – similar to 2019.
- On a per country basis, the observed average flight hour per flight, however, ranges in the same order of magnitude. This suggests that scale-related efficiencies took place (due the number of lower air traffic) while operating a similar network.

2022 - Continental Area: Average IFR traffic density (=A15/A9) (A19)



2022 - Continental Area: Number of IFR airport movements controlled (departures+arrivals) (A16)



- Traffic changes observed at the national airport level follow the overall traffic recovery in 2022 vs 2021.
- It is recognised that traffic levels may vary widely locally and depends on various factors.
- Airport IFR movements are concentrated within 13 reporting States accounting for a total of 80% of all movements. The average national number of IFR airport movements ranges around 350.000 while the top 4 States observed airport movement numbers of a factor of 4 - 6 more (1.400.000 – 2.000.000).
- VFR movements were concentrated within a small number of States within the European region.

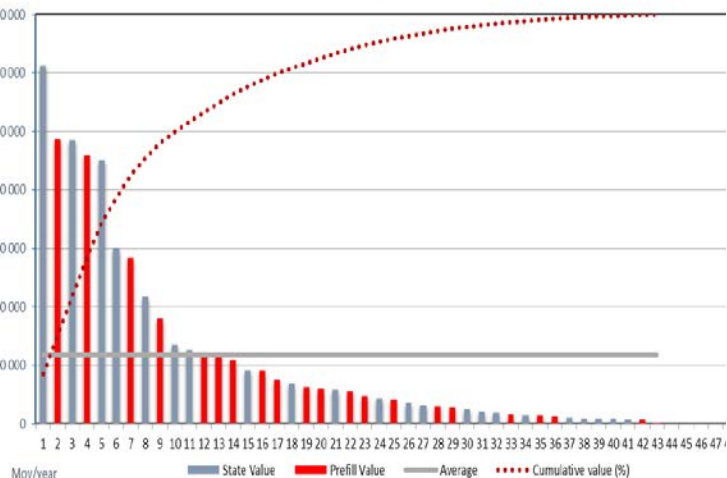


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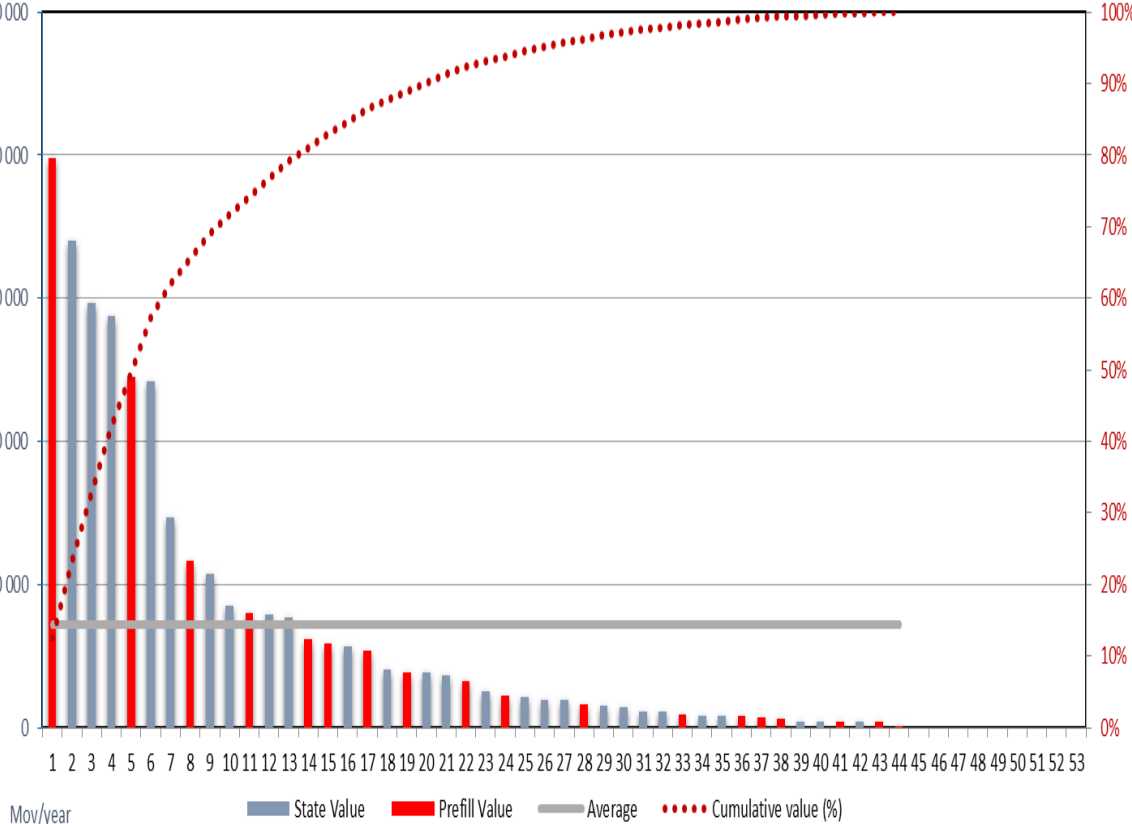
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- Consistent with the steady recovery in air traffic, the number of airport movements per participating State

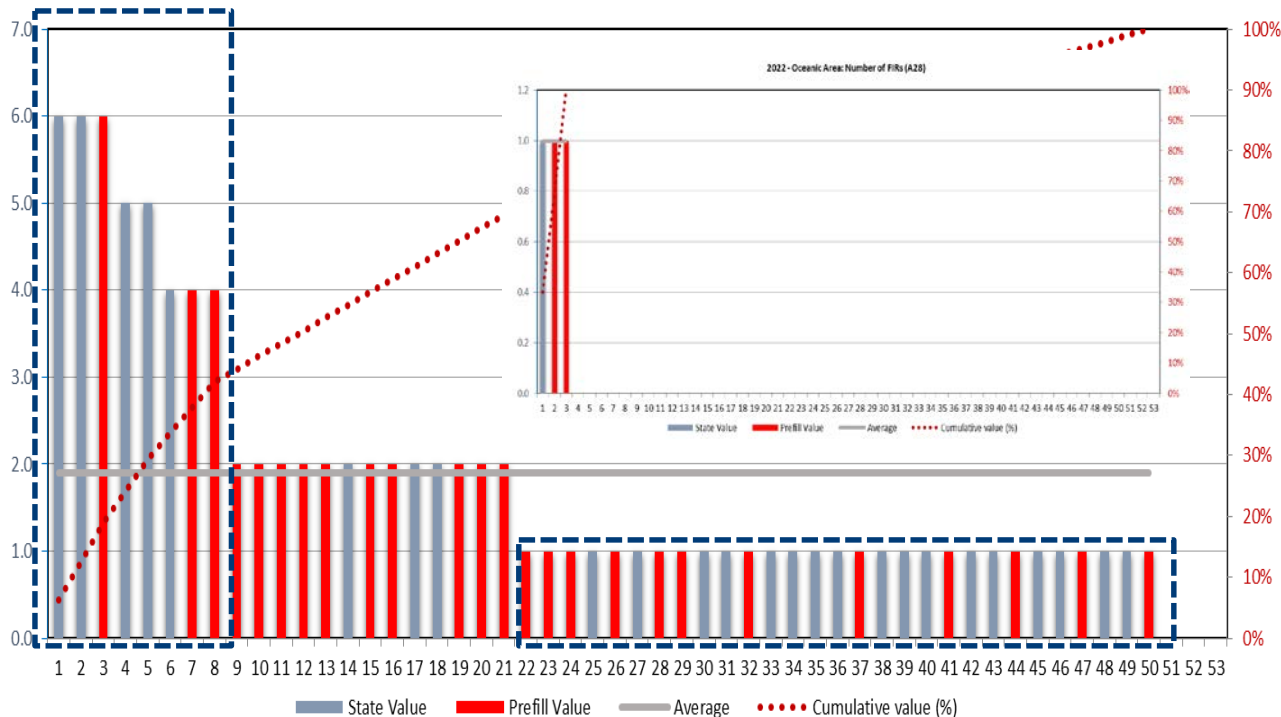
2021 - Continental Area: Number of IFR airport movements controlled (departures+arrivals) (A16)



2022 - Continental Area: Number of IFR airport movements controlled (departures+arrivals) (A16)



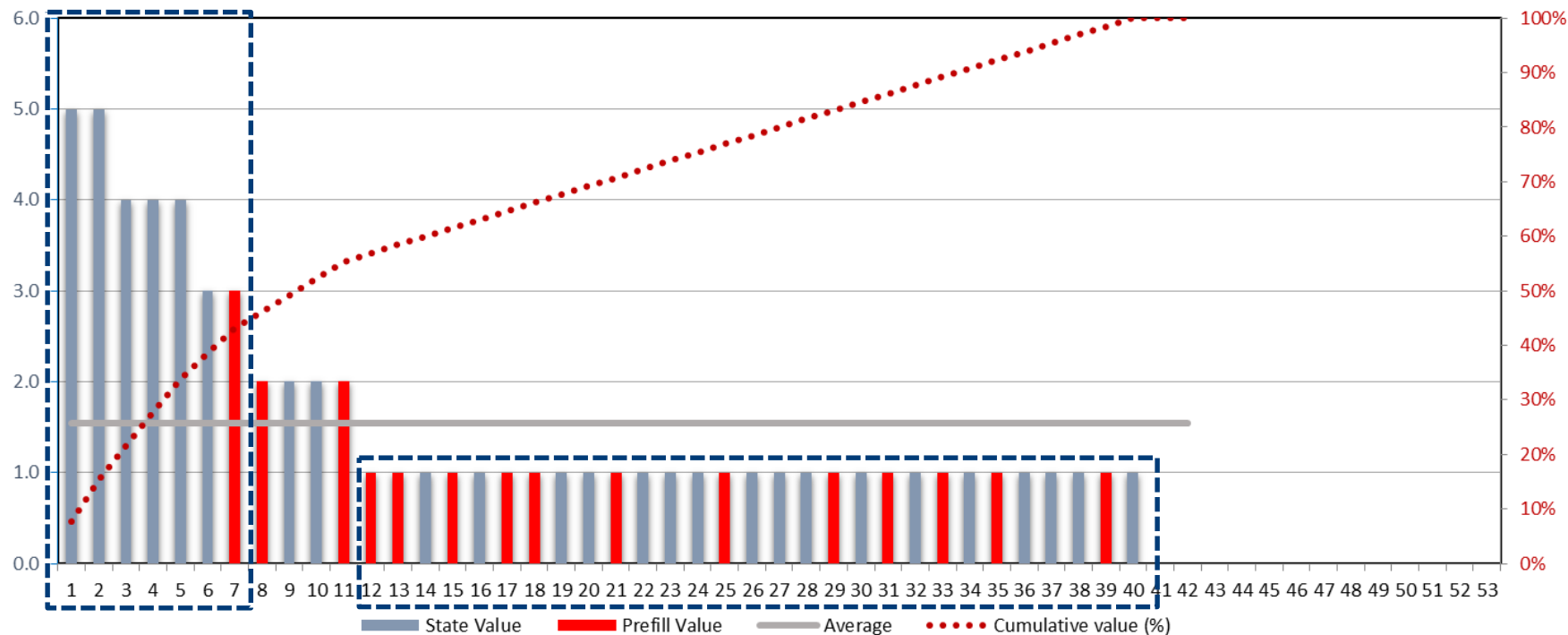
2022 - Continental Area: Number of FIRs (A8)



- More than half of the States have a single continental FIR. A smaller number has 2 (often a division between upper and lower), while 8 reporting States have 4 or more FIRs.
- The number of FIRs is associated with volume of airspace and number of control unit.
- Oceanic traffic is serviced by 3 participating States. The service provision is typically organised within a single oceanic region (FIR).

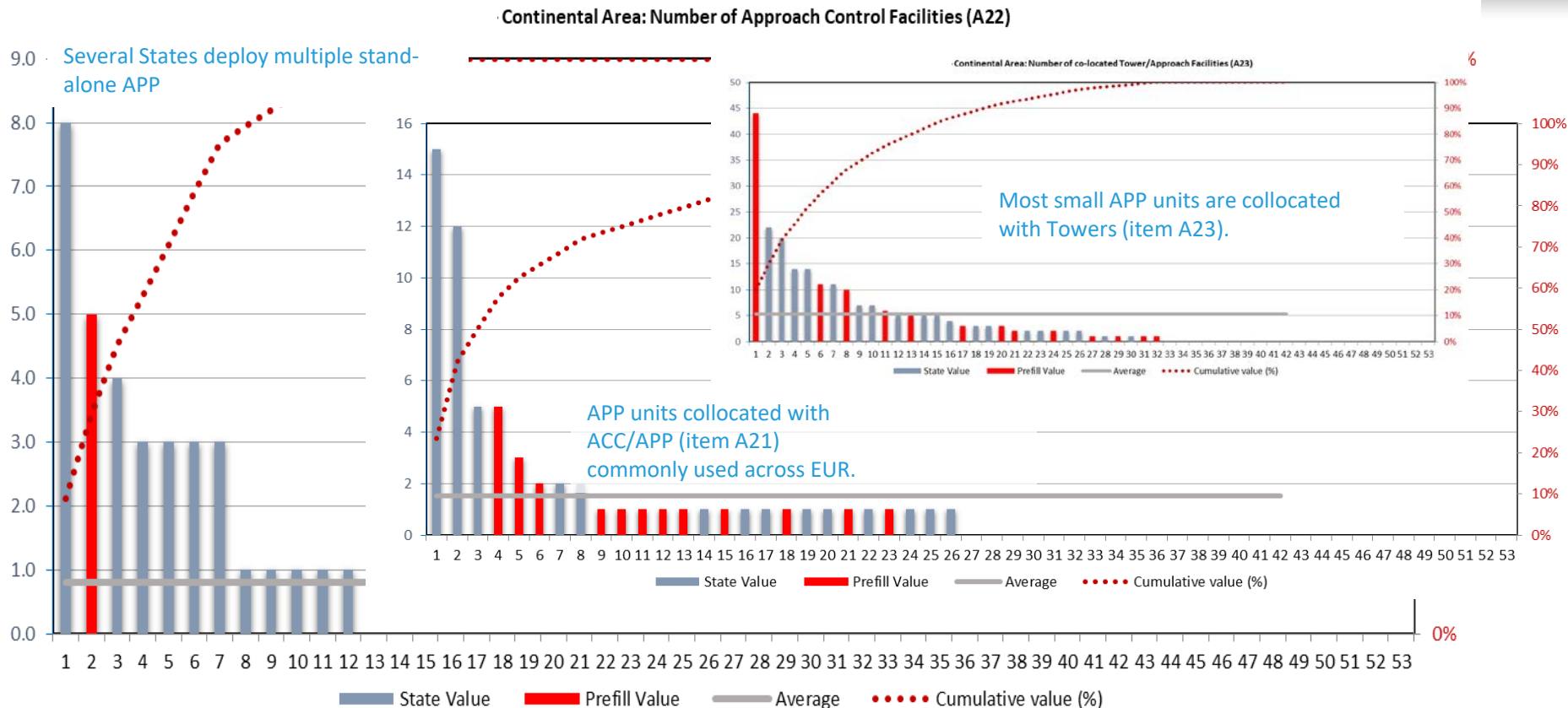


2021 - Continental Area: Number of ACCs (A20)

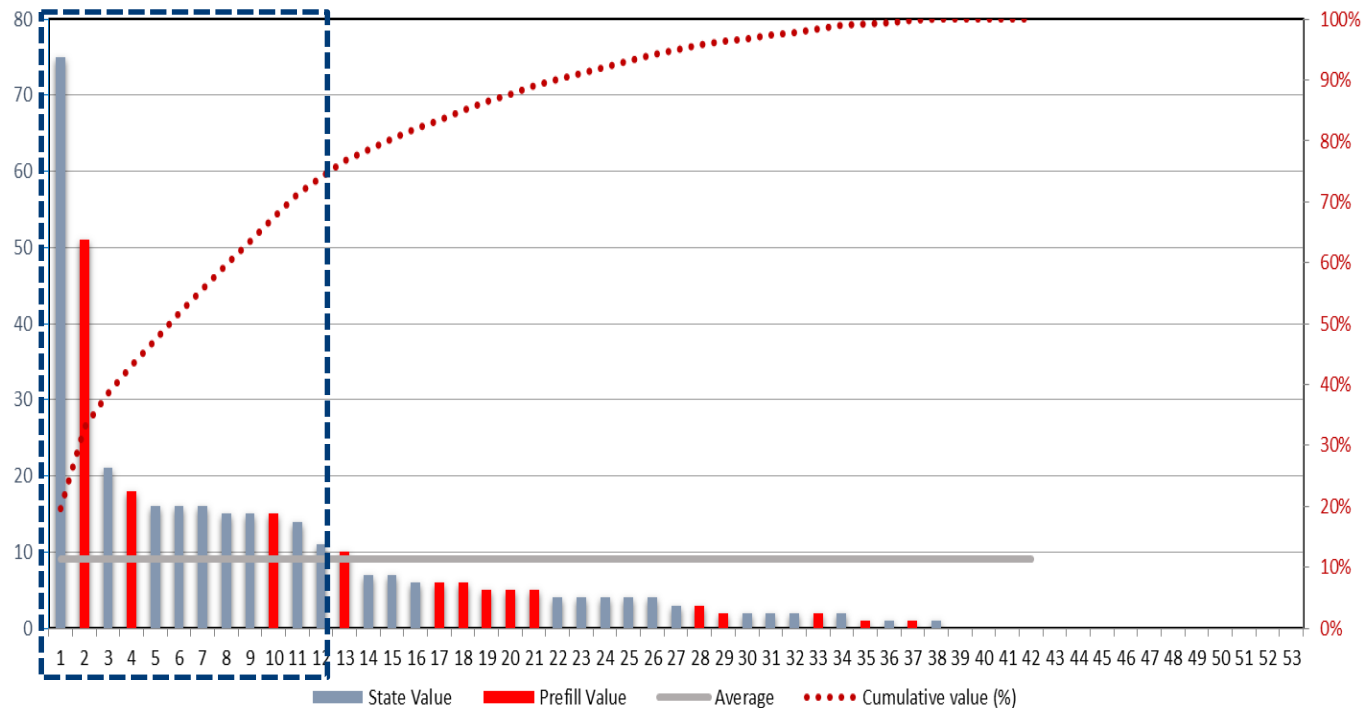


The majority of States service air traffic from single ACCs.

