

Welcome to the 2nd webinar of the series on **Sustainable Aviation Fuels**

by AFCAC and EASA on the acceleration of development,
production & deployment of SAF in Africa

The webinar will start @ 9:00 am, Dakar time, UTC
11:00 Brussels/Cologne Time, UTC +2

Your safety is our mission.

Market Outlook & SAF Policies

Rationale, status & challenges of SAF Policies as key enabler for the development of SAF and successful execution of SAF roadmaps

Working for sustainable aviation.
Your safety is our mission.

Some practicalities & moderators



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Project Assistant

- **Q&A** after the speaker
 - Use Q&A section (Slido)
 - Vote up/down questions
- **Free chat**, please express yourself live

Overview on AFCAC and EASA joint webinar series on the acceleration of development, production & deployment of SAF in Africa

Today

1

Market Outlook & SAF Policies

- Sustainable Aviation Fuels 2030 – Market outlook on demand & supply
- Detailing the role of SAF roadmaps and SAF taskforces
- SAF policies and regulation (ICAO, CORSIA, US IRA etc.) with a focus on the rationale of legislation to support the development and deployment of SAF

2

SAF Feedstocks & Certification

- Introduction to feedstocks and the role of related regulation
- Eligibility of feedstocks (e.g., under CORSIA)
- Sustainability certification (process, auditors, etc.) and LCA of SAF (ISCC, RSB)

3

Partnerships along the SAF Value Chain

- Partnerships along the SAF value chain
- Producers', airports' and airlines' perspectives on SAF development and deployment
- SAF engagement by airlines

4

Financing SAF and Engagement by Airlines

- Financing SAF production
- Building a viable business case (business plan) for investability of SAF projects (bankability)
- SAF engagement by airlines

Questions and answers

Join at
slido.com
#SAF1806



Our moderator & key speakers for today!



Frankline Omondi

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 AFCAC

 Environment Expert

Frankline Omondi is an Aviation and Environment Specialist with a focus in Climate Change Policy, Air Transport Liberalization, Sustainability and Efficiency at the African Civil Aviation Commission (AFCAC). Frankline coordinates environmental protection matters in corporation with African States, other organizations and bodies involved in the promotion and development of civil aviation in Africa. Currently, Frankline is coordinating the AFCAC's initiative to accelerate the development and deployment of Sustainable Aviation Fuels in Africa.

Frankline is also the AFCAC's Observer at ICAO CAEP where he coordinates environmental protection activities on behalf of the African aviation industry together with the CAEP member States from the African continent

Before joining AFCAC, Frankline worked as the Environment Specialist and Fuel Analyst for Kenya Airways where he was responsible for the airline's Carbon Emissions reduction and operational environmental compliance and risk mitigation strategies for the airline.

Frankline has 12 years in the aviation industry covering airline policies and operations, civil aviation regulatory landscape, environmental protection and sustainability in civil aviation.

Our speakers today



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 AFCAC

 Environment Expert



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 DG MOVE

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Sustainability Office



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 CBR Sustainability Partners

 CEO & Founder

Our key speakers for today!



Christoph Behrendt-Rieken

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 CBR Sustainability Partners

 CEO & Founder

More than 15 years experience in the chemical process industry, large production infrastructure projects and technology development with focus on green transition of various industries via ClimateTech related innovation (renewable fuel, green chemistry, sustainability, environmental management systems, environmental certification, etc.)

Consulting Focus @ CBR Sustainability Partners

- Commercial project development and deal advisory (due diligences, etc.) of green energy, fuel and chemicals investments and production plant projects
- Renewable fuel and chemical regulatory, commercial and technology expertise

Education

- EMBA -Executive Master of Business Administration-, Kellogg School of Management at Northwestern University / WHU Otto Beisheim School of Management
- Diploma -International Business Studies-, University of Paderborn, Germany / École Supérieure de Commerce de Reims, Grande École / NEOMA Business School, France

Agenda – Webinar: Market Outlook & SAF Policies

Market Outlook & SAF Policies



Intro: SAF as value driver for the aviation industry



SAF on global level: SAF supply outlook 2030



SAF technological production pathways and players



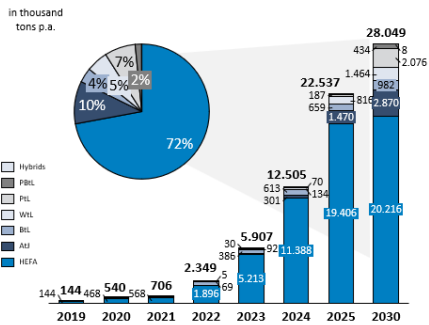
SAF national roadmaps: Key elements & success factors



SAF policies: Rationale, status & challenges



Guiding questions today



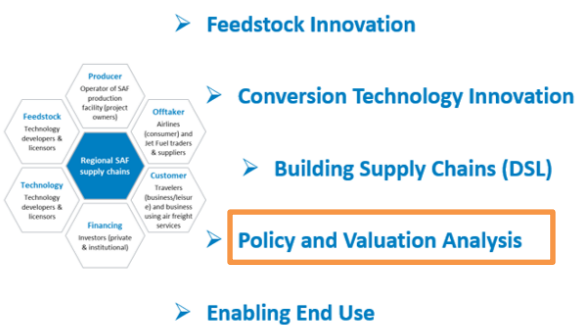
What are the current **market dynamics** and how does the **future SAF supply** scenario look like in **2030**?

- 1 HEFA
- 2 Power-to-Liquid
- 3 Waste-to-Liquid
- 4 Biomass-to-Liquid
- 5 Alcohol-to-Jet
- 6 Hybrid fuels, e.g. PBtL

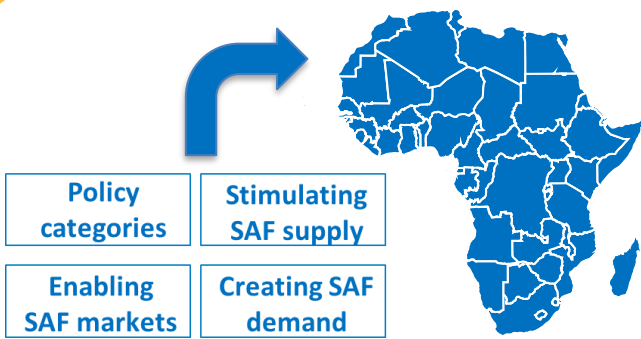
Which **SAF technologies** and related **feedstocks** drive the market?



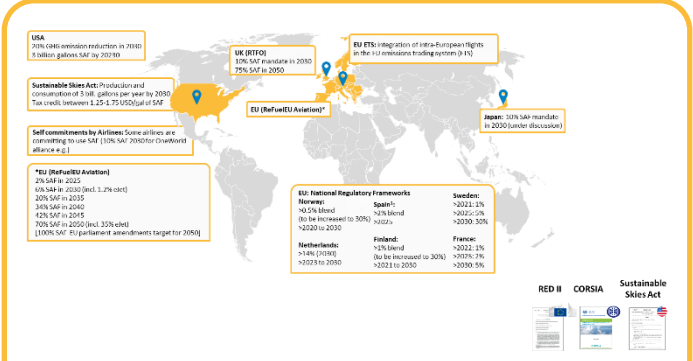
Who are the **frontrunners** in **SAF technology development** and **production**?



Why **policies** and **regulations** are fundamental to drive the **SAF market**?



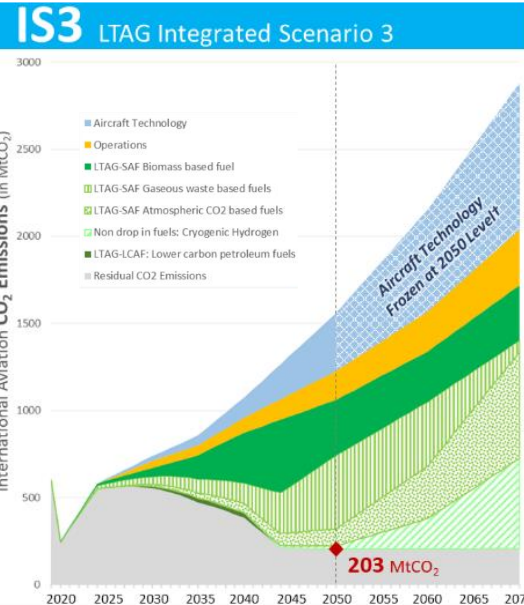
Which **factors** should be considered when **roadmaps** and **policies** are implemented in the **African context**?



What kind of **policies** are present in the world: **Rationale, implementation approach, challenges and learnings**?

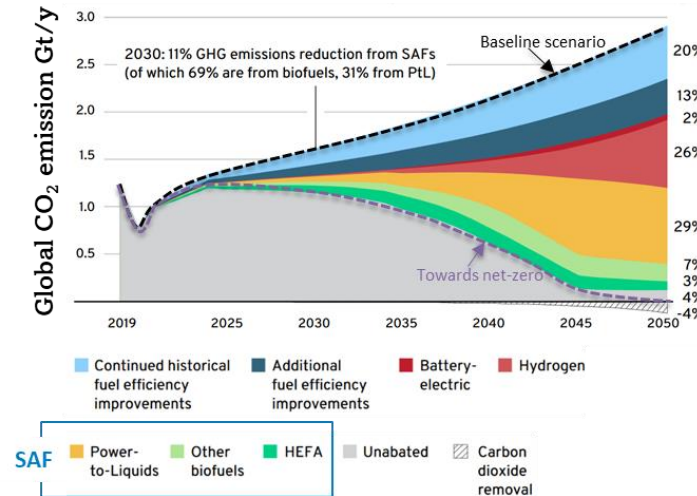
Independent of the various scenarios for emission reduction in the aviation sector, Sustainable Aviation Fuel will be the key contributor.

LTAG, ICAO



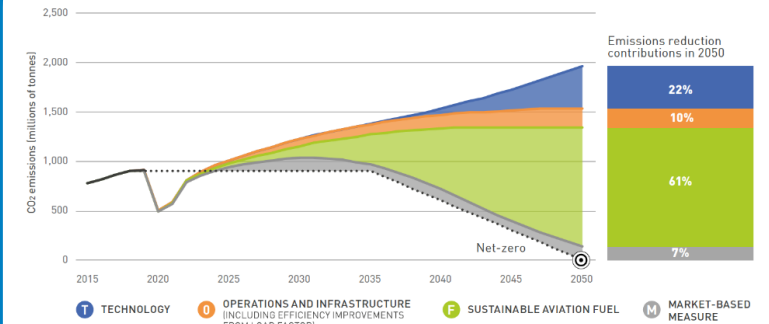
Until 2050 and beyond, **biomass, gaseous and atmospheric CO₂ based SAF** will play a **dominant role** in the **CO₂ emission reductions**.

