



ICAO Stocktaking industry informal briefing

12 July 2023 | Montreal

Agenda

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- 1 **Welcome and introduction**
 - 2 **Current state of play**
 - 3 **Elements of a CAAF/3 outcome:** core principles
 - 4 **Goal modelling:** the industry's thought process
 - 5 **The importance of book and claim**
 - 6 **The importance of finance**
 - 7 **Industry activity on SAF scale-up**
 - 8 **Q&A session**
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Welcome

Briefing sponsor:





GE Aerospace

What this informal briefing is... and what it is not!

- We will not be sharing industry perspectives on the potential goal of CAAF/3 itself.
- Instead, we will share our thought process and some of the principles of how an outcome of CAAF/3 can be developed.



Conrad Clifford
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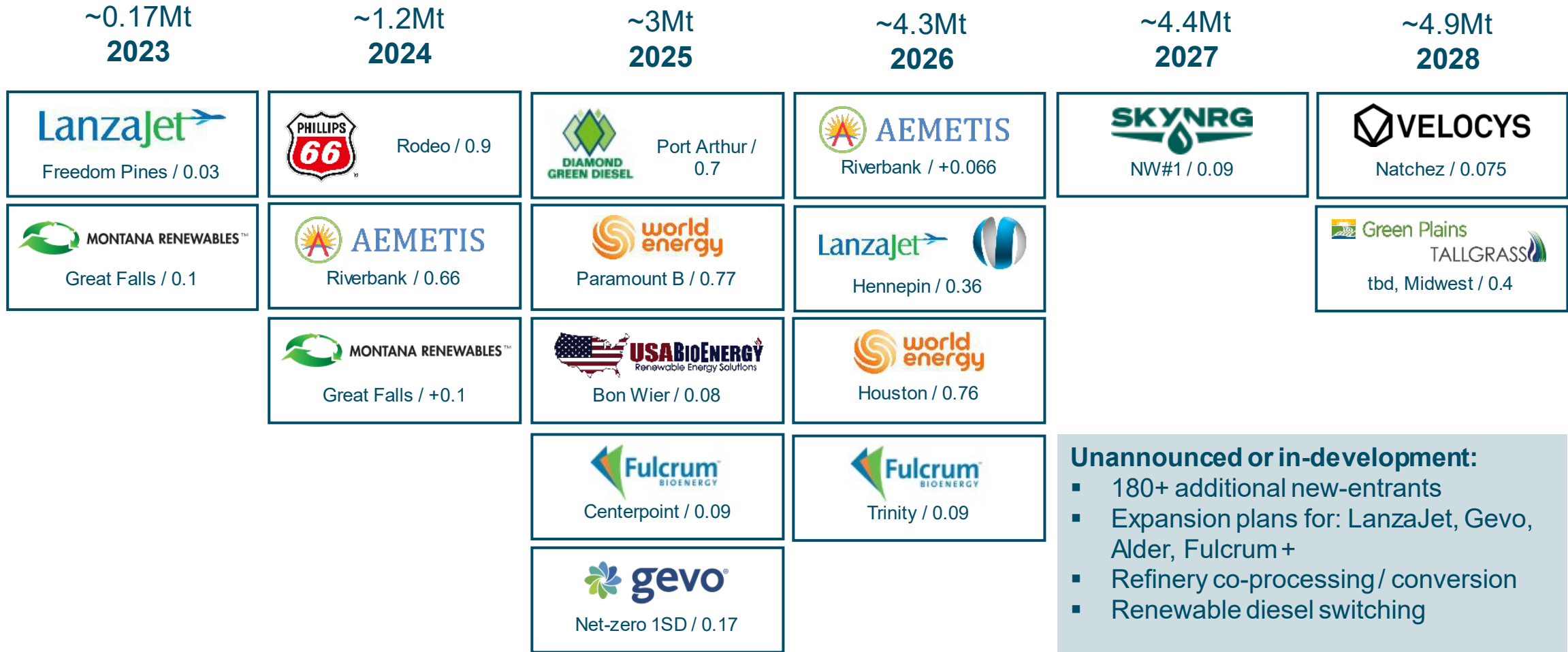
Current state of play

