FOURTEENTH AIR NAVIGATION CONFERENCE

Montréal, Canada, 26 August to 6 September 2024

Agenda Item 3: Air navigation system performance improvement
3.3: Eighth Edition of the Global Air Navigation Plan (GANP)

SUMMARY OF THE PROPOSED UPDATE TO THE ENVIRONMENT KEY PERFORMANCE AREA AND THE RESILIENCE FOCUS AREA OF THE GLOBAL AIR NAVIGATION PLAN PERFORMANCE FRAMEWORK

(Presented by the Secretariat)

Note.— The proposed text to be included in the eighth edition of the GANP is presented in bold and shaded.

1. INTRODUCTION

1.1 The proposed update to the performance framework of the *Global Air Navigation Plan* (GANP, Doc 9750) focuses on the environment key performance area (KPA)[1] and under the capacity KPA, the resilience focus area. The seventh edition of the GANP includes the environment and resilience performance ambitions and environment performance objectives related to the operational improvements defined in the Aviation System Block Upgrade (ASBU) framework.

1.2 The purpose of this update to the GANP's performance framework is in line with the priorities set by the Assembly during its 41st Session.

2. ENVIRONMENT KEY PERFORMANCE AREA

2.1 Environment ambitions

2.1.1 Performance ambitions are outlined in the Global Strategic level of the GANP. They are qualitative statements providing global priorities on the performance evolution of the global air navigation system. They should not be seen as a target to continuously monitor and report performance against, but rather as a catalyst for change.

2.1.2 The current environment ambitions in the GANP[2] are "ANS-induced inefficiencies to be progressively removed to contribute to the global ICAO aspirational goals for CO_2 emissions" and "To benefit from achieved flight efficiency gains". Their existing supporting text is "Improved flight efficiency will automatically lead to savings in fuel burn, which in turn will bring environmental benefits on a per

[1] There are eleven key performance areas in the GANP, environment and capacity, as well as access and equity, cost-effectiveness, efficiency, flexibility, global interoperability, participation by the ATM community, predictability, safety and security.
[2] PERFORMANCE AMBITIONS - Global Air Navigation Plan Strategy (EN) (icao.int)

flight basis. Faced with an unprecedented global environmental challenge requiring commitment from a wide range of industries, the aviation industry has itself committed to very ambitious goals: carbon neutral growth from 2020 and a 50 per cent cut in CO_2 emissions by 2050 compared to 2005. ICAO Member States have adopted two global aspirational goals: a 2 per cent fuel efficiency improvement per annum and carbon neutral growth from 2020, and a basket of measures, which include operational improvements, to progress towards these goals". The performance ambitions and supporting text in the current GANP show a difference in scope from the environment focus areas set by the Organization under the environment strategic objective, i.e. climate change, local air quality and aircraft noise.

2.1.3 To ensure a common direction in environment performance, it is important to harmonize the scope of the environment performance ambitions in the GANP to provide for an integrated approach, and enhance consistency and coherency. Therefore, the environment performance ambitions of the GANP are proposed to be updated as follows:

"To minimize, through operational improvements that in particular reduce fuel burn, the adverse environmental impacts of aviation activity on the climate."

Supporting text:

At the 41st Session of the ICAO Assembly, States agreed to work together to strive for a Long-term Aspirational Goal (LTAG) that the aviation industry achieve net zero carbon emissions by 2050, a goal in line with the objectives of the Paris agreement to limit global warming to 1.5°C.

This will require maximum effort by all aviation stakeholders to deploy the ICAO basket of measures, including operational improvements aimed at reducing fuel burn. Deployment of ASBU elements and other operational improvements and GANP initiatives can also lead to savings in fuel burn and associated emissions.

ICAO Resolutions call upon States to implement operational improvements outlined in the GANP as part of their national strategy to reduce environmental impacts, including CO_2 emissions, from international aviation.

"To minimize, through operational improvements, the adverse local environmental impacts of aviation regarding noise and local air quality."

Supporting text:

Aviation operations can have adverse[3] *environmental effects upon noise and air quality, particularly for people living and working in the vicinity of airports. To address these environmental effects, ICAO develops Standards, Recommended Practices and Procedures and/or guidance material on aircraft noise and emissions.*

Aviation is taking action to reduce noise and local air quality impacts through the deployment of operational improvements. Operational measures to reduce local environmental impacts should follow the balanced approach for noise management established by ICAO and consider the means to reduce air quality impacts.

[3] Such as sleep disturbance, annoyance and cardiovascular disease.

2.2 **Environment focus areas**

2.2.1 Focus areas identify and delineate the broad areas in which there are intentions to establish a performance policy via the definition of performance objectives. They are defined because of a high-level analysis indicating areas where performance must be addressed in any given KPA. Focus areas (and sub-focus areas) offer a possibility to break down areas of concern; these can be useful to drive performance objectives and provide hooks to other focus areas/KPAs for discussing interdependencies on a more concentrated basis.

2.2.1 ~~The Organization~~ ICAO and its ~~Contracting~~ Member States have agreed to concentrate their efforts on the three core areas of the Environmental Protection Strategic Objective, i.e. climate change and aviation emissions, aircraft noise and local air quality. The 41st Session of the ICAO Assembly:

a) adopted the following three Assembly Resolutions: A41-20, *Consolidated statement of continuing ICAO policies and practices related to environmental protection — General provisions, noise and local air quality*, A41-21, *Consolidated statement of continuing ICAO policies and practices related to environmental protection — Climate change* and A41-22, *Consolidated statement of continuing ICAO policies and practices related to environmental protection – Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)*;

b) reducing aviation's impact on climate is one of ICAO's top priorities and Resolution A41-21 commits ICAO and States to strive to achieve a collective long-term aspirational goal of reducing international civil aviation's carbon emissions to net zero by 2050 by resolving "that States and relevant organizations will work through ICAO to achieve a global annual average fuel efficiency improvement of 2 per cent until 2020 and an aspirational global fuel efficiency improvement rate of 2 per cent per annum from 2021 to 2050, calculated on the basis of volume of fuel used per revenue tonne kilometre performed";

c) acknowledged "the progress achieved on all elements of the basket of measures available to address CO_2 emissions from international aviation, including aircraft technologies, operational improvements, sustainable aviation fuels and CORSIA" and affirmed "the preference for the use of aircraft technologies, operational improvements and sustainable aviation fuels that provide the environmental benefits within the aviation sector";

d) recognized that air traffic management (ATM) measures under the ICAO GANP contribute to enhanced operational efficiency and the reduction of aircraft CO_2 emissions; and

e) recognized the importance of GANP as an operational strategy and part of the basket of measures to achieve ICAO's global aspirational goals on CO_2 emissions.

