AVIATION CO_2 REDUCTIONS

ONLINE STOCKTAKING PREVIEW

28 APRIL 2020

Reducing Aviation CO_2 Emissions Challenges and Opportunities

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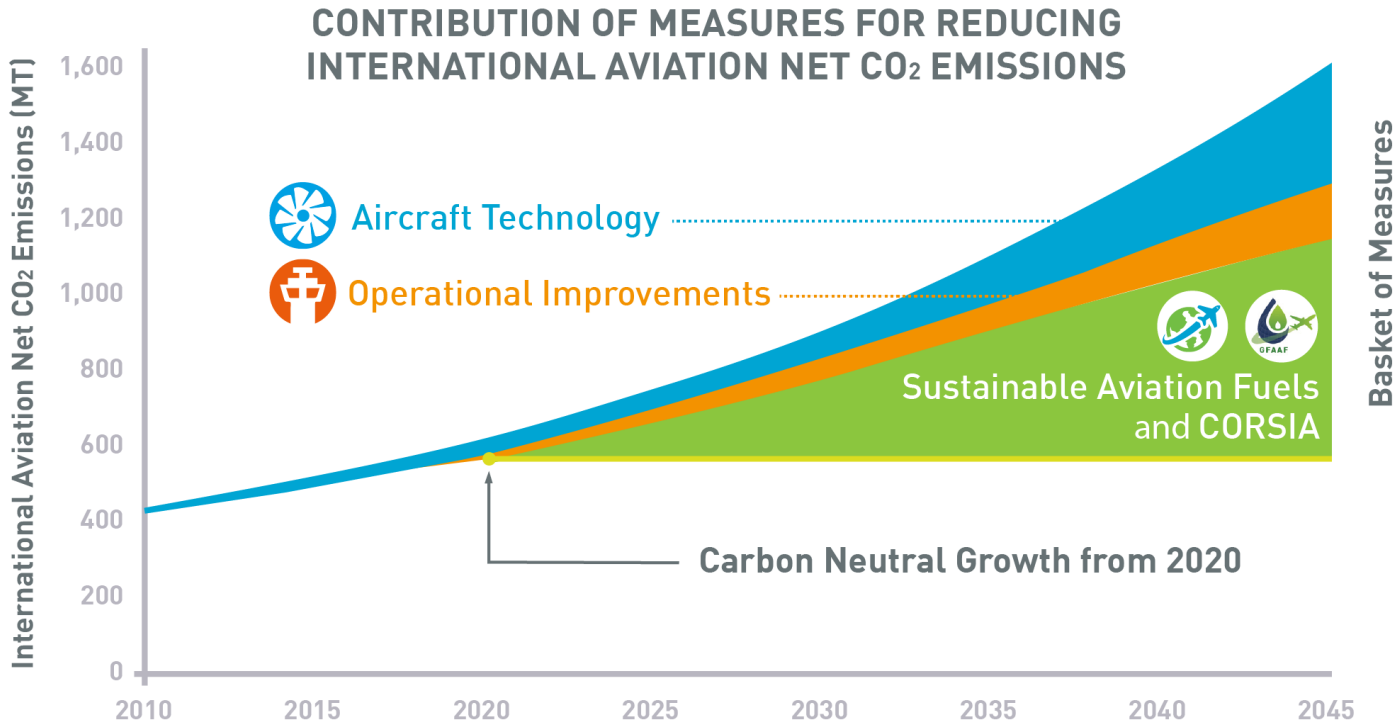
ICAO Basket of Measures

- Aircraft Technology Improvements
- Operational Improvements
- Sustainable Aviation Fuels
- Market-Based Measures (CORSIA)