Briefing sponsor:



Supply ramp-up in the United States

Estimated year-end production forecast
(millions of tonnes)



Unannounced or in-development:

- 180+ additional new-entrants
- Expansion plans for: LanzaJet, Gevo, Alder, Fulcrum +
- Refinery co-processing/ conversion
- Renewable diesel switching

Airlines are already signing offtake agreements

- Aegean Airlines
- Air Canada
- Air France
- Air Greenland
- Air Transat
- Alaska Airlines
- All Nippon Airways
- Amazon Air
- American Airlines
- Asiana
- Austrian Airlines
- British Airways
- Cathay Pacific
- Cebu Pacific
- Delta
- DHL Express
- EasyJet
- FedEx
- Finnair
- Hawaiian Airlines
- IAG
- IAG Cargo
- Iberia Airlines
- Icelandair
- ITA Airways
- Japan Airlines
- JetBlue
- KLM
- Korean Air
- LOT Polish Airlines
- Lufthansa Group
- Netjets
- Qantas
- Qatar Airways
- Ryanair
- SAS
- Scoot
- Singapore Airlines
- Southwest Airlines
- Sunclass Airlines
- United Airlines
- Verijet
- Virgin Atlantic
- VistaJet
- Wizz Air



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airlines with offtake
agreements for SAF
totalling over
\$40bn
so far...

Airlines also making longer-term commitments: **10% SAF by 2030**



Airlines covering
34%
of global
passengers and
40%
of global RPKs
have committed to a
significant proportion of
their fuel uplift in 2030
being SAF

Customers will also play a role: SAF purchases

By individual passengers

(as part of a ticket or separately through the booking process)



By corporate customers

(large purchasers of tickets or air services)