2.2.2 ~~The Organization~~ ICAO has dedicated Annex 16 — *Environmental Protection*, Volume I — *Aircraft Noise*, Volume II — *Aircraft Engine Emissions*, Volume III — *Aeroplane CO_2 Emissions*, and Volume IV — *Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)*; different working groups in Committee on Aviation Environmental Protection (CAEP) to formulate new policies and propose new Standards and Recommended Practices (SARPs) related to aircraft noise and emissions, and more generally to aviation environmental impact; and conducts work on climate adaptation as well and provides capacity-building and assistance activities along with the State Action Plans Initiative.

2.2.3 The seventh edition of the GANP did not define environment focus areas. However, in order to avoid overlapping of performance policies and to provide for an integrated approach to environment, the following focus areas within the environment KPA are proposed to be included in the eighth edition of the GANP:

- **Climate change**
- **Local air quality**
- **Aircraft noise**

2.3 **Environment performance objectives**

2.3.1 Performance policy is defined through a set of specific, measurable, achievable, relevant and timely (SMART) objectives.

2.3.2 The performance objective for the environment KPA in the seventh edition of the GANP is to maintain or improve environmental sustainability of aviation. Aligned with this performance objective, the following objectives and sub-objectives are proposed to be included in the eighth edition of the GANP under each proposed environment focus area:

2.3.3 Performance objectives and sub-objectives for climate change

*Note 1.— **The GANP only covers the definition of operational improvements from the ICAO basket of measures. Other elements of the ICAO basket of measures are marked with an asterisk (*) and they are not part of the GANP. They are listed in this tree only to reflect an integrated approach and show the other topics that are covered under the Environmental Protection Strategic Objective. The performance tree will not be developed and expanded for these measures. Further information is available at: https://www.icao.int/environmental-protection/Pages/default.aspx.***

*Note 2.— **Updated/new KPIs have been cross-referenced to the performance objective(s) trees to demonstrate where they can be applied. These are indicated in red and are applicable to all performance objectives at lower tree levels.***

*Note 3.— **In the climate change tree, the overall assumption is that to reduce CO_2 emissions, this is achieved by reducing fuel burn hence the majority of performance objectives start with "Reduce fuel burn/CO_2 emissions".***

Reduce emissions:

a) **Reduce fuel burn/CO_2 emissions with technology***
   - **i) Reduce fuel burn/CO_2 emissions by using new generation aircraft***
   - **ii) Reduce fuel burn/CO_2 emissions by reducing a/c weight***
     - **1) Reduce fuel burn/CO_2 emissions by reducing a/c weight by using lighter equipment***
     - **2) Reduce fuel burn/CO_2 emissions by reducing a/c weight with maintenance procedures***
     - **3) Reduce fuel burn/CO_2 emissions by reducing a/c weight by removing condensation from fuselage***
     - **4) Reduce fuel burn/CO_2 emissions by reducing a/c weight with last minute timing of procedures (e.g. fuel uplift)***
     - **5) Reduce fuel burn/CO_2 emissions by reducing a/c weight by reducing discretionary fuel***
     - **6) Reduce fuel burn/CO_2 emissions by reducing a/c weight with OPR procedures***
     - **7) Reduce fuel burn/CO_2 emissions by reducing a/c weight by not performing fuel tankering***

b) **Reduce fuel burn/CO_2 emissions with operational measures KPI16 – Additional fuel burn/CO_2**
   - **i) Reduce fuel burn/CO_2 emissions at the gate**
     - **1) Reduce fuel burn/CO_2 emissions with new ground infrastructure**
   - **ii) Reduce fuel burn/CO_2 emissions in the taxi-out phase**
     - **1) Reduce fuel burn/CO_2 emissions with new taxi solution technology**
     - **2) Reduce fuel burn/CO_2 emissions by using ground-based taxi technology**
   - **iii) Reduce fuel burn/CO_2 emissions by using aircraft-based taxi technology**
     - **1) Reduce fuel burn/CO_2 emissions with operational measures under standard conditions**
     - **2) Reduce fuel burn/CO_2 emissions by reducing taxi-out time**

- 3) **Reduce fuel burn/CO_2 emissions by reducing taxi time in peak hours due to increase of runway capacity enabled by new wake turbulence separations between arriving aircraft**
- 4) **Reduce fuel burn/CO_2 emissions by improving traffic predictability**
- 5) **Reduce fuel burn/CO_2 emissions by using less than all engine taxi procedures**

iv) **Reduce fuel burn/CO_2 emissions with operational measures under non-standard conditions**
- 1) **Reduce fuel burn/CO_2 emissions by reducing taxi-out time during low visibility operations**
- 2) **Reduce fuel burn/CO_2 emissions by reducing taxi-out time during rerouting events**

c) **Reduce fuel burn/CO_2 emissions in the climb phase**

i) **Reduce fuel burn/CO_2 emissions by minimizing vertical trajectory constraints**
- 1) **Reduce fuel burn/CO_2 emissions by minimizing permanent (airspace and departure procedure design) and semi-permanent (flow management measures) altitude constraints (level capping)**
- 2) **Reduce fuel burn/CO_2 emissions by minimizing tactical altitude constraints during climb imposed by ATM**
- 3) **Reduce fuel burn/CO_2 emissions by minimizing level-off instructions during climb issued by ATCOs for conflict resolution purposes**
- 4) **Reduce fuel burn/CO_2 emissions by minimizing altitude constraints during climb arising from interdependency with noise**

ii) **Reduce fuel burn/CO_2 emissions by minimizing horizontal trajectory constraints**
- 1) **Reduce fuel burn/CO_2 emissions by minimizing permanent (airspace and departure procedure design) and semi-permanent (flow management measures) track extensions**
- 2) **Reduce fuel burn/CO_2 emissions by minimizing tactical altitude constraints during climb imposed by ATM**

d) **Reduce fuel burn/CO_2 emissions in the cruise phase**

i) **Reduce fuel burn/CO_2 emissions with aircraft operator operating procedures**
- 1) **Reduce fuel burn/CO_2 emissions by optimizing speed**

ii) **Reduce fuel burn/CO_2 emissions with flight planning procedures**

iii) **Reduce fuel burn/CO_2 emissions by minimizing horizontal trajectory inefficiencies**
- 1) **Reduce fuel burn/CO_2 emissions by minimizing inefficiencies caused by aircraft equipage and operating limitations**
- 2) **Reduce fuel burn/CO_2 emissions by minimizing inefficiencies caused by cost optimization considerations**
- 3) **Reduce fuel burn/CO_2 emissions by minimizing inefficiencies caused by route network design**
- 4) **Reduce fuel burn/CO_2 emissions by minimizing inefficiencies caused by route availability and selection**
- 5) **Reduce fuel burn/CO_2 emissions by minimizing inefficiencies caused by linked to re-routes related to temporary airspace closures/restrictions**
- 6) **Reduce fuel burn/CO_2 emissions by minimizing inefficiencies caused by capacity constraints**
- 7) **Reduce fuel burn/CO_2 emissions by minimizing inefficiencies caused by flying fixed tracks in oceanic airspace**

iv) **Reduce fuel burn/CO_2 emissions by minimizing vertical trajectory inefficiencies**
- 1) **Reduce fuel burn/CO_2 emissions by minimizing inefficiencies caused by aircraft equipage and operating limitations**
- 2) **Reduce fuel burn/CO_2 emissions by minimizing inefficiencies caused by cost optimization considerations**

