LTAG GLADs
PROGRESS OF ICAO WORK ON LTAG

ICAO Secretariat

APAC/MID/EURNAT/NACC/SAM/ESAF/WACAF

Region, 10-14 May 2021

2019 ICAO 40th Assembly – LTAG

Resolution A40-18, paragraph 9 requested the LTAG work

Task

How to do the task

Timeline

Consideration

The Assembly… Requests the Council to

continue to explore the feasibility of a long term global aspirational goal for international aviation,

through conducting detailed studies assessing the attainability and impacts of any goals proposed, including the impact on growth as well as costs in all countries, especially developing countries,

for the progress of the work to be presented to the 41st Session of the ICAO Assembly. [2022]

Assessment of long term goals should include information from member States on their experiences working towards the medium term goal.

ICAO Council and CAEP after 40th Assembly

- **CAEP (December 2019)** recommended the establishment of the CAEP Long-term Aspirational Goal, Task Group (CAEP LTAG-TG) to provide technical support to the Council in exploring the feasibility of a LTAG
- **Council 219th Session (March/2020)** agreed to establish the CAEP LTAG-TG, which should undertake:

  1) data gathering

  2) development of in-sector emissions reduction scenarios

  3) impacts analysis of the scenarios

Roles of ICAO Bodies in LTAG work

1) Assembly	2) Council	3) CAEP
requests the Council to explore the feasibility of an LTAG for international aviation and considers the results of the work	provides guidance to CAEP technical work and analyses, and reviews the results of work and reports to Assembly on the feasibility of an LTAG	provides technical support to the Council in exploring the feasibility of an LTAG

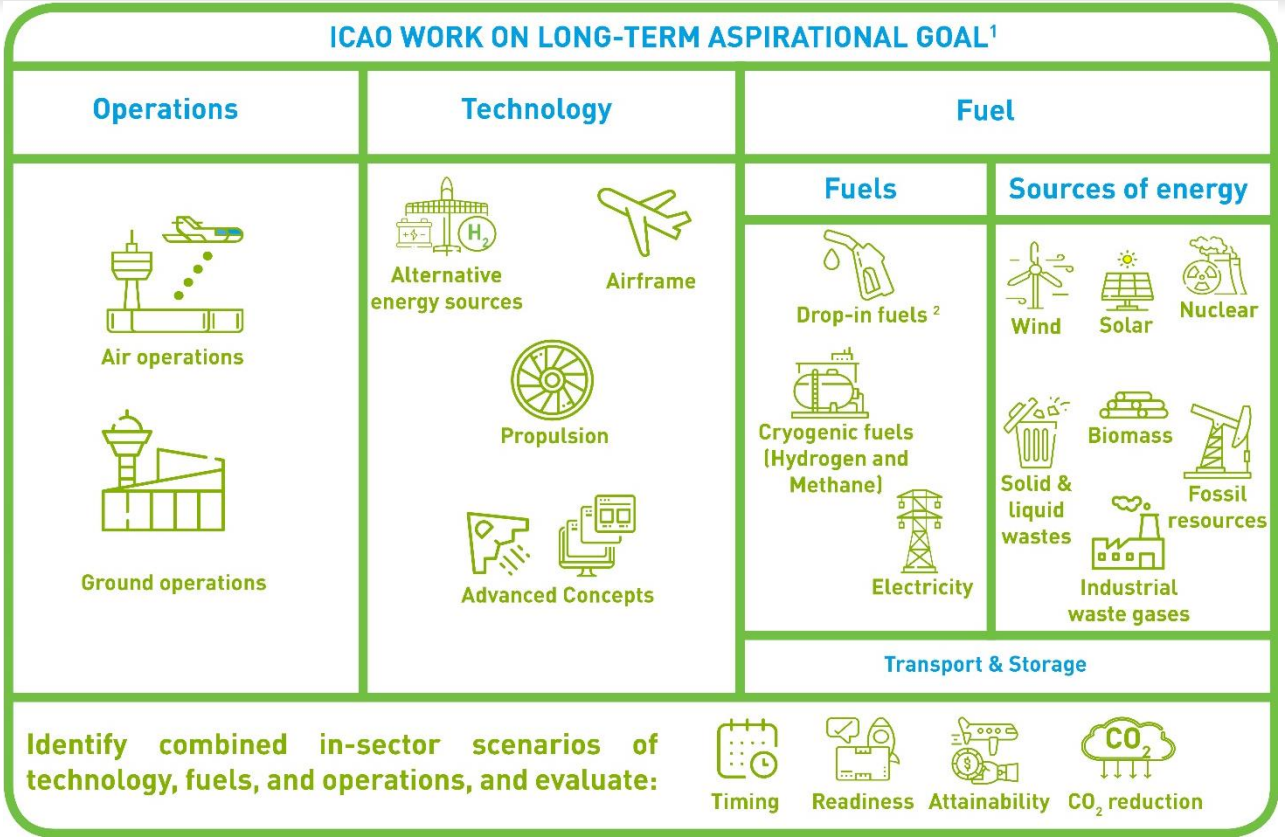
Secretariat – Supports the data gathering (Stocktaking) and consultation processes (GLADs) and the deliberations of ICAO bodies