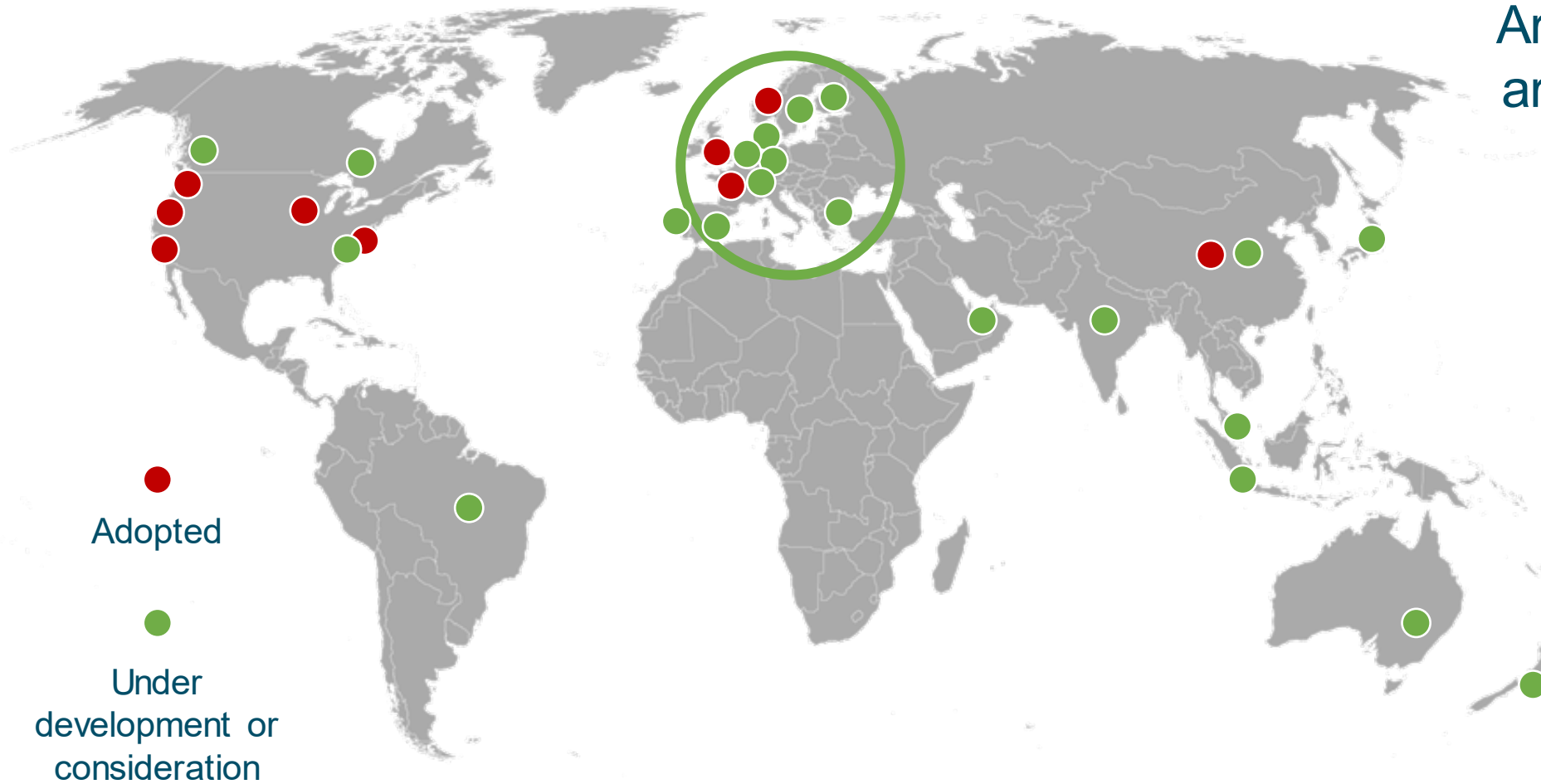


Separate to airline

(direct purchase of SAF into the system)



Government policy to add demand: **global picture**



Around 40 countries are implementing or considering SAF policy options.

Approved technical pathways

	Process / pathway	Feedstock	Blending limit
1	FT-SPK	Biomass (e.g. trash/rubbish, forestry residues, grasses)	up to 50%
2	HEFA-SPK	Oil-bearing biomass (e.g. UCO, algae, jatropha, camelina)	up to 50%
3	HFS-SIP	Sugars to hydrocarbon (e.g. molasses, sugar beet, corn dextrose)	up to 10%
4	FT-SPK / A	Same feedstock as Annex A1, but slightly different process	up to 50%
5	ATJ-SPK	Agricultural waste (e.g. forestry slash, crop straws)	up to 50%
6	CH-HK	Plant and animal fats, oils and greases (FOGs)	up to 50%
7	HC-HEFA-SPK	Bio-derived hydrocarbons, fatty acid esters	up to 10%
8	ITJ	Industrial Sugars	up to 50%









	Co-processing	Feedstock	Blending limit
9	FOG-CP	Waste fats, oils, greases (FOGs) from vegetable and animal sources	up to 5% (could inc. to 30%)
10	FT-CP	Fischer-Tropsch biocrude	up to 5% (could inc. to 30%)
11	CP-HB	Co-processing of hydroprocessed biomass	up to 5% (could inc. to 30%)