4 reporting States have established 2 ACCs, while 7 reporting States have 3 or more ACCs. The distribution is associated to the number of FIRs.

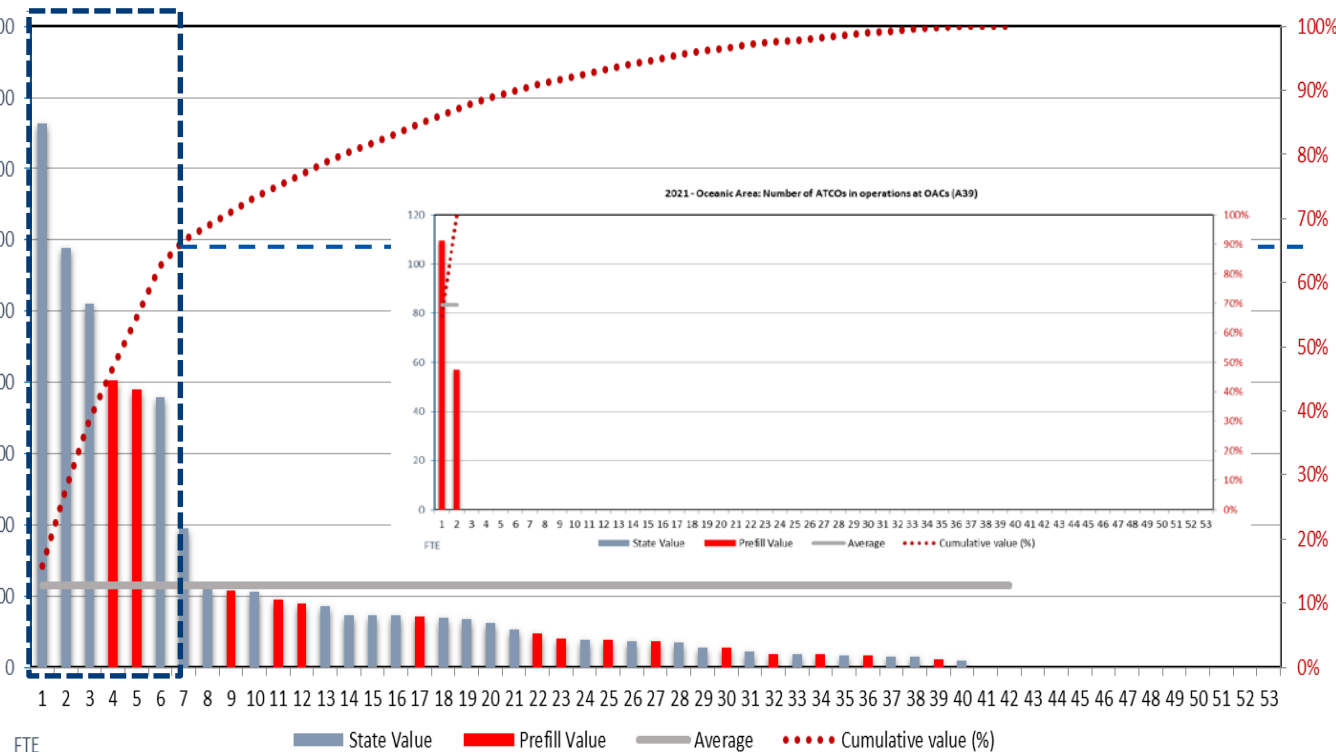


2021 - Continental Area: Number of stand-alone Towers (A24)



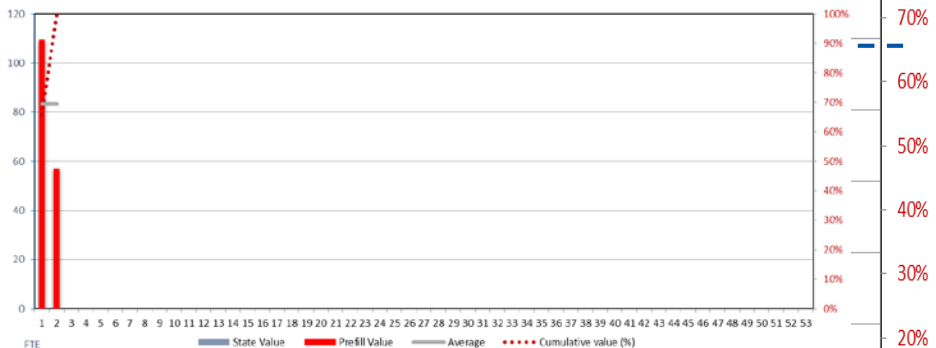
- The top-11 States account for about 75% of all Towers in the EUR Region.
- The remaining States operate 10 or less towers (aerodrome control services).
- The average number of stand-alone towers per State is 9.

2021 - Continental Area: Number of ATCOs in operations at ACCs (A26)

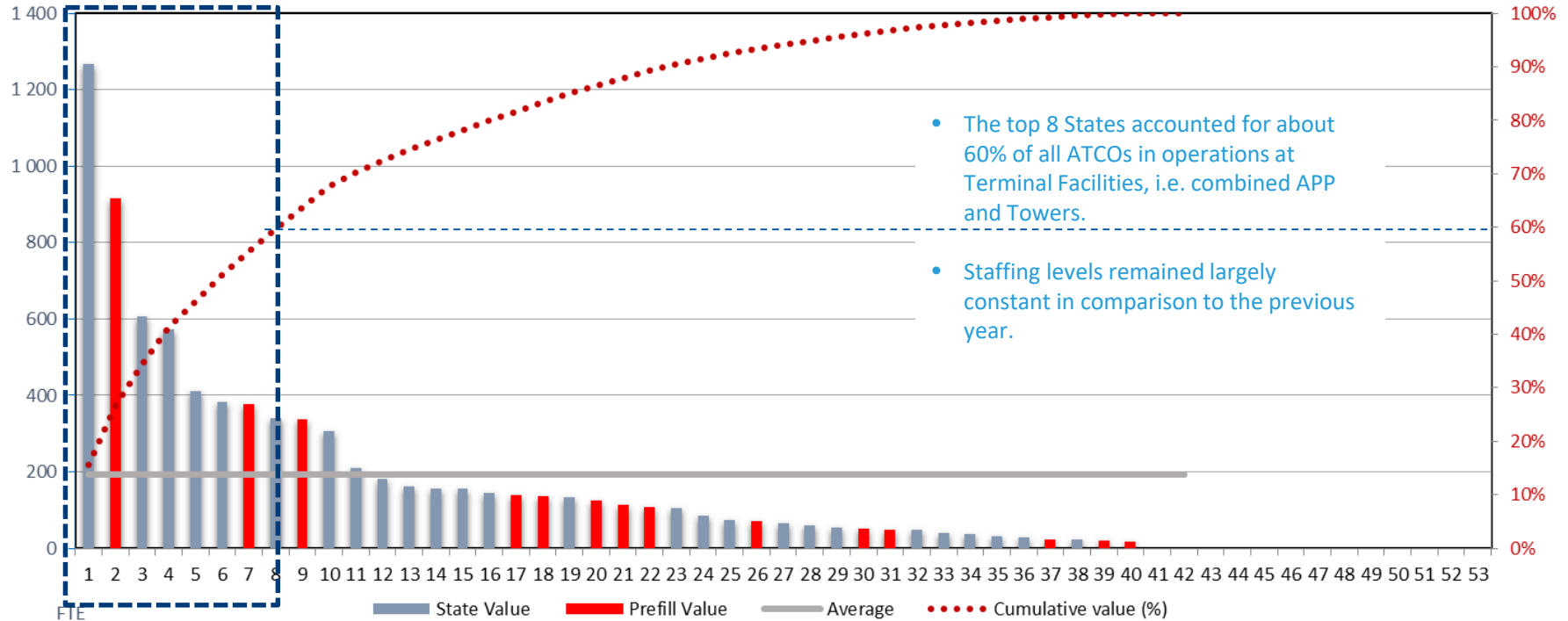


- Staffing levels reduced slightly in comparison to the previous year.
- Two-third of all ATCOs in operations at ACCs are deployed in 7 reporting States.
- There is only a small subset of States operating oceanic traffic with associated staffing levels.

2021 - Oceanic Area: Number of ATCOs in operations at OACs (A39)



2021 - Continental Area: Number of ATCOs in operations at Terminal Facilities (APP+TWRs) (A27)



## Performance data (Table B)



KPA	Capacity
Objective	Ensure that Air Navigation Service capacity meets demand in en-route airspace and at airports
Indicators	<ul style="list-style-type: none"><li>- Average ATFM delay per flight generated by the airspace volume (en-route)</li><li>- Average ATFM delay per flight in the main airports (to be identified by States in advance and based on the regional relevance)</li></ul>

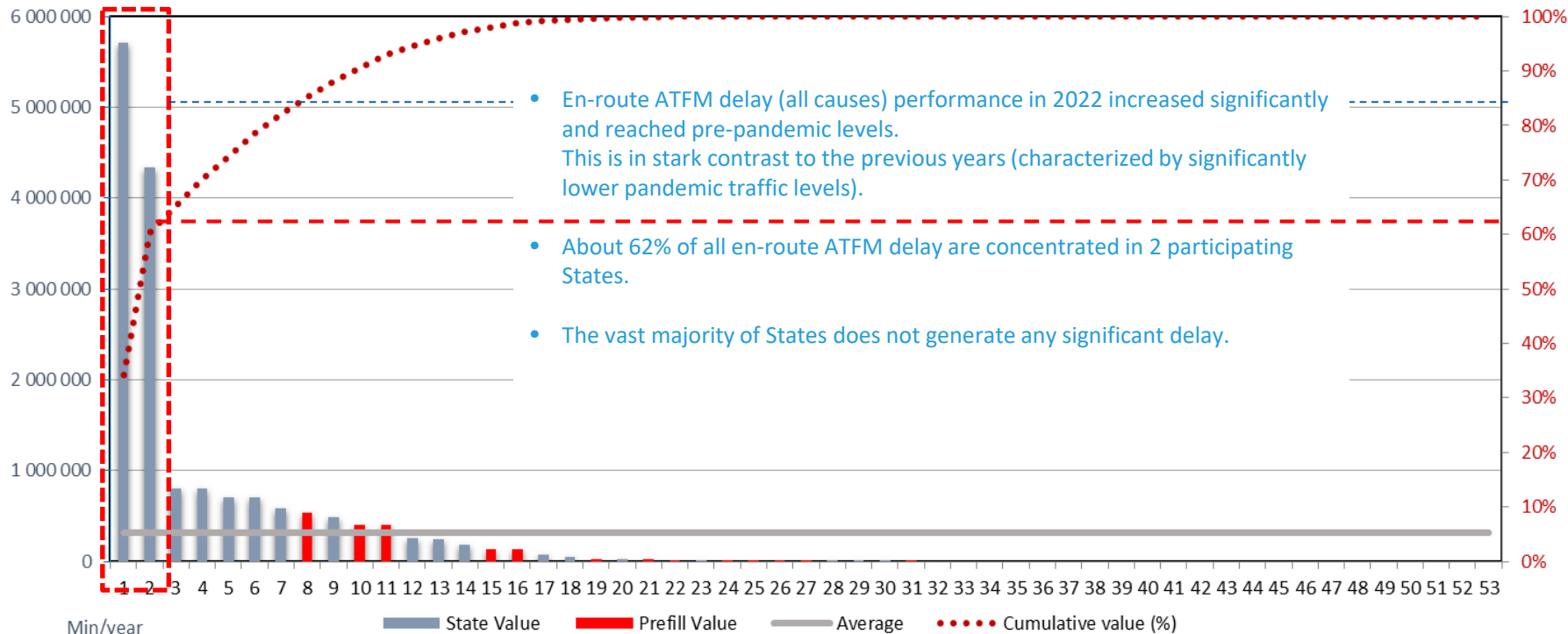
# Please note

- Indicators measure
  - The location where the problem (capacity bottleneck) is, not where the delay is taken (departure airport)
  - Performance of airspace volumes and airports, not flights
    - Despite the expression as a value “per flight”
  - Within the Capacity KPA
    - Demand/capacity imbalance
    - Not capacity itself
- Limitations
  - Not designed to measure excess capacity
  - No data if airspace or airport does not participate in a centralised ATFM process

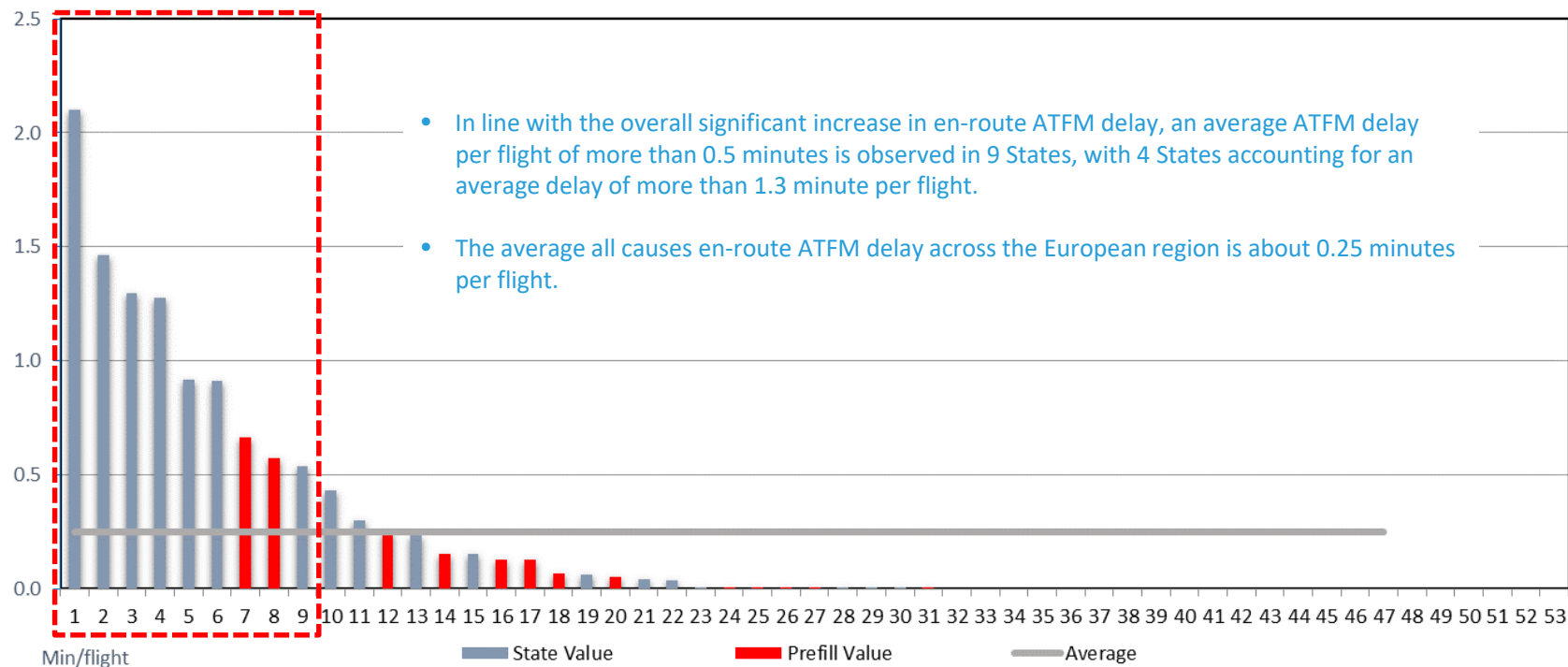


Capacity		
En-route ATFM delays (continental airspace)		
B35	Total en-route ATFM delay generated in the State (all causes) (=B37+B38+B39+B40)	Min/year
B36	Average ATFM delay per flight (=B35/A11)	Min/flight
B37	En-route ATFM delay generated in the State (ATC capacity causes)	Min/year
B38	En-route ATFM delay generated in the State (ATC other causes)	Min/year
B39	En-route ATFM delay generated in the State (Weather causes)	Min/year
B40	En-route ATFM delay generated in the State (All other causes)	Min/year
B35b	En-route ATFM delay generated in the State (Cause unknown, use only if B37, B38, B39 & B40 not available)	Min/year
Airport ATFM delays		
	Airport identifier	ICAO code
B41	Total number of IFR arrivals at the airport	Arrivals/year
B42	Total airport ATFM delay generated by the airport (all causes) (=B44+B45+B46+B47)	Min/year
B43	Average ATFM delay per arrival (=B42/B41)	Min/arrival
B44	Airport ATFM delay generated by the airport (ATC & aerodrome capacity causes)	Min/year
B45	Airport ATFM delay generated by the airport (ATC other causes)	Min/year
B46	Airport ATFM delay generated by the airport (Weather causes)	Min/year
B47	Airport ATFM delay generated by the airport (All other causes)	Min/year
B42b	Airport ATFM delay generated by the airport (Cause unknown, use only if B44, B45, B46 & B47 not available)	Min/year

