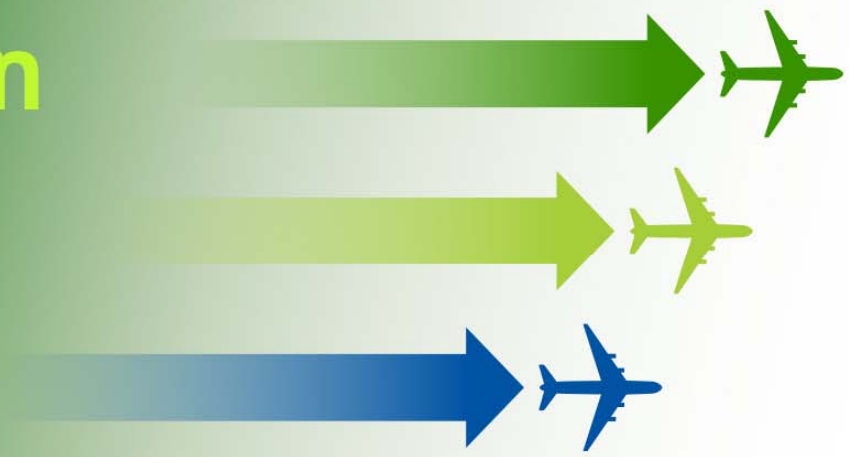
ICAO Aviation Green Recovery Seminar

TIME TO BUILD BACK BETTER



Summary of the 2020 ICAO Stocktaking Seminar on Aviation in-Sector CO2 Emissions Reductions