Technical pathways in the process of ASTM approval

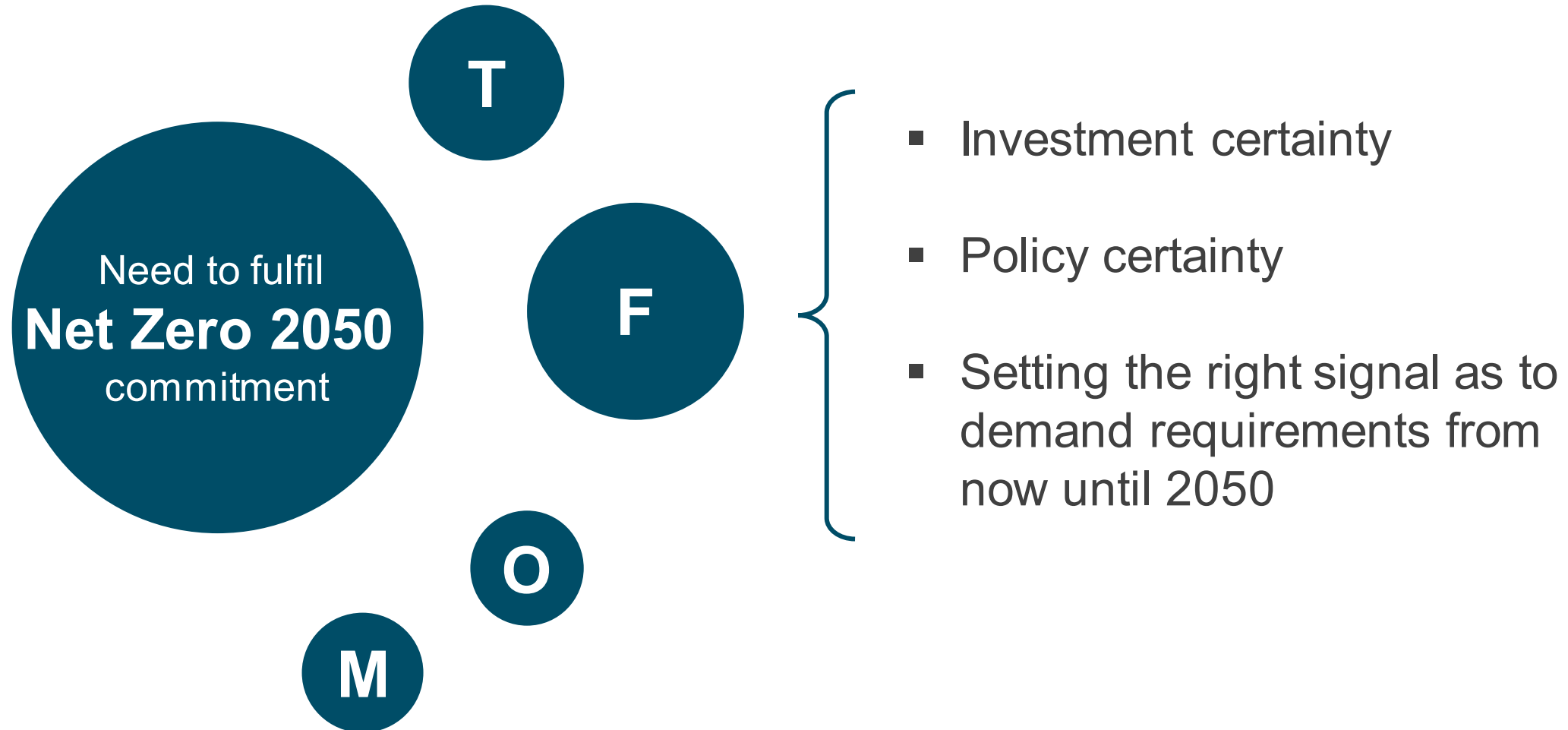
	Process / pathway	Feedstock	Blending limit	Timeline
12	SAK	synthesized aromatic kerosene (Virent)	tbc	2-5 years
13	IH2	Integrated hydropyrolysis and hydroconversion (Shell)	tbc	2-5 years
14	ATJ-BI	ATJ derivative biochemical production of isobutene (Global Bioenergies)	tbc	2-5 years
15	ATJ-MA	ATJ derivative starting with the mixed alcohols (Swedish Biofuels)	tbc	2-5 years
16	DILSAAF	Single reactor HEFA (Indian CSIR-IIP)	tbc	2-5 years
17	ReOIL	Pyrolysis of non-recyclable plastics (OMV)	tbc	2-5 years
18	MtJ	Methanol to Jet (Honeywell, Topsoe and Nacero)	tbc	2-5 years
19	CP-UT	Co-processing of pyrolysis oil from used tires	up to 5%	2-5 years

Power-to-Liquid (aka e-fuels)

- Whilst PtL is expected to be a longer-term solution, already airlines are investing

Airline	PtL partner	Details	Date
		Plant one: 1,000 tonnes per year from sunlight	from 2024/5
		4 plants at 50,000-100,000t per plant	from 2024
		45,000t SAF	from 2028
		40,000t of e-Fuel (a proportion for SAF)	from 2026

What is the benefit of a good outcome at CAAF/3?