LTAG Overview

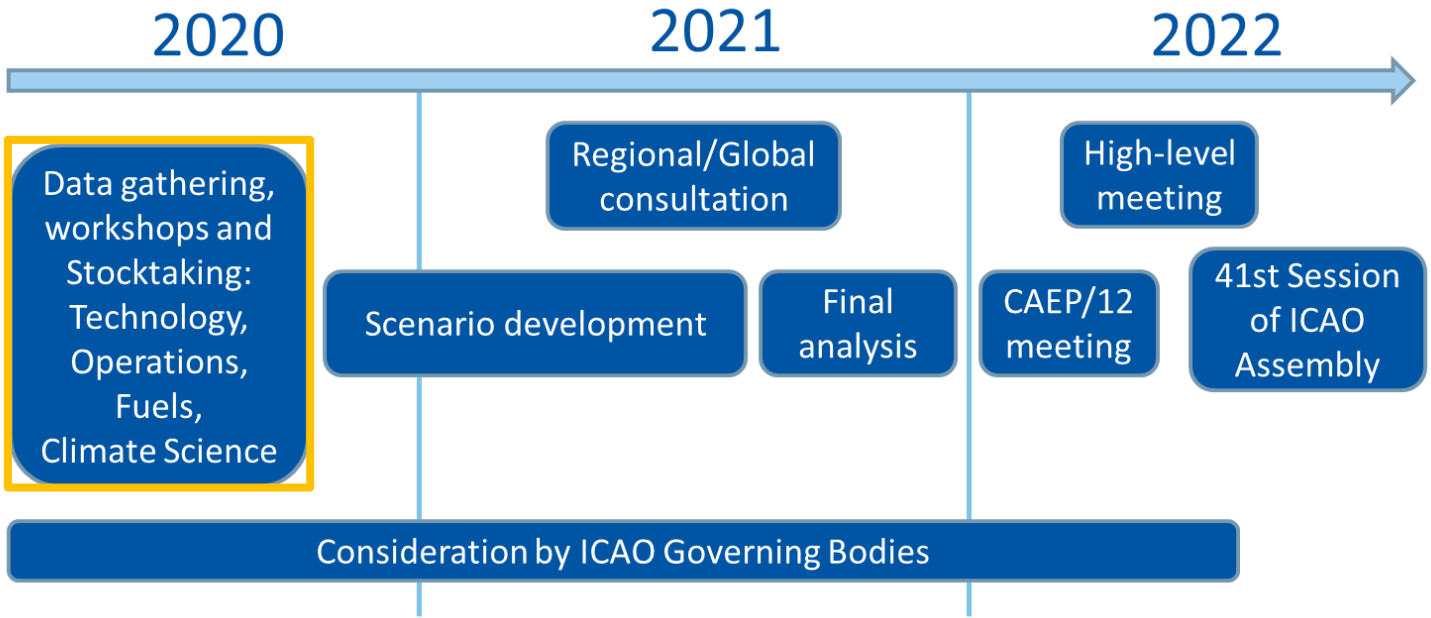
Open, transparent and inclusive:

Innovations:

In-sector focused:



1) Data gathering Process



Data Gathering – ICAO Stocktaking

Stocktaking 2019	Stocktaking 2020	Stocktaking 2021
• Focused on fuels (CAAF/2 request) • Mapping of technologies and production initiatives	• Expanded scope - technologies, operations, and fuels • Open invitation to provide information • more than 100 solutions submitted • Nearly 100 speakers	• From 30/Aug to 4/Sept • Ongoing pre-stocktaking webinars (1 per month) • Virtual event – registration is open