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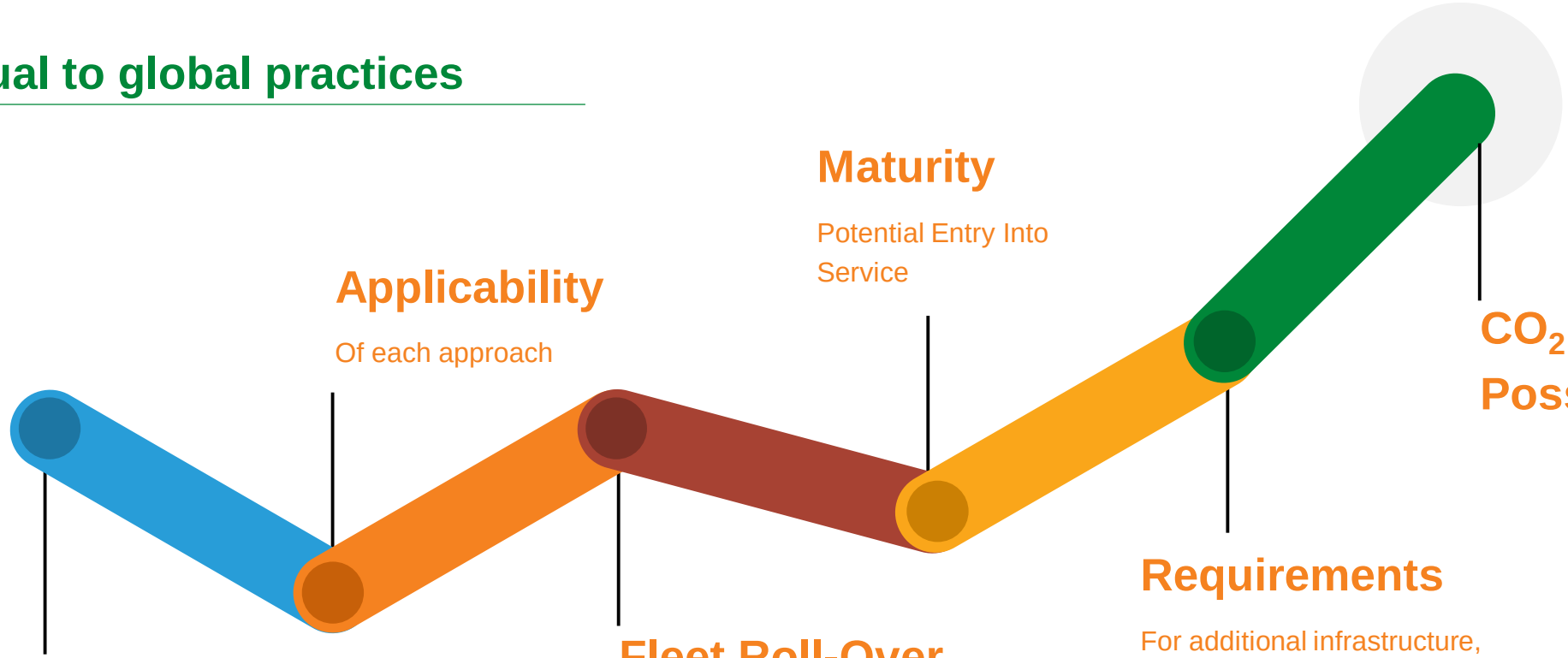
Key Parameters for Reducing Aviation CO_2 Emissions

Individual to global practices



Potential

Of each individual measure – 5%, 10%, 30% reduction?

Applicability

Of each approach

Fleet Roll-Over

Does the approach depend on fleet replacement?

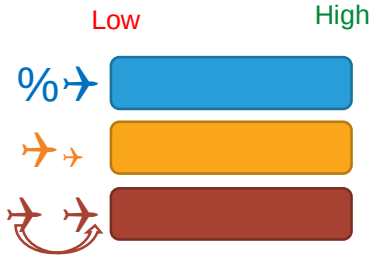
Maturity

Potential Entry Into Service

Requirements

For additional infrastructure, regulations, etc.