3) **Reduce fuel burn/CO_2 emissions by minimizing inefficiencies caused by route network design**
4) **Reduce fuel burn/CO_2 emissions by minimizing inefficiencies caused by route availability and selection**
5) **Reduce fuel burn/CO_2 emissions by minimizing inefficiencies caused by linked to re-routes related to temporary airspace closures/restrictions**
6) **Reduce fuel burn/CO_2 emissions by minimizing inefficiencies caused by capacity constraints**
7) **Reduce fuel burn/CO_2 emissions by minimizing inefficiencies caused by not access to the optimum flight level in oceanic and remote airspace**
8) **Reduce fuel burn/CO_2 emissions by minimizing inefficiencies caused by the current extent of RVSM airspace**

v) **Reduce fuel burn/CO_2 emissions by minimizing time constraints**
vi) **Reduce fuel burn/CO_2 emissions by enhanced information-sharing**

e) **Reduce fuel burn/CO_2 emissions in the descent phase**

i) **Reduce fuel burn/CO_2 emissions by enabling flight to start descent at optimal ToD**
1) **Reduce fuel burn/CO_2 emissions by minimizing uncertainty about the optimum ToD point**

ii) **Reduce fuel burn/CO_2 emissions by minimizing descent constraints after ToD has been chosen and executed**
1) **Reduce fuel burn/CO_2 emissions by minimizing descent constraints after ToD where trajectory extensions are provided by ATC resulting in an early ToD**
2) **Reduce fuel burn/CO_2 emissions by minimizing descent constraints after ToD where trajectory shortenings are provided by ATC resulting in a late ToD**

iii) **Reduce fuel burn/CO_2 emissions by minimizing vertical trajectory constraints**
1) **Reduce fuel burn/CO_2 emissions by minimizing permanent (airspace and departure procedure design) and semi-permanent (flow management measures) altitude constraints**
2) **Reduce fuel burn/CO_2 emissions by minimizing tactical altitude constraints during descent imposed by ATM**
3) **Reduce fuel burn/CO_2 emissions by minimizing level-off instructions during descent issued by ATCOs for conflict resolution purposes**
4) **Reduce fuel burn/CO_2 emissions by minimizing altitude constraints during descent arising from interdependency with noise**
5) **Reduce fuel burn/CO_2 emissions by minimizing altitude restrictions during descent introduced to facilitate merging of traffic flows in the vertical plane**
6) **Reduce fuel burn/CO_2 emissions by minimizing altitude restrictions during descent introduced for sequencing and metering (including holding in arrival stacks)**
7) **Reduce fuel burn/CO_2 emissions by minimizing altitude restrictions during descent introduced for dealing with aircraft capability limitations (e.g. navigation capabilities)**

iv) **Reduce fuel burn/CO_2 emissions by minimizing horizontal trajectory constraints**
1) **Reduce fuel burn/CO_2 emissions by minimizing permanent (airspace and arrival procedure design) and semi-permanent (sequencing measures) track extensions**

    2) **Reduce fuel burn/CO_2 emissions by minimizing tactical track extensions during descent imposed by ATM**
  - v) **Reduce fuel burn/CO_2 emissions by minimizing time in terminal airspace**
    1) **Reduce fuel burn/CO_2 emissions by absorbing delay in the en-route phase**
  - vi) **Reduce fuel burn/CO_2 emissions by reducing separation between arriving aircraft due to implementation of new wake turbulence separations between aircraft**
  - vii) **Reduce fuel burn/CO_2 emissions by reducing missed approach/diversions, with lower landing ceilings**
- f) **Reduce fuel burn/CO_2 emissions in the taxi-in phase**
  - i) **Reduce fuel burn/CO_2 emissions with new taxi solution technology**
    1) **Reduce fuel burn/CO_2 emissions by using ground-based taxi technology**
    2) **Reduce fuel burn/CO_2 emissions by using aircraft-based taxi technology**
  - ii) **Reduce fuel burn/CO_2 emissions with operational measures under standard conditions**
    1) **Reduce fuel burn/CO_2 emissions by reducing taxi-in time**
    2) **Reduce fuel burn/CO_2 emissions by improving traffic predictability**
    3) **Reduce fuel burn/CO_2 emissions by using less than all engine taxi procedures**
  - iii) **Reduce fuel burn/CO_2 emissions with operational measures under non-standard conditions**
    1) **Reduce fuel burn/CO_2 emissions by reducing taxi-in time during low visibility operations**
- g) **Reduce fuel burn/CO_2 emissions by using Sustainable Aviation Fuels***
- h) **Reduce fuel burn/CO_2 emissions with market-based measures***

2.3.4 Performance objectives and sub-objectives for noise

*Note 1.— **The noise performance objective tree is based on the four pillars of the ICAO balanced approach. The balanced approach is the foundation of aircraft noise management worldwide and provides a framework for analysis of the various measures available to reduce aircraft noise at and around airports noting that the fourth pillar, operating restrictions should only be applied as the last resort.***

*Note 2.— **The GANP only covers the definition of Pillar 3: reducing noise through operational measures from the balanced approach to noise management. Other elements of the balanced approach are marked with an asterisk (*) and they are not considered as a part of the GANP even though they may be considered as operational measures. They are listed in this tree only to reflect an integrated approach and show the other topics are covered under the Environmental Protection Strategic Objective. The performance tree will not be developed and expanded for these measures. Further information is available at: https://www.icao.int/environmental-protection/Pages/default.aspx.***

*Note 3.— **Updated / new KPIs have been cross-referenced to the performance objective(s) trees to demonstrate where they can be applied. These are indicated in red and are applicable to all performance objectives at lower levels. ICAO Doc 9829,*** **Guidance on the Balanced Approach to Aircraft Noise,** ***describes an analysis of encroachment as the percentage of change in population/households within the airport noise-regulated area***

where land-use planning is applicable as defined by the authority. The proposed KPI 24 for the noise focus area (People / Area impacted by significant noise), presented in paragraph 2.4.3.6, is considered a higher-level indicator under which the recommended encroachment KPI may be considered a more focused variant. "Significant noise" is determined by local or regional regulations.