Principles for a goal at CAAF/3

- The CAAF/3 discussions should concentrate on SAF deployment
 - Clear distinction between SAF and LCAF
 - Discussion on other forms of energy such as direct hydrogen and electric propulsion as a secondary matter.
- Re-opening the long-term aspirational goal discussions from last year must be avoided.
- Goal should be global.
 - Not ascribed to individual States.
 - Average of the fuel used globally, allowing some States to accelerate decarbonisation faster and others the time needed to scale-up.

“Realistic and achievable whilst still showing **ambition** to spur investment in the next 2-3 years”

Principles for a goal at CAAF/3

- Whilst the goal will likely be for international traffic (given ICAO's remit), any metric should be translatable to domestic traffic to ensure whole-aviation decarbonisation.
- Aligned with net-zero carbon 2050, whilst also being realistic and achievable in terms of timeframe, feedstock availability, sustainability and global development.
- It is important that sustainable aviation fuels can be qualified as such through adequate sustainability principles and themes.

“Realistic and achievable whilst still showing ambition to spur investment in the next 2-3 years”

How have we been approaching the goal discussions

Is it realistic?

Where is production heading?

Where is demand heading (industry commitments + policy measures)?

Is it achievable?

Timeframe: 2030 and 2050

Ramp-up of production (3-5 years for a facility)

Is it ambitious?

Does it push us further than we would be without it?

Does it contribute to the sector's push to net-zero?

Metric for a goal: options (there are others)

Metric	Proportional % of jet fuel	Volumetric Mt SAF	Carbon intensity % reduction in CO ₂
Example	By 2050, [XX]% of jet fuel uplifted should be SAF	By 2050, [XX] Mt of SAF should be used by aviation	By 2050 we should reduce [xx]% in CO ₂ through the use of SAF and LCAF
Benefits	<ul style="list-style-type: none"> Is able to naturally adjust up and down to changes in traffic forecasts and technology development. Easy to understand 	<ul style="list-style-type: none"> Provides tangible delivery goal for financing investment. Easy to understand Lacks context in terms of overall volume of fuel used. 	<ul style="list-style-type: none"> Is able to naturally adjust up and down to changes in traffic forecasts and technology development. Can take into account a global average of fuel used, including SAF and fossil. Has flexibility to balance volume and SAF emissions reduction factor
Drawbacks	<ul style="list-style-type: none"> Does not inherently provide the signal to finance on scale of investment Does not include the emissions reduction “quality” of the SAF 	<ul style="list-style-type: none"> Does not naturally adjust up and down to changes in traffic forecasts and technology development. Does not include the emissions reduction “quality” of the SAF 	<ul style="list-style-type: none"> Does not inherently provide the signal to finance on scale of investment. Harder to understand Needs a certain level of knowledge to transfer it to volumes or facilities.



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The important role of book and claim

