Sustainable Aviation Fuel

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SAF Demand and Production

1. ICAO CAAF/3 outcome
2. Regional / national policies – 2030
3. Airline commitments – 2030
4. Production outlook – 2030
5. Production today
6. Enablers for continuous ramp up to net zero 2050

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This presentation focuses on the demand and production of SAF

It first covers the demand side:

The outcome of the Third ICAO Conference on Aviation Alternative Fuels (CAAF/3) and:

- What this means in terms of supporting the ramp-up of SAF to 2030
- What existing regional and national policies should lead to, if effective, in terms of SAF volumes to 2030
- What airline commitments there are, to date, and what would they require in terms of volume for 2030

All three of these 'demand' drivers have overlap and are therefore complementary. It is important they are seen in this way. It illustrates how good demand drivers for SAF volumes to 2030 are already in place.

On the SAF production side:

- What is the production outlook to 2030 – what's the potential overall renewable fuel capacity and how much of the output needs to be SAF
- What is the production today - where are we at present.

Will we show that challenges exist to ensure the optimal output of SAF from renewable fuel refining. These will need to be resolved if SAF volumes are to meet 2030 demand levels.

Finally, the presentation looks at what is necessary for the continuous ramp up of SAF now and beyond 2030 to 2050.

1. ICAO CAAF/3 outcome

What is the Global Vision?

5% CO_2 emissions reduction in international aviation by 2030 through SAF and LCAF

What does this mean?

- **682Mt of CO_2** expected to be produced by international flights in 2030
- **34Mt** should be reduced through SAF & LCAF
- This corresponds to ~ **14 Mt SAF**

How?

- A global policy framework to promote SAF production
- Capacity building, including a "Finvest Hub"
- Recommendations for robust SAF accounting framework

Mt: million tonnes; 1 tonne = 1,250 liters

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The CAAF/3 output is an important development to support global scale up in the development and deployment of SAF and LCAF. The goal is to help reduce risk, attract investment by creating a global framework for States and ICAO to work toward decentralization of cleaner aviation fuel production and supply.

The CAAF/3 outputs set out the Global Vision for 2030: 5% of CO2 emissions reduction in international aviation by 2030 through the use of SAF, LCAF and other aviation cleaner fuels

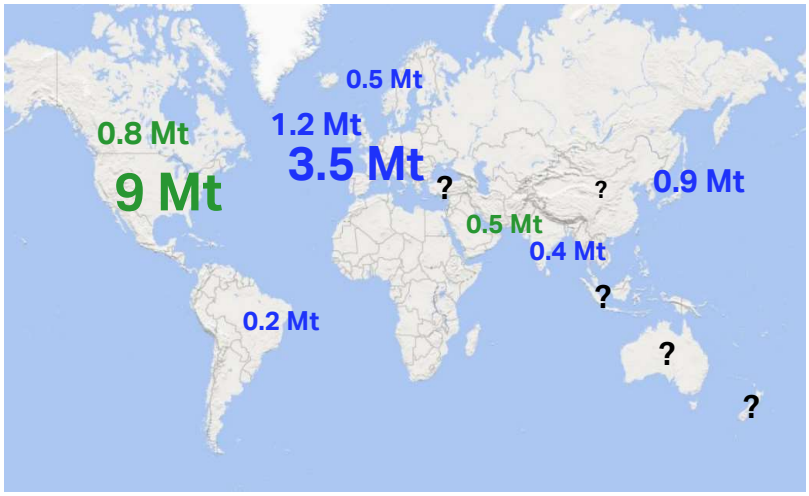
To put this into perspective:

- We estimate international flights would emit 682Mt of CO2 in 2030. 34Mt of this should be reduced through the use of SAF
- This would require around 14Mt of SAF to be available on the market in 2030.

There are very important supporting measures in the CAAF/3 Outcome:

- A global policy framework to promote SAF production
- Capacity building tools including a ICAO Finvest Hub to connect aviation projects and stakeholders, including financiers
- Recommendations for global coverage of SAF accounting methodologies to ensure environmental integrity of emissions reduction reporting.