Reduce Noise:

a) **Reduce noise at source***
   - **i) Reduce noise of fixed wing aircraft ***
     - **1) Reduce engine noise of aircraft***
       - — **Reduce engine noise by using new generation engines***
       - — **Reduce engine noise by using a low noise propellors on propellor aircraft***
       - — **Reduce engine noise through maintenance***
         - **(a) Reduce engine noise by maintaining compressor efficiency***
         - **(b) Reduce engine noise by reducing the fouling of the internal compressor***
         - **(c) Reduce engine noise by using automated engine parameter and fuel burn monitoring systems to identify degradation of engine performance***
         - **(d) Reduce engine noise by maintaining the acoustic liners in the nacelle intake in good condition***
     - **2) Reduce airframe noise of aircraft ***
       - — **Reduce airframe noise by using new generation aircraft***
       - — **Reduce airframe noise by employing appropriate cleaning solutions***
       - — **Reduce airframe noise with noise reduction kits ***
   - **ii) Reduce noise of helicopters***
     - **1) Reduce engine noise for helicopters***
     - **2) Reduce airframe and blade noise for helicopters***

b) **Reduce noise exposure through land-use planning and management***
   - **i) Reduce noise exposure by maintaining the use of an effective land-use planning process***
     - **1) Reduce noise exposure by maintaining compatible land use around airport***
     - **2) Reduce noise exposure by updating noise exposure maps regularly***
     - **3) Reduce noise exposure by undertaking community engagement to engage with local communities***
   - **ii) Reduce noise exposure by reducing encroachment***
     - **1) Reduce noise exposure by using appropriate platform to monitor city building plans and promoting compatible land use planning***
     - **2) Reduce noise exposure by requiring avigation easements for developments within noise zones around airports***
     - **3) Reduce noise exposure by regularly measuring the rate of encroachment***
     - **4) Reduce noise exposure by reducing the population within areas exposed to significant noise***

5) **Reduce noise exposure by acquiring incompatible land uses in the very high noise exposure zones***
6) **Reduce exposure through use of sound insulation programs for residential and other noise sensitive land uses***

c) **Reduce noise through operational measures**

i) Reduce noise in the taxi-out phase

1) **Reduce noise by using preferential taxi-out routes**
2) **Reduce noise with new taxi solution technology**
   — **Reduce noise by using ground-based taxi technology**
   — **Reduce noise by using aircraft-based taxi technology**

ii) Reduce noise in the climb phase (KPI 24 - People/Area Impacted by Significant Noise)

— **Reduce noise in the initial climb phase for fixed wing aircraft**
   (a) Reduce noise by minimizing noise close to the airport (NADP1)
   (b) Reduce noise by minimizing noise further away from the airport (NADP2)
   (c) Reduce noise by removing intermediate level off segments from climb
   (d) Reduce noise by flying noise preferential routes
   (e) Reduce noise by using preferential runways
      (i) Reduce noise by designating a noise preferred runway during day
      (ii) Reduce noise by designating a noise preferred runway at low activity times of the day
      (iii) Reduce noise by using a runway alternation and respite schedule
   (f) Reduce noise through optimizing SID design
      (i) Reduce noise by designing SIDs for specific aircraft types
      (ii) Reduce noise by designing SIDs for specific times of the day
   (g) Reduce noise by optimizing the lateral approach path and use PBN for flight track management
      (i) Reduce noise by concentrating flight paths away from centres of population
      (ii) Reduce noise by dispersing flight tracks overpopulated areas
      (iii) Reduce noise exposure by creating multiple paths for distributing the noise

2) **Reduce noise for helicopters**
   — **Reduce noise by using routes that avoid populated areas**
   — **Reduce noise by using specific transportation corridors**
   — **Reduce noise by using model-specific noise abatement procedures**
      (a) Reduce noise by maximizing climb rate
   — **Reduce noise by using enhanced handling techniques**

iii) Reduce noise in the cruise phase

1) **Reduce noise in the cruise phase for fixed wing aircraft**
2) **Reduce noise in the cruise phase for helicopters**
   — **Reduce noise by using enhanced handling techniques**

- **Reduce noise at high airspeeds and/or low ambient temperatures**
  - **(a) Reduce high speed impulsive (HSI) noise by reducing airspeed**

iv) Reduce noise in the hover phase (KPI 24 - People/Area Impacted by Significant Noise)

1) Reduce noise in the hover phase for helicopters

- **Reduce hover noise by minimizing hover operations near noise sensitive areas**

v) Reduce noise in the descent phase (KPI 24 - People/Area Impacted by Significant Noise)

1) Reduce noise in the descent phase for fixed wing aircraft

- **Reduce noise by optimizing the lateral approach path and use PBN for flight track management**
  - **(a) Reduce noise by deploying procedures to offset flight paths away from centres of population**
  - **(b) Reduce noise by avoiding airborne holding**
- **Reduce noise by minimizing constraints in the final approach vertical path**
  - **(a) Reduce noise by removing intermediate level segments from final approach**
  - **(b) Reduce noise by using displaced thresholds**
  - **(c) Reduce noise by using increased glideslope angles where appropriate**
  - **(d) Reduce noise by using decreased glideslope angles where appropriate**
  - **(e) Reduce noise by using multiple runway aiming point (MRAP)**
  - **(f) Reduce noise by using two-segment approaches**
- **Reduce noise by using preferential runways**
  - **(a) Reduce noise by designating a noise preferred runway during day**
  - **(b) Reduce noise by designating a noise preferred runway at low activity times of the day**
  - **(c) Reduce noise by using a runway alternation and respite schedule**
- **Reduce noise by optimizing STAR design**
  - **(a) Reduce noise by designing STARs for specific aircraft types**
  - **(b) Reduce noise by designing STARs for specific times of the day**
- **Reduce noise by minimizing missed approaches/go-arounds**
  - **(a) Reduce noise by improving runway access during bad weather with PBN routes**
- **Reduce noise on final approach with enhanced operational procedures**
  - **(a) Reduce noise by flying a low power-low drag approach**
  - **(b) Reduce noise by using a late deployment of gear and flaps**
  - **(c) Reduce noise by reducing the landing flaps setting**
- **Reduce noise on the runway with enhanced operational procedures**
  - **(a) Reduce noise by regulating deceleration through autoflight and autobrake equipment on board such as the brake-to-vacate (BTV) system**
  - **(b) Reduce noise by minimizing the use of reverse thrust**

2) Reduce noise in the descent phase for helicopters

- **Reduce noise by using enhanced handling techniques**
- **Reduce blade vortex interaction (BVI) noise by using enhanced operating procedures**

vi) Reduce noise in the taxi-in phase

1) Reduce noise by using preferential taxi-in routes

2) Reduce noise with new taxi solution technology

- **Reduce noise by using ground-based taxi technology**
- **Reduce noise by using aircraft-based taxi technology**

vii) Reduce noise on the ground

1) Reduce noise

2) Reduce noise from APU usage

3) Reduce noise by employing noise barriers

4) Reduce noise during ground runs

- **Reduce noise by minimizing ground runs**
- **Reduce noise by performing engine ground runs in hangars**
- **Reduce noise by performing engine ground runs in specialist ground run up enclosures**
- **Reduce noise by performing engine ground runs by natural noise barriers**

d) **Reduce noise through operating restrictions***

2.3.5 Performance objectives and sub-objectives for local air quality

*Note 1.— **The difference between the performance objective trees for the climate change and local air quality focus areas is that the climate change performance objectives relate to all phases of flight whereas the local air quality performance objectives are only to be applied in the landing take-off (LTO) cycle, i.e. below a height of 3 000 ft above aerodrome level.***