2022 - Continental Area: Total en-route ATFM delay generated in the State (all causes) (=B37+B38+B39+B40) (B35)



2022 - Continental Area: Average ATFM delay per flight (=B35/A11) (B36)

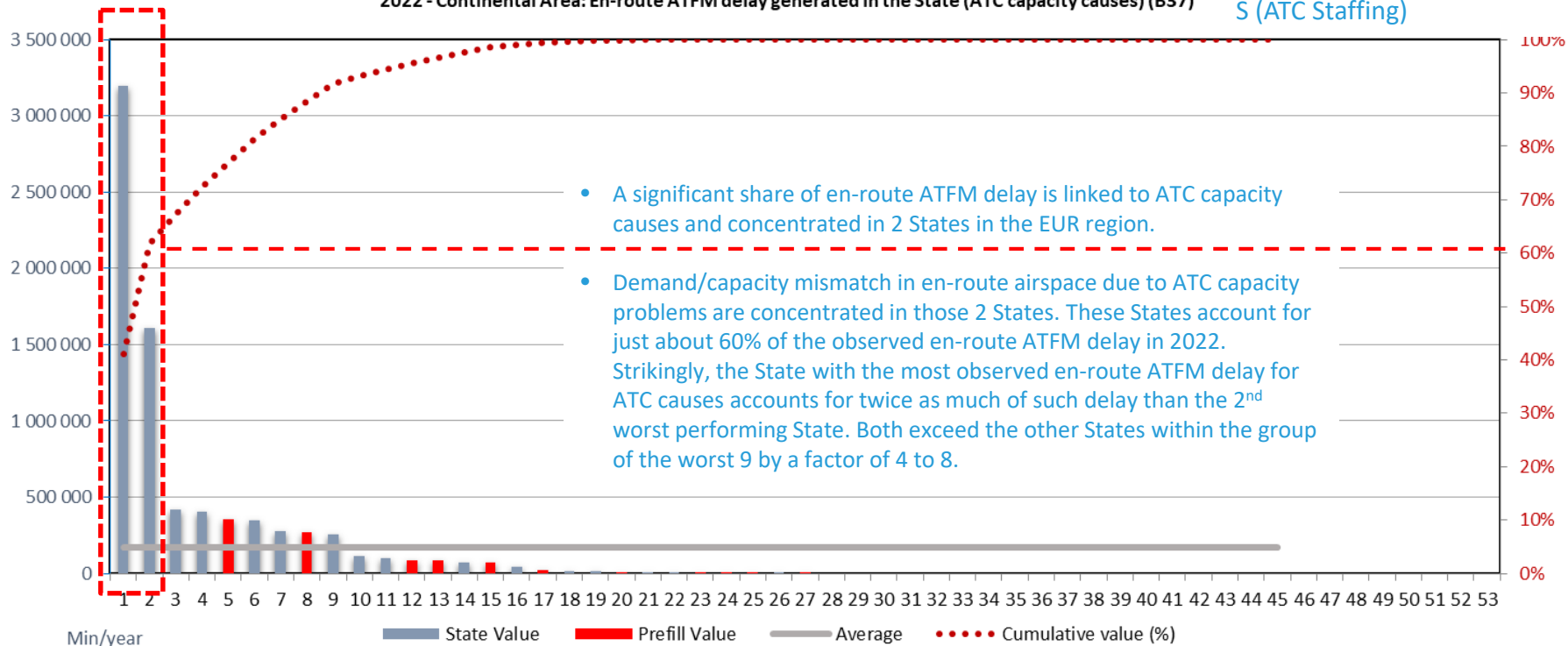


ATC causes (ATFM delay code)

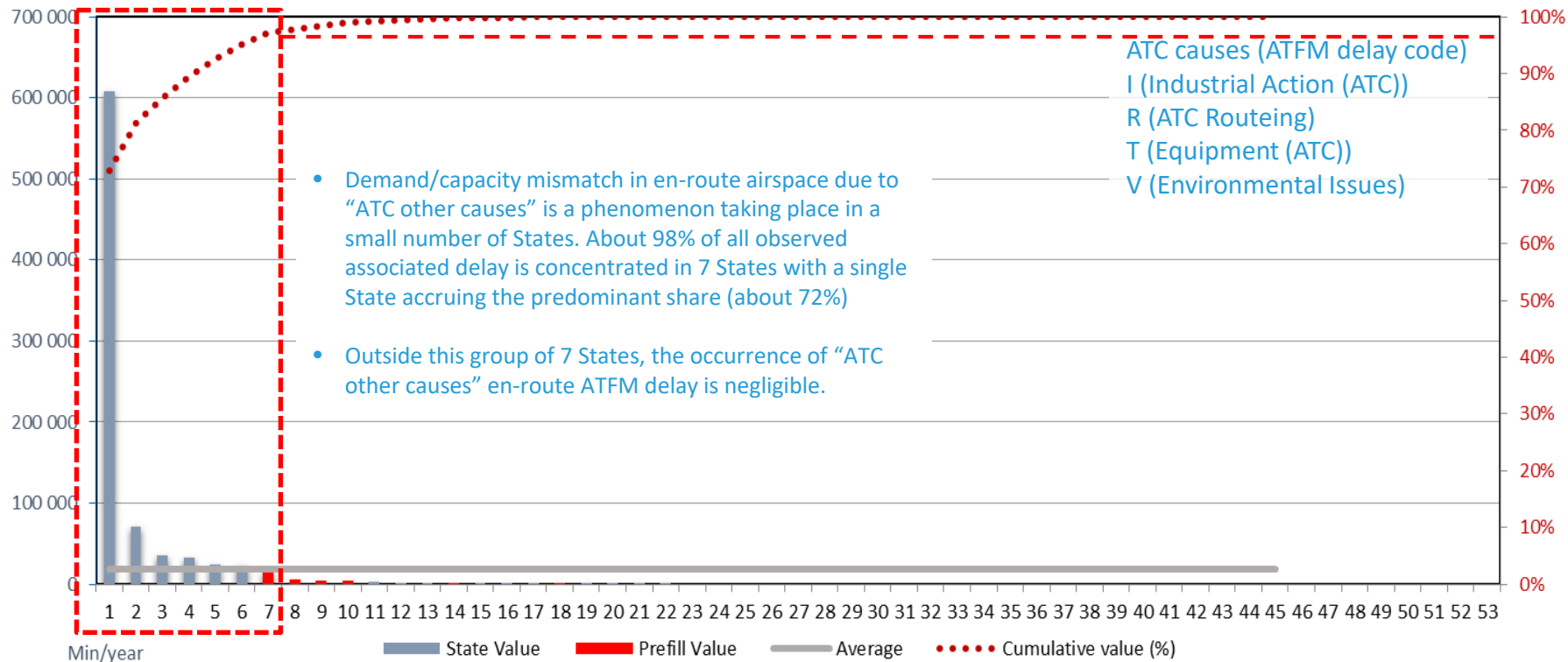
C (ATC Capacity)

S (ATC Staffing)

2022 - Continental Area: En-route ATFM delay generated in the State (ATC capacity causes) (B37)

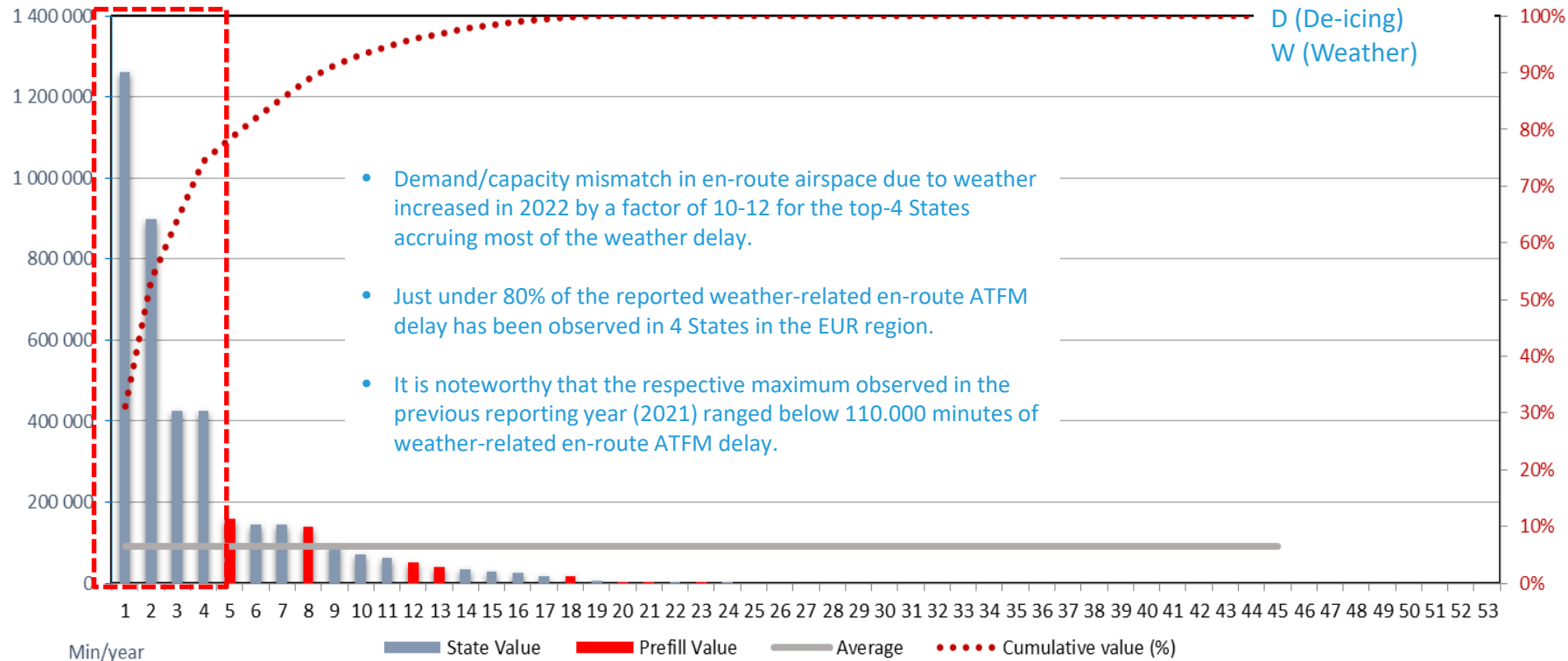


2022 - Continental Area: En-route ATFM delay generated in the State (ATC other causes) (B38)

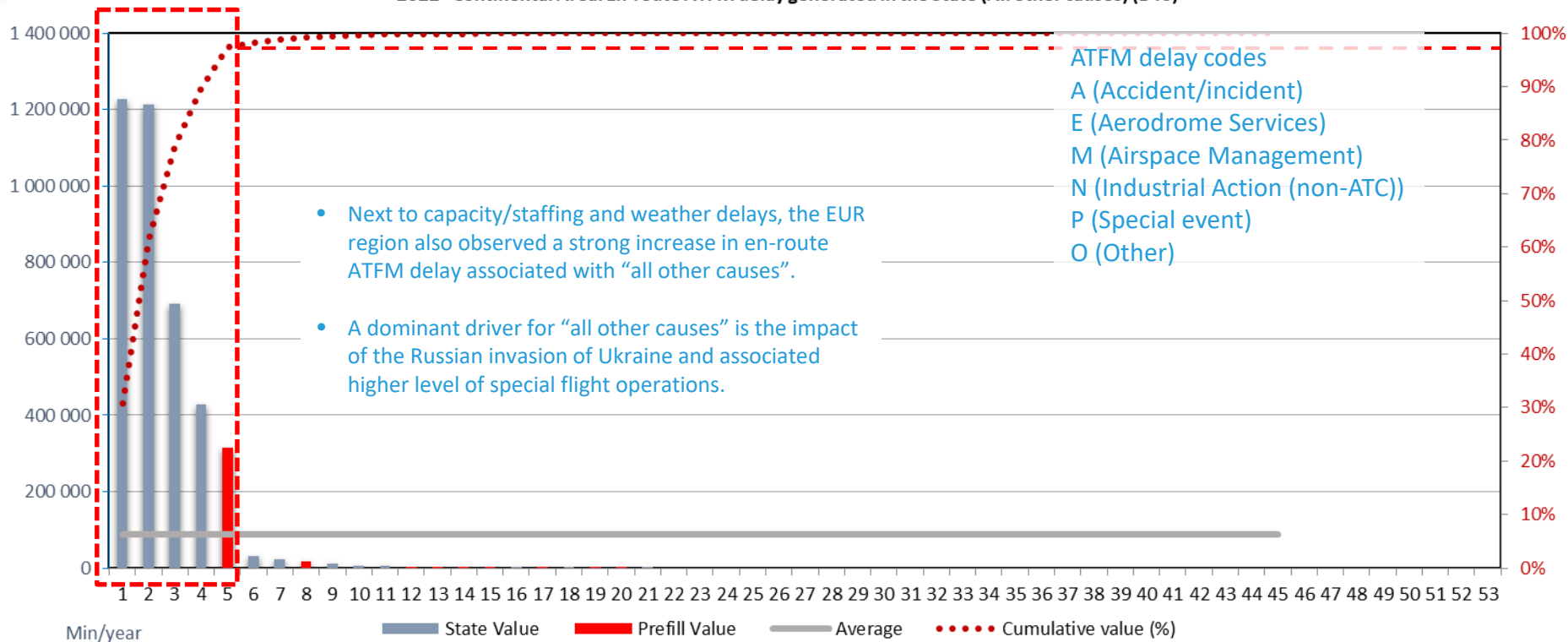


2022 - Continental Area: En-route ATFM delay generated in the State (Weather causes) (B39)

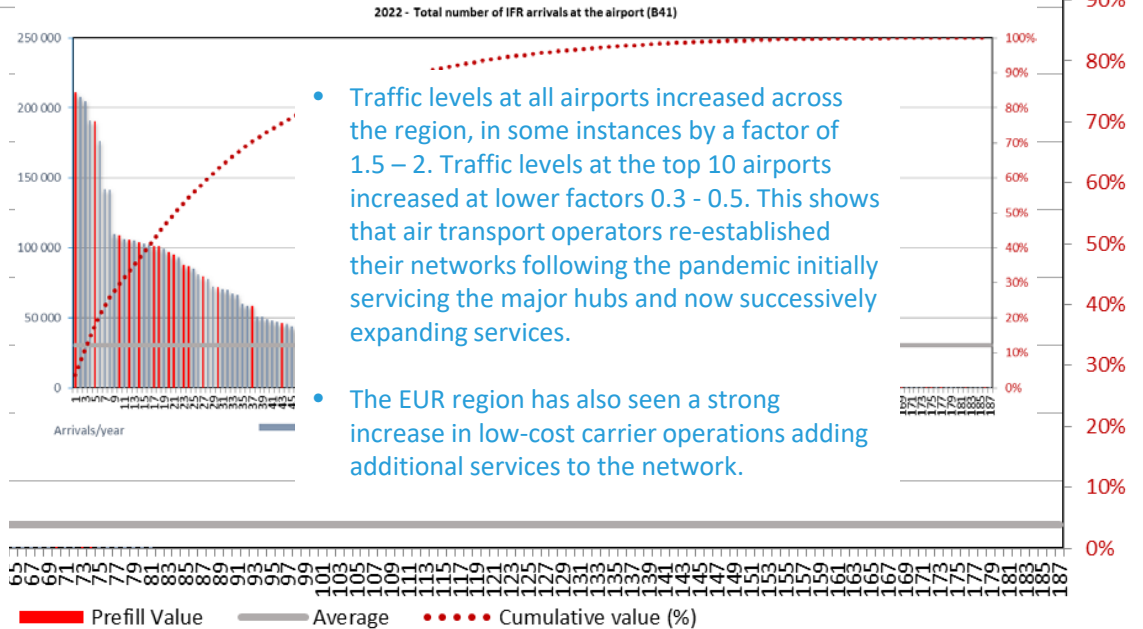
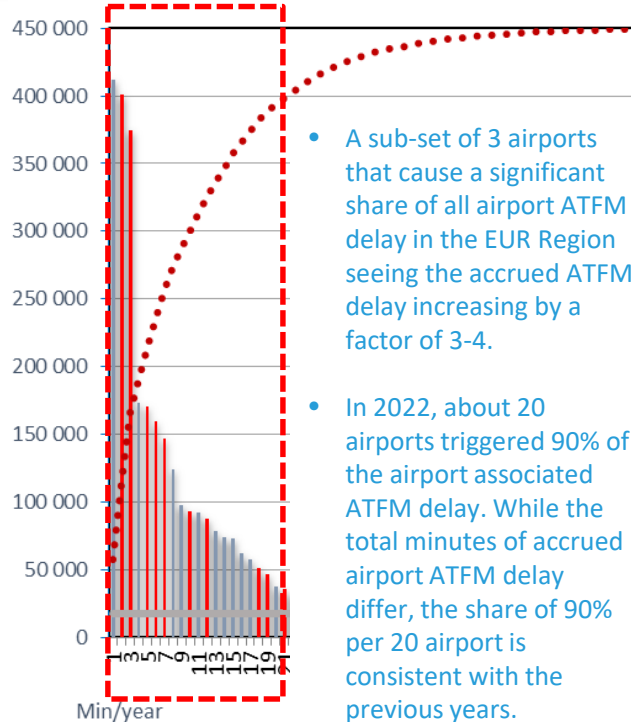
ATFM delay codes  
D (De-icing)  
W (Weather)