All presentations and videos available on the event websites

Stocktaking 2019 Stocktaking 2020 Stocktaking 2021

ICAO TV

Data Gathering – ICAO Green Recovery Seminar and Innovation Symposium

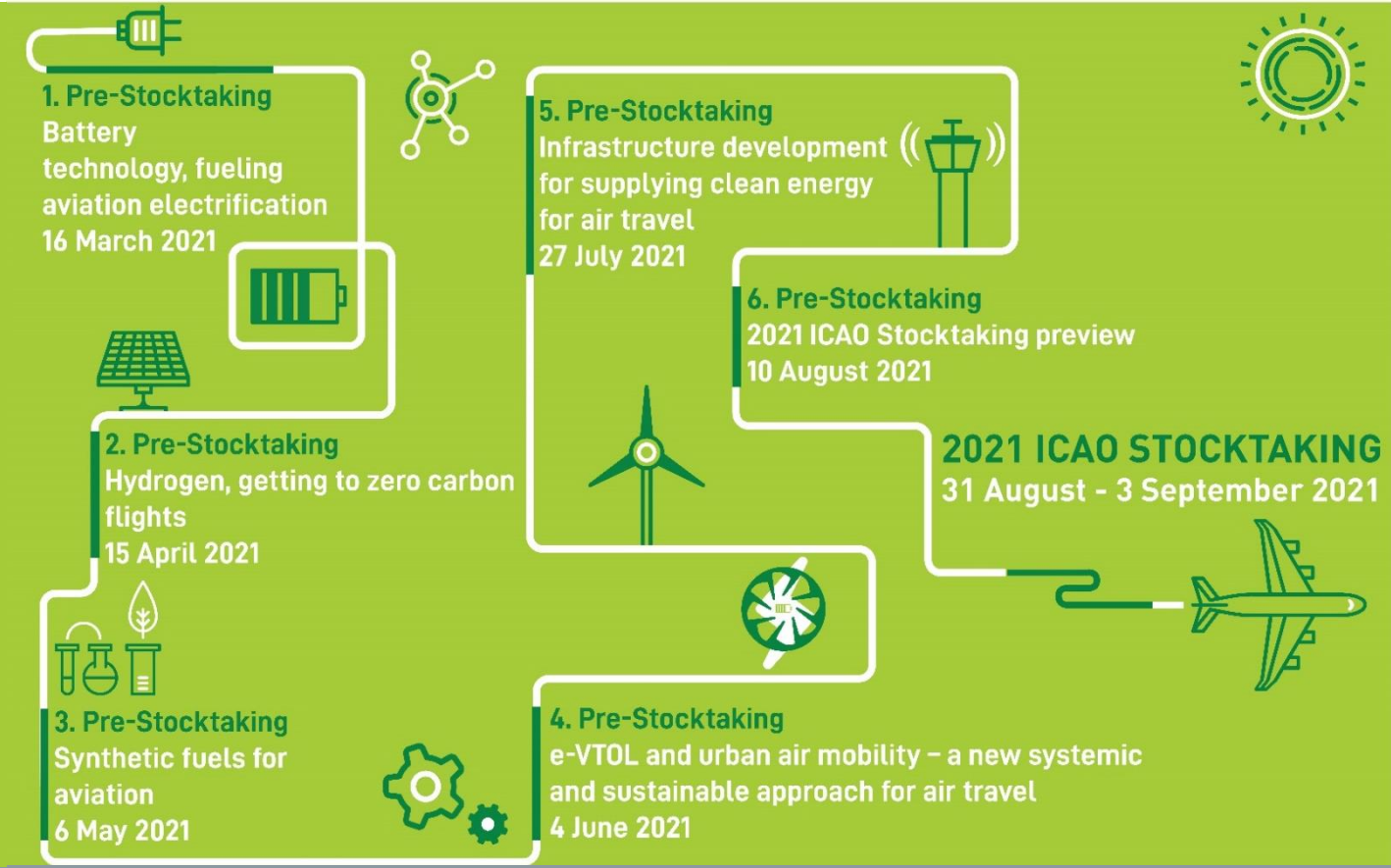
https://www.icao.int/Meetings/GreenRecoverySeminar/Pages/default.aspx

- Answering the call for aviation green recovery in the context of COVID 19 and climate change;
- Forum of discussion, with aviation and climate leaders and experts

https://www.icao.int/Meetings/InnovationSymposium2020/Pages/default.aspx

- Two Panels on Green Innovation.
- Announcements of new electric and hydrogen aircraft projects

Data Gathering – ICAO Stocktaking 2021



Data Gathering – CAEP Virtual Library

- The Secretariat and CAEP have compiled a Virtual Library of references, which is being used to support the CAEP-LTAG work
- Hundreds of references identified, divided in:
  - Internal ICAO references (ICAO documents, previous CAEP Work)
  - External references (e.g. scientific articles, reports)