*Note 2.— **The GANP only covers the definition of operational improvements from the ICAO basket of measures. Other elements of the ICAO basket of measures are marked with an asterisk (*) and they are not part of the GANP. They are listed in this tree only to reflect an integrated approach and show the other topics are covered under the Environmental Protection Strategic Objective. The performance tree will not be developed and expanded for these measures. Further information is available at: https://www.icao.int/environmental-protection/Pages/default.aspx.***

*Note 3.— **Updated/new KPIs have been cross-referenced to the performance objective(s) trees to demonstrate where they can be applied. These are indicated in red and are applicable to all performance objectives at lower levels.***

*Note 4.— **In the local air quality tree, the overall assumption is that to reduce CO_2 emissions, this is done by reducing fuel burn hence the majority of performance objectives start with "Reduce fuel burn/CO_2 emissions".***

Reduce emissions:

a) **Reduce fuel burn/CO_2 emissions with technology***
   - **i) Reduce fuel burn/CO_2 by using new generation aircraft***
      - **1) Reduce fuel burn/CO_2 emissions by reducing a/c weight***
      - **2) Reduce fuel burn/CO_2 emissions by reducing a/c weight by using lighter equipment***
      - **3) Reduce fuel burn/CO_2 emissions by reducing a/c weight with maintenance procedures***
      - **4) Reduce fuel burn/CO_2 emissions by reducing a/c weight by removing condensation from fuselage***
      - **5) Reduce fuel burn/CO_2 emissions by reducing a/c weight with last minute timing of procedures (e.g. fuel uplift)***
      - **6) Reduce fuel burn/CO_2 emissions by reducing a/c weight by reducing discretionary fuel***
      - **7) Reduce fuel burn/CO_2 emissions by reducing a/c weight with OPR procedures***
      - **8) Reduce fuel burn/CO_2 emissions by reducing a/c weight by not performing fuel tankering***

b) **Reduce fuel burn/CO_2 emissions with operational measures KPI16 – Additional fuel burn / CO_2**
   - **i) Reduce fuel burn/CO_2 emissions at the gate**
      - **1) Reduce fuel burn/CO_2 emissions with new ground infrastructure**
   - **ii) Reduce fuel burn/CO_2 emissions in the taxi-out phase**
      - **1) Reduce fuel burn/CO_2 emissions with new taxi solution technology**
         - — **Reduce fuel burn/CO_2 emissions by using ground-based taxi technology**
         - — **Reduce fuel burn/CO_2 emissions by using aircraft-based taxi technology**
      - **2) Reduce fuel burn/CO_2 emissions with operational measures under standard conditions**
         - — **Reduce fuel burn/CO_2 emissions by reducing taxi-out time**
         - — **Reduce fuel burn/CO_2 emissions by reducing taxi time in peak hours due to increase of runway capacity enabled by new wake turbulence separations between arriving aircraft**
         - — **Reduce fuel burn/CO_2 emissions by improving traffic predictability**
         - — **Reduce fuel burn/CO_2 emissions by using less than all engine taxi procedures**
      - **3) Reduce fuel burn/CO_2 emissions with operational measures under non-standard conditions**
         - — **Reduce fuel burn/CO_2 emissions by reducing taxi-out time during low visibility operations**
         - — **Reduce fuel burn/CO_2 emissions by reducing taxi-out time during rerouting events**
   - **iii) Reduce fuel burn/CO_2 emissions in climb out**
      - **1) Reduce fuel burn/CO_2 emissions by minimizing vertical trajectory constraints**
         - — **Reduce fuel burn/CO_2 emissions by minimizing permanent (airspace and departure procedure design) and semi-permanent (flow management measures) altitude constraints (level capping)**
         - — **Reduce fuel burn/CO_2 emissions by minimizing tactical altitude constraints during climb imposed by ATM**
         - — **Reduce fuel burn/CO_2 emissions by minimizing level-off instructions during climb issued by ATCOs for conflict resolution purposes**

- **Reduce fuel burn/CO_2 emissions by minimizing altitude constraints during initial climb arising from interdependency with noise**

2) **Reduce fuel burn/CO_2 emissions by minimizing the horizontal climb trajectory constraints**
   - **Reduce fuel burn/CO_2 emissions by minimizing permanent (airspace and departure procedure design) and semi-permanent (flow management measures) track extensions**
   - **Reduce fuel burn/CO_2 emissions by minimizing tactical altitude constraints during climb imposed by ATM**

iv) Reduce fuel burn/CO_2 emissions on final approach

1) **Reduce fuel burn/CO_2 emissions by minimizing missed approach/diversions with lower landing ceilings**
2) **Reduce fuel burn/CO_2 emissions by reducing arrival spacing**

v) Reduce fuel burn/CO_2 emissions in the taxi-in phase

1) **Reduce fuel burn/CO_2 emissions with new taxi solution technology**
   - **Reduce fuel burn/CO_2 emissions by using ground-based taxi technology**
   - **Reduce fuel burn/CO_2 emissions by using aircraft-based taxi technology**
2) **Reduce fuel burn/CO_2 emissions with operational measures under standard conditions**
   - **Reduce fuel burn/CO_2 emissions by reducing taxi-in time**
   - **Reduce fuel burn/CO_2 emissions by improving traffic predictability**
   - **Reduce fuel burn/CO_2 emissions by using less than all engine taxi procedures**
3) **Reduce fuel burn/CO_2 emissions with operational measures under non-standard conditions**
   - **Reduce fuel burn/CO_2 emissions by reducing taxi-in time during low visibility operations**

c) **Reduce fuel burn/CO_2 by using sustainable aviation fuels***

d) **Reduce fuel burn/CO_2 by implementing market-based measures***

2.4 Environment key performance indicators (KPIs)

2.4.1 Some objectives require precisely defined numerical performance indicators, which serve to establish quantitative measures that, collectively, will indicate progress towards achieving an objective. In order to facilitate this task, the seventh edition of the GANP contains, in its global technical level, a list of 23 KPIs[3] within the KPAs of capacity, efficiency, predictability and safety. These KPIs are associated to the generic performance objectives in the GANP and can be tailored to regional and national instantiated performance objectives. Some of the 23 KPIs defined in the GANP can be used to measure environmental performance as follows.

2.4.2 Currently, the ICAO Council, through the Committee on Aviation Environmental Protection (CAEP), is leading the work on the development of a methodology to monitor progress towards achieving the long-term global aspirational goal for international aviation (LTAG) of net-zero carbon emissions by 2050. This work includes the development of metrics to monitor emissions reductions across all aspects of operations (including the air traffic management measures under GANP), technology, and fuel streams, with a targeted completion of recommendations to the Council at the CAEP/13 meeting in February 2025. The metrics to be agreed on for LTAG monitoring may affect the Key Performance Indicators (KPIs) defined for operational measures within the scope of GANP. Upon the completion of the LTAG monitoring methodology by the Council, there may be a need to review and update the Key Performance Indicators (KPIs) within the scope of the GANP.