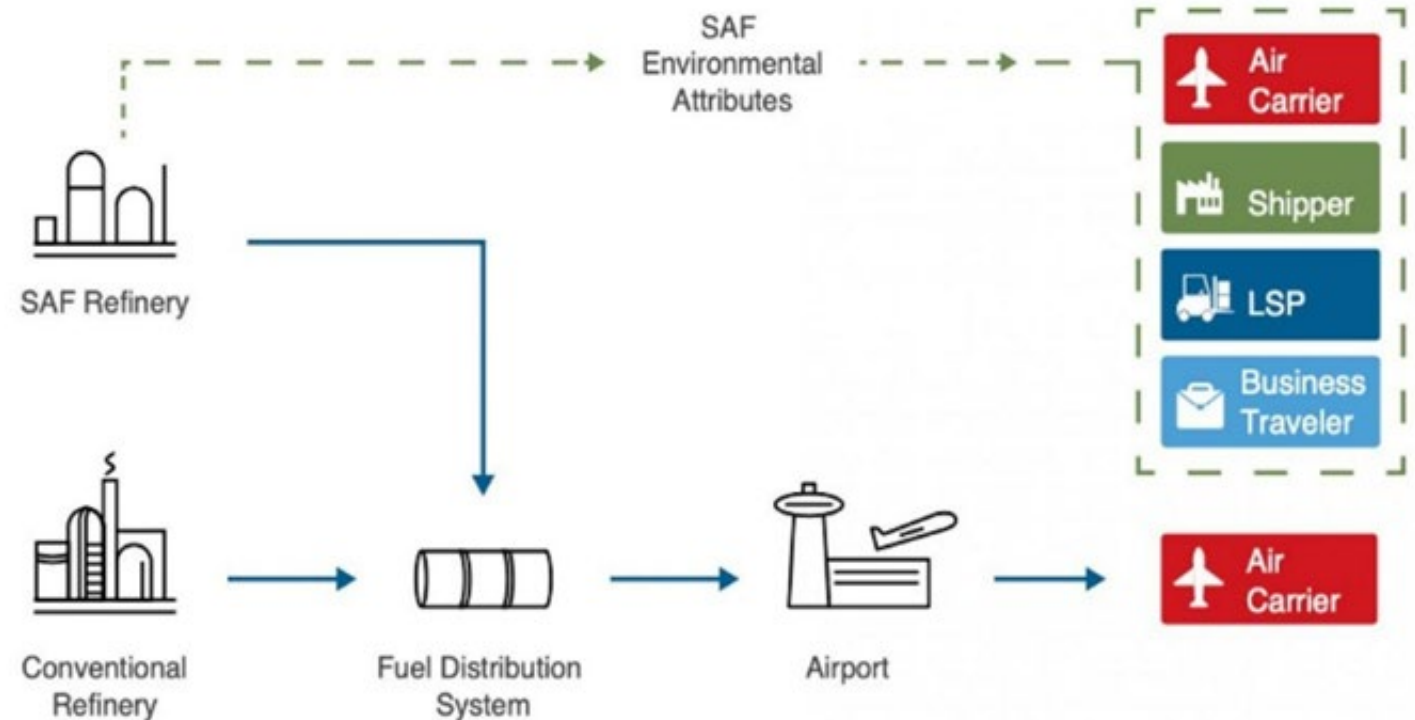
Briefing sponsor:



Book and claim: a solution for mid-term action

Chain-of-custody model allowing “de-coupling” of environmental benefits from physical transfer of SAF via book and claim registry

- Allow companies to contribute to goals of Paris Agreement;
- Provide return on investment on innovative climate solutions;
- Allow for efficient capital deployment;
- Provide real emissions reductions.



Book and claim: benefits

- To decarbonise aviation, emissions reductions from SAF use must be inset and counted as in-sector ones – this is also very relevant to Track Net Zero/LTAG
- Key benefits of B&C as chain of custody approach (as opposed to physical segregation or mass balance):
 - Enabling and promoting SAF production where it is most efficient – **including, importantly, in developing nations**
 - Stimulating SAF uptake where demand would not justify local SAF production, or where physical supply is too expensive or otherwise inefficient
 - Promoting competition in a broader marketplace
 - Minimising costs of logistics
 - Avoiding additional greenhouse gas emissions from transport

Book and claim: initiatives

- A number of existing initiatives developing book and claim systems
- All existing initiatives share the same principles:
 - Immutable traceability/trackability
 - Transparency
 - Verifiability
 - Avoidance of undue double counting/claiming/issuance
 - Interoperability
 - Neutrality
 - Enable stacking and divisibility of claims (where allowed)