Title and link	Organization	Year	Brief Description	technologies	operations	fuels	scenarios
Strategic Research and Innovation Agenda – 2017 update Volume 1	ACARE (Advisory Council for Aviation Research and Innovation in Europe)	2011	Background report for the EU, including goals, actions areas and timeframe. Challenge 3: protecting the environment and the energy supply. Technologies, operations, fuels, climate science, adaptation to climate change, regulations and policies.	x	x	x	x
Adelaide Airport Heat Reduction Trial documentation	Adelaide Airport, SA Water	2019	A 2 year trial at Adelaide Airport to quantify the benefits that could be achieved through the irrigation of a 4 hectare parcel of the airside area, including the decrease of local air temperature leading to increased aircraft performance during take-off		x		
Aichi Low Carbon Hydrogen Supply Chain 2030 Vision	Aichi and Toyota	2018	2030 Vision, roadmap and supply chain for hydrogen in the automobile Toyota group and Aichi region.	x		x	
Air France Horizon 2030	Air France	2019	Goal, Vison and roadmap, including technology, operations and fuels measures (in French and English)	x	x	x	x

Examples of internal ICAO references

Technology	**ICAO doc 10127 - Independent Expert Integrated Technology Goals Assessment and Review for Engines and Aircraft (Doc 10127)**
Fuels	**CAEP/10 Short-term and long-term fuel production assessment** https://www.icao.int/environmental-protection/Documents/CAEP10%20Fuel%20Production%20Assessment%20%282016%29.pdf
Operations	**Doc 10013 Operational Opportunities to Reduce Fuel Burn and Emissions**

Examples of identified Aviation CO_2 Reduction Measures

Technology	Operations	Aviation fuel and energy
Advanced aircraft technology (e.g. aerodynamics, structures, materials) Revolutionary aircraft technology (e.g. hydrogen and electric aircraft, flying wing/strut-braced wing configurations)	Air Traffic Management improvements Operational Improvements in the air Operational improvements on the ground.	Sustainable Aviation Fuels (biomass / waste-based) Power to Liquids (drop-in SAF created from hydrogen and waste/atmospheric CO2) Lower Carbon Aviation fuels (petroleum-based) Non-drop in fuels (hydrogen) Electrification

Which are measures at global level ….
in short-term, medium-term and long-term ???

Key takeaway points on Technology

- **"Aviators are Innovators"**
  - **Advances on technologies** with CO_2 emission reduction opportunities, including **engines, aerodynamics and airframes**, and novel aircraft concepts including **electric and hydrogen aircraft**.
  - Potential to adopt and scale up **rapid testing to reduce aviation development timescales**.
  - Possibilities to invest in **new propulsion technologies and deploy them for range-appropriate missions**.
- **Challenges/barriers to realization of measures:**
  - **More investments and support** are needed to help the development of new technologies.
  - The development of **certification requirements and new Standards**.
  - Technologies should meet the **demand of different market segments**.

Key takeaway points on Operations/Infrastructure

- Many **innovative operational procedures in the air and on the ground** that can deliver concrete and rapid results in terms of aviation in-sector CO_2 emissions reduction.

- **Challenges/barriers to realization of measures:**
  - For ground operations, there is a need for **stakeholders' cooperation, investment and expansion of infrastructure** to accommodate increased number of zero-emissions ground equipment.
  - For air operations, there is potential to use of advanced algorithms, artificial intelligence and software to reduce fuel cost.
  - For air operations, there is a need for improved management as well as coordination with Air Navigation Service Providers (ANSPs).

Key takeaway points on Fuels

- "**Clean energy is the key to decarbonize aviation**"
  - Impressive progress has been made in the use and production of Sustainable Aviation Fuels (SAF) since the first biofuel flight ten years ago.
  - Many new production pathways are being developed and certified (e.g. Power to Liquids).
  - There is a need for robust sustainability criteria for SAF.
- **Challenges/barriers to realization of measures:**
  - Closing price delta – **scale up SAF production** to levels where costs fall and SAF become self-sustaining
  - **Policy frameworks** have a key role in this crucial early phase of SAF industry development, e.g. **more incentives and financing** to facilitate its introduction and scale-up.
  - **Level playing field** with other transport modes is needed.