2. Regional / national policies – 2030



10.3Mt through incentivizing policies: government / industry collaboration

6.7Mt through mandates: government imposed targets on industry

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When we look at potential demand driven by existing regional or national policies, there are two distinct approaches:

- Examples of governments supporting technological development, ramp-up and purchasing of SAF to help create functioning markets – industry led and government supported.
- Examples of governments imposing mandates on industry - government defined and leave the industry to take risk.

The US SAF Grand Challenge is expected to deliver about 10% of the jet fuel volume uplifted in the US in 2030, and has a very good chance of succeeding.

Mandates are generally imposed by governments with little to no consultation, so their effectiveness as a standalone measure is yet to be assessed. Fuel suppliers may support mandates - increased demand for any scarce commodity can drive prices up, increasing margins significantly

Governments are slowly realizing that supportive policies are necessary. The end goal of any policy decision should be to create functioning markets for SAF. ICAO's call for such policies is very timely in this context.

Details of numbers on the chart:

- US SAF Grand Challenge: 3 billion gallons annually by 2030
- Canada: C-SAF target of 1 billion liters in 2030
- Mandates in Norway (5% of fuel use) and Sweden (27% of emissions reductions from the use of SAF) in 2030
- UK: 10% mandate in 2030, but they have also explicitly said 1.2Mt
- EU: 6% mandate in 2030
- UAE: 700 million liters/yr by 2030 as stated in their roadmap
- Japan: 10% of fuel used on international flights in 2030
- India: 2% if fuel used on international flights in 2028; we should assume the same percentage for 2030

3. Airline commitments – 2030

43 airlines around the globe have SAF voluntary commitments / agreements

Corresponding to **~13 Mt of SAF** use by 2030

5 6 December 2023

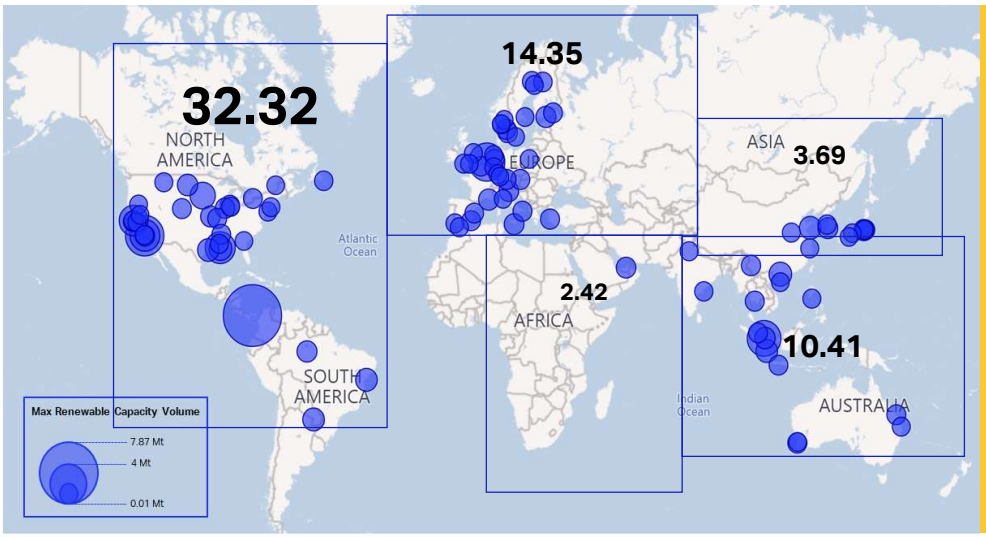
43 airlines have committed to different SAF uptake levels going from 5 to 30% by 2030, most of them committing to 10% SAF use.

We did an estimation of how much SAF this could mean and estimate around 13 Mt.

All the numbers presented from CAAF/3, regional / national policies, airline commitments are complementary – largely overlapping in scope – and they support each other to clearly demonstrate that demand for 2030 from states and the industry is there.

These numbers will undoubtably continue to increase over time in consistency with our IATA Roadmaps, which is for 24 Mt of SAF to be available for 2030.

4. Production outlook – 2030



Global forecast for Renewable Fuel capacity **~63 Mt**

We need ~25-30% SAF output

Global forecast for renewable fuel production (not just SAF) shows a regional distribution of production. At present we estimate a potential output of 63 Mt from renewable fuel projects which have slated SAF as a potential output. This should increase in coming years but it is also true some of these projects will fail.