CO_2 Reduction Possibility



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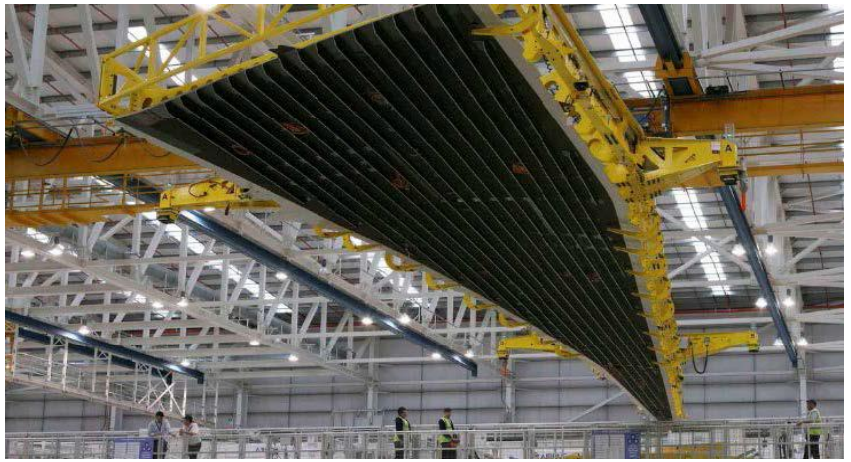
Aircraft Technologies

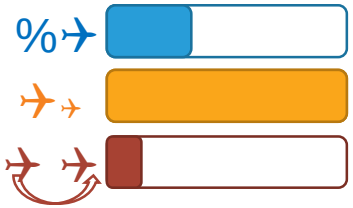
Challenges & Opportunities

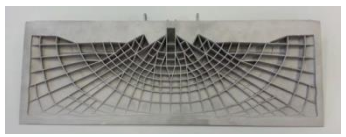
Advanced Aircraft Technology

Challenges & Opportunities

- Short term (2020-2035), reductions up to 25% or 30% - BUT harder each time!
- More feasible to implement than “Novel” concepts
- High applicability and compatibility







Images courtesy of Boeing, Airbus

Examples:

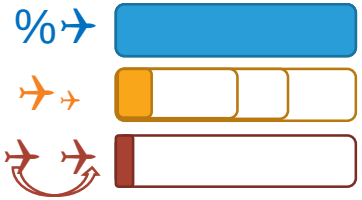
- Propulsion: Higher by-pass ratio, GTF, higher turbine temperature
- Aerodynamics: Winglets, foldable wings
- Materials: Additive manufacturing, composites

Novel Aircraft Technology

Challenges & Opportunities

Opportunities

- Reductions in emissions up to 100%
- Long term reductions
- Also benefits on local air quality



Challenges

- Often require extra infrastructure
- Dependent on life-cycle emissions
- Depend on long fleet roll-over times
- High development costs

Examples:

- Electric/ hybrid propulsion
- Blended wing body – Strut-braced wing
- Hydrogen propulsion

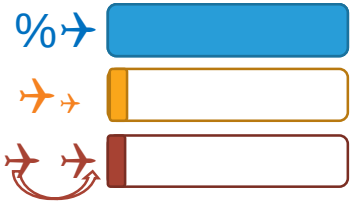
Images courtesies of: EnableH2, Eviation Alice, Airbus

Novel Aircraft Technology Examples

Electric Aircraft

Opportunities

- Long term (>2040)
- Reductions in up to 100%
- Reduction of Local Air Quality pollutants
- Reduced maintenance cost

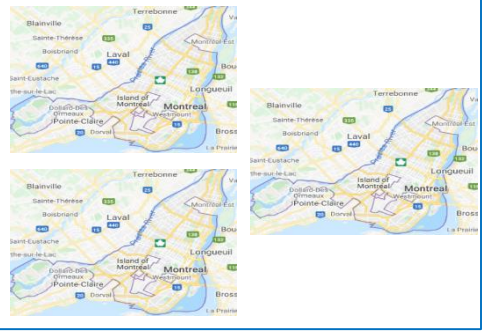


Challenges

- Availability of clean electrical energy
- Transportation and network
- Storage, battery capacity, lithium availability
- Depend on energy mix
- Applicability very limited by power density
- Infrastructure required

Key energy figure

- Per day, electrification of all flights from YUL would need ~3X the household energy usage of Montreal.