Jane Hupe

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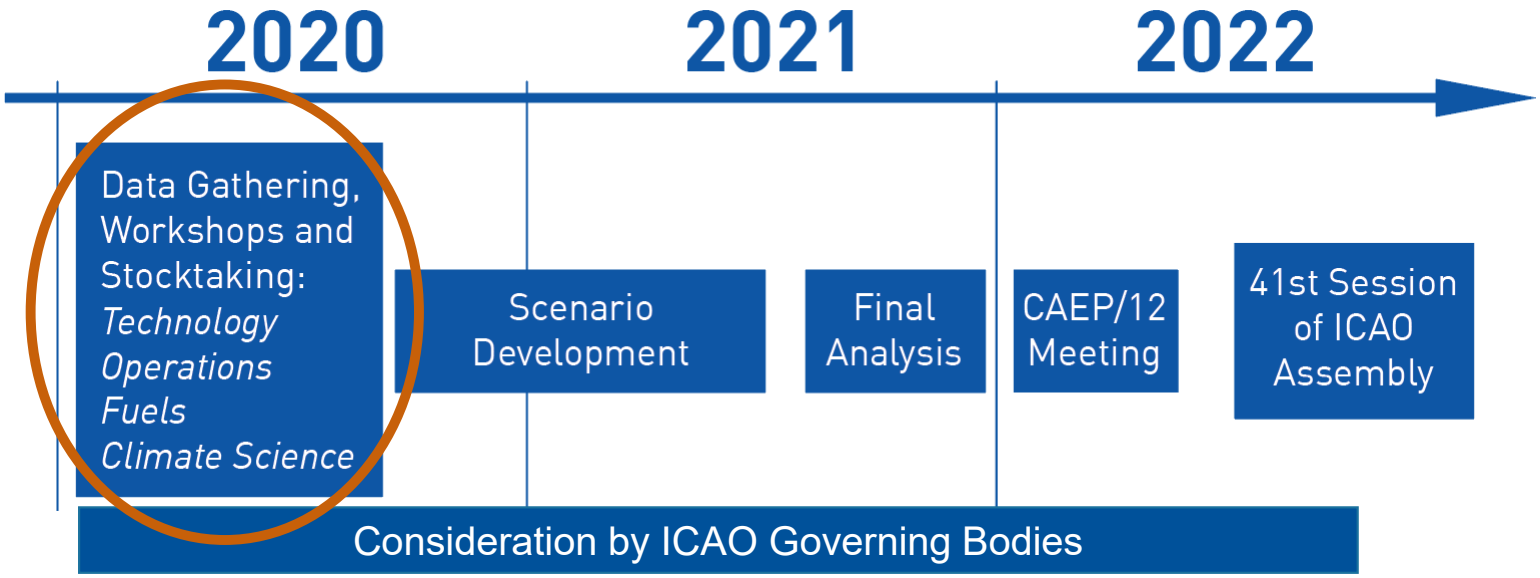
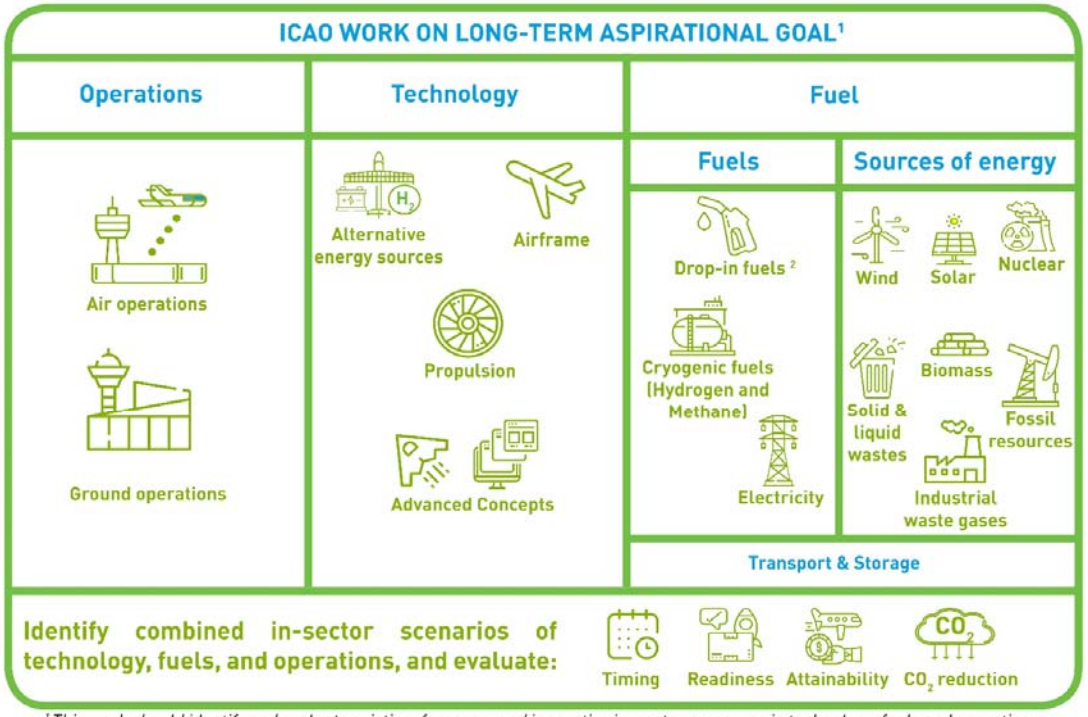
LONG TERM ASPIRATIONAL GOAL (LTAG) - WORK TIMELINE



The Information collected through the ICAO Stocktaking process feeds the LTAG process.

LONG TERM ASPIRATIONAL GOAL (LTAG)

- **ICAO 40th Assembly (2019)** – Exploration of the feasibility of a Long-Term Global Aspirational Goal (LTAG) for international aviation.
- **New activities** are arising which could further reduce aviation emissions.
- Focused on **in-sector measures.**
- The expanded **Stocktaking process** will **help to collect information** on **existing, foreseen and innovative measures.**



[1] *This work should identify and evaluate existing, foreseen, and innovative in-sector measures in technology, fuels and operations, and their enablers, including information of probable costs. This will assist in identifying gaps, and information and expertise needed, in order to complete a thorough assessment of all in sector CO_2 reductions for international aviation. This should include timing, readiness, attainability and the quantity of CO_2 reduction possible, based on a feasible roll out into the aviation sector.*

[2] *Sustainable Aviation Fuels (SAF), Low Carbon Aviation Fuels (LCAF), E-Fuels.* *Icons made by Freepik from www.flaticon.com*