MPP, WEF



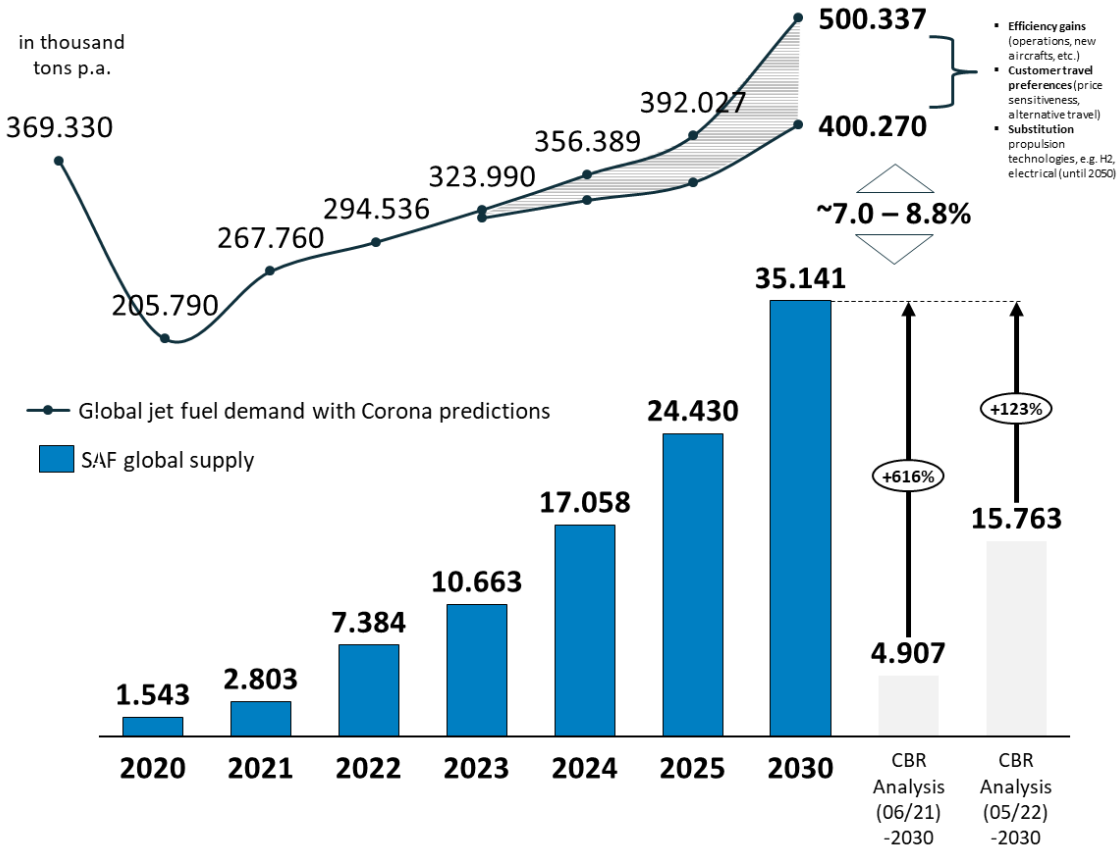
Power-to-Liquid based SAF is foreseen as the **major contributor** to a **net-zero aviation sector** by **2050** followed by other biofuels and HEFA.

Waypoint 2050, ATAG

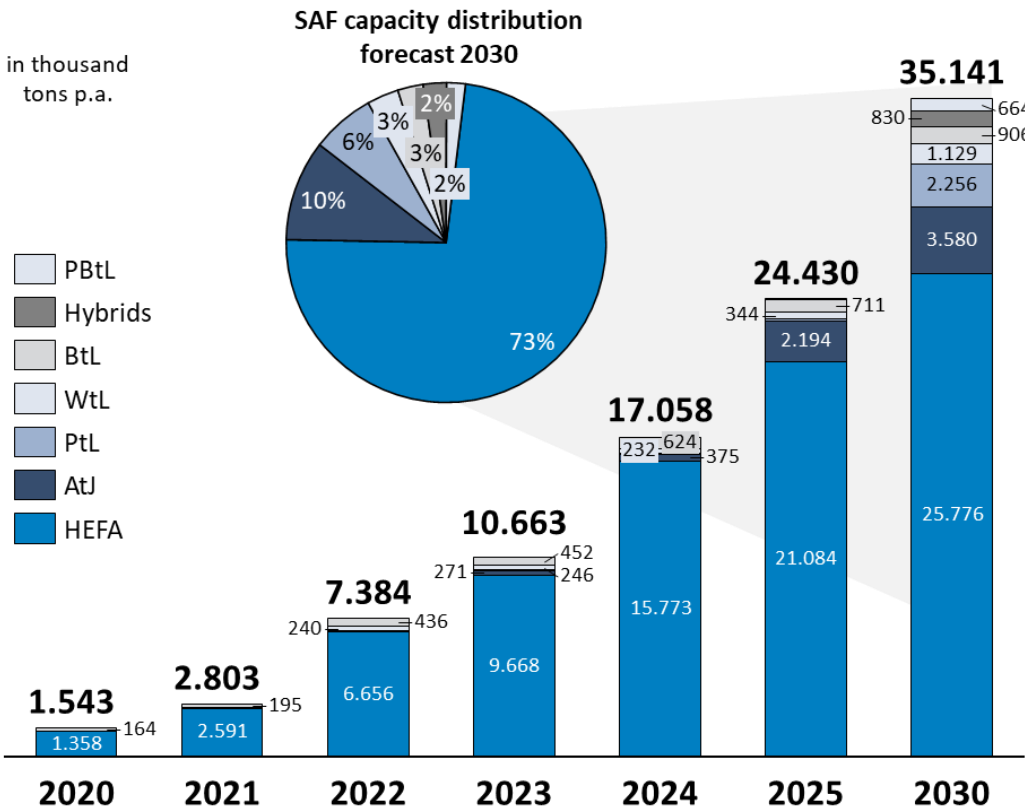


Pathway towards a **net-zero aviation sector** in **2050** mainly enabled by **SAF** with a **contribution of 61%** with **ramp-up** beginning already in the **current decade**.

Projected global SAF supply only covers ~7% up to 8.8% of expected demand in 2030 with HEFA as predominant SAF pathway.

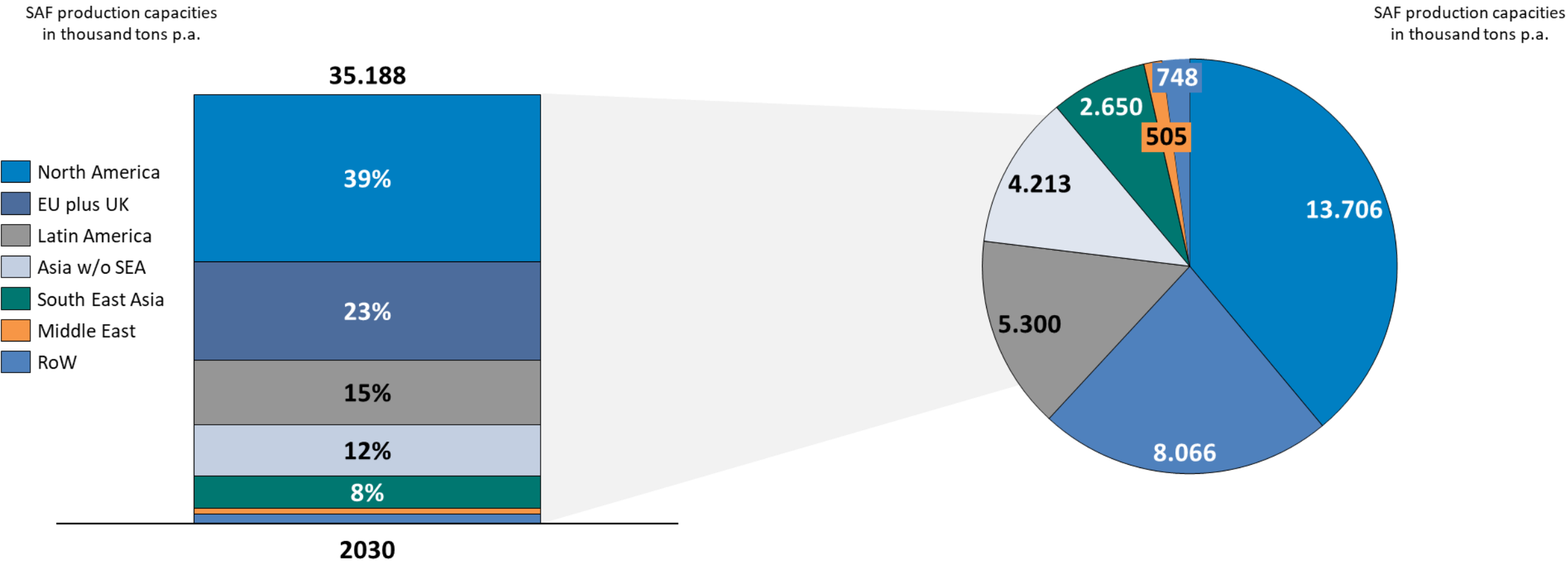


SAF production capacity only covering ~5.6% up to 7.0% of global demand in 2030 depending on consumption



HEFA is the recognized commercial pathway, as reflected in its market share today and in 2030.

North America (NA) takes the lead in terms of SAF production capacity.



More than 60% of SAF production capacity in 2030 is planned to be established in North America and EU.

All figures are subject to constant review, as new projects will be announced and some projects could have significant delays or not materialize.

Eleven conversion routes are currently certified by ASTM for SAF production.

Exemplary feedstock		ASTM qualified conversion process (D7566, D1655)	Max. blend
Syngas (via gasification or from H ₂ /CO ₂)	→	1 FT-SPK: Fischer-Tropsch hydro-processed synthetic paraffinic kerosene	50%
Fatty acids or fatty acid esters (from virgin or used fats and oils)	→	2 HEFA: Synthesized paraffinic kerosene from hydroprocessed esters and fatty acids	50%
Sugars (from crops or 2G biomass)	→	3 SIP: Synthesised iso-paraffins from hydroprocessed fermented sugars	10%
Syngas (via gasification or from H ₂ /CO ₂)	→	4 FT-SKA: Synth. kerosene with aromatics derived by alkylation of light aromatics from non-petr. sources	50%
Ethanol, Iso/n-butanol, Isobutene (from crops, 2G biomass, H ₂ /CO ₂)	→	5 ATJ-SPK: Alcohol to jet synthetic paraffinic kerosene	50%
Fatty acids or fatty acid esters (from virgin or used fats and oils)	→	6 CHJ: Catalytic hydrothermolysis jet fuel	50%
Algae	→	7 HC-HEFA-SPK: Synthesized paraffinic kerosene from hydrocarbon - hydroprocessed esters and fatty acids	10%
C2-C5 Alcohols (various feedstocks)	→	8 ATJ-SKA: Alcohol to jet synthetic paraffinic kerosene with aromatics (Pure SAFSM)	50%
Fatty acids or fatty acid esters (co-processed with fossil petroleum)	→	9 Co-processed HEFA: Co-hydroprocessing of esters and fatty acids in a conventional petroleum refinery	5%
FT hydrocarbons (co-processed with fossil petroleum)	→	10 Co-processed FT: Co-hydroprocessing of Fischer-Tropsch hydrocarbons in a conventional petroleum refinery	5%
Hydrocarbons derived from triglycerides or their derivatives	→	11 Cofractionation using maximum 24% of bio-material, with result of maximum 10% bio-share in the jet fuel.	10%

Further conversion processes currently being assessed for ASTM certification include:

- **Methanol-to-Jet** (submitted by Exxon)
- **Synthesised Aromatic Kerosene** (Virent)
- **AtJ derivative** utilising biochemical production of **isobutene** (Global Bioenergies)
- **Mixed Alcohol-to-Jet** (Swedish Biofuels)
- **Integrated Hydropyrolysis and -conversion IH2** (Shell)
- **Pyrolysis of non-recyclable plastics** (OMV)
- **Coprocessing of pyrolysis oil** from used tires

SAF blend component



+ Fossil Jet A-1

SAF blend

SAF/Fossil Jet A-1
(up to maximum blend)

Besides, work is ongoing to

- allow 100% use of SAF in aircraft and
- to increase maximum blending for co-processing (up to 30%).