©ICAO 2021

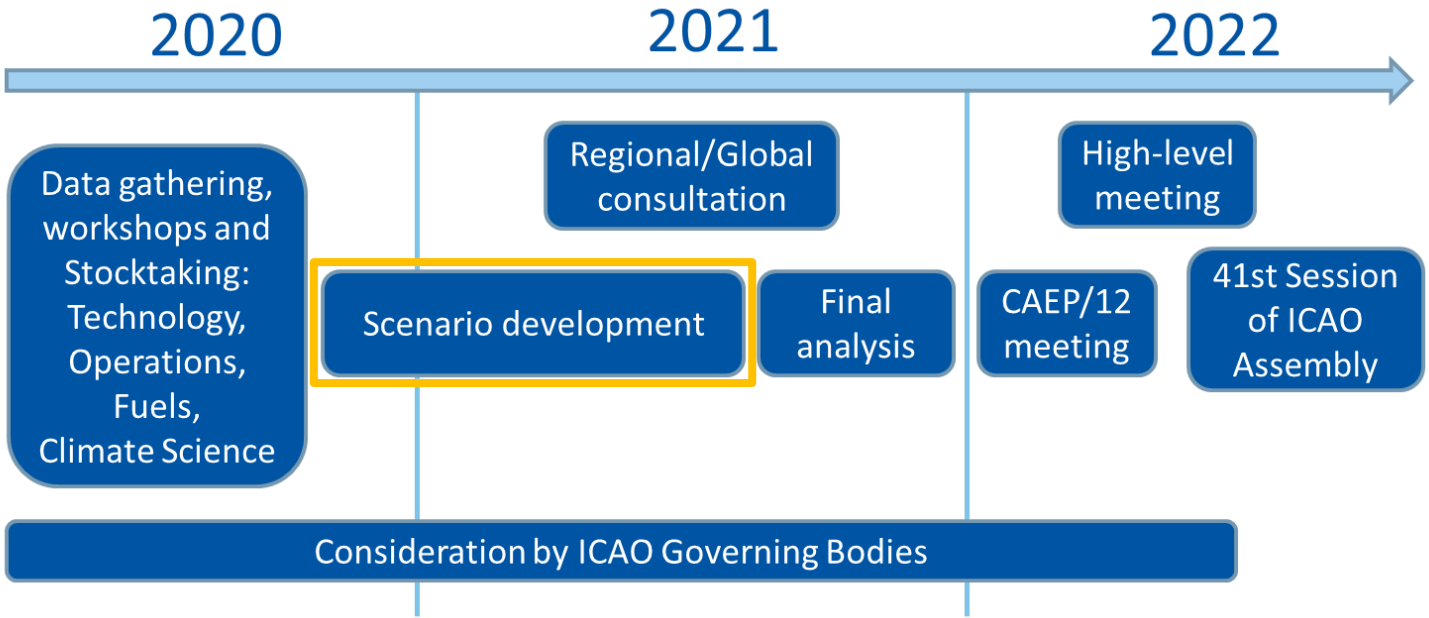
Key takeaway points on Electrification

- **"Electric aircraft can result in major environmental opportunities"**
  - Opportunities of electrification: from reduced noise and emissions to reduced potential operational costs (energy and maintenance).
  - Restriction: currently limited use to shorter haul aircraft due to the issue of weight and life of batteries.
- **Challenges/barriers to realization of measures:**
  - **Certification processes and the development of new Standards**
  - Support for electric and associated hybrid technologies must be aligned with availability of **low-cost green electricity and associated airport infrastructure**.
  - Electric / hybrid technologies should be pursued with **a longer-term perspective and working with other sectors**.
  - **Enhanced financing and investment** from all stakeholders is needed.

Key takeaway points on Hydrogen

- Various stakeholders consider **hydrogen as one of the potential sustainable fuels**, with zero-emission capability.
  - Hydrogen aircraft for shorter flights could hit the market between 2030 and 2035
- **Challenges/barriers to realization of measures:**
  - Further investigation and research into hydrogen aircraft, along with investigations into the **availability of infrastructure**.
  - **Significant investment** is required, along with **legal and certification support, and the development of Standards**.
  - **Hydrogen would need to be produced in a sustainable way**, on a life cycle basis, and at an affordable cost.
  - Global coordination to ensure the systemic development of aircraft, infrastructure and fuel.