ICAO STOCKTAKING - EVENT SUMMARY

- **ICAO Stocktaking Seminar on aviation in-sector CO_2 emissions reductions**
- "Take stock" of stakeholders' progress:
  - Collecting data on:

    Technology **Operations** **Sustainable Aviation Fuels**
  - Sharing solutions, innovations, visions, roadmaps
  - Receiving over 100 questionnaires submitted by stakeholders
- Virtual 4 half days event: 8-11 September 2020
- Open and free to attend; Broadcasted on ICAO TV
- 16 sessions, ~ 100 panelists , > 25 High levels guests, 4 sponsors, 18 supporting organizations
- 1143 participants registered on Zoom + ~ 185/day viewers on ICAO TV

ICAO STOCKTAKING 2020 – GENERAL HIGHLIGHTS

- Provided an overview of the **potential of in-sector solutions (technology, operations and energy) for CO2 emissions reductions**, energy sources and requirements.

- Showcased inspiring **concrete examples of zero emissions and decarbonization plans** from aviation leaders and decision makers; opened a dialogue on innovative approaches with industry leaders to help understand the obstacles.

- Presented initiatives to **enable** a green transition for the aviation sector, and efforts to **boost innovation** and shorten the path from knowledge to implementation of solutions.

AIRCRAFT TECHNOLOGIES – KEY POINTS

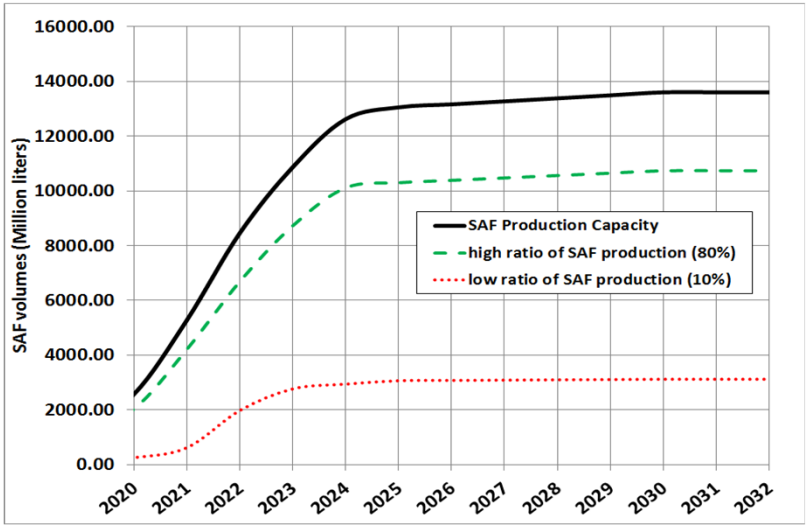
- "**Aviators are Innovators**":
  - The Seminar showcased some of the **latest advances on technologies** with CO2 emission reduction opportunities, including **engines, aerodynamics and airframes**; presented novel aircraft concepts including **electric and hydrogen aircraft**.
  - Potential to adopt 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 to address for further development**:
  - **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**.

SUSTAINABLE AVIATION FUELS – KEY POINTS

➢ "**Clean energy is the key to decarbonize aviation**"

- The Seminar presented the scope of **SAF current deployment**, along with the next steps for **scaling-up** their use.
- **Impressive progress** has been made in the **use and production** of SAF since the first biofuel flight ten years ago.
- Aviation fuels need to be **increasingly replaced by SAF**. This includes dealing with technical issues (blending, storage, handling, distribution, and transportation).
- However, without a **supportive policy landscape**, the aviation industry is unlikely to scale up biofuel consumption to levels where costs fall and SAF become self-sustaining.



https://www.icao.int/environmental-protection/Pages/SAF_Stocktaking.aspx

SUSTAINABLE AVIATION FUELS – KEY POINTS

- **Challenges to address for further SAF expansion**:

  - **Closing price delta**, build **confidence** on SAF, raise **awareness** on its benefits, enable **more financing,** supporting **government policies** and robust **fuel sustainability criteria**.
  - **Policy frameworks** have a key role in this crucial early phase of SAF industry development: to facilitate its introduction and scale-up.