Overview on SAF player landscape

NON-EXHAUSTIVE

1 HEFA

Dominating Player Type



Oil & Gas

2 Power-to-Liquid



Energy

3 Waste-to-Liquid



Technology Developers

4 Biomass-to-Liquid



Energy Forest Technology Developers

5 Alcohol-to-Jet

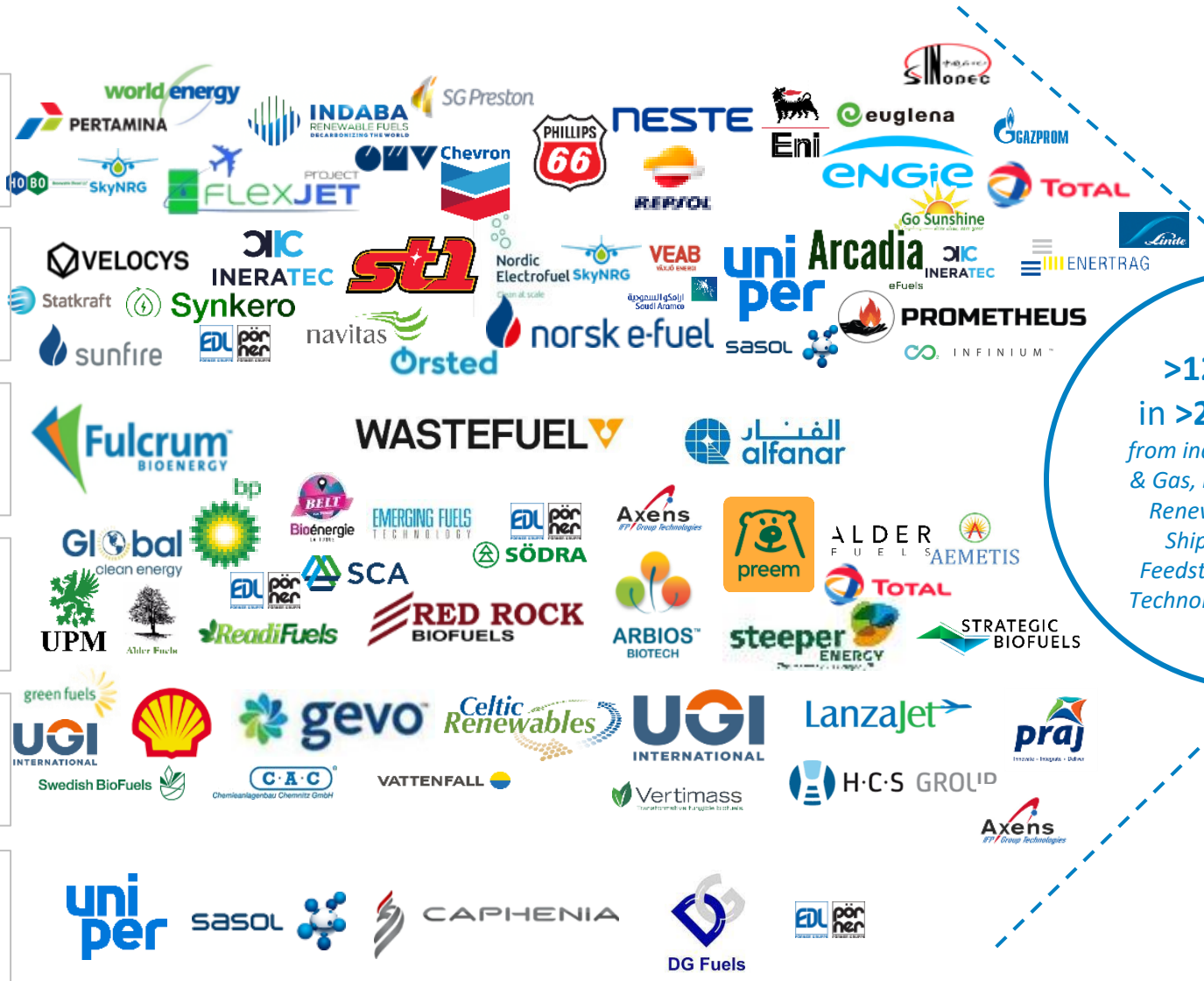


Technology Developers

6 Hybrid fuels & Others, incl. PBtL



Technology Developers



>120 players
in >200 projects
from industries such as Oil & Gas, Energy, Chemicals, Renewables, Aviation, Shipping, Logistics, Feedstock Suppliers and Technology providers, etc.

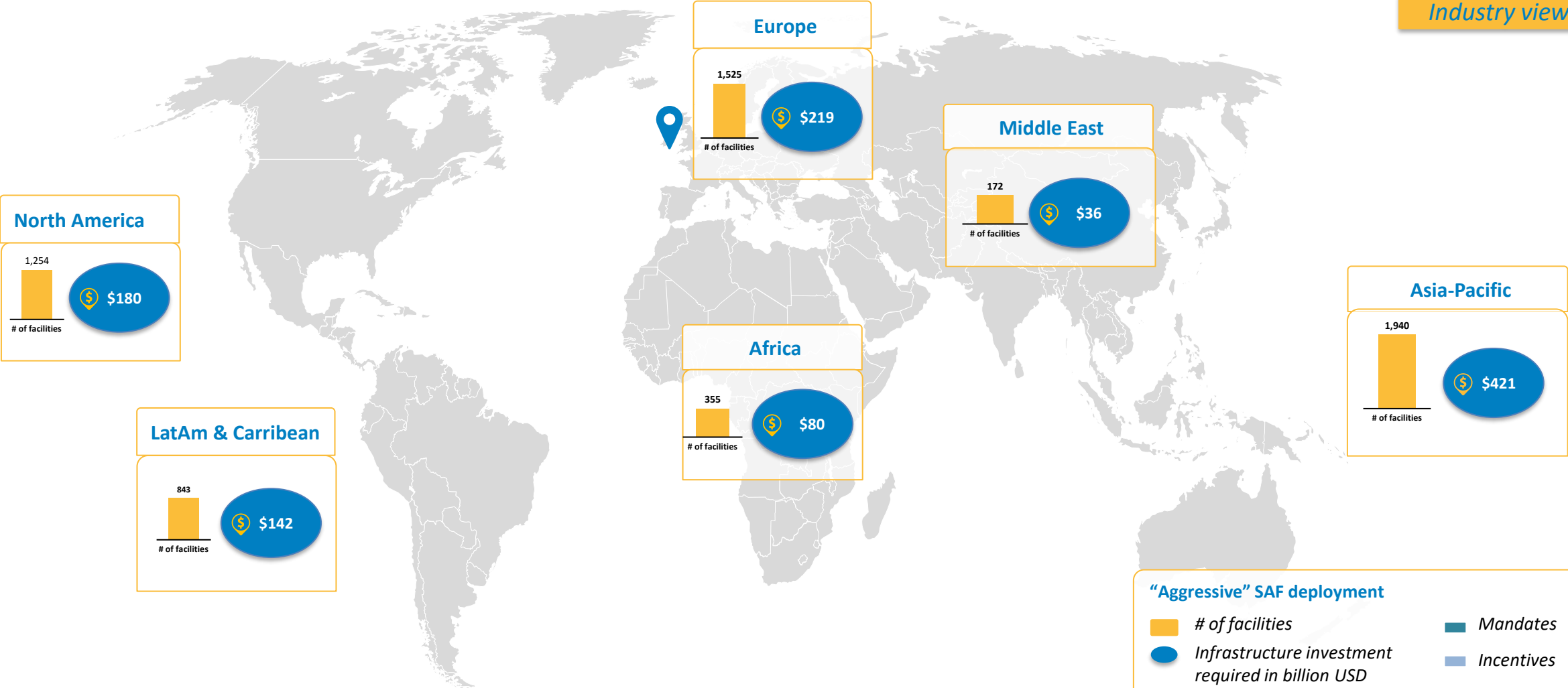
Cross industry partnerships: Collaboration of airlines with leaders across the value chain

NON-EXHAUSTIVE

Producer / Project developer	NESTE	SKYNRG	GRÖN FUELS, LLC	norsk e-fuel	AEMETIS	Fulcrum BIOENERGY	Synhelion
Airlines	AIR CANADA PrimeAir KLM DELTA 	KLM BOEING 	jetBlue 	norwegian cargolux 	Supply agreement (with 10 airlines) 	Jet2.com Friendly low fares CATHAY PACIFIC 	SWISS
Airports, logistics and trade	SFO San Francisco International Airport LAX	Schiphol	jetBlue	AVINOR	SFO San Francisco International Airport LAX	WorldFuel Services	Flughafen Zürich
Technology (HEFA, PtL, WtL, BtL, AtJ, etc.)	HEFA	HEFA	HEFA	PtL	BtL	WtL	Sun-to-Liquid
Feedstocks	Triglyceride	UCO (regional industries)	Traditional & emerging feedstocks	Renewable power	Biomass	Municipal waste	Sun Water CO ₂
Consortium partners (non-exhaustive)	Neste has offtake agreements with several commercial airlines, cargo carriers and international airports.	MACQUARIE TOPSOE	CAPIO SEQUESTRATION, LLC PORT OF GREATER BATON ROUGE TOPSOE	PAUL WURTH SMS group sunfire	DELTA QANTAS BRITISH AIRWAYS IBERIA	bp JAL JAPAN AIRLINES Marubeni	CEMEX eni amag

Investment of approx. \$1 - 1.45 trn will be necessary to build sufficient SAF capacity to achieve the LTAG of ICAO (factor of 1.300)