2022 - Continental Area: En-route ATFM delay generated in the State (All other causes) (B40)



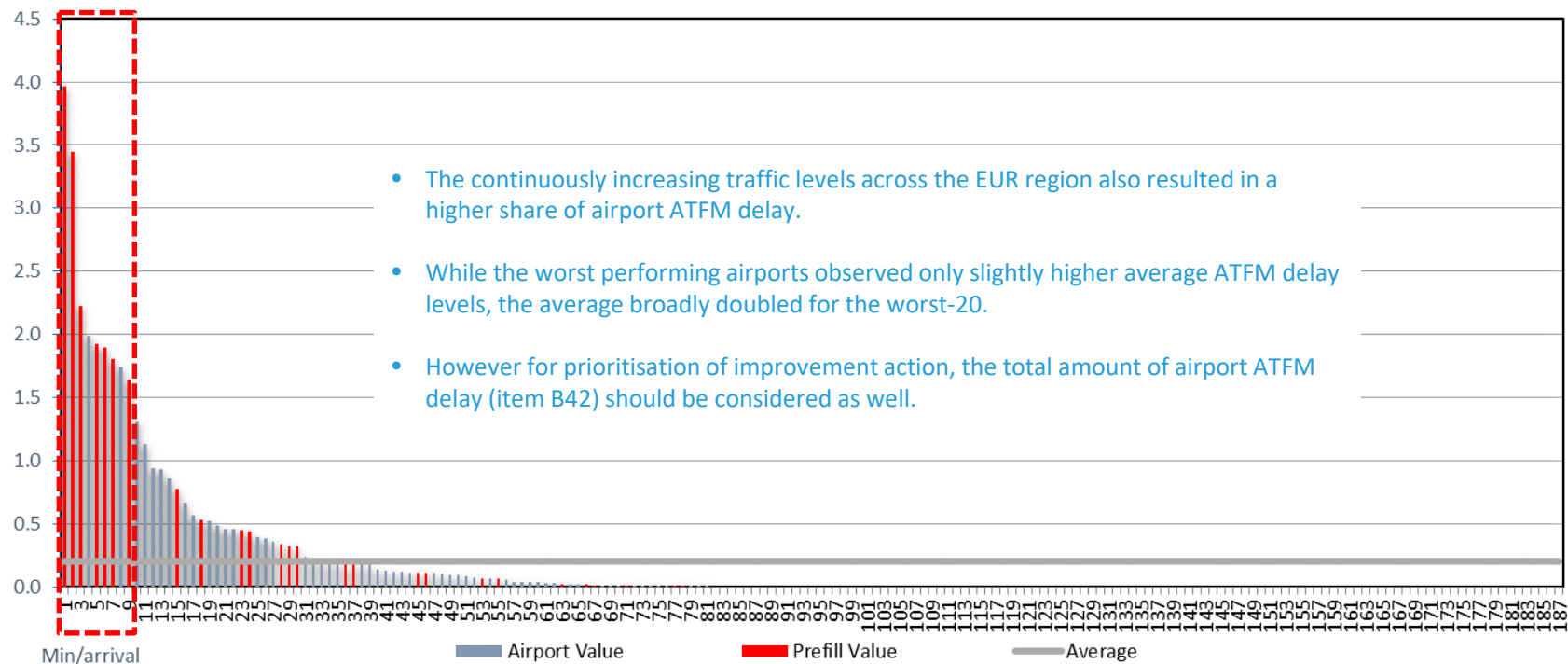
2022 - Total airport ATFM delay generated by the airport (all causes) (=B44+B45+B46+B47) (B42)



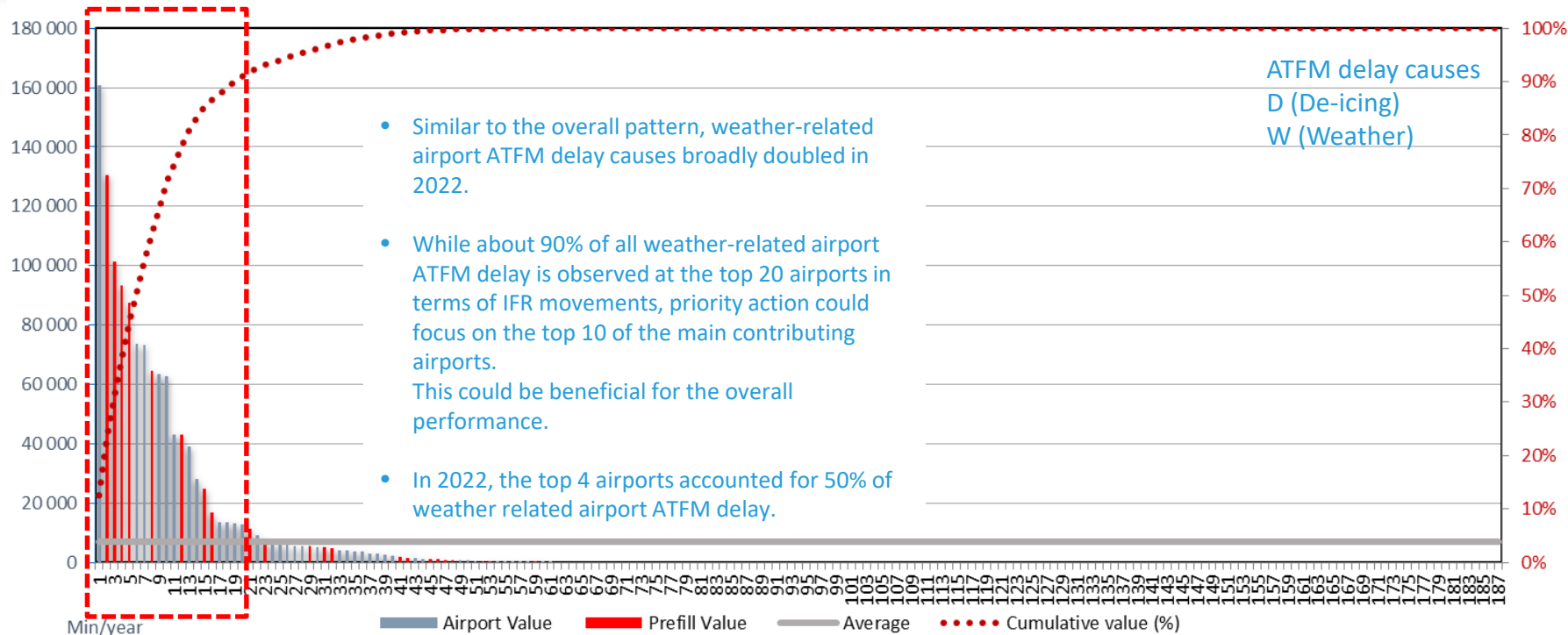
6 airports are causing 50% of all airport ATFM delay in the EUR Region.



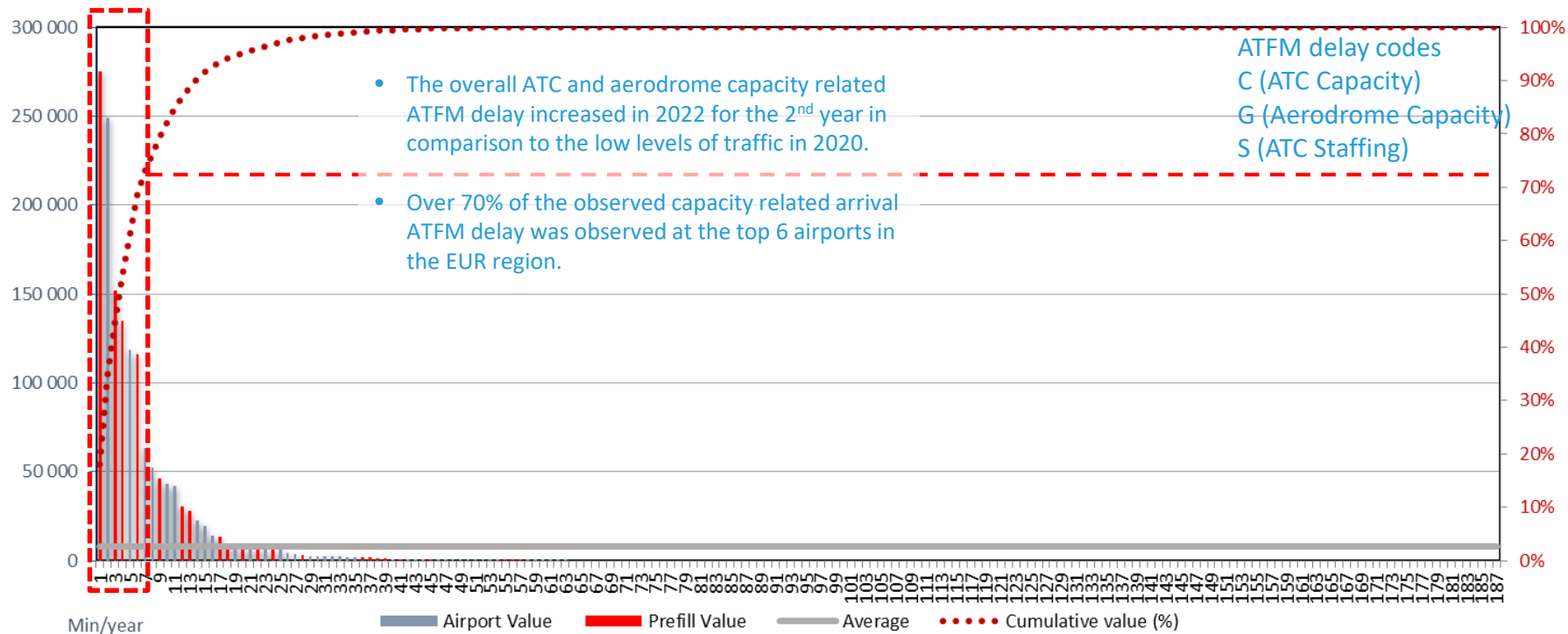
2022 - Average ATFM delay per arrival (=B42/B41) (B43)



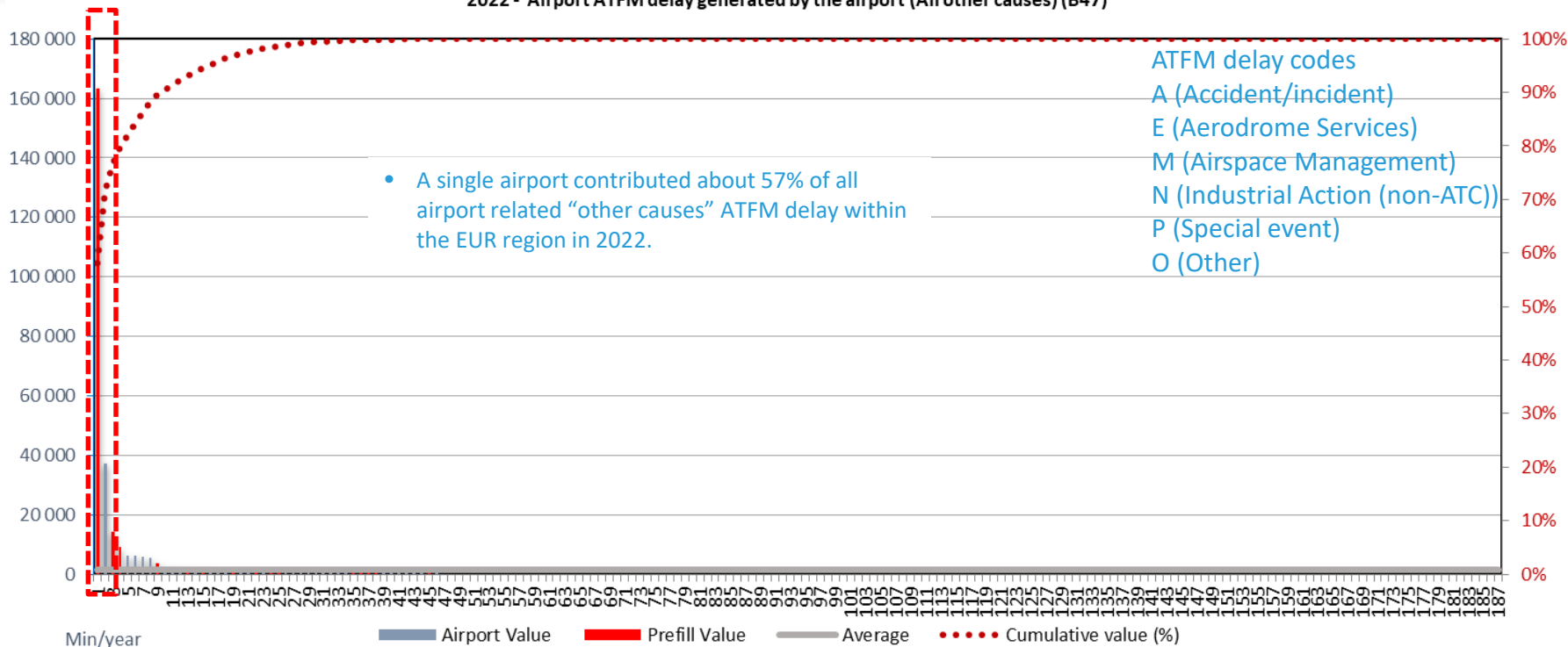
2022 - Airport ATFM delay generated by the airport (Weather causes) (B46)



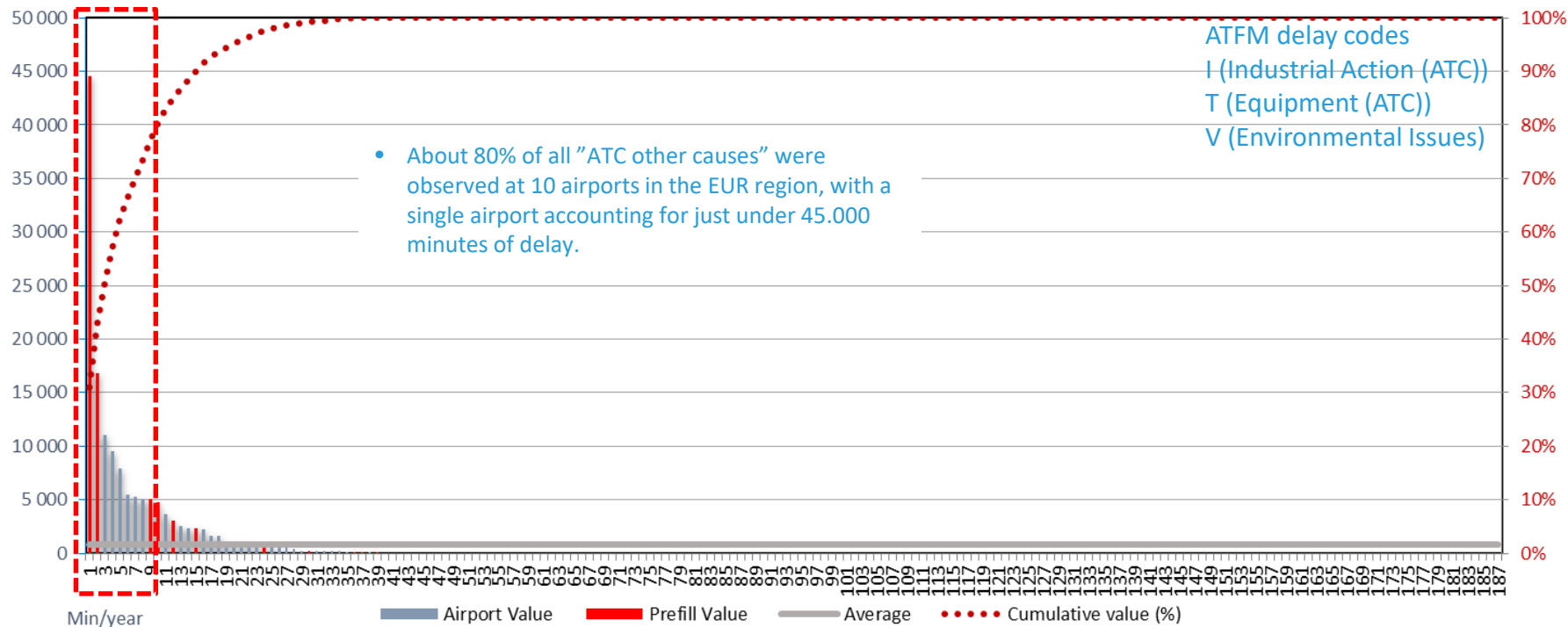
2022 - Airport ATFM delay generated by the airport (ATC & aerodrome capacity causes) (B44)



2022 - Airport ATFM delay generated by the airport (All other causes) (B47)



2022 - Airport ATFM delay generated by the airport (ATC other causes) (B45)



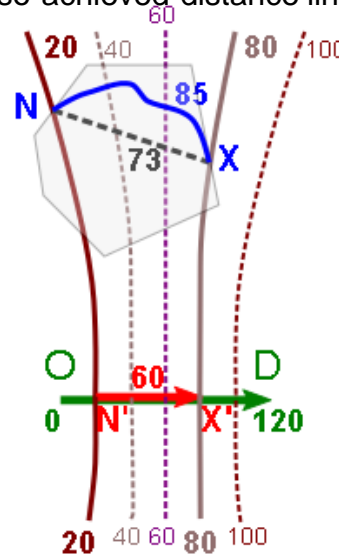
On average, ATC other causes is the smallest contributor to airport ATFM delay



KPA	Efficiency
Objective	Ensure that users [can?] use the most efficient routes – focussing on the horizontal flight-efficiency
Indicator	Average horizontal en route flight efficiency, defined as the difference between the length of the en route part of the actual trajectory (where available) or last flight planned route and the great circle.