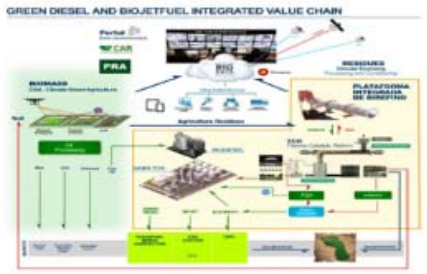
- **Policy measures** could include:
  - Financial de-risking measures for refinery project investments (grants, loan guarantees).
  - Measures to provide guaranteed SAF offtake (mandates, targets, CO2 reduction targets).
  - Other mechanisms to close the price delta (tax incentives, carbon pricing).

Sustainable aviation fuel produced from Macaúba in Brazil

Aviation Fuels

Feedstock type	Conversion process
Bio QAV	HEFFA / HPO

Vegetable Oil and Bio-Oil produced under sustainable and economically viable supply chain based on Macaúba tree,



SOLEA BRASIL

CO_2 reductions per flight	TBD
Level of finance required	85%
Timeframe	2030
Main challenges	50%

Sustainable aviation fuel from MSW in the UK

Aviation Fuels

Feedstock type	Conversion process
Municipal Solid Waste (woody biomass also available)	Gasification / Fischer-Tropsch

Altalto project to build Europe's first commercial waste-to-fuels plant in Immingham, UK; to treat >500,000 tonnes black bag waste and produce >50 million litres of SAF per year

VELOCYS

CO_2 reductions per flight	70%[1]
Level of finance required	$ hundreds of millions
Timeframe	2025[2]
Main challenges	Finance

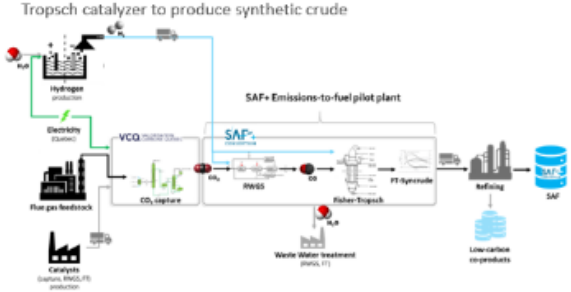
[1] LCA for biogenic fraction of waste; could be >100% with CCS
[2] Commercial operation, subject to financial close in 2022

Sustainable aviation fuel produced from CO2 capture in Canada

Aviation Fuels

Feedstock type	Conversion process
CO2	FISCHER TROPSCH

CO2 capture from large emitters, Reverse Water Gas Shift and Fischer Tropsch catalyzer to produce synthetic crude



SAF + CONSORTIUM

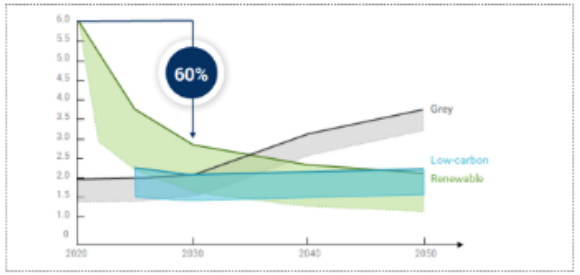
CO_2 reductions per flight	80%
Level of finance required	75%
Timeframe	2025
Main challenges	• Scaling-up • Financing

H2 will be economical

on Fuels

H2 direct-burning turbines	e-fuels
Fuel Cells	*Liquid H2*

Renewable hydrogen production costs can be reduced by 60% through 2030 :

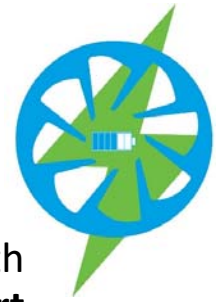


AIR LIQUIDE

- Up to - 100 % of direct CO2 emissions avoided
- Volumes will bring cost down
- LH2 for aviation will benefit from synergies with ground mobilities well established in 2030
- Regulations and political support

ELECTRIFICATION – KEY POINTS

- "Electric aircrafts can result in **major environmental opportunities"**:
  - The Seminar showcased the 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 to address for further development**:
  - **Certification** processes and the development of new Standards;
  - The support for electric and associated hybrid technologies must be aligned with **improving the availability of low-cost green electricity and associated airport infrastructure**.
  - Electric and hybrid technologies should be pursued with a **longer-term perspective and working with other sectors.**
  - Enhanced **financing and investment** from all stakeholders.
  - **Creation of a global platform** for further collaboration to encourage a **systemic approach**.