2.4.3 Climate change

2.4.3.1 Reducing aviation's impact on climate is one of ICAO's top priorities and Resolution A41-21 commits ICAO and States to strive to achieve a collective long-term aspirational goal of reducing international civil aviation's carbon emissions to net zero by 2050.

2.4.3.2 Air traffic management reduces climate impact through maximizing flight efficiency for aircraft operating on the ground or in the air. It is well understood that inefficiencies in ATM can extend flight distance or time or result in aircraft operating in a less than optimal profile that results in excess fuel burn. The GANP Performance Framework already has a robust set of KPIs to measure flight efficiency:

a) Taxi-out additional time (KPI02)

b) Filed flight plan en-route extension (KPI04)

c) Actual en-route extension (KPI05)

d) Additional time in terminal airspace (KPI08)

e) Taxi-in additional time (KPI13)

f) Level-off time during climb (KPI17)

g) Level-off during cruise (KPI18)

h) Level-off during descent (KPI19)

2.4.3.3 Additionally, the KPI for Additional Fuel Burn (KPI16) provides stakeholders with a methodology to amalgamate inefficiencies identified by KPI02, KPI05, KPI08, KPI13, KPI17, KPI18 and KPI19 and calculate a cumulative additional fuel burn figure[4]. The performance framework can use this KPI as an environment performance indicator by converting the value to CO_2 (kg fuel burn * 3.16 kg CO2/kg fuel for Jet-A fuel) - provided a database containing suitable fuel flow performance data is available and used - or as a cost effectiveness performance indicator (by converting the fuel burn to the monetary value of fuel).

2.4.3.4 KPI16 is a useful environmental metric that can help to identify an overall “benefit pool” by suggesting the ATM-induced flight inefficiency that is theoretically actionable by operational stakeholders (although it is acknowledged that not all inefficiencies are able to be eliminated or the proportion of which individual stakeholders may be responsible for mitigating). However, information about excess fuel burn alone, or additional CO_2 emissions alone, do not necessarily provide actionable information that helps identify where measures should be taken to reduce ATM inefficiencies. That information is more readily available in the individual flight efficiency metrics used to calculate the more cumulative environmental KPI16 metric. For example, a high number of nautical miles in level flight after top of descent (KPI19) can help point to potential actions in airspace redesign or improved sequencing capabilities that may address the identified inefficiencies that are contributing to environmental impacts.

2.4.3.5 As KPI16 can be used to measure an overall ATM-induced flight efficiency “benefit pool” through the linear conversion factor of 3.16 kg CO_2/kg fuel for Jet-A fuel, an expansion of KPI16 to “additional fuel burn/CO_2” is proposed in order to align with the performance objectives and sub-objectives of the climate change focus area.

2.4.4 **Noise**

2.4.4.1 Noise from aviation operations impacts people living and working in the vicinity of airports. The aviation industry has made major source noise reductions over the past decades.

2.4.4.2 Regulations governing noise at and around airports are predominantly set at a local or regional level. Accordingly, noise metrics used globally vary, with different governments mandating the use of various metrics. Additionally, many States mandate land-use management planning to limit housing and other building development within areas with significant noise exposure. Some States will also use noise reducing insulation in dwellings to reduce noise from aviation. The threshold of what consists of “significant noise” is highly dependent on the noise metric used for the assessment and is also determined by local or regional regulations.

2.4.4.3 The 33rd Session of the ICAO Assembly adopted Resolution A33-7: *Consolidated statement of continuing ICAO policies and practices related to environmental protection*, Appendix C, *Policies and programmes based on a “balanced approach” to aircraft noise management*. This Assembly Resolution, which is the main overarching ICAO policy on aircraft noise, has since been reaffirmed at all subsequent Sessions of the ICAO Assembly, with the most recent being A41-20. Detailed guidance on the application of the “balanced approach” is provided in the *Guidance on the Balanced Approach to Aircraft Noise Management* (Doc 9829). The balanced approach consists of identifying the noise problem at a specific airport and analysing available actions to reduce noise through the exploration of various measures.

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[4] Compute the KPI16: (KPI02 Taxi-Out Additional Time x Average fuel flow during taxi) + (KPI13 Taxi-In Additional Time x Average fuel flow during taxi) + (KPI05 Actual en-Route Extension (%) x Average en-route distance flown x Average fuel flow in en-route airspace) + (KPI08 Additional time in terminal airspace x Average fuel flow during arrival in terminal airspace) + (KPI17 Level-off distance during climb x Average additional fuel flow during climb) + (KPI18 Average number of FL too low x Average distance during cruise x Average additional fuel flow per FL too low during cruise) + (KPI19 Level-off distance during descent x Average additional fuel flow during descent).

These measures can be classified into four principal elements: reduction of noise at source (technology standards), land-use planning and management, noise abatement operational procedures and operating restrictions on aircraft. The GANP covers the definition of Pillar 3: reducing noise through operational measures from the balanced approach to noise management.

2.4.4.4 Two main types of noise metrics exist and are commonly used for noise monitoring. The first records the maximum noise level measured for each aircraft operation. The other type of metric observes on a cumulative basis the total sound exposure from all aircraft operations (typically one average day of operations). While both types of noise metrics have value in specific circumstances, the cumulative metrics are more suited for assessing airspace-wide noise impact of operational improvements.

2.4.4.5 Regardless of which noise metric is used, an easy way to assess noise impact is by generating the total noise footprint contours. An assessment of the noise footprint contour and associated number of people affected by significant noise is a well understood method to understand total noise impact at and around an airport. These contours can be generated to address different aspects of noise management. For instance, where land-use management is applicable, the total area or persons within a specified contour may be of interest. When assessing an operational improvement, the total area of a specified noise contour may be of interest. Assessments of the noise footprint contours for different scenarios or for different years can provide an indication of the change of noise impact. Noise footprint contours can be used to identify population areas in which operational improvements result in a reduction (or increase) of the noise impact on people living and working in the vicinity of airports and associated impact on land-use planning.