- O, D, N, X: **O**rigin, **D**estination, **N**try, **X**it
- “Corresponding portion of the great circle distance OD” = **achieved distance N’X’** (needed to calculate the indicator at State level)
- Calculation of **achieved distance N’X’** for flight segment NX:  
(distance-closer-to-destination + distance-away-from-departure)/2
- Important properties
  - Sum of achieved distances of flight segments is always equal to total direct (great circle) distance from O to D
  - Actual, achieved and excess distances for flight segments are aggregatable (bottom-up from State level to regional level)

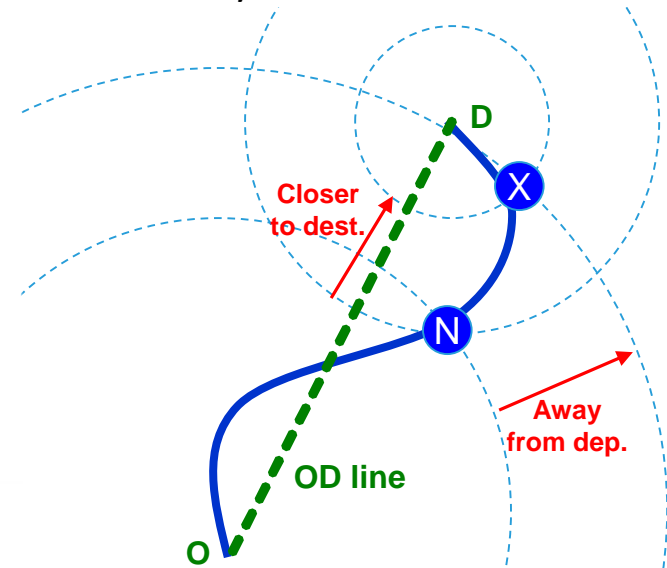
Iso-achieved-distance lines



In the example to the left:

Extra distance:  $85 - 60 = 25$

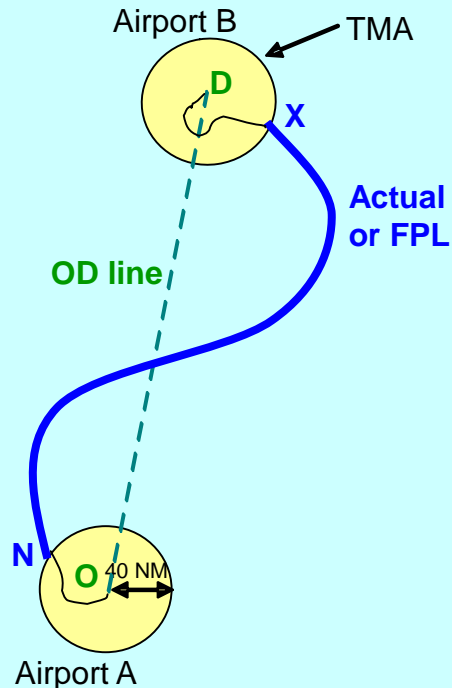
Inefficiency =  $25 / 60 = 0.42 = 42\%$



# Processing of domestic flights and overflights

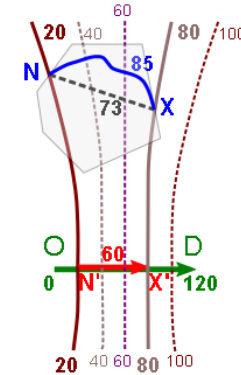
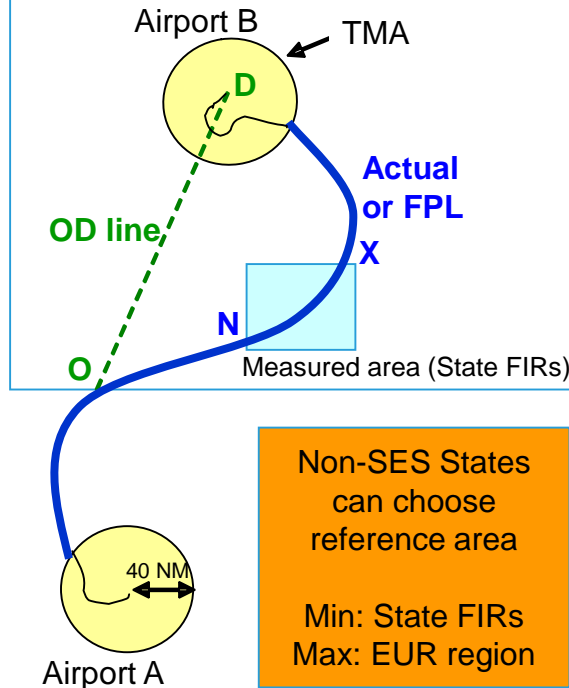
## Domestic flight

Measured area (State FIRs)



## Overflight

Reference area (eg EUR region)

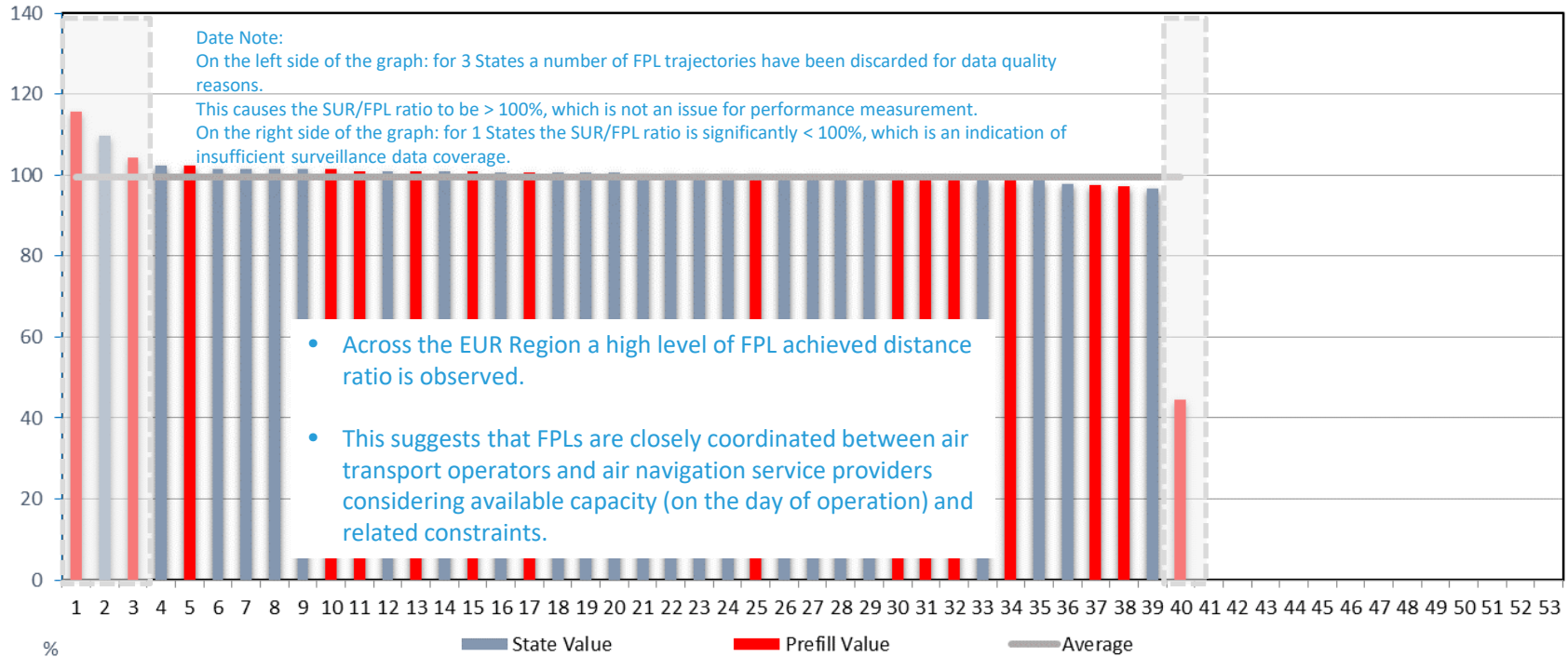


- Required inputs: Trajectory and the coordinates of points O, D, N, X (Origin, Destination, eNtry, eXit)
- Computed: Trajectory distance (NX), achieved distance (N'X')
- For the NX parts of all trajectories of IFR flights domestic, departing, arriving, or overflying IFR flights

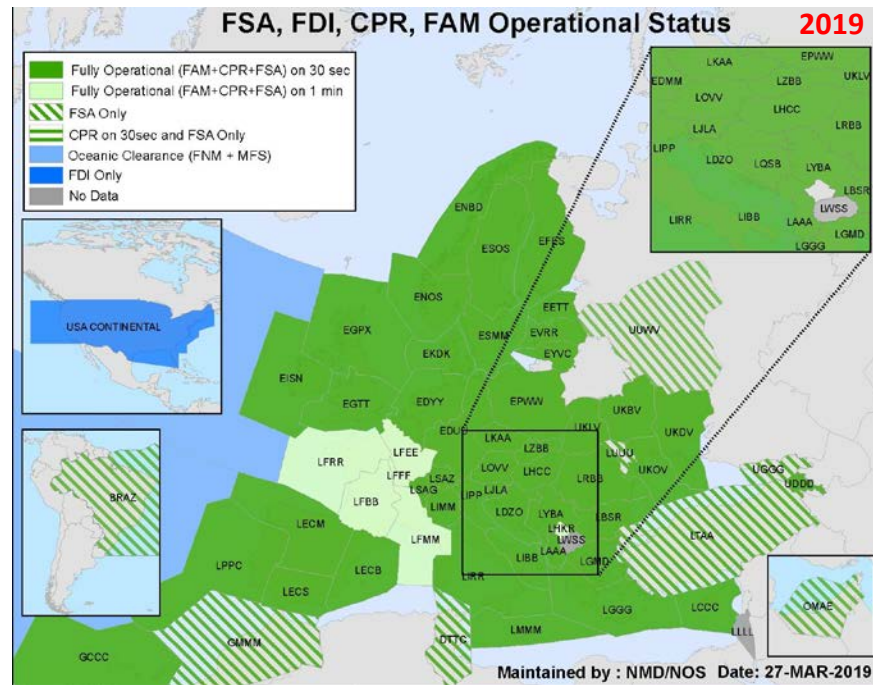
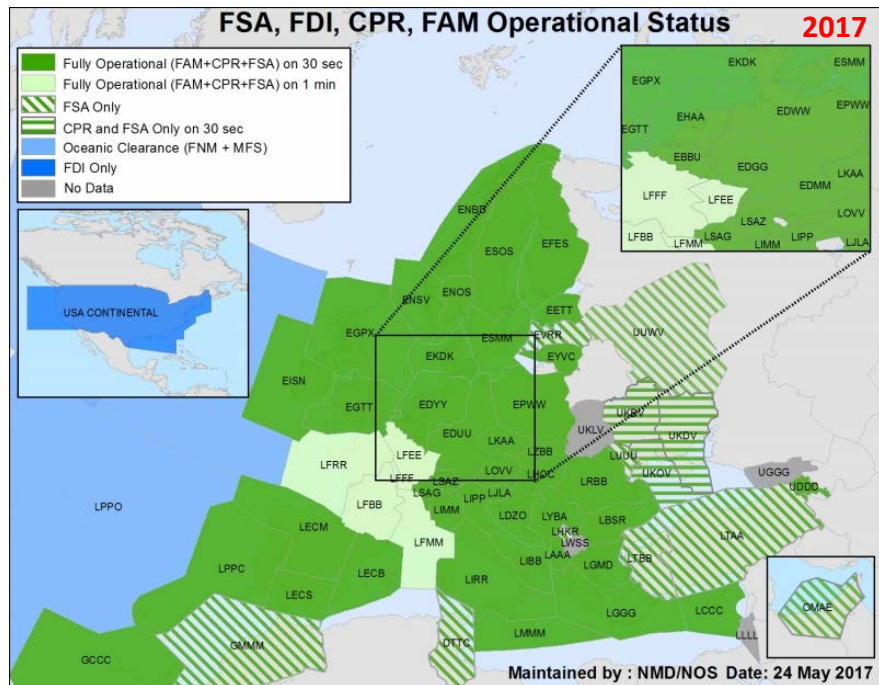


Flight Efficiency		
	Horizontal en-route flight efficiency	
B48	Name of selected reference area (provide list of FIRs in annex)	Text
B50fpl	Total planned IFR distance (flight plan)	km/year
B51fpl	Total achieved IFR distance (flight plan)	km/year
B50sur	Total actual IFR distance (surveillance data)	km/year
B51sur	Total achieved IFR distance (surveillance data)	km/year
B49	Data source for B50 - B53 (surveillance data or flight plan)	SUR or FPL
B49b	SUR/FPL achieved distance ratio (<95% = incomplete coverage)	%
B50	Total flown IFR distance	km/year
B51	Total achieved IFR distance	km/year
B52	Total extra IFR distance (=B50 – B51)	km/year
B53	Horizontal en-route flight efficiency (=B52/B51)	%

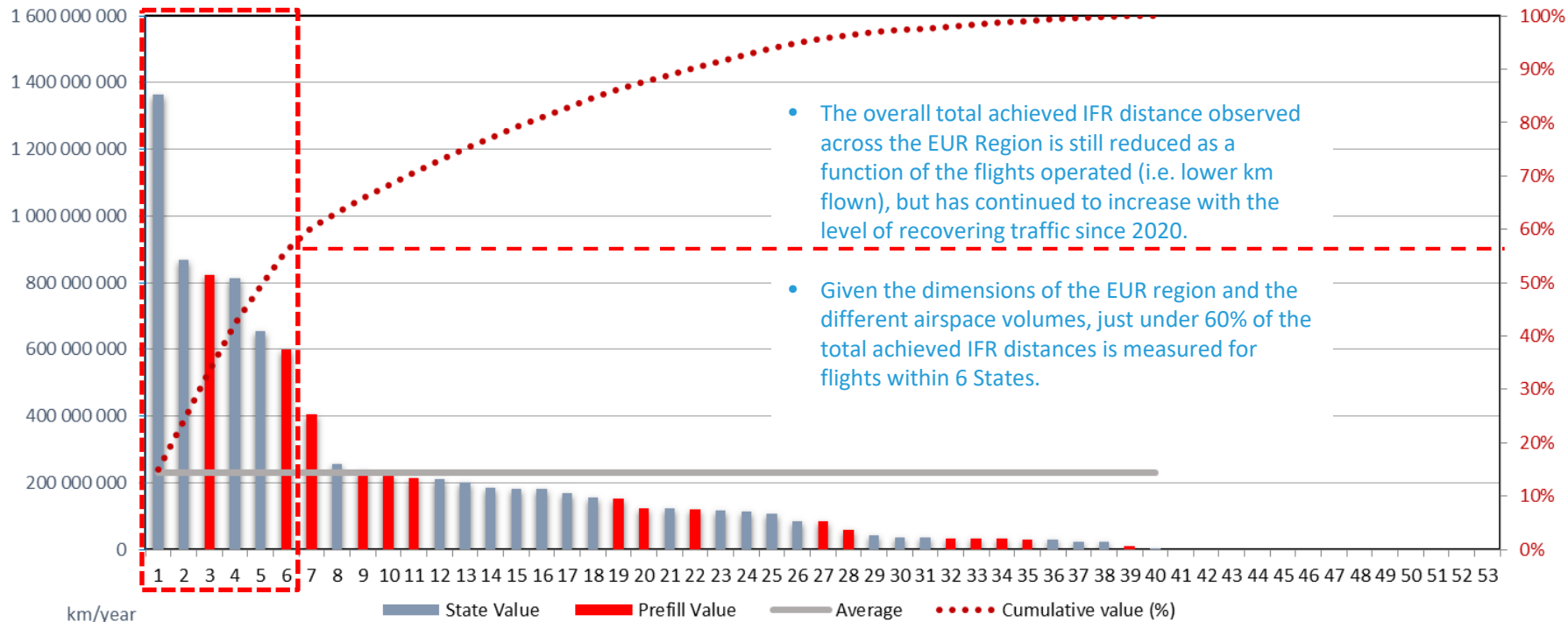
2022 - SUR/FPL achieved distance ratio (<95% = incomplete coverage) (B49b)



Expanding status of surveillance data coverage to support flight efficiency measurement across EUR region (i.e. exchange of correlated position reports CPR within EUROCONTROL area)

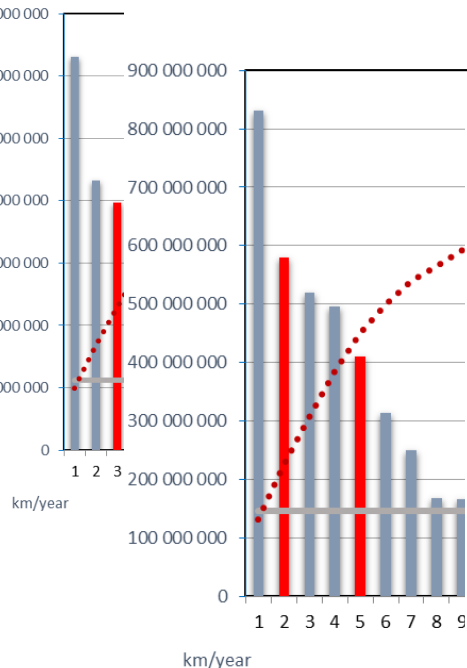


2022 - Flt. Efficiency: Total achieved IFR distance (B51)