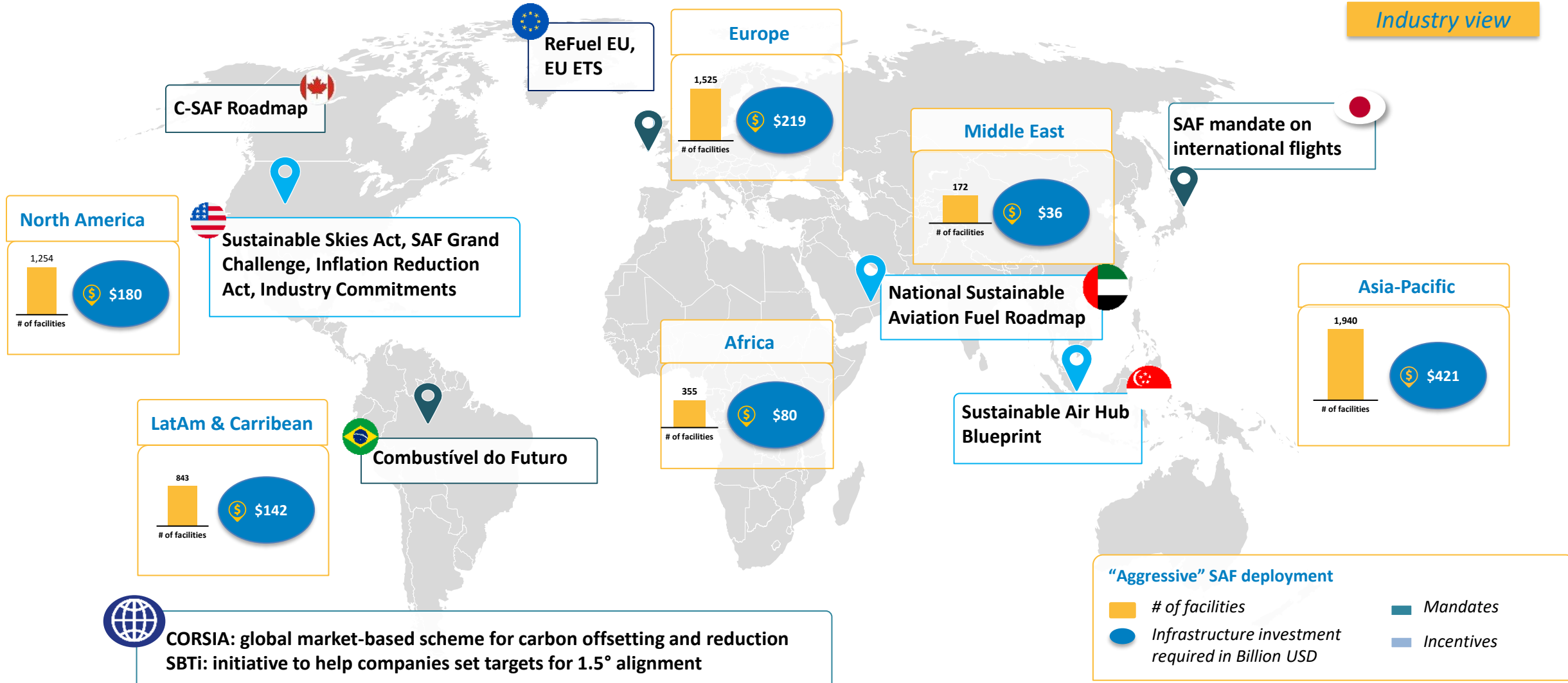
Industry view



Global regulatory landscape is very heterogenous, and schemes differ between incentives, mandates and voluntary ambitions.

NON-EXHAUSTIVE

Industry view

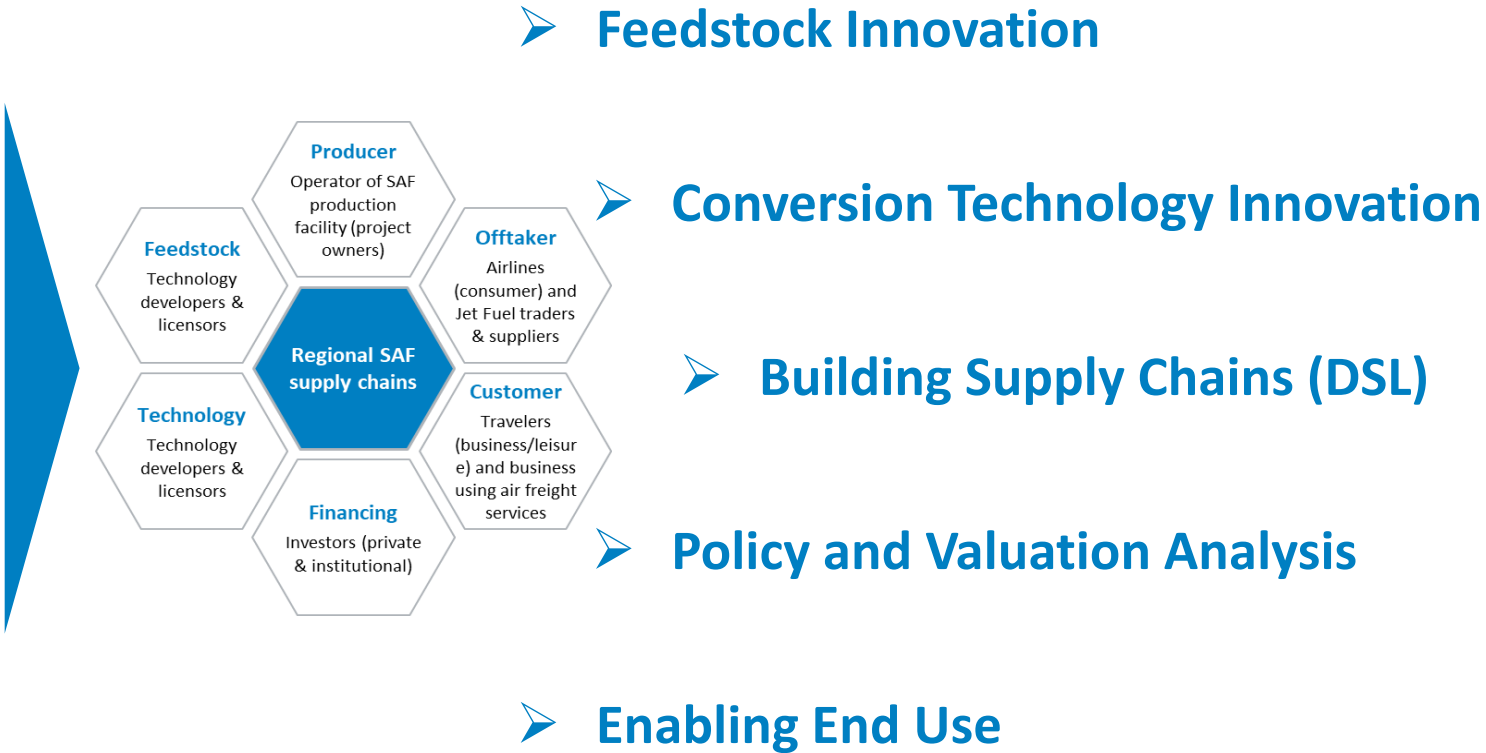


Key success factors SAF ramp-up – Elaboration of SAF roadmaps involving all key stakeholders along the regional SAF value chain

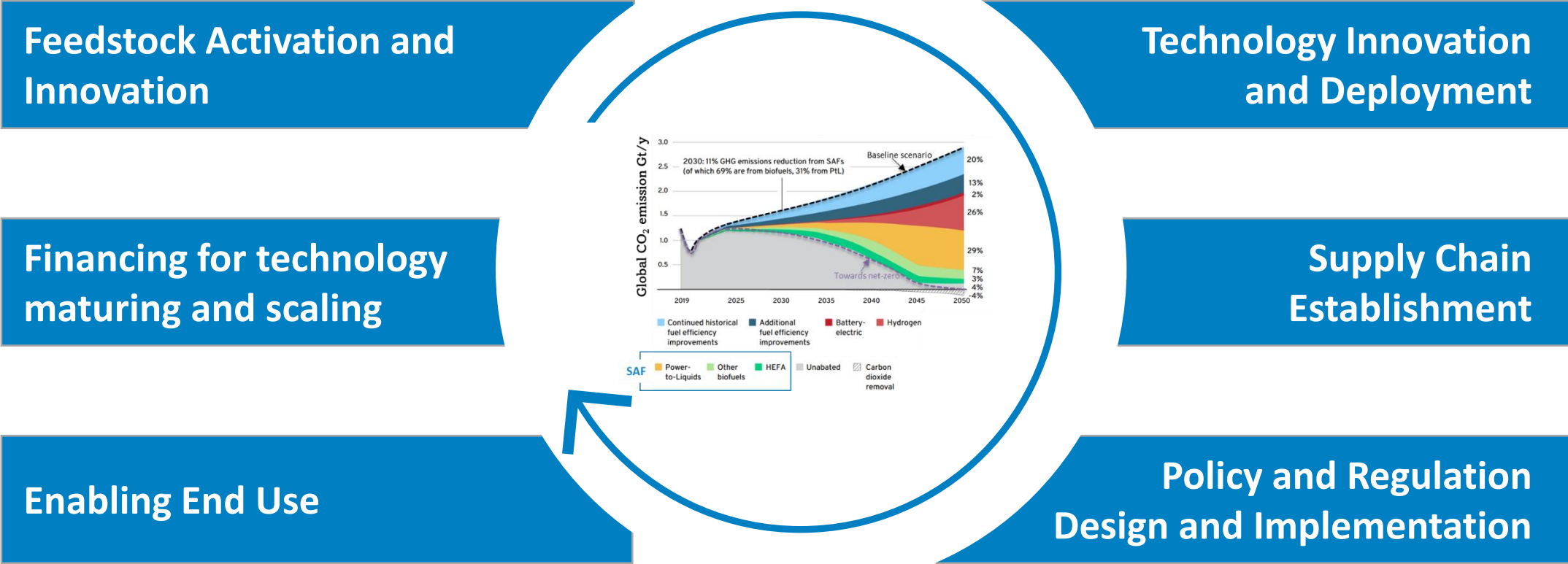
SAF roadmap objectives

- 1 Expansion of SAF supply and use
- 2 Reduction of SAF cost
- 3 Enhancement of SAF sustainability

SAF roadmap building blocks

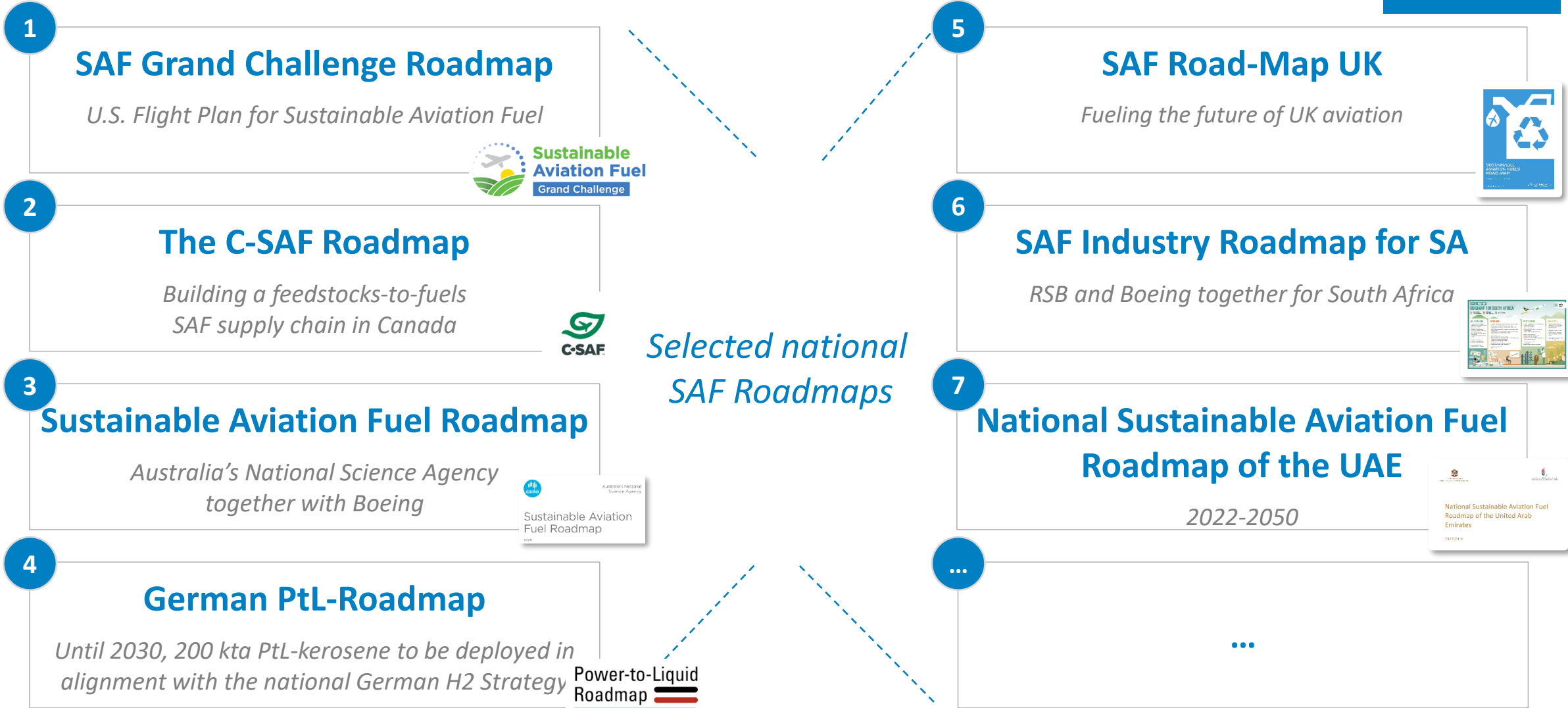


Overview SAF roadmap building blocks



Examples and role models for national SAF Roadmaps and alike¹

NON-EXHAUSTIVE



SAF Roadmap, Platform and Taskforce as central instruments can be activated via eight key activities.