2.4.4.6 Since none of the 23 KPIs in the GANP can be used to measure noise, the following environment KPI is proposed to be included in the eighth edition of the GANP:

KPI ID	**KPI24**
KPI Name	**People/Area Impacted by Significant Noise**
Definition	**Quantification of population/area size exposed to noise above a specified threshold(s)**
Measurement Units	**People/Area**
Operations measured	**Take-off, departure, arrival, approach**
Variants	**Variants can be based on different metrics that are considered acceptable by different global jurisdictions. Examples of noise metrics include DNL, L_{den}, L_{Aeq}**
Object(s) characterized	**The KPI is typically computed for individual airports, or clusters of airports (selection/grouping based on size and/or geography)**
Utility of the KPI	**This KPI is intended to give an indication of the total noise footprint impact of all operations on people living and working in the vicinity of airports. The noise impact can be used for assessing the total noise of an airport, the change in noise impact due to operational improvements, air traffic system changes, and airport growth.**
Parameters	**• Area within a noise footprint contour representing a given threshold level of significant noise • Total number of people living within a noise footprint contour representing a given threshold level of significant noise**
Data requirement	**• Noise monitoring data from NTK systems • Flight tracks • Aircraft type • Mission range/take-off mass • Number of departures/arrivals • Population/census data**
Data feed providers	**Airports (airport operations), airlines (OOOI data), ADS-B data providers and/or ANSPs**
Formula/ algorithm	**In a noise modelling tool: a) Determine the total number of movements by aircraft type**

	b) Assign flight procedures to each movement **c) Compute the noise footprint** **d) Generate contours of the significance threshold, and the area/people within that contour**
References and examples of use	**U.S. FAA Part 150 Study** **Australian Noise Exposure Forecast (ANEF)**

2.4.5 **Local air quality**

2.4.5.1 Air traffic management (ATM) reduces climate impact through maximizing flight/ground efficiency for aircraft operating on the ground or in the air below 3 000 ft (commonly referred to as the landing take-off (LTO) cycle), which is the phase of flight where local air quality impacts are measured. It is well understood that inefficiencies in ATM can extend flight distance or time or result in aircraft operating in a less than optimal profile that results in excess fuel burn.

2.4.5.2 The GANP Performance Framework already has two KPIs that measure flight efficiency related to the LTO cycle:

a) Taxi-out additional time (KPI02)

b) Taxi-in additional time (KPI13)

2.4.5.3 Additionally, the KPI for Additional Fuel Burn (KPI16) provides stakeholders with a methodology to amalgamate inefficiencies identified by KPI02 and KPI13 and calculate a cumulative additional fuel burn figure[5]. The performance framework can use this KPI as an environment performance indicator by converting the value to CO_2 (kg fuel burn * 3.16 kg CO_2/kg fuel for Jet-A fuel) – provided a database containing suitable fuel flow performance data is available and used - or as a cost effectiveness performance indicator (by converting the fuel burn to the monetary value of fuel).

3. **RESILIENCE FOCUS AREA**

3.1 Resilience is a well-researched topic for which an extensive body-of-knowledge exists. The concept has been researched and applied in different disciplines with slightly varying definition and/or terminology. However, across all disciplines resilience broadly relates to the capability to address, absorb and recover from disruption of a perceived "normal".

3.2 Air navigation system resilience is defined as the ability of the air navigation system to demonstrate readiness and preparedness, to respond and adapt, and to recover from or adjust to disruptive events in a rapid and effective manner, including its ability to scale with demand, while maintaining provision of safe and quality assured services.

3.3 The definition of resilience builds upon the following core elements:

a) A systems thinking/approach – classical performance view on air navigation. The system approach provides for generality and domain independence. It also allows for the fractional aggregation and decomposition of systems: system components can themselves be seen as systems.

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[5] Compute the KPI16: (KPI02 Taxi-Out Additional Time x Average fuel flow during taxi) + (KPI13 Taxi-In Additional Time x Average fuel flow during taxi).

b) An air navigation service perspective – based on the systems approach the classical view on resilience (disruption resulting in overdemand/load) requires amendment to also consider events resulting in under-demand/load. The service perspective recognizes that services are "co-constructed" by the service provider and the service user/consumer.

c) A holistic view on disturbances/disruptions – triggers for disruptions can be of different nature and classified in broad categories/domains. However, in order to keep the generality of the framework, the focus should not be in the triggers for disruptions, but on the impact that these can cause.

d) A temporal dimension – resilience cycle. The variety and nature of scenarios, but also the interplay between the level of disruption and differentiation between planned/unplanned disruptions is amplified by the duration of the disruption and impact on service provision or service consumption and the stages of the resilience cycle.

e) A tipping point and disruption level – identification of nominal/non-nominal service provision and service consumption. In broad terms the identification of disruption levels is typically affected in terms of impact vs the known reference/current performance level. With long duration events the level of the impact and the duration of the disruption may exceed capabilities. Reaching that tipping point can lead to subsequent stress on the service provider.

3.4 **Resilience ambition**

3.4.1 The current strategic level of the GANP specifies the resilience performance ambition "Disruptive events do not interrupt service provision and do not significantly affect the performance of the system" and provides the supporting text "The air navigation system should also be resilient to planned and unplanned disruptive events. This is essential to enable airspace users to execute their planned flight operations in a predictable manner, in support of their business model". The resilience ambition is defined in the context of the capacity KPA and therefore focusses on the service provision capability consumable by airspace users.

3.4.2 The existing performance ambition was formulated based on the pre-pandemic perception/understanding of resilience. It follows from the current wording that the underlying paradigm was primarily driven from a demand/capacity overload perspective. The derived resilience ambition takes a more holistic perspective, and links air navigation system response to planned/unplanned events with a view to achieving the overall objective of air navigation to provide services ensuring the safe, orderly and efficient flow of air traffic.

3.4.3 The current ambition does not account for or specifies the time horizon. Particularly for large-scale disruptions uncertainty about the evolution of service provision and service demand may require a refined or supporting ambition statement. This will then support the identification and development of associated performance objectives.

3.4.4 Hence, in order to formulate an ambition that:

a) has an actionable expected behaviour of the air navigation system;

b) no longer states a theoretical aspiration or avoidance of a negative outcome “no interruption of services”, but instead communicates a pragmatic ambition to achieve continual improvement that focusses on outcomes and be actioned in terms of change implementation; and

c) recognizes and is applicable to the different temporal and regional contexts, covering shorter-term disruptions as well as global and longer-term scenarios (e.g. COVID-19).

3.4.5 The following refinement of the ambition and supporting text is proposed:

“The maintenance of service provision and system performance in the face of disruptive events.”