Images courtesies of: Lilium, Alpha electro Pipistrel

Sources: - https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2510006001
- https://www.atag.org/facts-figures.html (2019)

Novel Aircraft Technology Examples

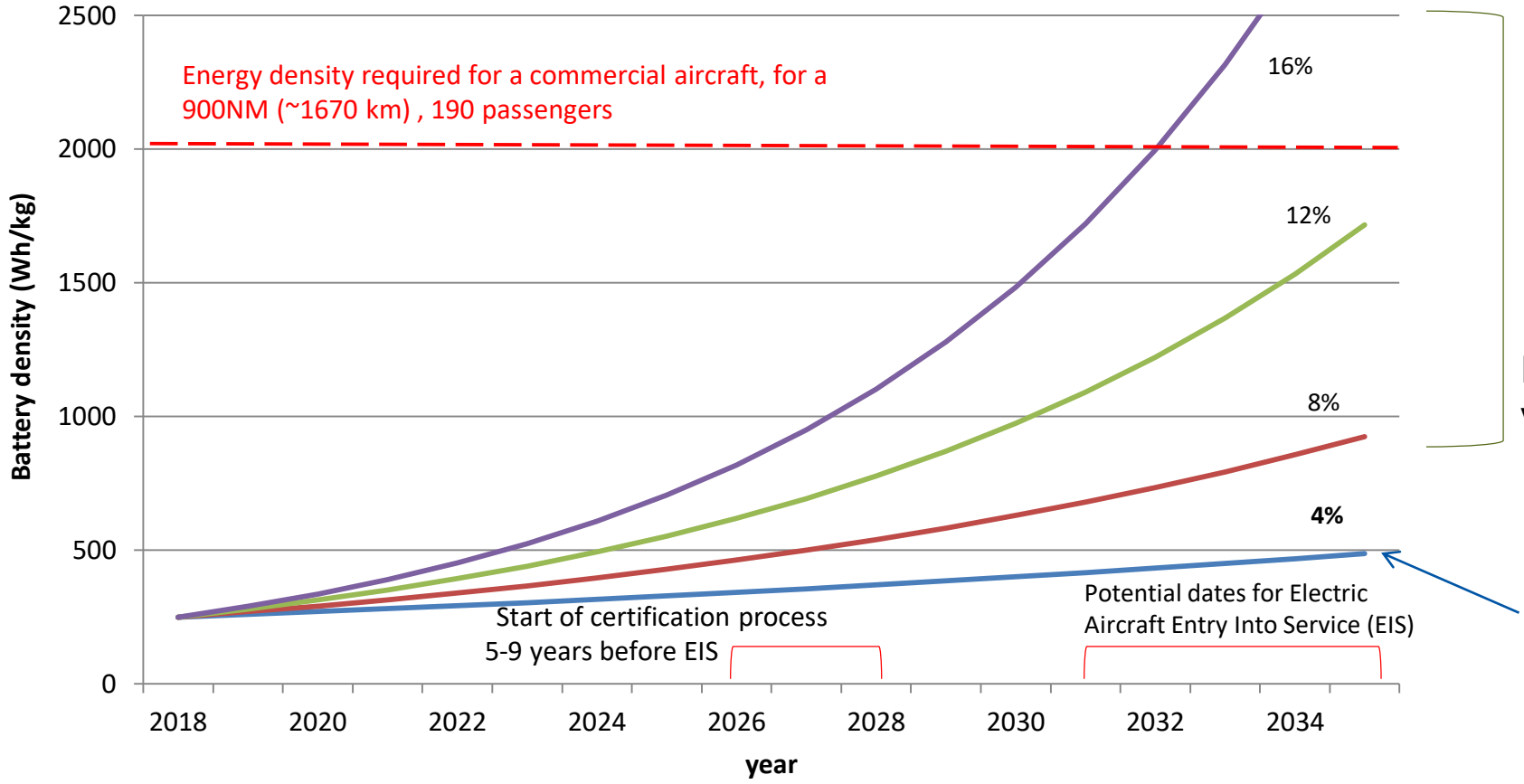
Electric Aircraft Video

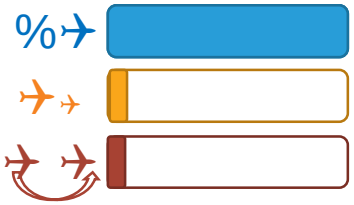
Company : **NASA**

Presenter name : James Heidmann

Novel Aircraft Technology

Electric Aircraft – Battery specific energy development





Hypothetical scenarios, very optimistic

Currently: ~4% Improvement per year

- If a cell phone battery had the same specific energy as kerosene (kJ/kg) the battery would last for nearly 2 months without charging! A long way to go to match batteries to Jet-A1!