1

SAF Roadmap: Stakeholder Map

- Identification of all relevant stakeholders within the national SAF value chain
- Stakeholder activation
- Stakeholder onboarding

2

SAF Roadmap: Sponsorship

- Outline of required sponsorship support
- Identification of most eligible sponsors of the SAF Roadmap
- Engagement of sponsor(s)

3

SAF Roadmap: Vision & Mission

- Development of SAF Vision and Mission 2030 & beyond
- Set-up of strategic agenda 2023 with first defined strategic goals

4

SAF Roadmap: Action plan

- Projekt management capabilities established
- Break-down of strategic goals into actions
- Timeline 2023 elaboration

5

SAF Platform: Capacity Building

- Areas for capacity building
- Activation of experts and potential support, e.g., EASA
- Development of internal experts per dedicated areas

6

SAF Task Force: Organization chart & Ressource Planning

- Set-up of organigram
- Definition of required ressources and budgets
- Activation of ressources and budgets for 2023

7

SAF Task Force: Roles & Responsibilities

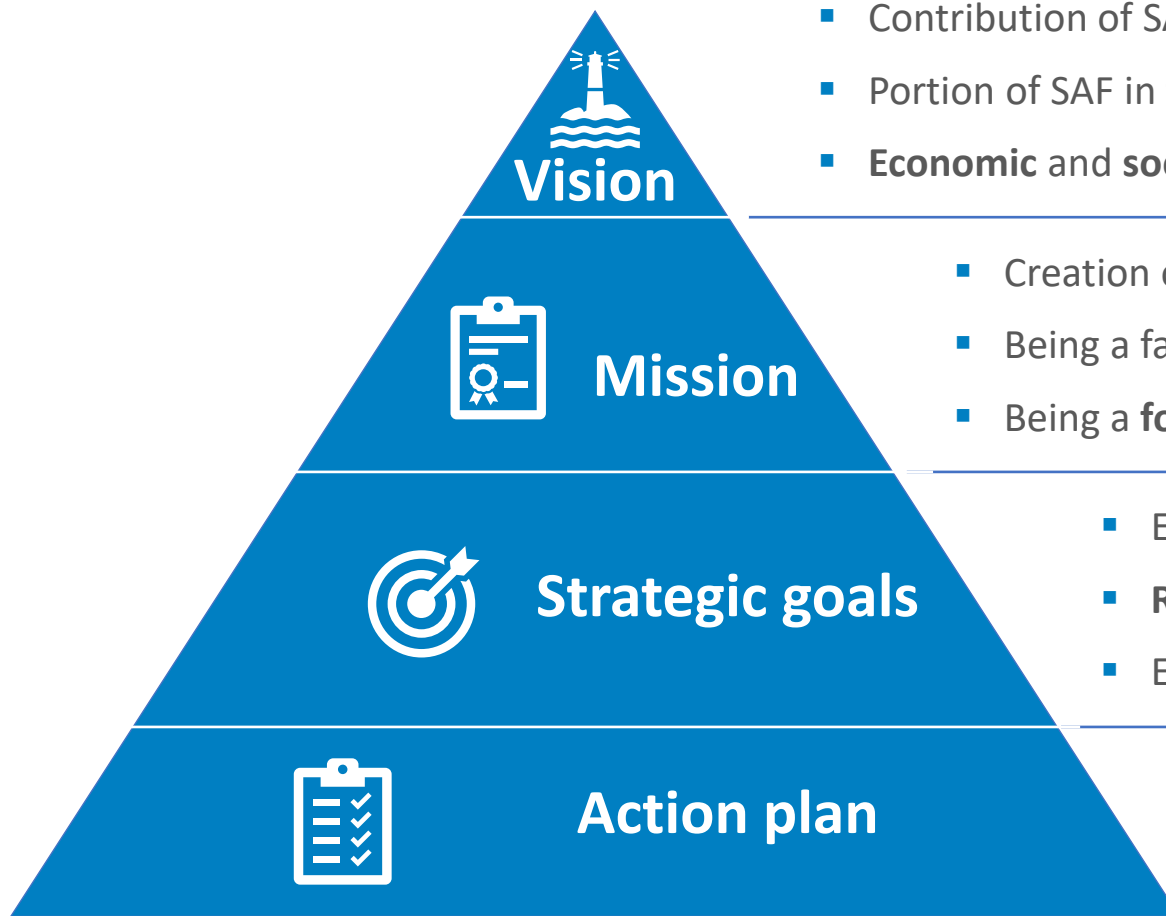
- Definition of roles within SAF task force (role model)
- Definition of leadership team
- Establishment of RACI matrix and responsibilities allocation

8

SAF Task Force: Governance - Rules & Procedures

- Principles of collaborating and working together
- Planning of meeting series 2023 and agendas
- Rotation of chairmanship

SAF Roadmap requires a Vision and Mission as cornerstones for the strategic goals and action plan



- Contribution of SAF Roadmap to **national decarbonization and net zero goals**
- Portion of SAF in the **national renewables mix**
- **Economic** and **social** beneficial **contribution**

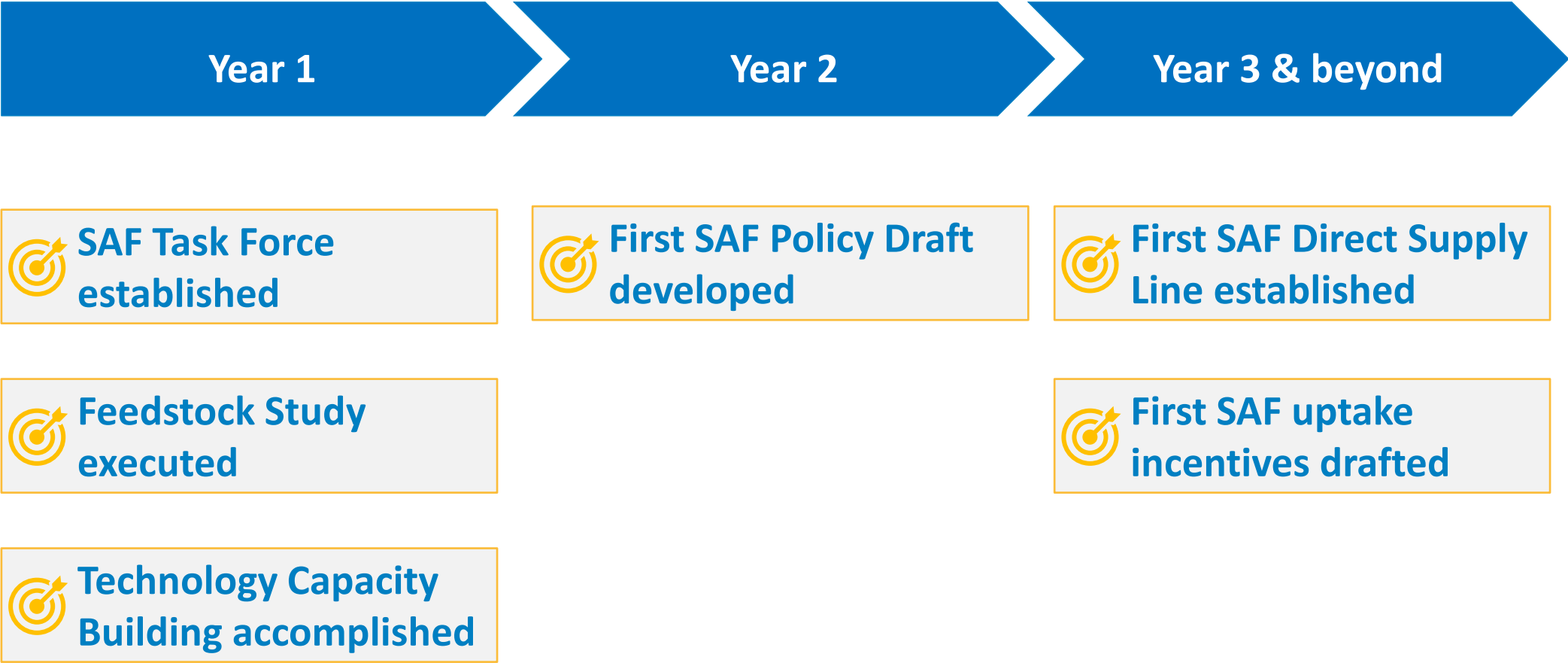
- Creation of **SAF awareness** and **momentum** in the country
- Being a facilitator **connecting SAF value chain stakeholders**
- Being a **focal point of expertise** and capacities for SAF

- Expansion of **SAF supply** and **end use**
- **Reduction** of **SAF cost**
- Enhancement of **SAF sustainability**