2) Scenario Development Process

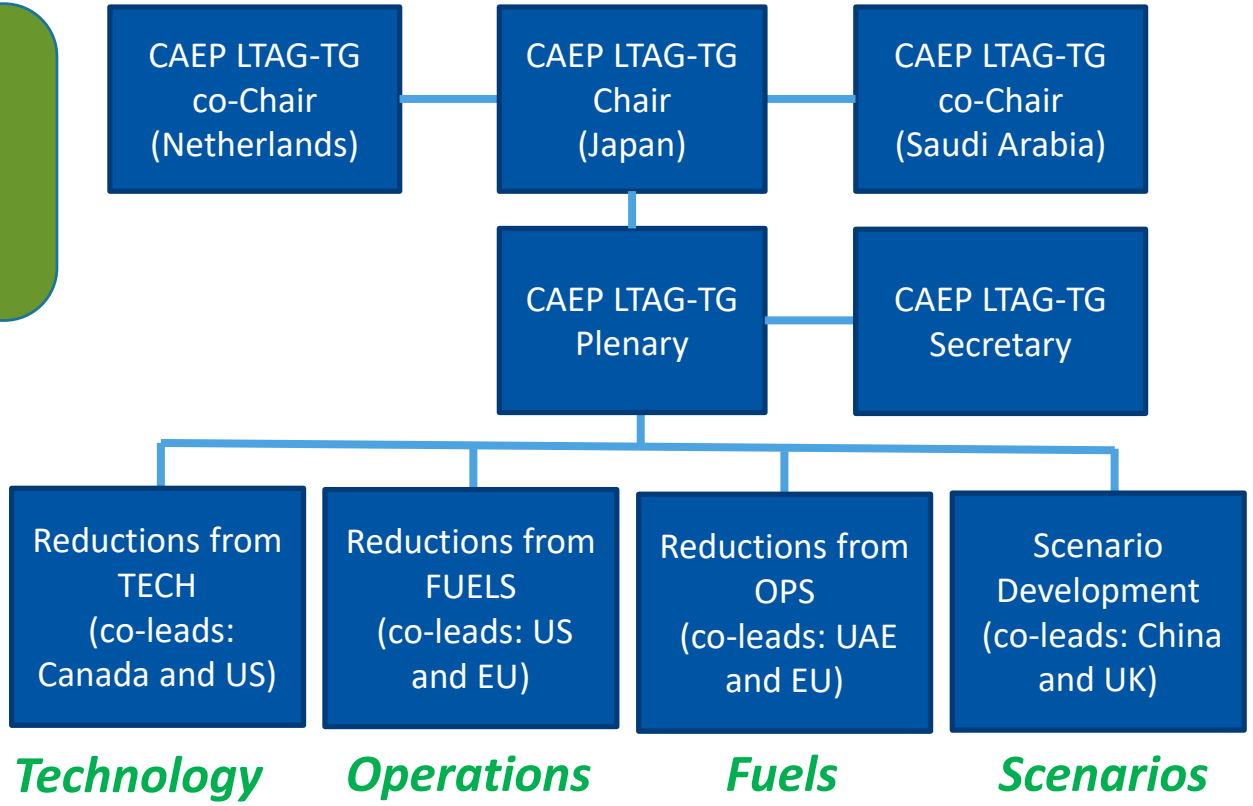


CAEP LTAG-TG Overview

CAEP LTAG-TG is exploring the feasibility of a long term aspirational goal for carbon

over **279** experts

more than **150** calls



CAEP LTAG-TG Work on Technology

Technology Subgroup objective - assess the CO2 reduction potential of new and evolutionary technologies for airframes, propulsion systems and advanced concepts (including energy storage). The vehicle integration analysis completes the aircraft concept for further modelling in scenarios.

ICAO Documents

Stocktaking Questionnaires

External Sources

Data Input Review

Airframe improvements – aerodynamics, structures/materials, systems, and vehicle integration

Propulsion system improvements – improved turbofan, unducted propulsor, turboelectric, hybrid

Advanced Concepts and Energy Storage – hydrogen and electric aircraft concepts, flying wing, strut-braced wing

©ICAO 2021

CAEP LTAG-TG Work on Operations

Operations Subgroup objective - identify and evaluate existing, foreseen, and innovative in-sector CO2 reduction measures relating to air and ground operations

ICAO Documents

Stocktaking Questionnaires

Data Input Review

External Sources

Ground operation improvements

Examples – congestion and delays management, at airports, single engine taxi, emission free taxiing, ground support equipment (GSE), switch-off auxiliary power unit (APU), lighter aircraft (payload, seats, magazines), aircraft wash, cut contingency fuel, reduction of the local air temperature at airports

Air operations improvements

Examples – continuous descend operations (CDO), continuous climb operations (CCO), performance based navigation (PBN), scheduling, route planning, formation flying

CAEP LTAG-TG Work on Fuels

Fuels Subgroup objective - develop in-sector emissions reduction scenarios associated with identified fuel categories.

ICAO Documents

Stocktaking Questionnaires

External Sources

Data Input Review

LTAG sustainable aviation fuels – fuels made from biomass, wastes (e.g. Municipal Solid Waste, CO2 waste streams), atmospheric CO2

LTAG lower carbon aviation fuels – fuels made from petroleum, with production improvements to reduce CO2 emissions (e.g. reduced flaring, venting and fugitives, use of renewable energy, carbon capture)

Non drop–in fuels – Hydrogen, electricity, Liquefied gas aviation fuels, cryogenic hydrocarbon gas (methane, butane, propane)

©ICAO 2021

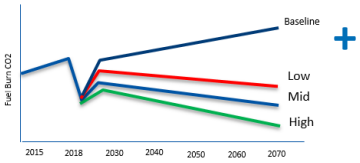
CAEP LTAG-TG Methodology for Scenario Development

Scenario development – combined in-sector scenarios of technology, operations and fuels that represent a range of readiness and attainability, including uncertainty in future demand for air transport.