CoSAFA

Avélia



SABA
SUSTAINABLE AVIATION BUYERS ALLIANCE

Cost of the transition: getting to net-zero

Item	Total 2020-2050	Annual average		Comparison
Cost to aircraft operators	\$5.3 trillion	\$170bn	Mainly incremental costs of SAF	Airlines have spent \$4.3 trillion on fuel in the last 30 years
SAF investment	\$1.45 trillion	\$48bn	Capital expenditure on SAF production facilities	Oil and gas company capex was \$499 billion in 2022
Manufacturer R&D investment	\$180-350 billion	\$6-11bn	Research and development of novel aircraft (hydrogen and electric, etc)	Current average efficiency-related R&D is around \$15 billion a year



LTAG report
\$3.2 trillion
 for fuel suppliers



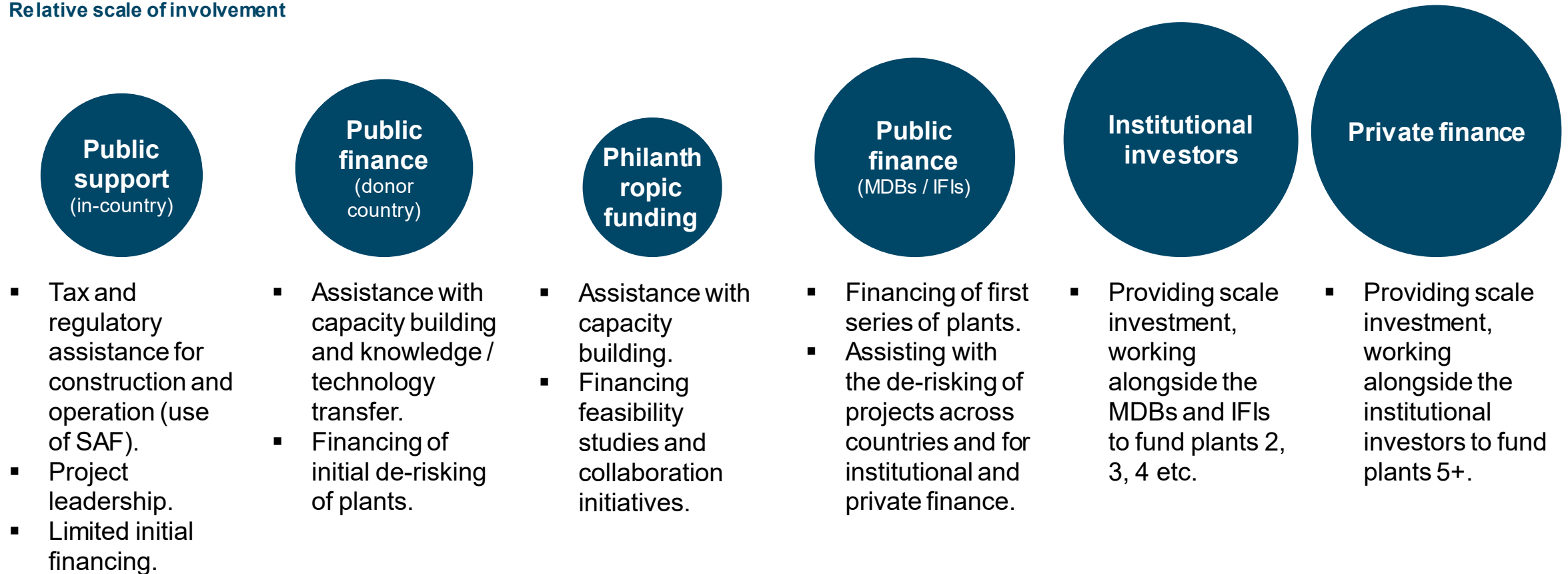
Net zero roadmaps
\$5.3 trillion



Aviation roadmap
\$175 billion/year

The role of blended finance

Relative scale of involvement



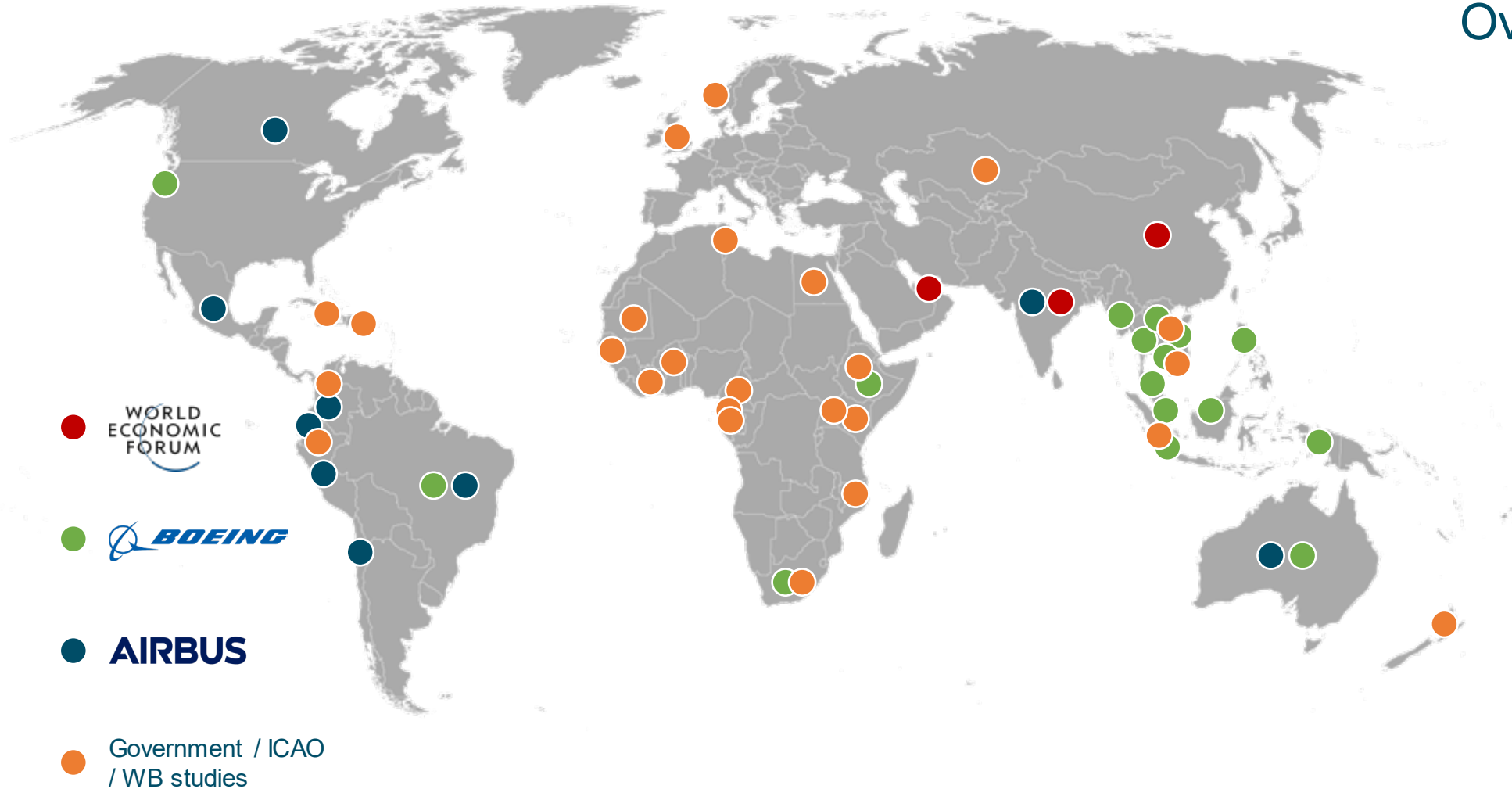
Outreach to the finance community

- ATAG has started reaching out to the finance sector this year



- In addition, a number of other initiatives will do the same thing in coming years.
- Finance community is highly interested in SAF, needing some core reassurances before making it part of their investment strategy.

Feasibility studies and projects



Over 50 feasibility studies are completed or underway

Resources

www.atag.org

↳ Industry topics / CAAF/3