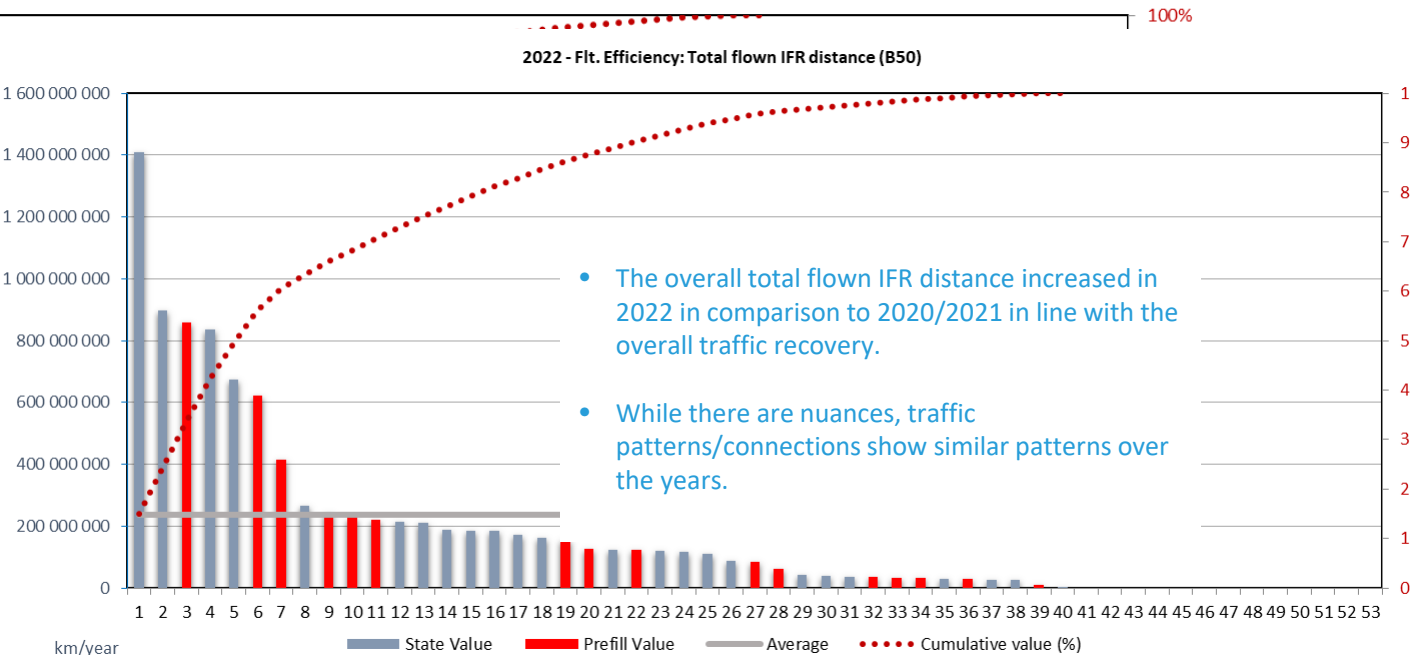


Note: Total achieved IFR distance := contribution to the great circle distance of the flights

2020 - Flt. Efficiency: Total flown IFR distance (B50)



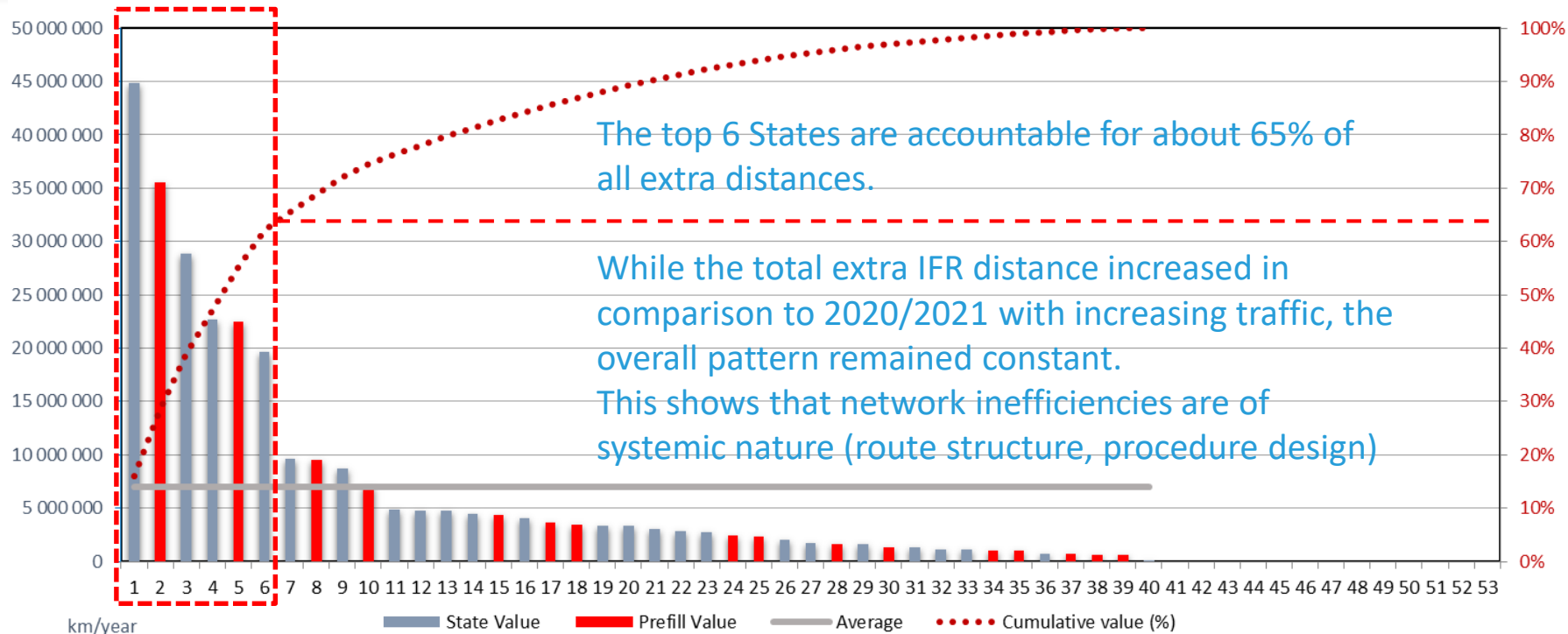
2021 - Flt. Efficiency: Total flown IFR distance (B50)



- The overall total flown IFR distance increased in 2022 in comparison to 2020/2021 in line with the overall traffic recovery.
- While there are nuances, traffic patterns/connections show similar patterns over the years.

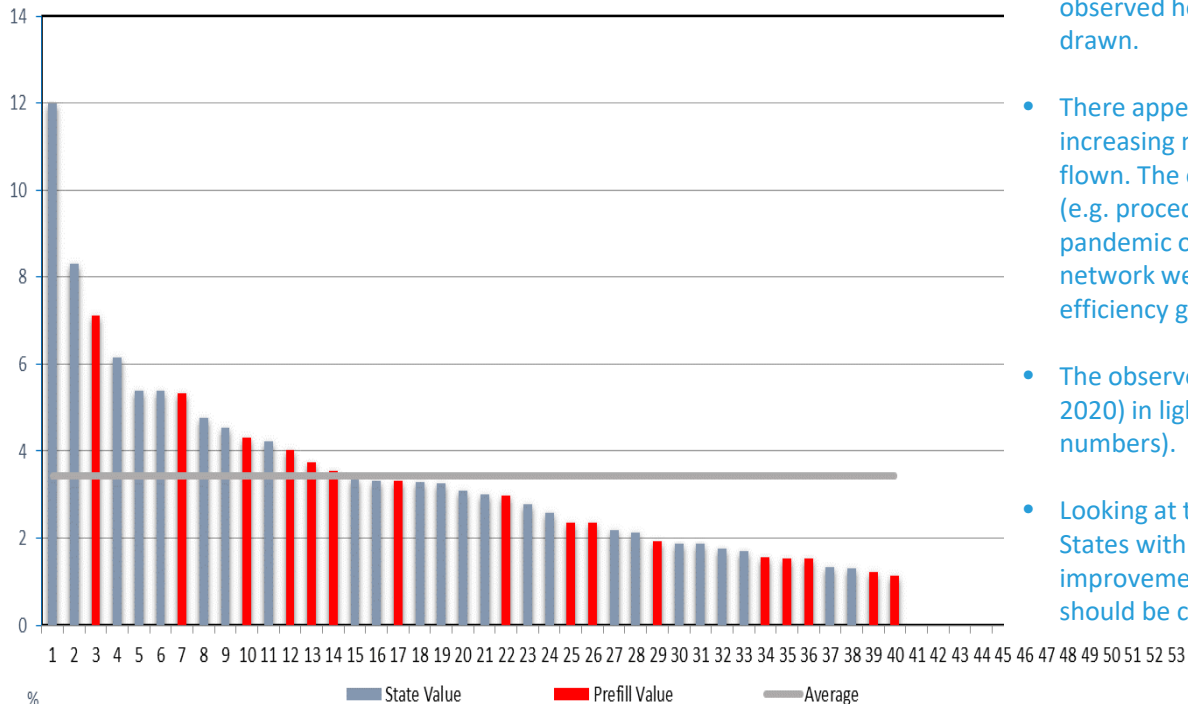
Note: Total flown IFR distance (=actual distance) fused from SUR and FPL data sources and adjusted to compensate for insufficient surveillance data coverage.

2022 - Flt. Efficiency: Total extra IFR distance (=B50 – B51) (B52)



Note: Total extra IFR distance (=excess distance flown) based on fused SUR and FPL data sources and adjusted to compensate for insufficient surveillance data coverage.

2022 - Horizontal en-route flight efficiency (=B52/B51) (B53)



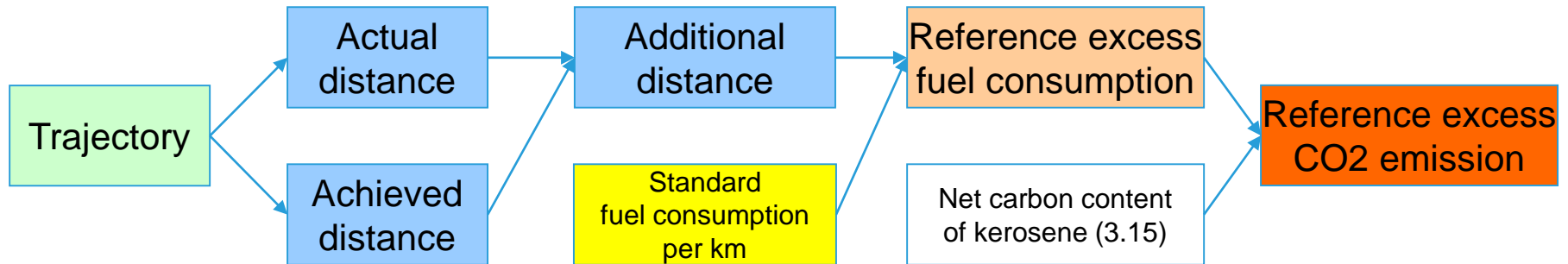
- With traffic levels recovering, an immediate conclusion from the observed horizontal en-route flight efficiency performance cannot be drawn.
- There appears to be a scale effect that is linked to the steadily increasing number of flights, associated density, and connections flown. The overall pattern suggests that constraints on airspace users (e.g. procedural restrictions, routings) are re-established in post-pandemic operations. It appears that no significant changes to the network were made (or lessons learned drawn from the flexibility and efficiency gains observed during the pandemic).
- The observed values for 2022 increased compared to 2021 (and 2020) in light of aforementioned scale effect (i.e. higher air traffic numbers).
- Looking at the indicator, improvements should primarily focus on the States with the highest value. However, for prioritisation of improvements the total amount of extra IFR distance (item B52) should be considered as well.

KPA	Environment
Objective	Contribute to the protection of the environment – focussing on fuel savings and CO2 emission reductions
Indicator	CO2 emissions deriving from inefficiencies in flight efficiency (conversion of additional distance into CO2 emissions based on standard values formula)



# Definition of indicator

- Reference excess fuel consumption:  
Total additional distance flown in the airspace volume (i.e. State) multiplied by a standard fuel consumption factor (value chosen by each State)
- Reference excess CO<sub>2</sub> emission:  
Reference excess fuel consumption multiplied by 3.15 (net carbon content of kerosene)



# Remarks

- Indicator
  - Has low data requirements and is therefore easy to implement
    - Because mostly based on “additional distance” already computed
  - Publishes an approximation of excess CO<sub>2</sub> emission, resulting from horizontal flight inefficiency
    - The optimum indicator value is not equal to zero
    - Value is influenced by many different factors (including traffic volume, fleet characteristics etc.)
    - Indicator does not cover everything (missing: vertical flight efficiency, TMA inefficiencies, surface movement inefficiencies)
    - Hence the absolute value of the indicator should not be interpreted as representing the CO<sub>2</sub> emissions caused by ANS.
    - Indicator to be used for “general purpose” and trend analysis only



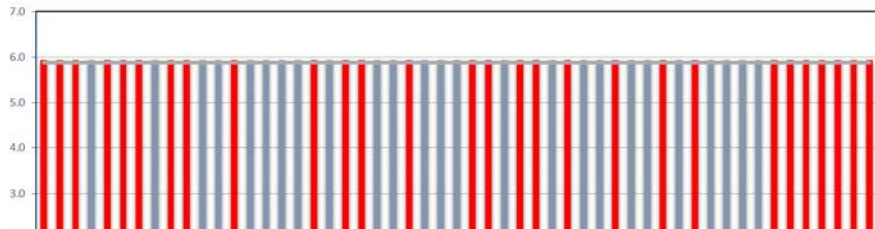
Environment		
	CO2 emissions deriving from inefficiencies in flight efficiency	
B54	Average en-route fuel consumption factor for the State (provide source and computation method in annex)	kg/km
B55	Average en-route CO <sub>2</sub> emission factor for the State (=B54 * 3.15)	kg/km
B56	Theoretical CO <sub>2</sub> emissions deriving from inefficiencies in horizontal en-route flight efficiency (=B52 * B55 / 1000)	Tonnes/year



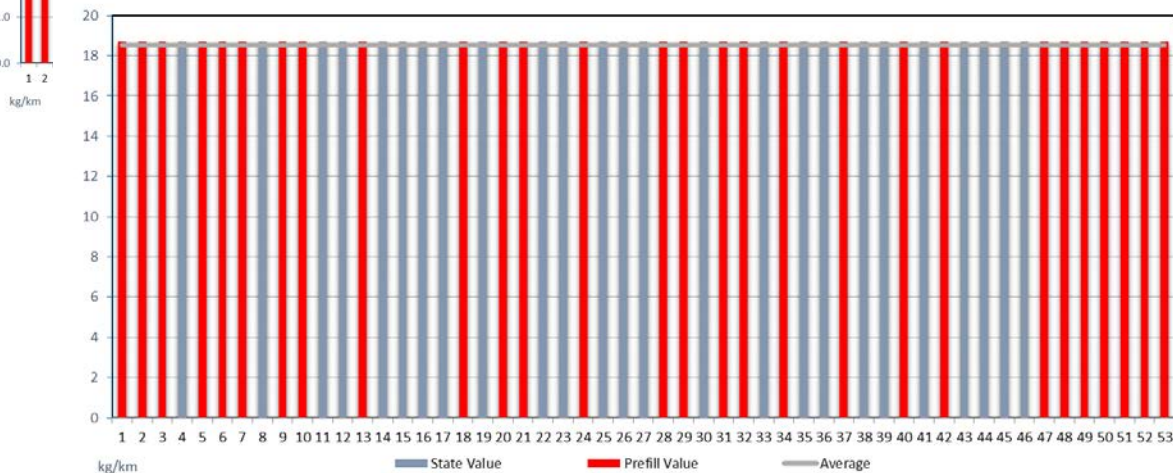
## B54 – Average en-route fuel consumption factor

- State can choose method/value
  - Global standard value from ICAO
    - Average fuel burn per nautical mile (NM) of flight = 11 kg/NM = 5.9 kg/km
      - Source: Doc 9750 3rd ed. page App H-8
    - Used for the prefiling of the template
  - State-specific standard value: the standard kerosene consumption per kilometer of a typical jet aircraft type
    - States can select their own “typical aircraft type”, reflecting the composition of traffic in their airspace
  - State-specific measured value: a calibrated average fuel consumption per kilometre flown,
    - computed from the State’s average annual traffic composition in terms of aircraft types, vertical traffic distribution and distance flown
      - using the ICAO Fuel Savings Estimation Tool (IFSET)
      - or any other modeling tool, if available
    - recalibration needed every couple of years to take into account changes in traffic composition

2022 - Average en-route fuel consumption factor for the State (provide source and computation method in annex) (B54)