Novel Aircraft Technology Examples

Electric Aircraft Videos

Company : **AMPAIRE**

Novel Aircraft Technology Examples

Hydrogen Aircraft

Opportunities

- Long term (>2050)
- Reductions in up to 100%
- Wide applicability: Long and short haul
- High specific energy fuel

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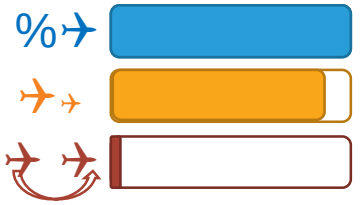
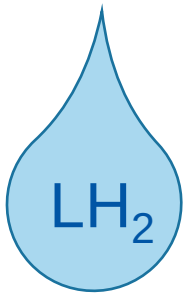




Challenges

- Availability of clean hydrogen
- Highly dependent on fleet roll-over
- Large investment & infrastructure required
- Reductions depend on energy mix
- Cost competitiveness

Key energy figures *

- Aviation 2019 fuel consumption: ~290 MT

  Hydrogen production 2019: ~ 120 MT (<1% renewable)

- Hydrogen has 2.8 times more energy per unit mass than aviation fuel. By energy content, the world supply of Hydrogen needs to increase by 80%

*Image courtesy of EnableH2, receiving funding from the European Union Horizon 2020 research and innovation programme

Sources – ATAG; IRENA- Hydrogen a renewable energy perspective

Novel Aircraft Technology Examples

Hydrogen Aircraft Video

Company : **EnableH2**

Presenter name : Bobby Sethi

Sustainable Aviation Fuels

Challenges & Opportunities

Sustainable Aviation Fuels

Challenges & Opportunities

Opportunities

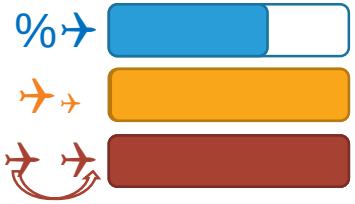
- **High** emissions reduction potential
- **Wide** applicability
- **No delay** due to of fleet roll-over
- **>240,000** flights already operated

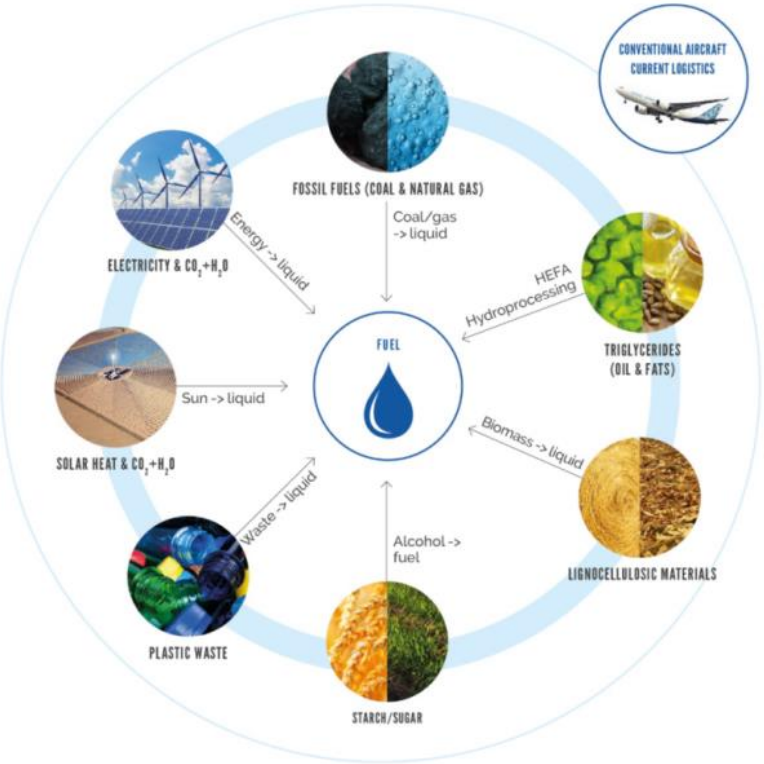
Challenges

- **Availability** of feedstock
- **Environmental** sustainability
- **Cost** competitiveness