If we assumed a 30% production channeled towards SAF (an assumption which is aligned to optimal refining for the HEFA pathway) the outputs could actually match today's 2030 projections on the regional policies slide, about 10 Mt in North America, about 5 Mt in Europe, about 2 Mt in APAC.

While planned capacity generally matches forecast demand as of today, actual SAF output will greatly depend on supportive policies vs. other renewable fuels. If a country has incentives on renewable diesel and not for SAF, more of the output from the producer will be channeled to the renewable diesel and not to SAF for aviation. We need balanced policies for renewables fuels to ensure a fair output of SAF.

5. SAF production today

Year	2019	2020	2021	2022	2023e	2024f
Estimated SAF Output (Mt)	<0.02	0.05	0.08	0.24	**0.45-0.5**** (625 million liters or 3% RF output)	1.5*** (1.875 bn liters or 6% RF output)
Global Jet Fuel (Mt)*	287	157	189	233	**286***	301
SAF % of Global Jet Fuel	<0.01%	0.03%	0.04%	0.1%	**0.2%***	0.5%

2023 SAF Production:
~0.5Mt of SAF in 2023
Average SAF output only ~3% of total Renewable Fuel output

Need incentives for optimal SAF output

* IATA Economics
** Based on current insights; Q4 2023 numbers to be confirmed in retrospect in Q1 2024
*** Based on current projections and assumptions that delayed 2023 capacity will fully commercialize in 2024

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SAF production today clearly illustrates the potential challenges ahead.

We do see production increasing from 240,000 tonnes in 2022 to an estimated 500,000 tonnes this year. However, this is notably less than expected due to a delayed or shorter SAF output from several refineries.

There is a fair chance this shortfall will be made up in 2024 but the bigger issue is, today, SAF is actually only 3% of the total outputs from the renewable fuel refineries. It's forecast to be 6% by next year, to 1.5Mt of SAF.

As mentioned before, SAF output will greatly depend on supportive policies vs. other renewable fuels. We need balanced policies for renewable fuels to ensure a fair output of SAF. Government mandates for SAF, by themselves, will not solve this problem.

6. Enablers for continuous ramp up to 2050

A. Pathway diversification

B. Broader sustainability benefits

C. Regional feedstock value chains

D. Global SAF accounting framework

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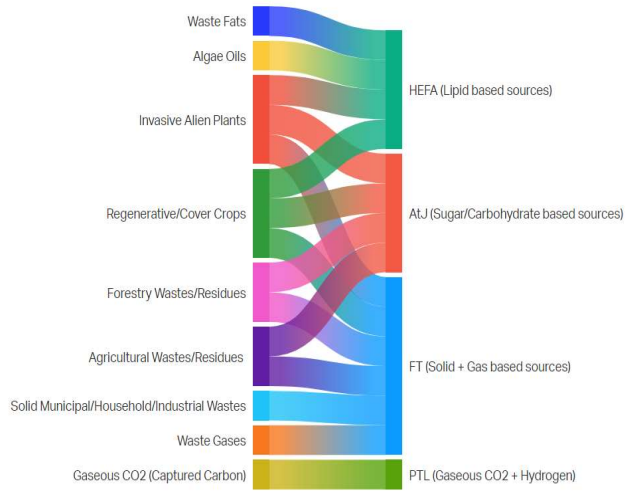
So far the focus has been on demand vs production to 2030. Aviation's commitment for net zero carbon emissions by 2050 means we will need around 20 times as much SAF in 2050 compared to 2030.

For that to happen, we need to focus on four main enablers going forward:

a. We must diversify from the HEFA pathway, which is the most constrained in terms of volume of feedstock supply.
b. In doing so, there is opportunity to capitalize on broader sustainability benefits that new feedstocks and pathways can offer
c. Regional value chains best utilizing the feedstock potential in any region is key.
d. And a robust SAF accounting framework is paramount to making this all work – across the globe.

A. SAF pathway diversification

Feedstock Component to Pathway



a) Scale **Alcohol-to-Jet & Fischer Tropsch** production projects

b) Invest in & fast-track certification of **New Production Pathways**

c) Invest in & fast-track new Feedstock Conversion Technologies

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On the way to 2030 and particularly 2050, we must scale- up production and most importantly diversify our feedstock pool. Most of the growth to 2050 will come from pathways not yet available at scale today.