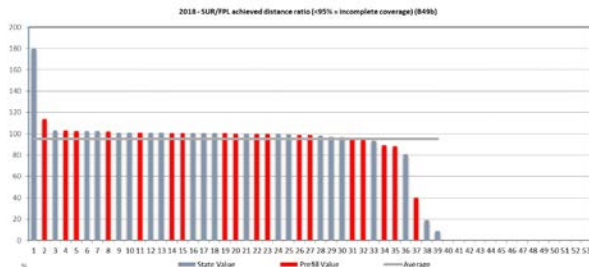
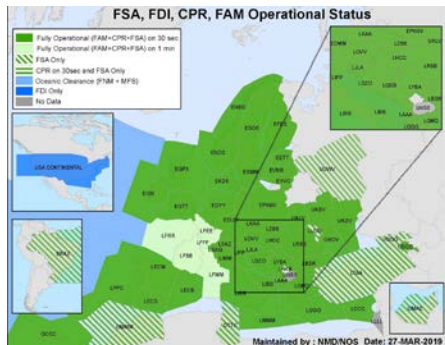


2022 - Average en-route CO2 emission factor for the State (=B54 \* 3.15) (B55)



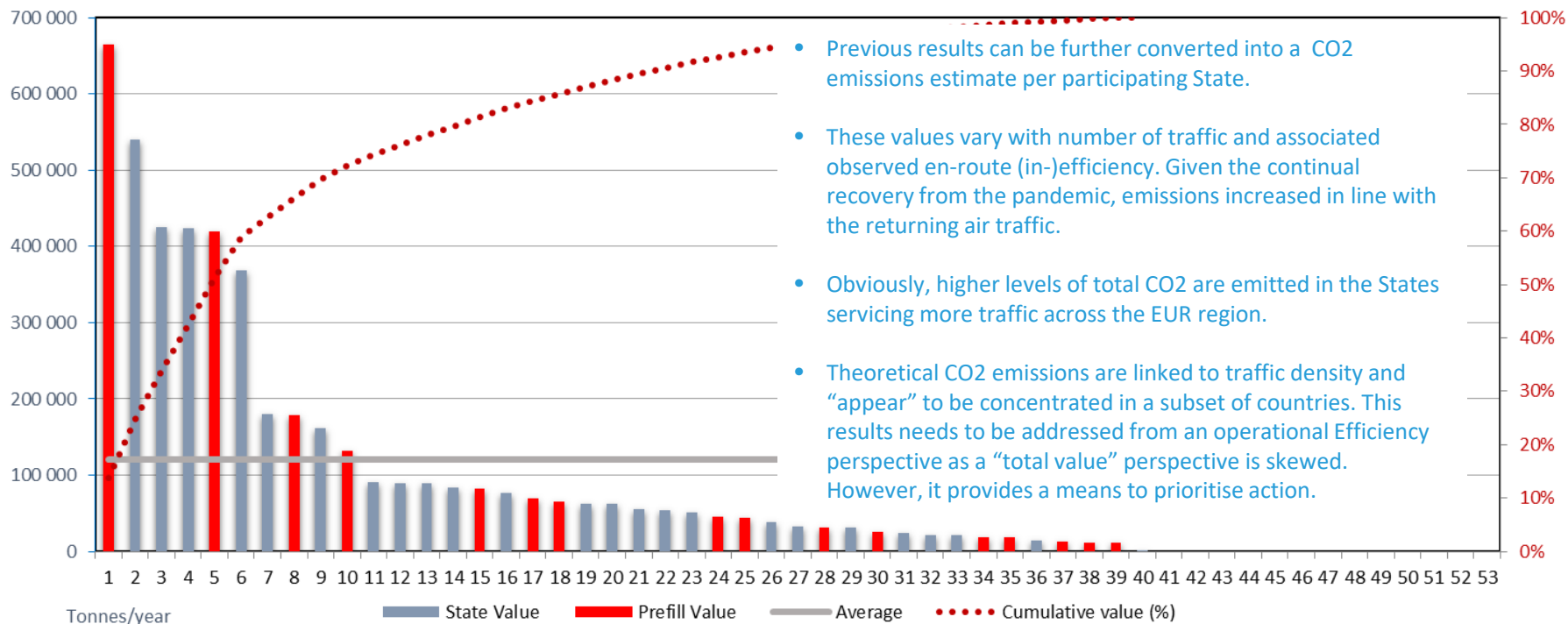
- The average en-route fuel consumption factor for the participating States remained constant over the past years. This reflects the reported stability of the observed en-route flight efficiency benefit pool reported above.
- The associated average en-route CO2 emission factor represents then the estimated emission per km flown, i.e. B54-factor \* 3,15.
- The EUR region network is characterised by a certain stability of the network traffic (in-) efficiency. Accordingly, the benefit pool for CO2 emissions – expressed per km flown – remained constant.

# Addressing coverage issues



- Indicator is an absolute value
  - Susceptible to coverage issues
    - Geographical, time, flight category filtering
- Coverage checks & corrections
  - SUR data available
    - Sufficient match with FPL data (achieved distance comparison >95%)
      - Use additional distance from SUR data as is
    - Insufficient match with FPL data
      - Upscale additional distance from SUR data to 95% of additional distance from FPL data
  - SUR data not available
    - Use additional distance from FPL data

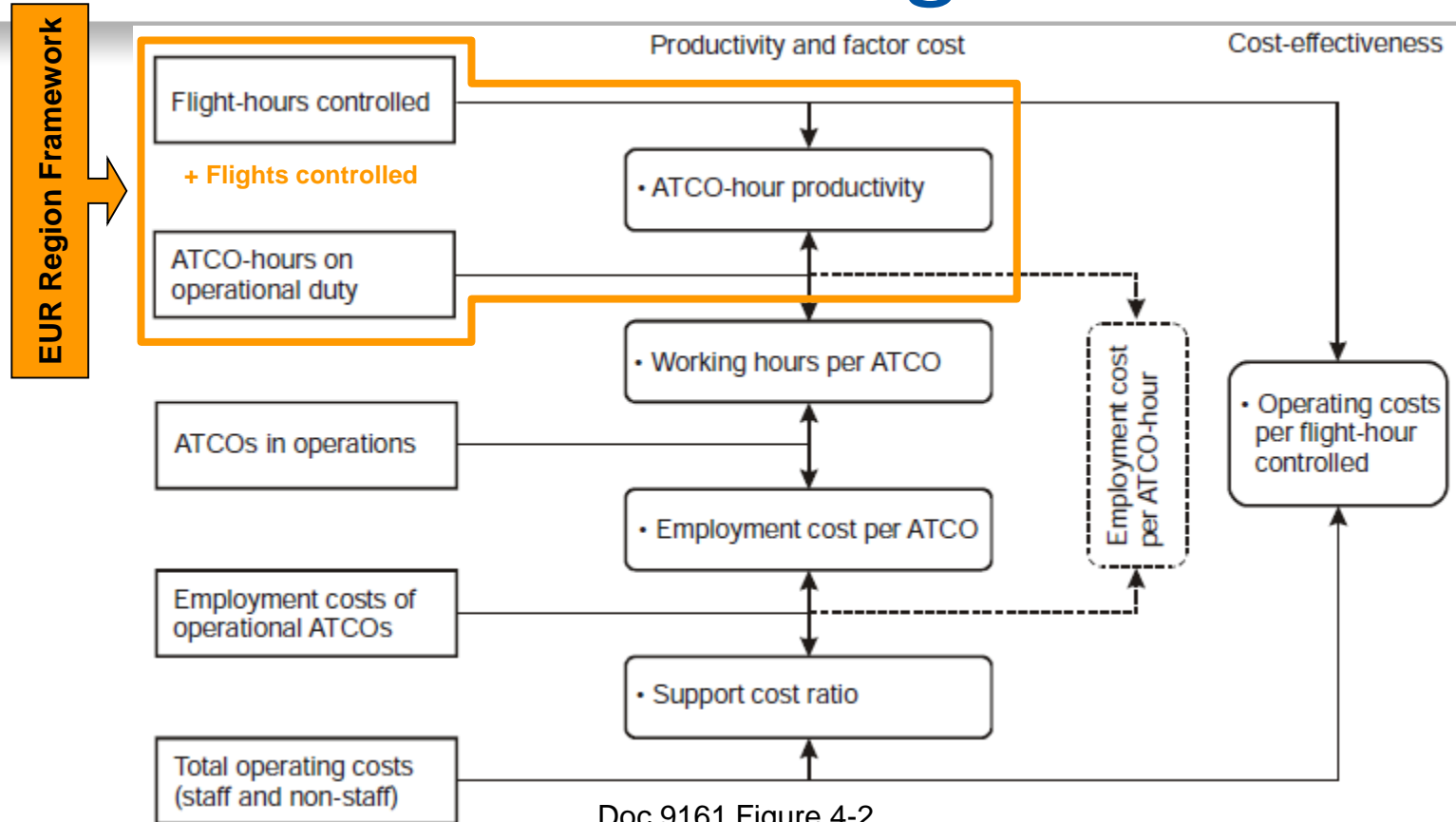
2022 - Theoretical CO2 emissions deriving from inefficiencies in horizontal en-route flight efficiency (=B52 \* B55 / 1000) (B56)



KPA	Cost effectiveness
Objective	Contribute to optimize the cost for air navigation services
Indicators	<ul style="list-style-type: none"><li>- IFR flights (en-route) per ATCO hour on duty</li><li>- IFR flight hours (en-route) per ATCO hour on duty</li><li>- IFR movements (airport) per ATCO hour on duty</li></ul>



# Origin of indicators



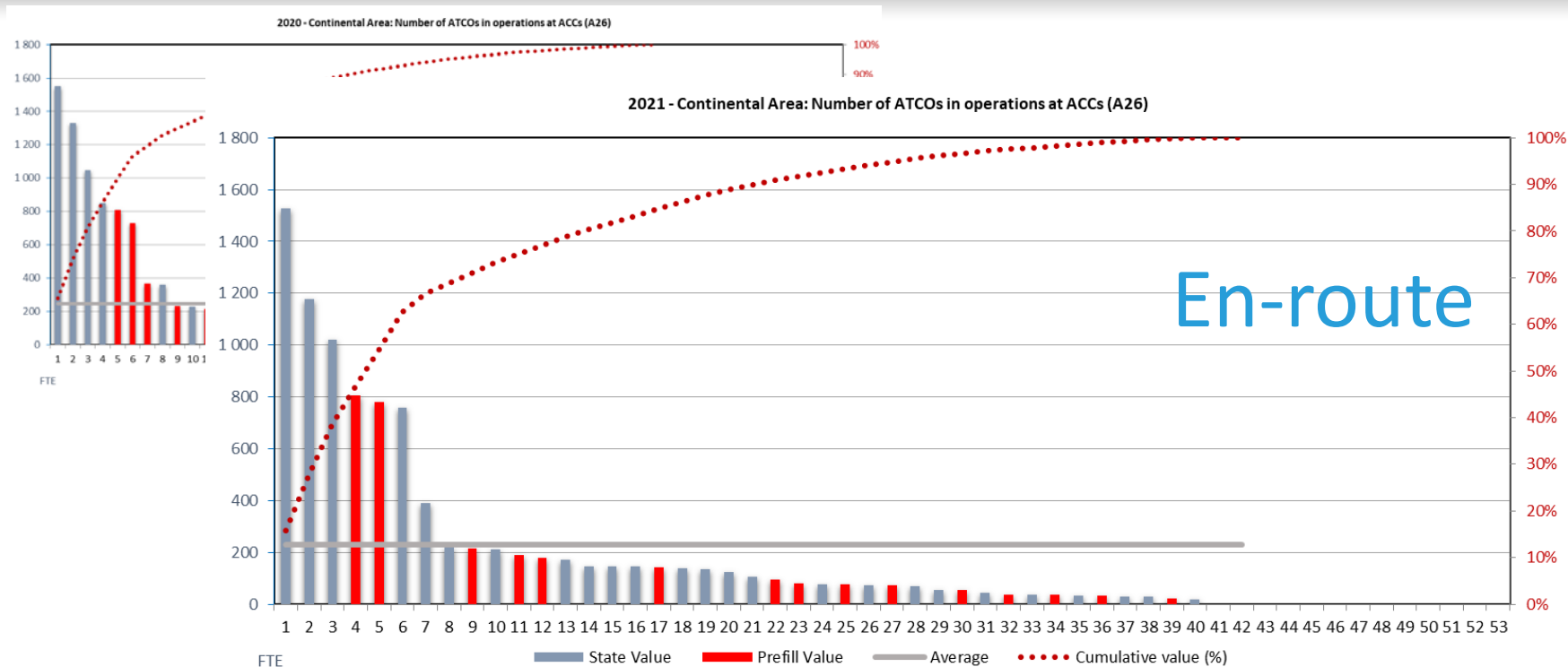
Doc 9161 Figure 4-2

# Remarks

- Indicators
  - Focus on an important component of ANSP costs
    - However with the limitation that working hours per ATCO, employment cost per ATCO, and support cost are not covered
  - Reuse data reporting already in place for many States
    - Also reuse existing data definitions and terminology
      - EUROCONTROL Specification for Economic Information Disclosure (SEID)
  - Have relatively simple reporting requirements
    - Only traffic volume and ATCO hours on duty
  - Avoid entering into financial information disclosure issues for the initial implementation of the framework

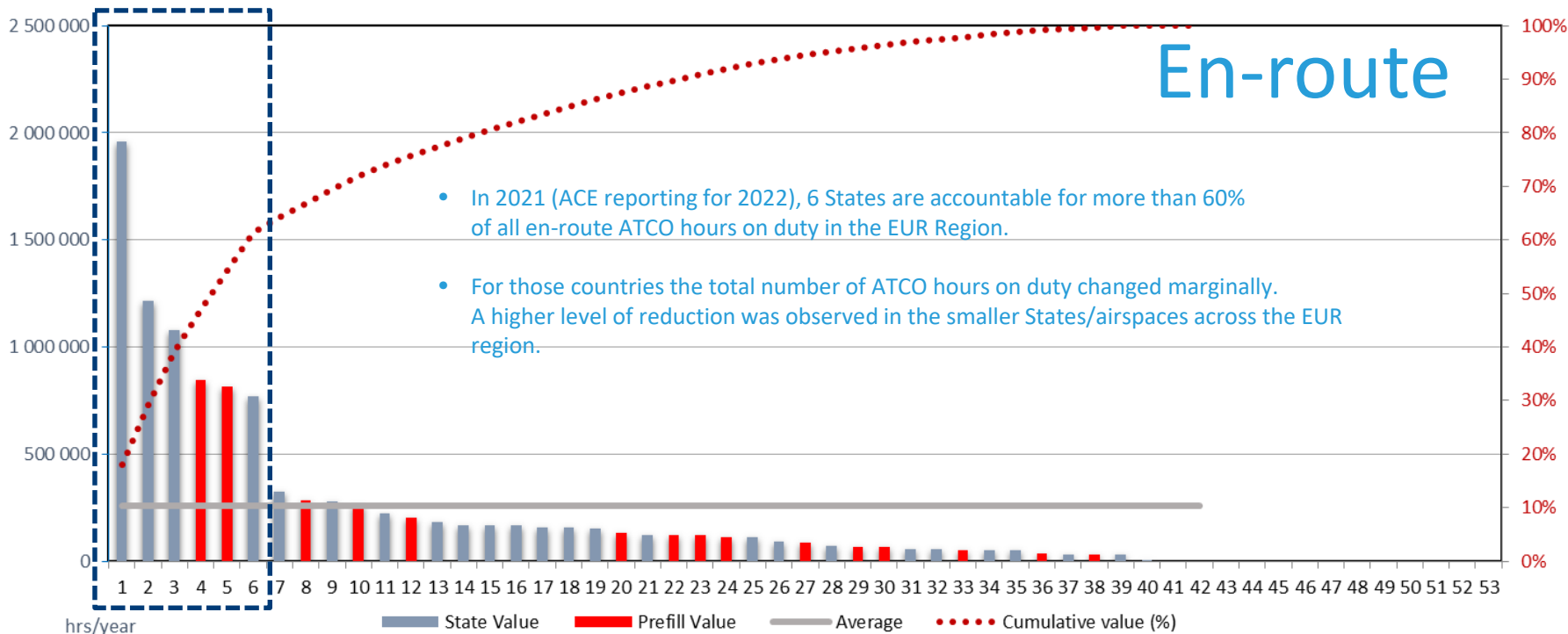
Cost effectiveness		
	ATCO productivity (Continental Area)	
B57	Number of ATCO hours on duty (ACCs)	hrs/year
B58	Number of ATCO hours on duty (APP+TWRs)	hrs/year
B59	IFR flights (en-route) per ATCO hour on duty (ACCs) (=A11/B57)	Flights/hr
B60	IFR flight hours per ATCO hour on duty (ACCs) (=A15/B57)	hrs/hr
B61	IFR movements (airport) per ATCO hour on duty (APP+TWRs) (=A16/B58)	Mov/hr



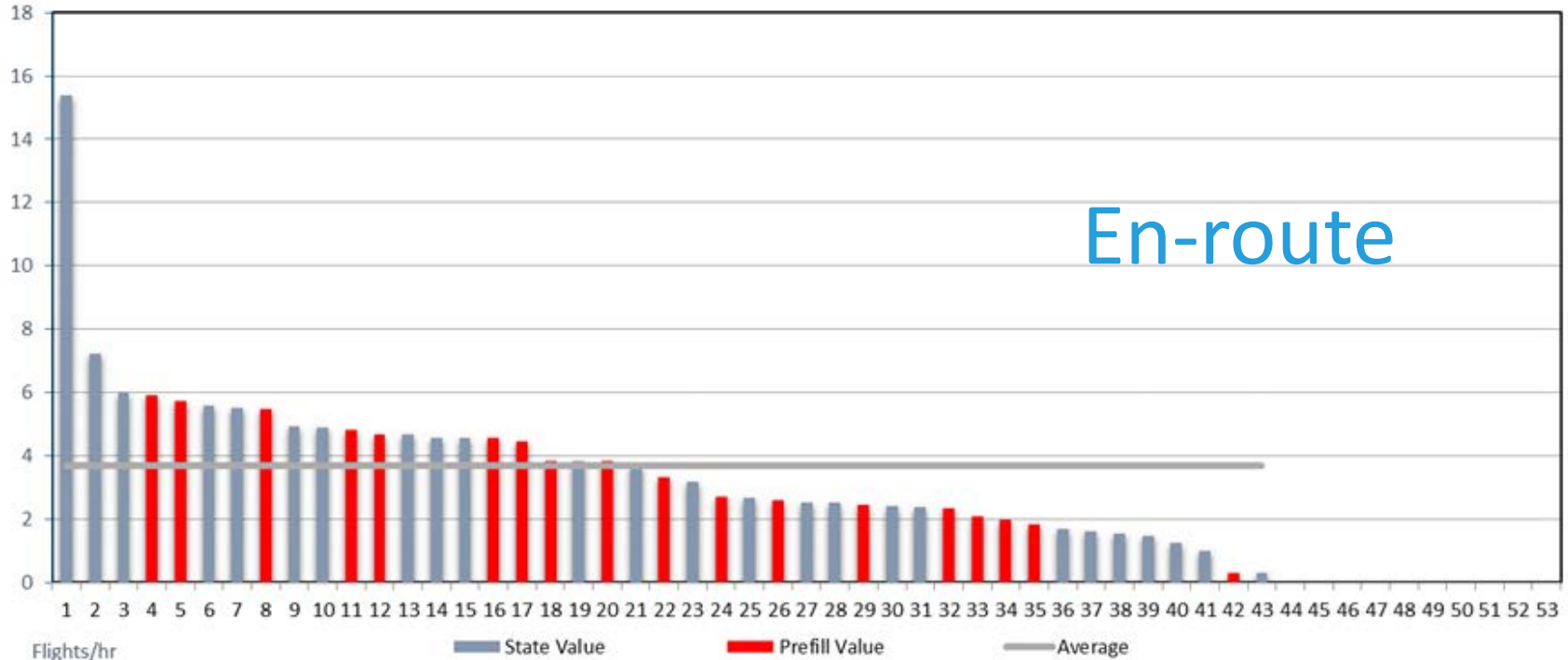


Note: These graphs are repeated here for ease of reference and comparison with the next graph (ATCO hours on duty). There has been a gradual change (reduction) in terms of ATCOs in operations at en-route ACCs from 2020 to 2021.