GFAAF

Global Framework for Aviation Alternative Fuels





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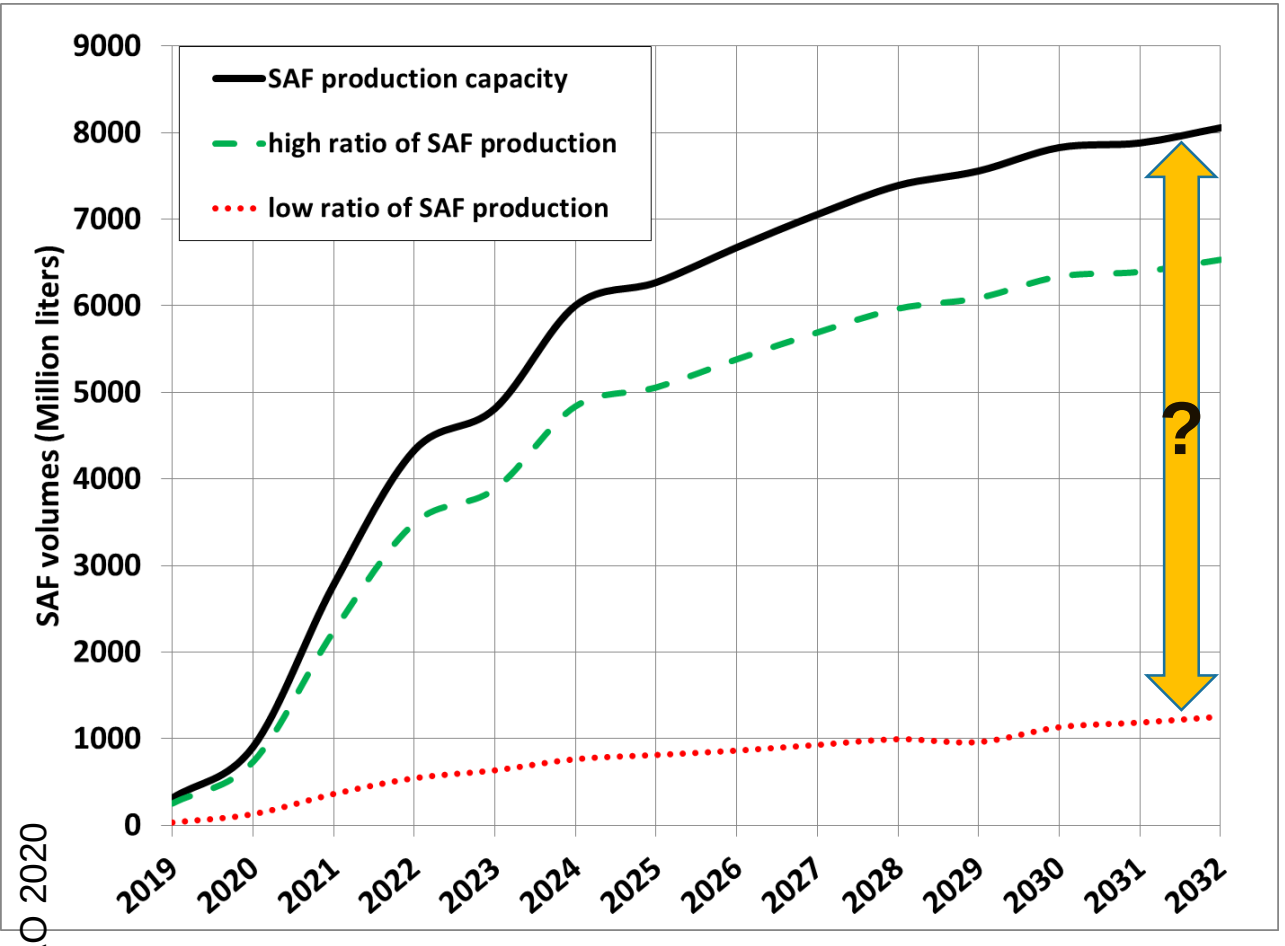
- Endorsement of the **2050 ICAO Vision for Sustainable Aviation Fuels**
- Calls for a **significant proportion of SAF use by 2050**
- **A quantified long-term goal for SAF** to be defined in CAAF/3 (by 2025)
- A **Stocktaking process** will support the definition of this goal