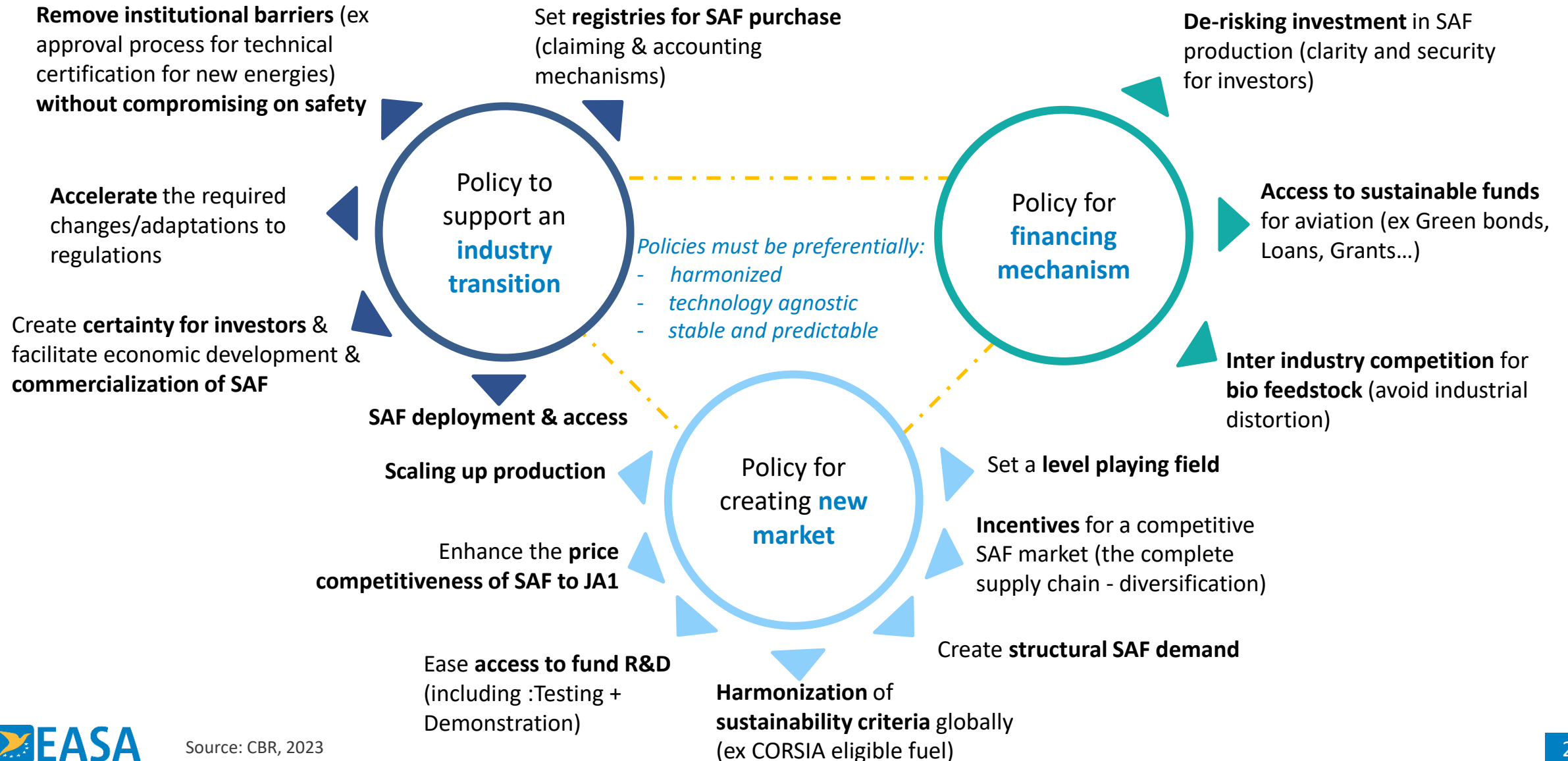
- **Defined actions** with targeted **deliverables** linked to the **strategic goals** (contribution)
- **Defined timelines**, here 360 days plan plus strategic timeline covering three to five years

Overview on ambition level: Strategic timeline looking looks at a time horizon of three to five years

EXAMPLARY



Policies and regulations as enablers



Exemplary policy options to stimulate SAF supply

Impact area: Stimulating Growth of SAF Supply			
1 Government funding for RDD	2 - Targeted incentives and tax relief to expand SAF supply infrastructure	3 - Targeted incentives and tax relief to assist SAF facility operation	4 - Recognition and valorization of SAF environmental benefits
1.1 - Government R&D 1.2 - Government demonstration and deployment	2.1 - Capital grants ; 2.2 - Loan guarantee programs 2.3 - Eligibility of SAF projects for tax advantaged business status ; 2.4 - Accelerated depreciation/'bonus' depreciation 2.5 - Business Investment Tax Credit (ITC) for SAF investments 2.6 - Performance-based tax credit 2.7 – Bonds / Green Bonds	3.1 Blending incentives: Blender's Tax Credit 3.2 – Production incentives: Producer's Tax Credit 3.3 - Excise tax credit for SAF 3.4 - Support for feedstock supply establishment and production	4.1 – Recognize SAF benefits under carbon taxation 4.2 - Recognize SAF benefits under cap and-trade systems 4.3 - Recognize non-carbon SAF benefits: improvements to air quality 4.4 - Recognize non-carbon SAF benefits: reduction in contrails

Examples

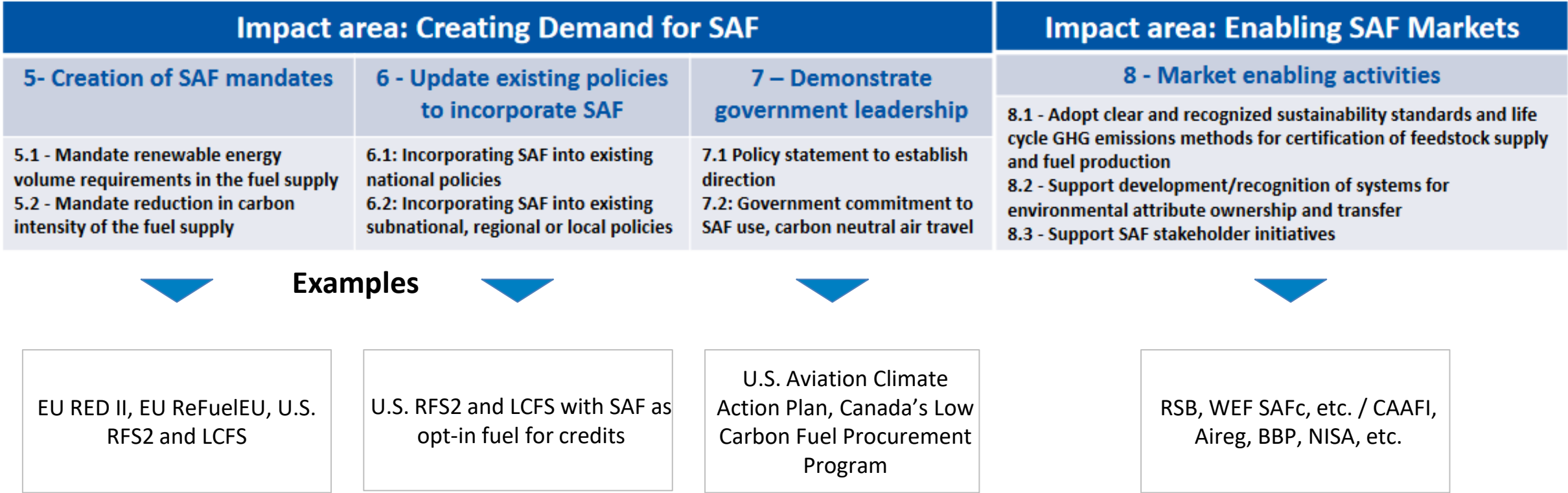
Canadian Strategic Innovation Fund (SIF), EU InnoFund

U.S. States bonds for SAF producers, e.g. Fulcrum

U.S. BTC providing USDs per gallon for certain biofuels

CORSIA³, reducing offsetting obligations, or EU ETS³

Exemplary policy options to create SAF demand and measures to enabling SAF markets



Our key speakers for today!



Ewa Oney

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 DG MOVE

 Team Leader



Ewa is a Team Leader in charge of sustainable aviation in European Commission, Directorate General for Mobility and Transport (DG MOVE), Aviation Policy Unit. She is dealing with the topics of energy transition in aviation, investments and strategy.

Before joining aviation, she worked in the area of industrial policy. She has nearly 15 years of professional experience in European policy-making.

Prior to joining the European Commission, she worked in the management consulting in PwC. Ewa holds a double major - in finance and in international economic law.

Working focus @ European Commission

- Energy Transition in Aviation Sector
- Assessment of investments and strategies