The work should be placed in the context of an analysis of achieving the current ICAO aspirational goals.

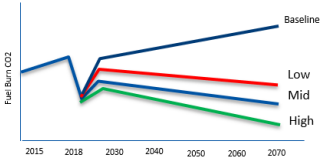
Time horizon - 2070

Modeling of effects of technology & operations & fuel



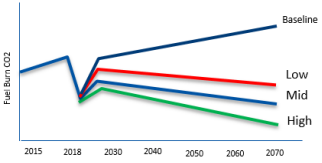
Technology emission scenarios (low, mid, high)

+



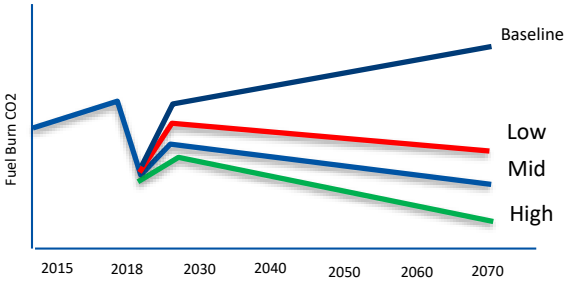
OPS emission scenarios (low, mid, high)

+



Fuels emission scenarios (low, mid, high)

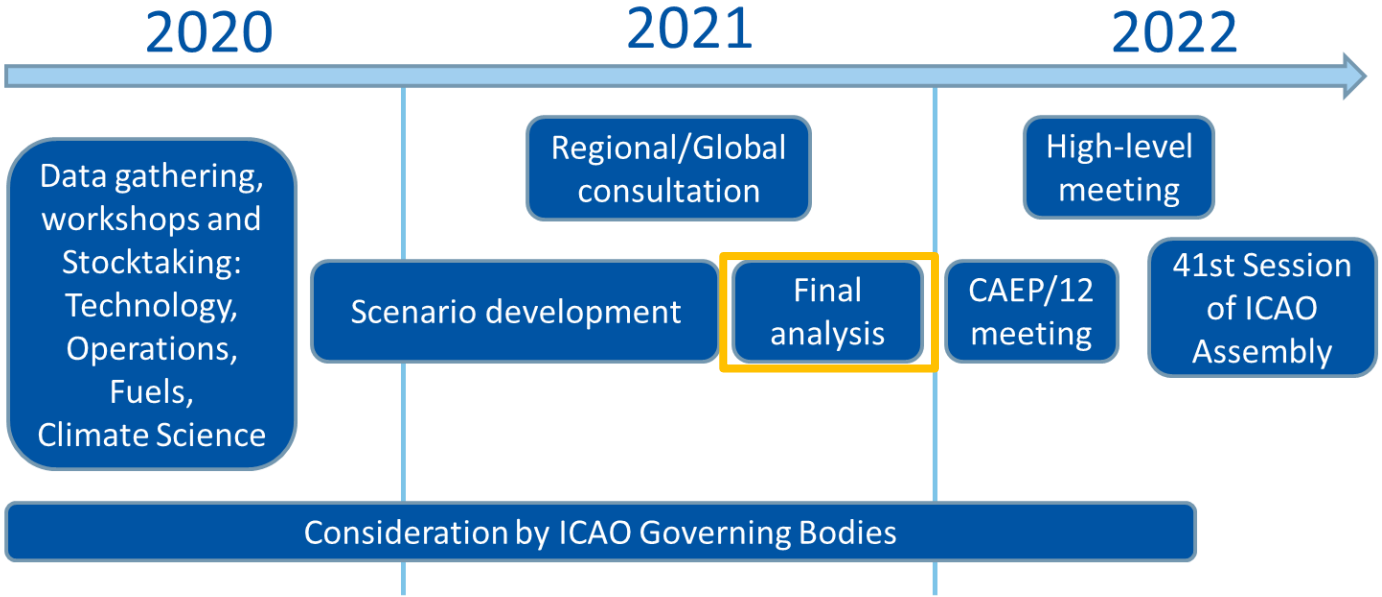
Economic modelling & traffic forecasting → **Baseline fleet fuel burn forecasting** → **Fleet evolution & traffic forecasting**



LTAG combined in sector scenarios

CAEP LTAG TG Future Work (later 2021)

3) Impacts Analysis of Scenarios



CAEP LTAG TG Future Work (later 2021)

Scenarios will be analyzed in terms of the CO_2 benefits, costs, and economic impacts on aviation growth. Potential impacts on noise and air quality will be noted.