ICAO STOCKTAKING SEMINAR
TOWARD THE 2050 VISION FOR
SUSTAINABLE AVIATION FUELS
ICAO Headquarters, Montréal | 30 April - 1 May 2019
LEARN MORE
#SustainableFuels



ICAO stocktaking Results 2019

ICAO Vision has a view to include a quantified proportion of SAF use by 2050.

CAAF/2 encouraged States to develop policies that promote the use of SAF, or promote policies that strive to establish a level playing field between aviation and other transportation sectors on the use of sustainable fuels.

Sustainable Aviation Fuels Examples

Videos

Company : **Neste**

Company : **SAF+**

Presenter name : Jean Paquin

ATM & Aircraft Operations

Challenges & Opportunities

ATM & Aircraft Operations

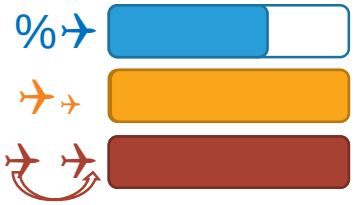
Challenges & Opportunities

Opportunities

- **Wide** applicability
- **Cost effective** to implement
- **Lower dependency** to fleet roll-over
- **Often Reduced** A/C maintenance cost
- **Route** efficiency

Challenges

- Safety
- Regulatory constraints
- Constant limitations (weather, equipment, facilities, military activity, traffic)
- Site-specific requirements
- Limited airport capacity -> Congestion and delays



Examples:

Continuous climb and descend

Harmonized airspace- Direct routing

Big data and AI to optimize operations

ATM & Aircraft Operations Examples

Videos

Company : **OpenAirlines**

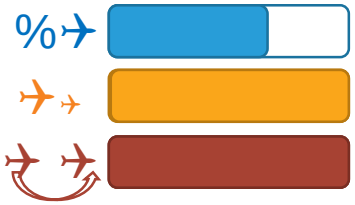
Presenter name : Alexandre Feray

Company : **Signol**

Presenter name : Daniel White

ATM & Aircraft Operations Examples

- Engine and airframe maintenance (e.g. engine wash)
- Reducing aircraft mass
  - Fuel (tankering)
  - Payload (magazines, seats etc.)
- Reducing engine idling time
- Emission-free taxiing
- Reducing APU operational time (e-GSE)
- Training personnel on emission friendly practices