We should begin to allocate time/resources/investment into the most optimized feedstock/pathway combinations, which help achieve a balance of appropriate volume/carbon reduction/nature impact.

Important:

1. The feedstock informs the SAF production pathway

2. One feedstock may align with several different SAF production pathways; therefore, identifying relevant regional value chains becomes about:

a) Identifying all local viable feedstocks (see slide 11)
b) Assessing which pathway(s) this grouping of feedstocks align with
c) Identify the most relevant production pathway(s) for the region, based on their combination of feedstocks
d) Consider if a given SAF pathway will derive higher yields/stronger emission reductions from a given feedstock, relative to another pathway using the same feedstock

B. Broader sustainability benefits

Projects that aggregate wastes or recultivate degraded land create numerous socio-economic co-benefits, which are **major factors for attracting investment**:

Sustainable supply chains	**Job & wealth creation**	**Energy security**
Land restoration	**Biodiversity**	**Regional development**

SAF is the biggest lever for aviation's transition to net zero carbon emissions. But this key solution for aviation also offers broader benefits positively impacting sustainability, economic opportunity and energy security.

Projects aimed at aggregating wastes or recultivating degraded land have several positive socio-economic effects which become a major pull factor for attracting institutional and critically, government investment.

Governments should be encouraged and supportive of projects because of the potential to:

- Develop sustainable supply chains at the regional level
- Create of local income and employment
- Support land restoration and/or regeneration
- Promote and foster biodiversity
- Aiding the development of localized energy independence and security

C. Global feedstock value chains

Feedstock by Region

Several options exist per region; lending itself to the development of multiple value chains, environmental restoration and nature positive projects, and the opportunity to leverage all our certified SAF technologies.

Africa	ASPAC	Europe	Middle East	N.America	N.Asia	Oceania	S.America
Cover Crops	Agri Wastes	Forestry Wastes	Atmospheric CO2	Agri Wastes	Waste Fats/Oils	Regenerative Crops	Agri Wastes
Agri Wastes	Waste Fats/Oils	Urban Landfill	Food Waste	Cover Crops	Agri Waste	Agri Wastes	Regenerative Crops
Invasive Plants	Municipal Waste	Cover Crops	Algae Oils	Waste Fats/Oils	Atmospheric CO2	Waste Fats	Waste Fats/Oils
Off-Gases	Industrial Waste	Atmospheric CO2	Waste Gases	Urban Landfill	Off-Gases	Atmospheric CO2	Forestry Wastes

NB: The above is not an exhaustive list, but represents the key identified feedstock categories

We not only see a regional distribution of production sites but also of feedstocks, and a wide variety of them. We see here groupings of some of the most common feedstock categories by region.

It is non-exhaustive but should serve to demonstrate the unique diversity of feedstock groupings, relevant to the environments and ecosystems of different regions. This clearly represents why different technologies will be more or less relevant in different places, so as to leverage the locally prominent feedstocks and address broader sustainability opportunities specific to the region.

It points to the opportunity to collaborate with other sectors, including farmers, municipal governments, supply chain operators etc., in order to optimize value chains, define feedstock aggregation/cultivation systems and ultimately support local economic development.

Essential for continued progress

1. Accelerated **investment** into sustainable aviation fuels by traditional and new fuel companies
2. Government **incentives** to facilitate optimal SAF outputs from renewable fuel refineries
3. Regional **diversification** of feedstock and SAF production
4. Use and recognition of global **SAF Accounting framework** by all parties

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To recap of some of key issues that need to be addressed:

Investment needs to be continued and accelerated for SAF and the financing community should facilitate key projects to support the demand coming from international, regional, national policies and well as airline commitments. A key factor in this has to come from traditional major oil companies increasing investment in SAF.

Government incentives for renewable fuels must take account of SAF - cannot be ignored - otherwise there is danger we will not have optimal outputs for SAF from producers. There needs to be continued focus on the diversification of SAF and pathways to support ramp up of SAF production in all regions – this is also supported with the CAAF/3 declaration. Paramount to facilitating all of this is the adoption of global SAF accounting principles and methodologies.


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IATA
SAF
Accounting
Framework

Slide 13

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