Results will be placed in the context of latest consensus scientific knowledge.

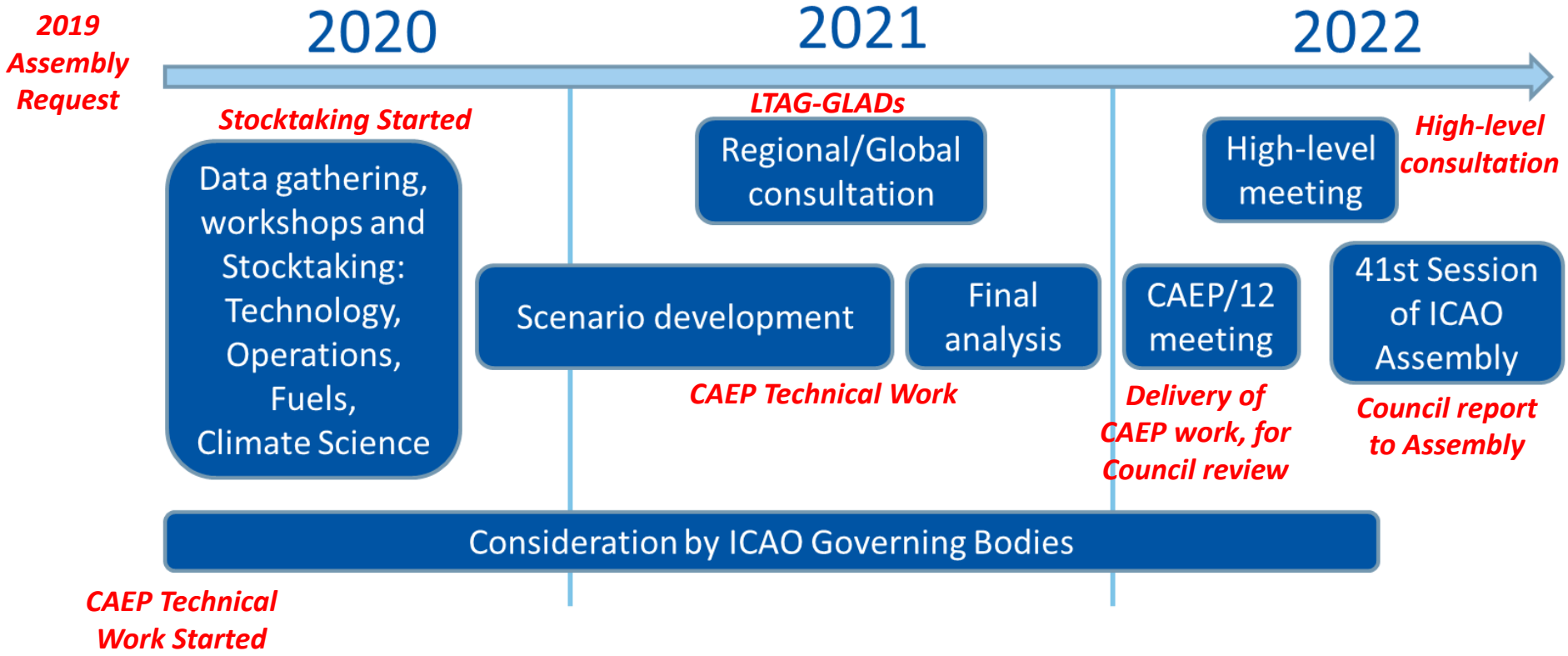
CAEP is considering the inclusion of various cost elements in the analysis:

- Capital expenditures
- Infrastructure costs
- Fuel costs (i.e. savings)
- Asset Value Losses
- Research and Development (R&D)
- Manufacturers non Recurring Costs (NRC)
- Incremental Build Cost (IBC)
- Price gap vs. conventional fuel

LTAG route to 2022 – Milestones ahead

- ICAO Stocktaking 2021 (Aug/Sep) to further take stock of the latest information on aviation in-sector CO_2 reductions
- States are encouraged to provide their State Action Plans to include the latest green innovations
- CAEP LTAG-TG will deliver scenarios / analyses results to the CAEP/12 meeting in February 2022
- Year 2022 – Council's review of CAEP work, High-level Meeting, and possible LTAG recommendations to the 41st Session of the Assembly in 2022
- Discussions in 2022 may also involve the future role of CORSIA in light of possible LTAG recommendations

ICAO LTAG Process Summary



Questions?

ICAO


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
THANK YOU