Source – Indianapolis International Airport

ATM & Aircraft Operations Examples

Videos

Company : **Smart Airport Systems**

Presenter name : Maxime Mahieu

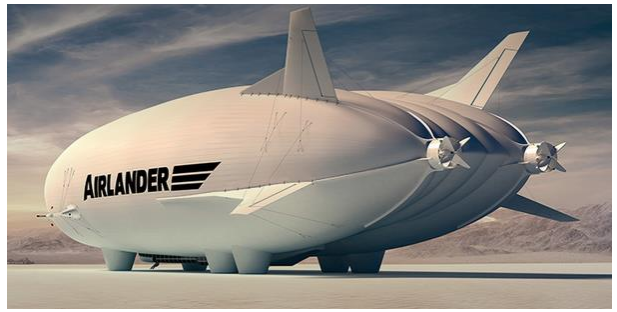
Company : **Airbus**

Other Examples

Technologies, Fuels, Operations and beyond

- More videos available on the Stocktaking Seminar's webpage

CRIAQ
CONSORTIUM DE RECHERCHE ET D'INNOVATION EN AÉROSPATIALE AU QUÉBEC



aena

ICF

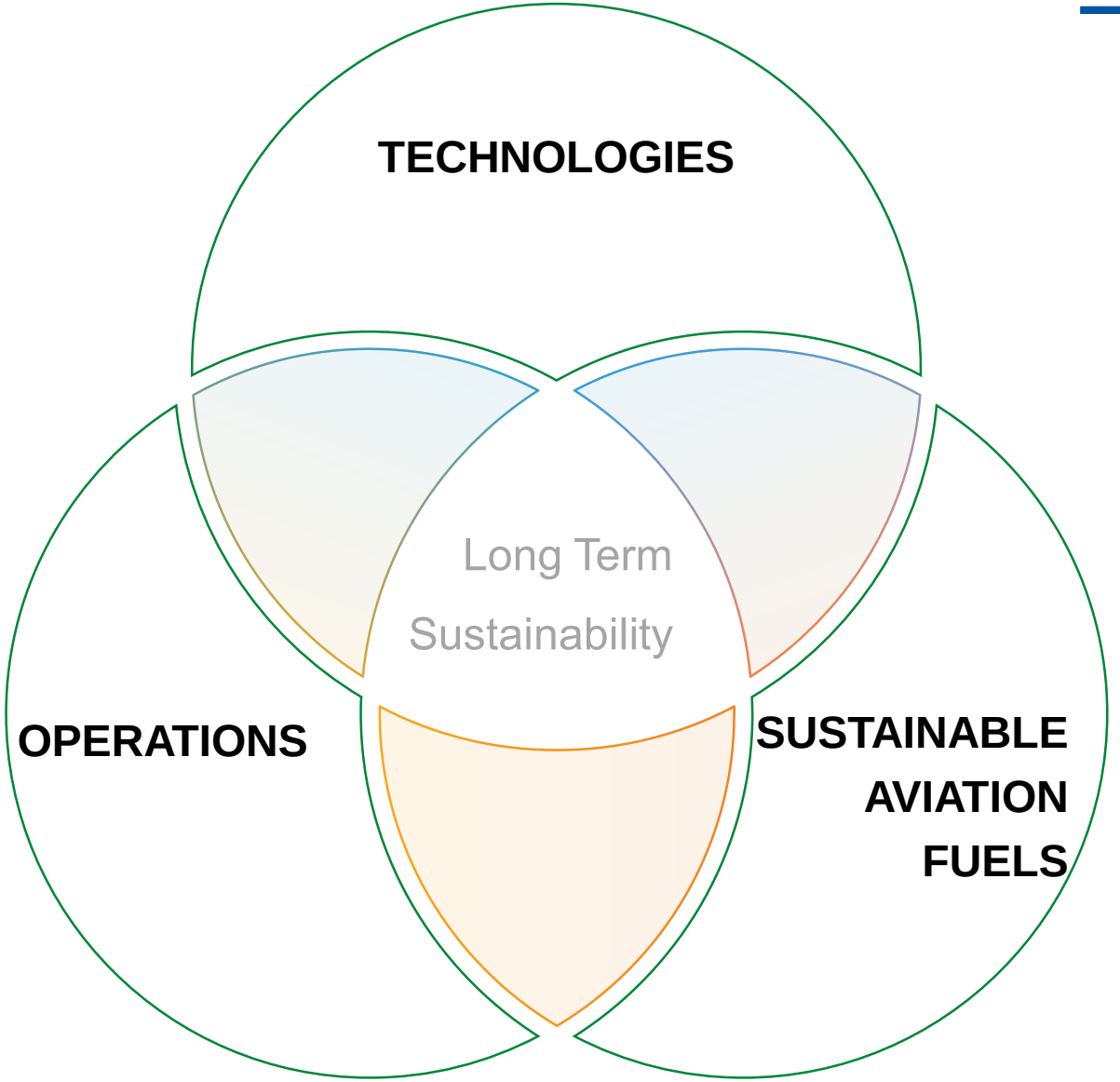
NATS

FLYING WHALES
CONNECTING THE LAND-LOCKED WORLD TO THE GLOBAL ECONOMY

- To submit a new video, please contact officeenv@icao.int

Conclusions

- Strong synergies
- Long term sustainable solutions
- Holistic approach
- Interdependencies with other sectors



Thank You

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