ReFuelEU Aviation: EU SAF policy Rationale, Status & Challenges

Ewa Oney

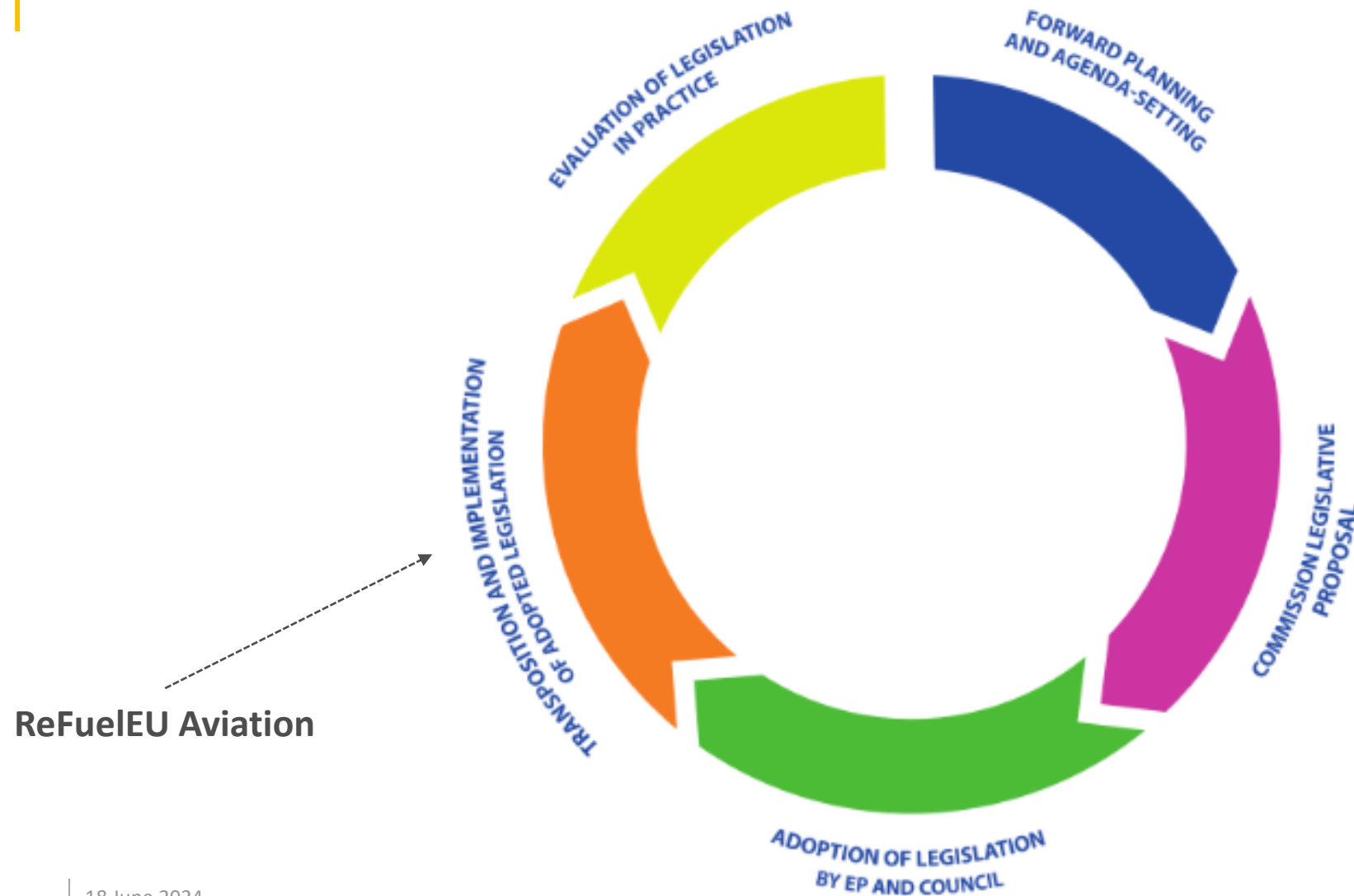
Team Leader for Sustainable Aviation

Aviation Policy Unit

Directorate-General for Mobility and Transport
European Commission

*Webinar 01: Market Outlook & SAF Policies
Brussels, 18 June 2024*

EU policy making cycle



I. Agenda-setting



ReFuelEU Aviation

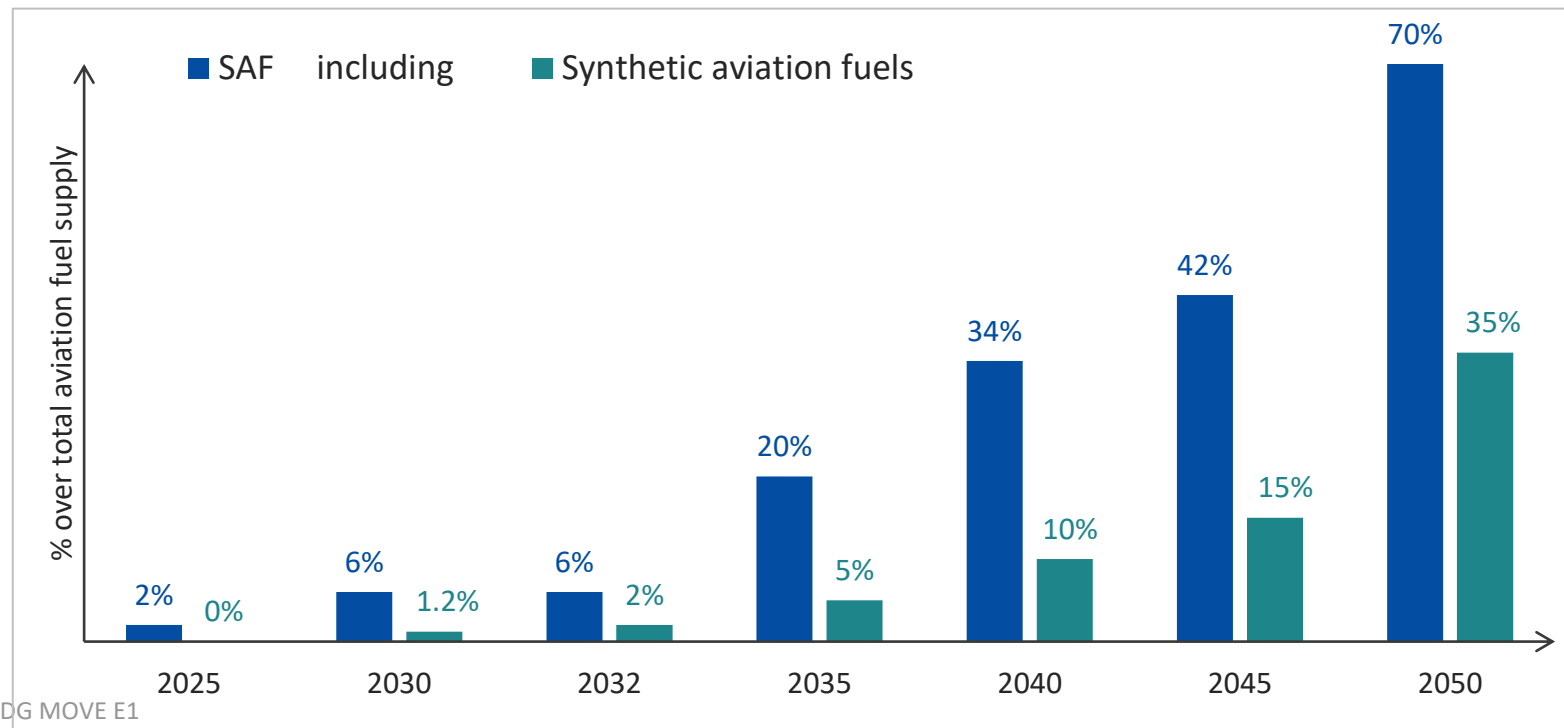
II. Policy design – objectives: considerations

- Highly integrated aviation internal market
 - SAF feasible to scale, but requires significant investments
 - Overall transport targets did not bring SAF
- **Regulatory framework** accompanied by support measures:
- ✓ **Uniform:** a regulation that avoids different national measures
 - ✓ **Robust:** volumetric mandates that are easy to implement and monitor
 - ✓ **Long-term:** mandates for 2025-2050 to provide certainty to the new market
 - ✓ **Flexible:** transition periods, annual reporting by EASA, periodical reviews by the Commission



II. Policy design – objectives: considerations

- **Twin objectives:**
 - Ramp up of SAF deployment 
 - Level playing field through EU uniform rules 
- **Supply obligation:** aviation fuel suppliers to supply SAF-blends at EU airports:



II. Policy design – process: consultations

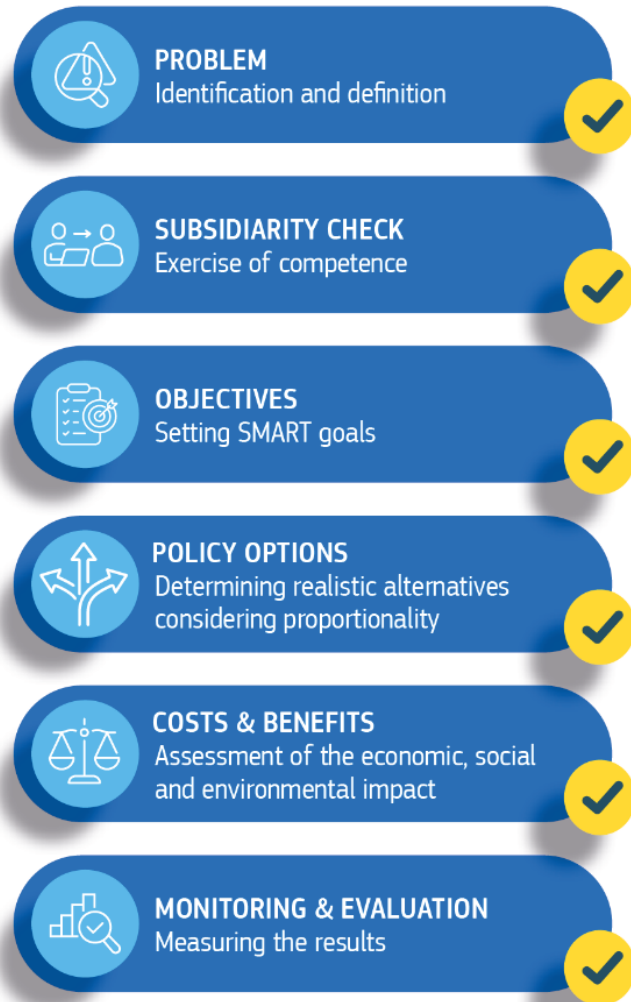
- **Inter-department consultations and negotiations**
- **Stakeholder written consultations:**
 - Public feedback on the roadmap
 - Open public consultation focused on: problem drivers, draft policy measures and policy options, expected costs and benefits.
 - Public feedback on the proposal adopted by the Commission
- **Roundtables with Member States and stakeholders:**
 - Focused on a problem definition and policy options



[Sustainable aviation fuels –
ReFuelEU Aviation \(europa.eu\)](https://european-council.europa.eu/media/1000000/attachment/data/2020/03/2020032401_en.pdf)

II. Policy design – process: an impact assessment

ELEMENTS ADDRESSED IN THE IMPACT ASSESSMENT



Regulatory Scrutiny Board (RSB)

An independent body,
quality control, issues
opinions on an impact
assessment



Brussels, 14.7.2021
SWD(2021) 633 final

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the

**Proposal for a Regulation of the European Parliament and of the Council
on ensuring a level playing field for sustainable air transport**

{COM(2021) 561 final} - {SEC(2021) 561 final} - {SWD(2021) 634 final}

 Opinion on impact assessment - SEC(2021)561 English (739.8 KB - PDF - 9 pages)	Download
 Impact assessment report - SWD(2021)633 English (3.8 MB - PDF - 142 pages)	Download
 Summary of the impact assessment report - SWD(2021)634 English (376.9 KB - PDF - 3 pages)	Download

Available languages (23) ▼



II. Policy design: options considered

Policy options were structured around a **regulatory requirement** consisting of a **SAF obligation** which allows ensuring a **level playing field** in the air transport sector.

Set of policy options:

Obligation on aviation fuel suppliers to distribute SAF at all EU airports

Obligation on aircraft operators to uptake SAF when flying from EU airports

Obligation on aviation fuel suppliers to distribute SAF and on aircraft operators to uptake jet fuel at EU airports

Targets expressed in: **SAF volumes (incl. synthetic sub-targets)** vs in jet fuel CO₂ intensity reduction
Scope of flights: **departing from the EU** vs intra-EU

II. Policy design: assessment of impacts



Reduction of CO₂ emissions by more than **60%**



Reduced costs of local air pollution around airports



Moderate ticket price increase 1% in 2030, 5% in 2040, 8% in 2050



Net creation of **200,000+ jobs** and **100+ SAF plants**



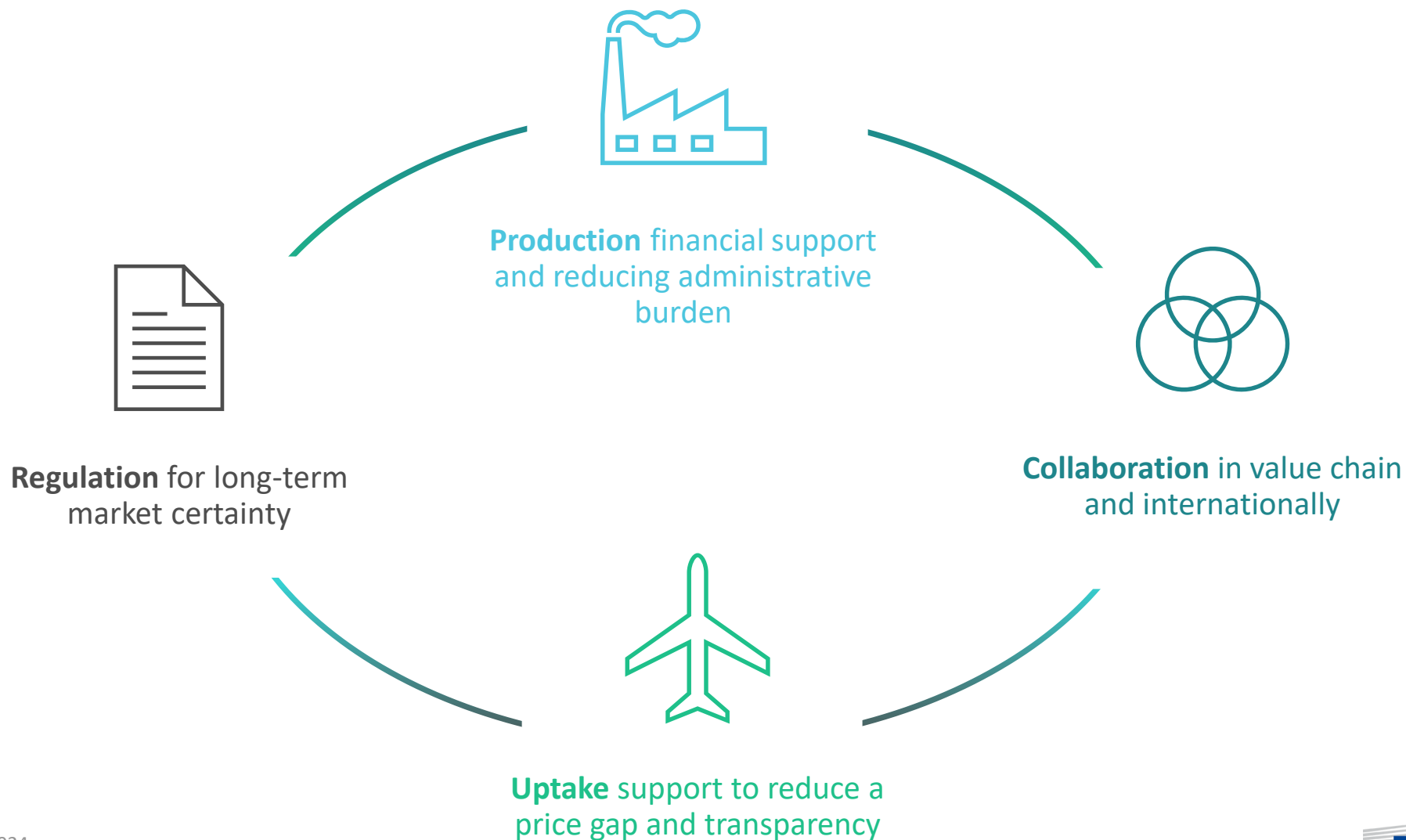
Improved EU **energy security** due to energy diversification