HYDROGEN – KEY POINTS

- Various stakeholders consider hydrogen as one of the **potential sustainable fuels**, with zero-emission capability.
  - Hydrogen aircraft could hit the market between 2030 and 2035 using fuels, such as **hydrogen for shorter flights**.

- **Challenges to address for further development:**
  - 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 green way, on a life cycle basis, and at an affordable cost**.
  - Global coordination to ensure the **systemic development** of **aircraft, infrastructure and fuel**.

Airbus ZEROe concept

Middle Mile Small and Regional all-electric propeller aircraft (5-50 pax)

MAGNIX

Technology

Electric propulsion systems (including motors and power electronics) designed for commercial aircraft. 280KW – 2MW. Multiple sources of electricity.

CO_2 reductions per flight	100%
Level of finance required	-50%
Timeframe	2022
Main challenges	Mindset

Long-range wide-body aircraft powered by liquid hydrogen

TU DELFT

Technology

Passengers in wing, no normal fuselage. Suitable for hydrogen/LNG tanks.

TUDelft KLM AIRBUS

CO_2 reductions per flight	20%
Level of finance required	TBD
Timeframe	2040
Main challenges	• Technological • Investments • Certification

Next Generation Single-Aisle Transport

NASA

Technology

Transonic truss-braced wing concept with high efficiency small core engines and potential electrification of propulsion system, supported by high rate composite manufacturing

CO_2 reductions per flight	60% Relative to 2005 best-in-class
Level of finance required	TBD
Timeframe	2032
Main challenges	• Unique airframe / propulsion system certification • Cost of advanced technology • High rate manufacturing

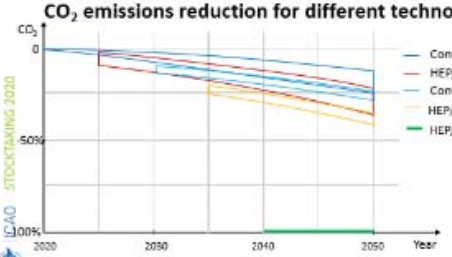
Advanced commercial hydrogen-powered aviation

CIAM

Technology

Hybrid Electric Propulsion / Distributed Electric Propulsion (HEP/DEP), High and Low Superconductivity (HTSC, LTSC), LNG, LH2, Battery (BAT), Hydrogen Fuel Cells (HFC)

CO_2 emissions reduction for different technology options



Only HEP using Superconductivity, LH2 and HFC provide CO_2 reduction by 100% !

CO_2 reduction in flight (climate impact)	100% (50-75%)
Level of finance required*	-20-30% per PAX
Timeframe	2035-2070
Main challenges	Capital investment (new design, infrastructure) Green LH2 production Fuel price Lack of Standards

* for short-range aircraft powered by hybrid H2 propulsion (ref. Hydrogen-powered aviation. A fact-based study of hydrogen technology, economics, and climate impact by 2050. May 2020.

GROUND/AIR OPERATIONS AND INFRASTRUCTURE – KEY POINTS

- The Seminar highlighted the **current and 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 to address for further innovation** :
  - **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).

CORSIA – KEY POINTS

- ICAO Stocktaking was focused on measures for **in-sector CO2 reduction –** did not cover CORSIA.
- CORSIA has a crucial **complementary role in addressing aviation CO_2 emissions**.
  - **CORSIA Eligible Emissions Units** are used to offset international CO_2 emissions, and need to meet the **ICAO-approved criteria that includes additionality and no double counting**.
  - CORSIA contains a **mechanism to incentivize emissions reduction from the use of sustainable CORSIA Eligible Fuels.**
  - **CORSIA Eligible Fuels** are from a wide variety of feedstock and conversion processes. Eligible Fuels need to comply to the **ICAO-approved sustainability criteria**.