2021 - Continental Area: Number of ATCO hours on duty (ACCs) (B57)

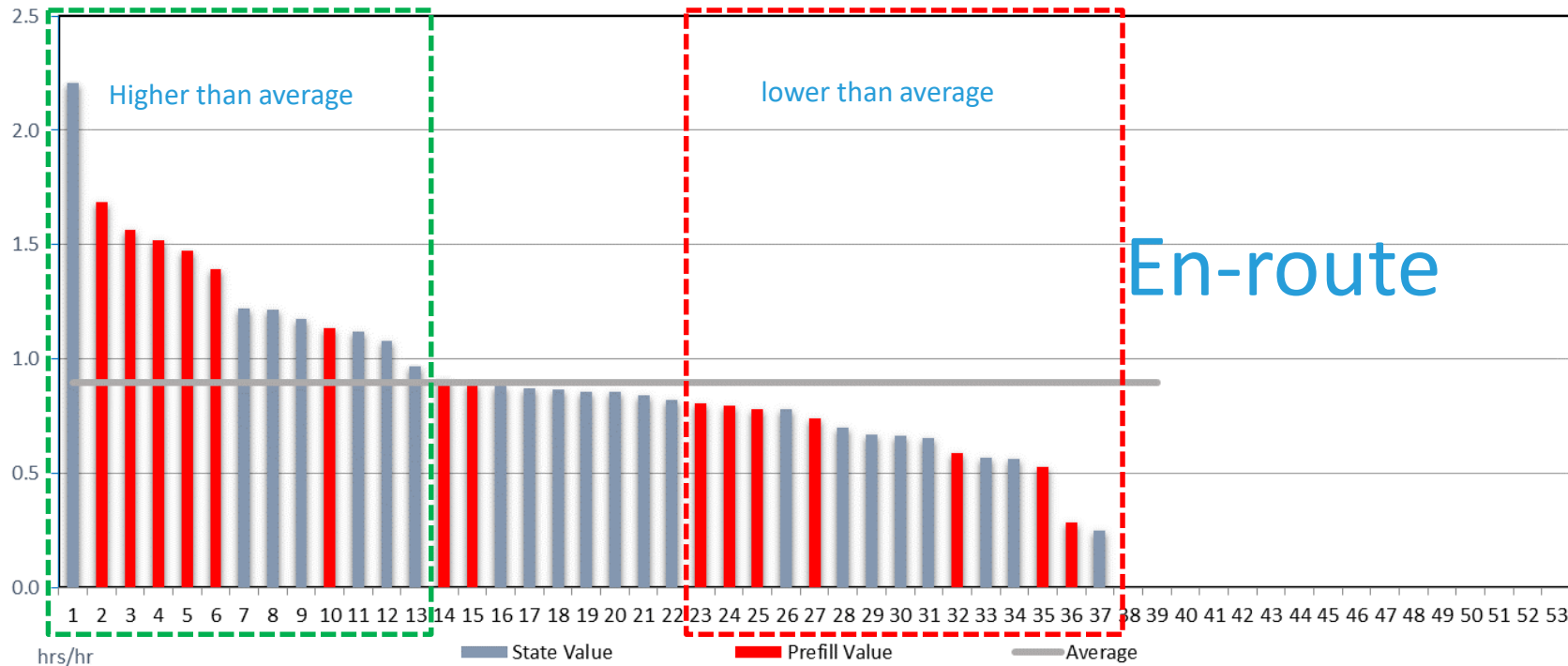


Continental Area: IFR flights (en-route) per ATCO hour on duty (ACCs) (=A11/B57) (B59)



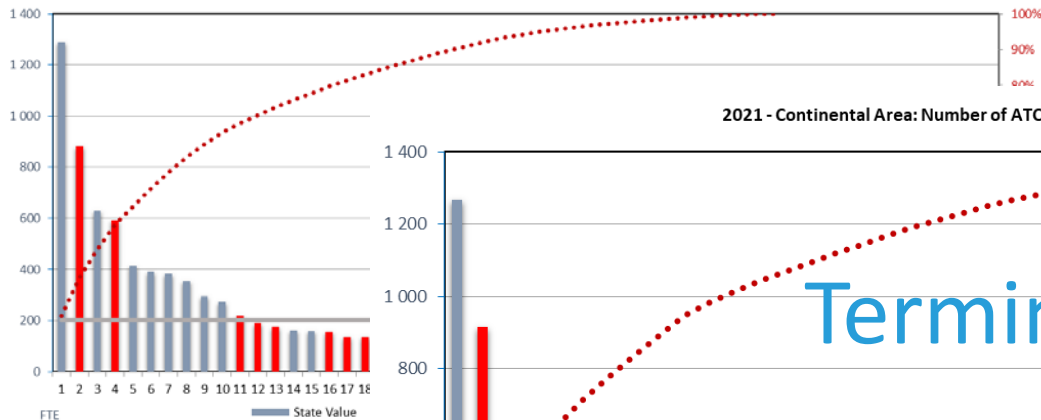
In terms of number of movements handled per en-route ATCO hour on duty, there is a large variation but this does not take into account the average flight duration in the State.

2021 - Continental Area: IFR flight hours per ATCO hour on duty (ACCs) (=A15/B57) (B60)

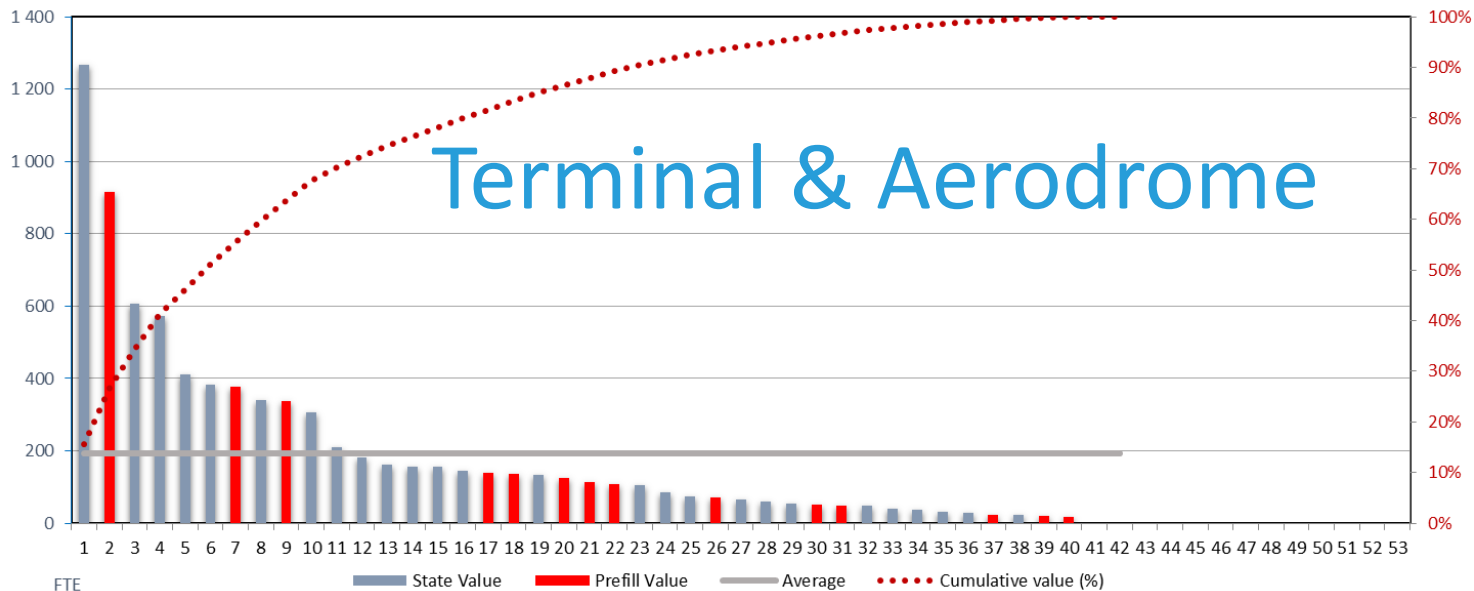


Item B60 is a better indicator for en-route ATCO productivity than item B59. The data suggest that about 15 States at the tail end of the distribution need to work on improving their ATCO productivity. Lessons can be learned from the dozen States, i.e. 13, on the left side of the graph which perform better than average.

2020 - Continental Area: Number of ATCOs in operations at Terminal Facilities (APP+TWRs) (A27)



2021 - Continental Area: Number of ATCOs in operations at Terminal Facilities (APP+TWRs) (A27)



## Terminal & Aerodrome

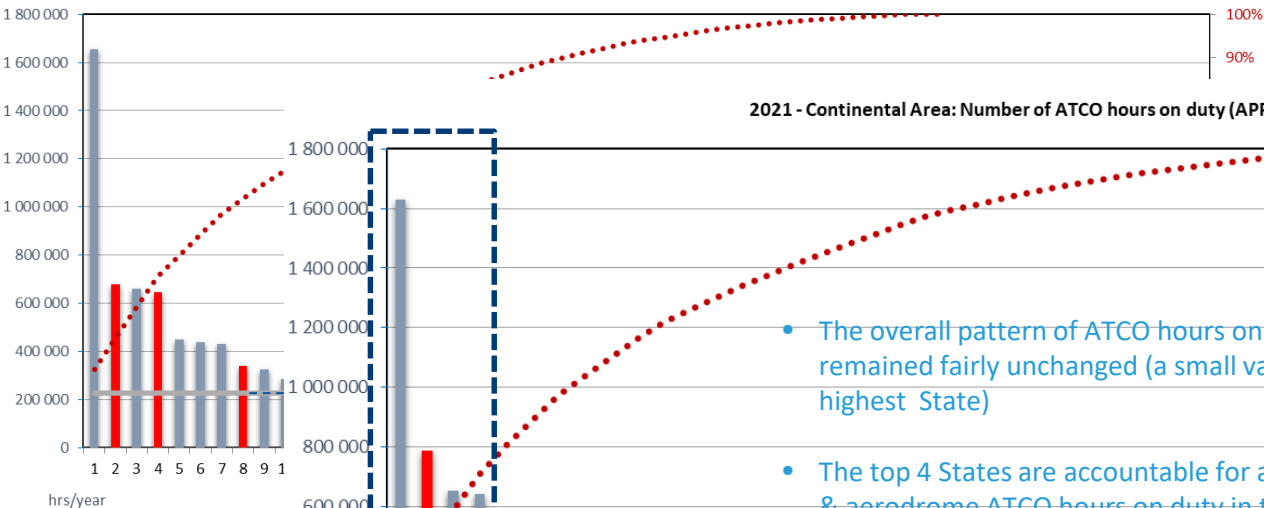
Note: These graphs are repeated here for ease of reference and comparison with the next graph (ATCO hours on duty).  
They also show a negligible change of the ATCO workforce at terminal facilities (APP + TWR)



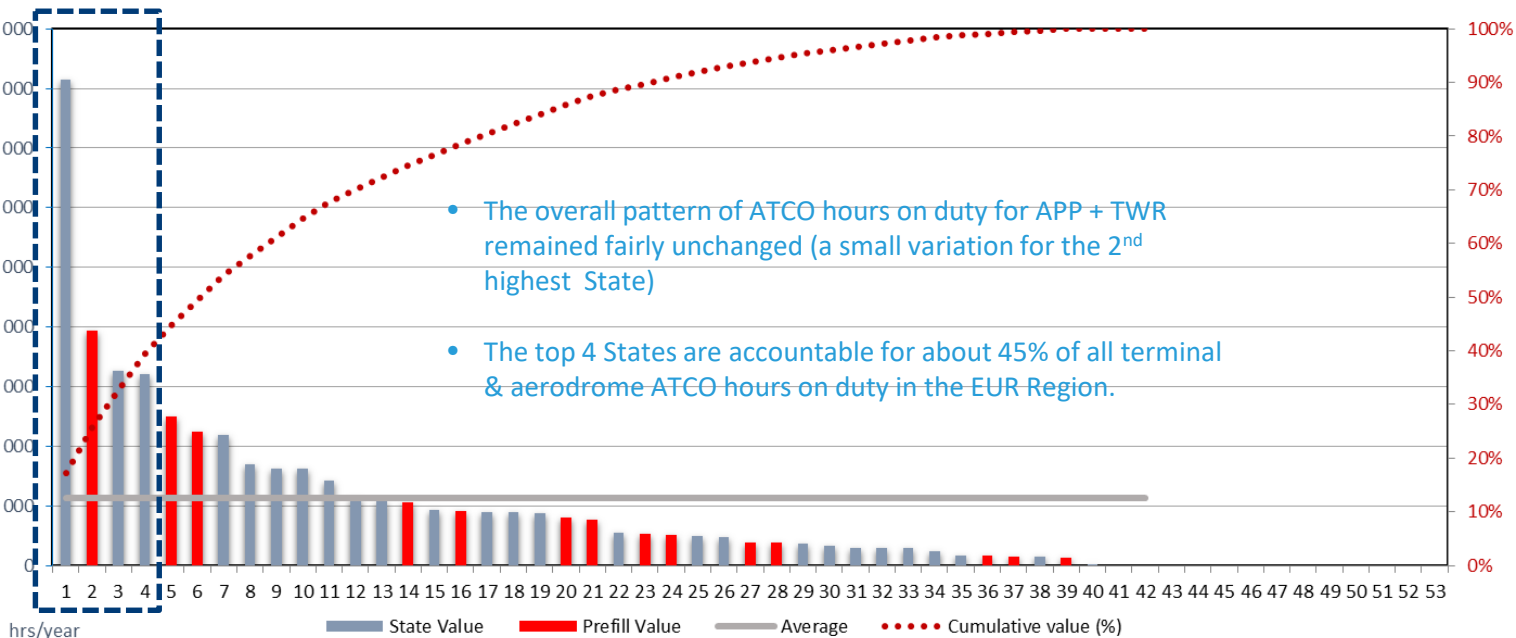
# Data item B58

## Terminal & Aerodrome

2020 - Continental Area: Number of ATCO hours on duty (APP+TWRs) (B58)



2021 - Continental Area: Number of ATCO hours on duty (APP+TWRs) (B58)





## Participation KPA





- The COVID19 pandemic limited the ability to conduct larger participation events in 2020 and 2021.
- A number of events were planned/conducted for 2022. However, the overall number still reflects pandemic / precautionary mechanism (i.e. reduced number of person-to-person contact, primary stakeholder interaction mechanism through online/virtual events).
- Note: submissions are cross-checked for comments on in-person or virtual events.



ICAO PARIS

UNITING AVIATION



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North American  
Central American  
and Caribbean  
(NACC) Office  
Mexico City

South American  
(SAM) Office  
Lima

ICAO  
Headquarters  
Montréal

Western and  
Central African  
(WACAF) Office  
Dakar

European and  
North Atlantic  
(EUR/NAT) Office  
Paris

Middle East  
(MID) Office  
Cairo

Eastern and  
Southern African  
(ESAF) Office  
Nairobi

Asia and Pacific  
(APAC) Sub-office  
Beijing

Asia and Pacific  
(APAC) Office  
Bangkok