Supporting text: **The air navigation system should be capable of absorbing, adapting and recovering from disruptive events. Disruptive events can be, either internal or external, under expected or unexpected conditions, and of short or long duration. Such events can impact service provision by the air navigation system or service consumption on the airspace user side.**

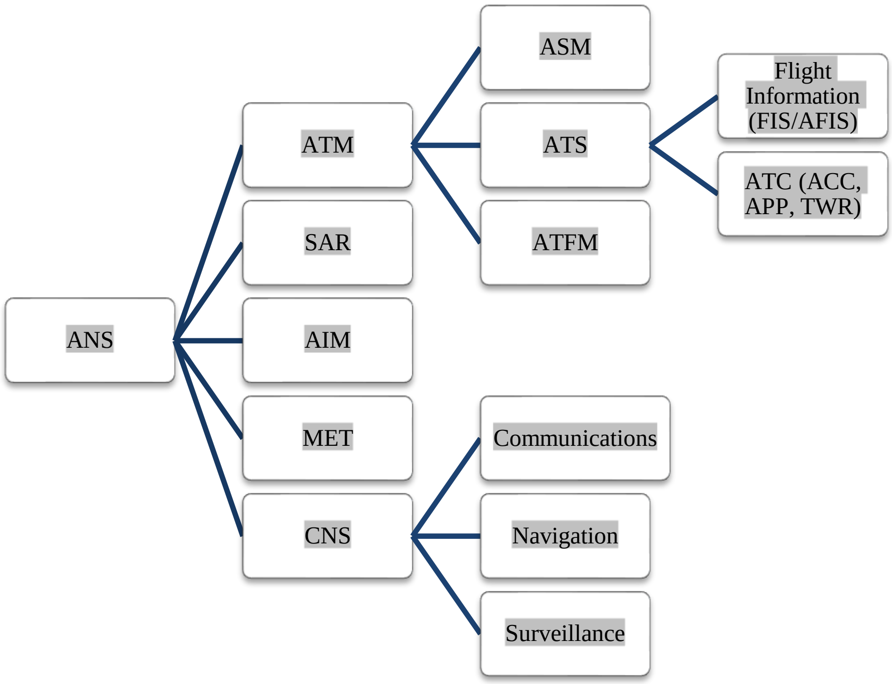
3.5 **Resilience sub-focus areas**

3.5.1 Resilience is in the GANP Performance framework a focus area of the capacity key performance area. Based on the definition of “air navigation system resilience” and the core elements upon which the definition is built on, the following sub-focus areas are proposed to be included in the eighth edition of the GANP:

Operational service resilience – ensuring resilient operations based on the interplay of service provision and service consumption (critical lack of demand).

3.5.2 Following the taxonomy of the essential air navigation services to be provided for international civil aviation (Basic Building Block framework refers), the following sub-focus areas are proposed to be included in the eighth edition of the GANP for the operational service resilience sub-focus area.

Operational service resilience



Organizational resilience – addressing the organizational level consideration of resilience predominantly impacting financial survivability and scalability of organization to high/extreme variations of demand/service consumption and workforce.

3.6 Based on the concept of organizational resilience, the following sub-focus areas are proposed to be included in the eighth edition of the GANP for the organizational resilience sub-focus area:

- **Organizational resilience**
    - **Workforce**
    - **Financial resilience**
    - **Management System Resilience**

3.7 Resilience performance objectives

3.7.1 There are no performance objectives for the resilience focus area in the seventh edition of the GANP. The following objectives and sub-objectives are proposed to be included in the eighth edition of the GANP under each proposed resilience sub-focus area:

*Note 1.— **The resilience cycle comprises the readiness and preparedness, the response and adaptation, and the recovery from and adjustment to disruptive events in the air navigation system.***

a) OPERATIONAL SERVICE RESILIENCE
   i) ANS
      1) ATM – AIR TRAFFIC MANAGEMENT
         a. ASM – AIRSPACE MANAGEMENT AND ORGANIZATION
            - **Maintain airspace management and organization services during resilience cycle**
            - **Ensure the capability to transition services in case of operational failure/restrictions during the resilience cycle**

         b. ATS –FIS/AFIS
            - **Maintain flight information service during resilience cycle**
            - **Maintain aerodrome flight information service during the resilience cycle**
            - **Ensure the capability to transition services in case of operational failure/restrictions during the resilience cycle**

         c. ATS – AIR TRAFFIC CONTROL (ATC) AREA
            - **Maintain ATC service during resilience cycle**
            - **Ensure the capability to transition services in case of operational failure/restrictions during the resilience cycle**
            - **Exploit benefit pools during phases of lower demand/air traffic**

         d. ATS – AIR TRAFFIC CONTROL (ATC) APP
            - **Maintain ATC service during resilience cycle**
            - **Ensure the capability to transition services in case of operational failure/restrictions during the resilience cycle**
            - **Exploit benefit pools during phases of lower demand/air traffic**

         e. ATS – AIR TRAFFIC CONTROL (ATC) AERODROME
            - **Maintain ATC service during resilience cycle**
            - **Ensure the capability to transition services in case of operational failure/restrictions during the resilience cycle**
            - **Exploit benefit pools during phases of lower demand/air traffic**

         f. ATFM – AIR TRAFFIC FLOW MANAGEMENT
            - **Maintain ATFM services during resilience cycle**
            - **Ensure the capability to transition services in case of operational failure/restrictions during the resilience cycle**

2) AIM – AERONAUTICAL INFORMATION MANAGEMENT
   - **Maintain Aeronautical Information services during resilience cycle**
   - **Ensure the capability to transition services in case of operational failure/restrictions during the resilience cycle**

3) METEOROLOGY
   - **Maintain Meteorological services during resilience cycle**
   - **Ensure the capability to transition services in case of operational failure/restrictions during the resilience cycle**

4) SEARCH AND RESCUE
   - **Maintain the SAR service during resilience cycle**
   - **Ensure the capability to transition services in case of operational failure/restrictions during the resilience cycle**

5) CNS - COMMUNICATION/NAVIGATION/SURVEILLANCE
   - **Maintain CNS services during resilience cycle**
   - **Ensure the capability to transition CNS services in case of operational failure/restrictions during the resilience cycle**
   - **Ensure resilience of CNS/ATM infrastructure**

b) ORGANIZATIONAL RESILIENCE

Note 1.— The GANP does not elaborate on financial, resources or training elements, that is why they are market with (*), however, it is recognized that these elements are necessary to achieve operational resilience. They are listed in this tree only to reflect an integrated approach and show the other topics that are covered under other ICAO initiatives.

ii) WORKFORCE

1) **Provide appropriate resourcing of personnel during the resilience cycle***
2) **Provide appropriate training for personnel during the resilience cycle***
3) **Ensure proficiency training for personnel post the resilience cycle to accommodate changes in demand, operational procedures, system changes, etc.***

iii) FINANCIAL RESILIENCE

1) **Safeguard sources of financing – during the resilience cycle***
2) **Identify and ensure accessibility to alternative sources of financing***

iv) MANAGEMENT SYSTEM RESILIENCE

1) **Maintain management system integrity and continuity during the resilience cycle**
2) **Ensure compliance with national/international standards, rules and regulations during the resilience cycle**
3) **Maintain risk management during the resilience cycle**

3.8 **Resilience performance indicators**

3.8.1 The addition of a new performance indicator for resilience is not recommended at this time. The work has demonstrated that the existing set of performance indicators is sufficient to measure and monitor the expected performance of air navigation services and functions during all phases of the resilience cycle including recovery.

3.8.2 However, the performance objectives serve as a mapping tool for States and air navigation service providers to ensure a stronger focus on required capabilities, functions, and processes. The objectives may therefore complement requirements on change activities within ANS. In particular, system resilience should be considered an integrated part of the overall system design and operation: "Resilience is a property of the air navigation system and not a specific feature or service." It is therefore important to build resilience "into the system" and not "bolt it on".

— END —