ICAO completes all essential components for CORSIA implementation package

CORSIA is on track

2018 | 2019 | 2020 | 2021

Jun-18 | Mar-19 | Jun-19 | Nov-19 | Mar-20 | Jun-20 | Nov-20

CORSIA MRV starts from 1 January 2019

Pilot Phase

C/214 | C/216 | C/217 | C/218 | C/219 | C/220 | C/221

CORSIA Implementation Elements

CORSIA SARPs (Annex 16, ETM, Volume IV)

- Annex 16, Vol. IV (1st edition)
- ETM, Vol. IV (1st edition)
- ETM, Vol. IV (2nd edition)

CORSIA States

- 88 volunteer States for 2021

ICAO CORSIA CERT

- CERT ICAO CORSIA CO_2 Estimation and Reporting Tool (2018 version)
- CERT ICAO CORSIA CO_2 Estimation and Reporting Tool (2019 version)
- CERT ICAO CORSIA CO_2 Estimation and Reporting Tool (2020 version)

CORSIA Eligible Fuels

- Sustainability Criteria
- Default life cycle CO2 values
- Actual life cycle CO2 values
- Eligible SCS

CORSIA Eligible Emissions Units

- Emissions Units Criteria
- Establishment of TAB
- SCS requirements
- Eligible emissions units
- Updated eligible emissions units
- List of operators (regularly updated)
- List of verification bodies (regularly updated)

CORSIA Central Registry (CCR)

- Establishment of CCR
- States reporting of 2019 CO_2 data in CCR

ROLE OF ICAO AND MEMBER STATES – KEY POINTS FROM STOCKTAKING

- **ICAO's leading role** in sustainable aviation is crucial. ICAO must ensure the development of **more stringent standards.**
- ICAO needs to continue facilitate the development of the **new certification requirements** for the latest innovations.
- States need to develop, through ICAO, **global policies and regulations in a uniform way**. The development of the policy/legal framework must be accelerated to match the pace of technological development.
- The **transition** towards decarbonization requires standards, incentives, R&D support, implementation of new infrastructures and consumer mobilization.
- Decarbonisation will require more **financial support** from governments and financial institutions (loans or subsidies).

HIGH LEVEL GUESTS – SOME MESSAGES

- The current health crisis should not overshadow the climate crisis. **Act urgently, creatively and ambitiously** to reduce green house gas emissions! ***– Valérie Plante, Mayor of Montreal***
- We have to go back to the track of disruptive innovation. **Aviators are Innovators**. We can build the next phase of the history of aviation, **all together** ***– Bertrand Piccard, Solar Impulse Foundation***
- **Manufacturers are ready** to build on this history of success and explore a all range of innovative technologies ***– Eric Fanning, ICCAIA***
- Bailout with **green conditions**. Prepare the next technological breakthrough. Decarbonizing world air traffic. **Energy is key.** Call for a **global action** ***– Patrick Gandil, French DGCA***
- **Committed** to achieve **net-zero** operations by 2050 ***– Rob Gurney, oneworld***
- **Inclusivity and transparency** are essential ***– Drew Kodjak, ICCT***
- **The transition to net zero is inevitable.** The risks of 1.5°C are high. Kids are angry. Scientists are scared. We need a **collective roadmap** to zero emissions by 2050. ***– Nigel Topping, UK Climate Champion, COP26***

CONCLUSION – KEY OUTCOMES

- The current crisis affecting aviation is unprecedented, but so is the **volume and speed** of initiatives for disruptive, revolutionary **solutions for a greener aviation**.
- The pace by which you see the development of electric and hydrogen planes or new processes for generating sustainable aviation fuel is **unparalleled**, and for the first time, **sustainably motivated**.
- The flying public wants the ability to **fly sustainably** and innovation can help substantially.
- Some green technologies and solutions are **available right now** or very soon, and all stakeholders **need to get ready for it** (States, industry, financial institutions).
- There is no Silver Bullet. **All measures count**, and global **cooperation** has never been so important.






Thank you

Jane Hupe

Deputy Director, Environment, ICAO

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