Aviation of tomorrow

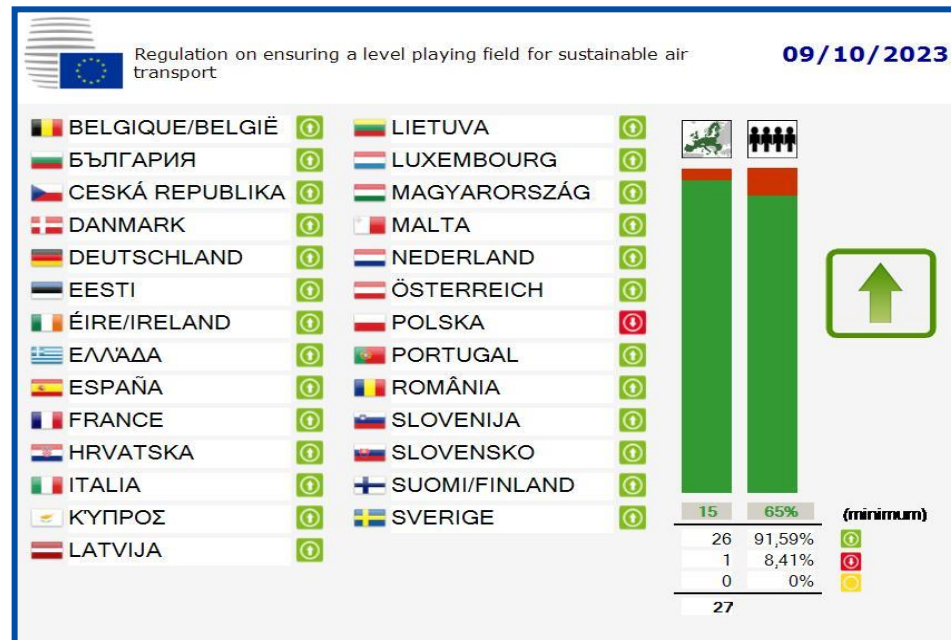


II. Policy design: support measures



III. Legislative process

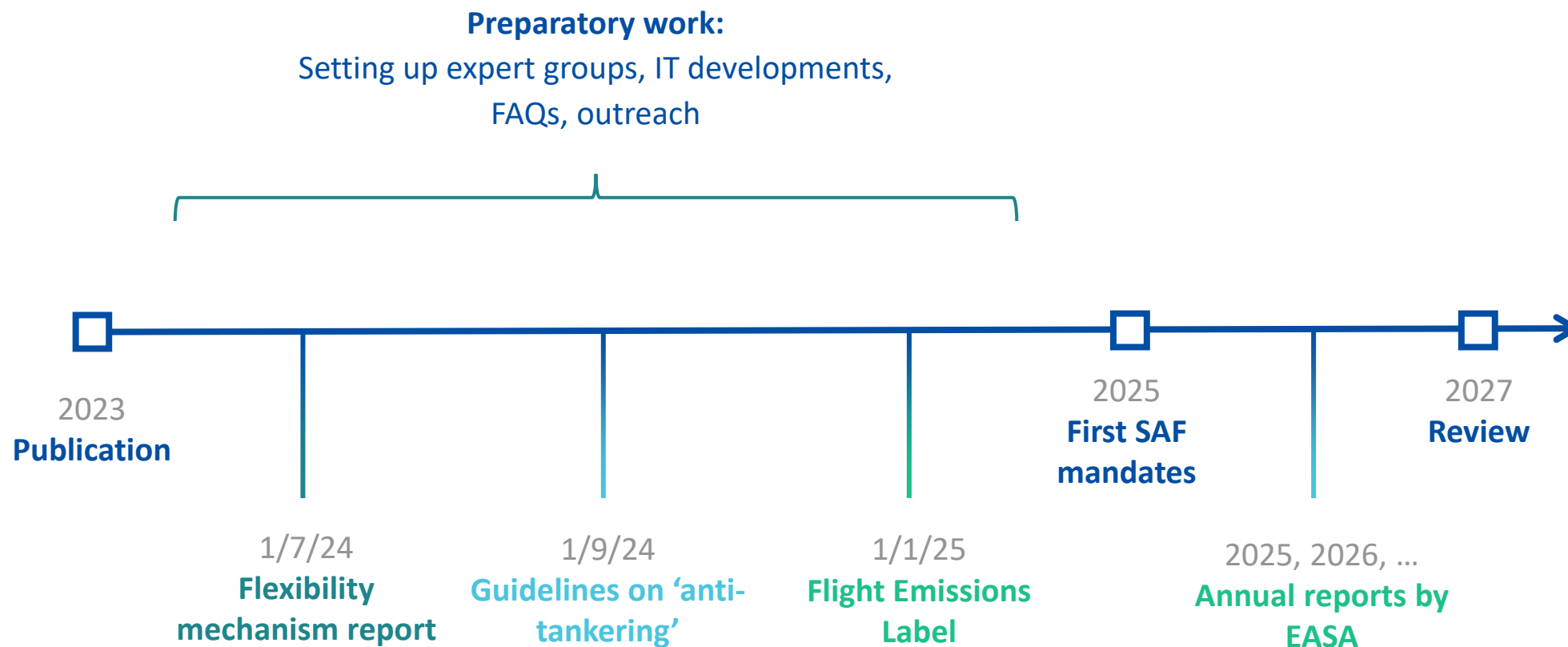
Council: EU Member States



European Parliament



IV. Implementation & V. Evaluation





Thank you for your attention!



EU SAF policy: an industrial policy to support the transition of aviation



Collaboration

Cross-sectoral collaboration

Renewable and Low Carbon Fuels Industrial Alliance (RLCF)

Global collaboration at ICAO

Long-Term Aspirational Goal, CAAF/3 Global Framework



Production

Financing to de-risk SAF production

Horizon Europe, Innovation Fund, InvestEU, Global Gateway

New SAF pathways and new plants

EU SAF Clearing House, Net Zero Industry Act, ACT-SAF



Uptake

Financing to narrow the price gap

20 million SAF Allowances and zero rating ETS, energy taxation

Enhancing transparency

Flight Emissions Label, EU taxonomy

Our key speakers for today!



Prem Lobo

@ Prem.Lobo@faa.gov

 Federal Aviation Administration

 Energy Division Manager

Dr. Prem Lobo is the Energy Division Manager in the Office of Environment and Energy at the United States Federal Aviation Administration (FAA). He has over 20 years of experience in the aviation sector focused on fuels, technologies, and emissions.

Dr. Lobo is responsible for managing a broad portfolio of research, development, and deployment projects associated with sustainable aviation fuels (SAF) and novel energy sources to mitigate the environmental and climate impacts of aviation.

His primary focus on SAF is on supply chain development, life cycle assessment, emissions, testing, analysis, and policy. He coordinates FAA's engagement with CAAFI (Commercial Aviation Alternative Fuels Initiative), and the SAF Grand Challenge interagency working group.

Dr. Lobo is a nominated member of the International Civil Aviation Organization's (ICAO) Committee on Aviation Environmental Protection (CAEP) Fuels Task Group where he co-leads the Technology, Production and Policy subgroup.

Our key speakers for today!



Shamsul Leman

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 CAAS

 Assistant Director of Sustainability Office

Shamsul has over 15 years' experience in aviation environment and sustainability with the civil aviation authority and previously with the airlines industry. He is currently overseeing several Sustainable Aviation Fuel (SAF) initiatives for CAAS including the implementation of the national SAF target and central SAF procurement function as part of the Singapore Sustainable Air Hub Blueprint, and building ecosystem partnerships to accelerate the adoption of SAF in Singapore and the region.

Shamsul has also supported various ICAO-related work such as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), Long-term Global Aspirational Goal (LTAG), Third Conference on Aviation and Alternative Fuels (CAAF/3) and the Committee of Aviation Environmental Protection (CAEP).

SINGAPORE SUSTAINABLE AIR HUB BLUEPRINT

CAAS Sustainability Office

Jun 2024



Singapore aviation sector must play its part in drive towards sustainability

In 2019, Singapore's airports contributed to around 0.7% of Singapore's domestic emissions and Singapore's aircraft operators contributed 1.9% of global aviation emissions

- **In Feb 2022, the Civil Aviation Authority of Singapore (CAAS) convened the International Advisory Panel (IAP) on Sustainable Air Hub to discuss how international aviation can be made more sustainable and accessible for all, and how Singapore can contribute to this international effort**
 - Held four meetings and six deep dives across three key domains from Feb to Jul 2022
 - Engaged more than 120 representatives from 40 local and international partners
 - Published recommendations in Sep 2022, with 15 initiatives
 - CAAS studied the IAP's recommendations and did further consultations



CAAS also conducted a 20-month Sustainable Aviation Fuel (SAF) pilot with Singapore Airlines, GenZero, Changi Airport Group, ExxonMobil and Neste

- Key objectives:
 - Validate supply chain readiness
 - Understand demand for SAF credits
 - Understand end-to-end cost components of SAF deployment
- SAF was first uplifted onto Singapore Airlines flight at Changi Airport on 7 Jul 2022, via the airport's fuel hydrant system
- Sale of SAF credits launched in Jul 2022 to customers such as corporate and individual travellers



Pilot found that Singapore is operationally ready to supply SAF but more is needed to support adoption

Singapore Sustainable Air Hub Blueprint

- Launched the Singapore Sustainable Air Hub Blueprint on 19 Feb 2024
- Singapore's State Action Plan for the decarbonisation of its aviation sector
- Incorporates and builds upon the recommendations by the International Advisory Panel on Sustainable Air Hub
- Adopts a balanced approach to the long term, sustainable growth of Singapore's aviation sector, taking into account the need for environmental sustainability while ensuring that the Singapore air hub remains competitive
- Sets out Singapore's medium-term and long-term targets, as well as concrete steps that CAAS and the aviation stakeholders will take to decarbonise Singapore aviation



Overview of Blueprint

Singapore Sustainable Air Hub Blueprint

Reduce domestic aviation emissions from airport operations by 20% from 2019 levels in 2030 and achieve net zero domestic and international aviation emissions by 2050



Airport domain

Maximal efforts to reduce energy use and deploy renewables

- Solar power deployment
- Clean energy airside vehicles
- Building energy efficiency
- Low-carbon electricity imports
- Resource circularity through waste-to-energy



Airline domain

Build ecosystem to support the use of Sustainable Aviation Fuel (SAF) in Singapore

- National SAF target and SAF levy
- Central SAF procurement
- SAF production in Singapore and the region
- Airline fleet renewal and operational improvements



Air Traffic Management (ATM) domain

Operational improvements to increase efficiency and reduce fuel burn

- Advanced demand-capacity balancing implementation
- Performance-based navigation enhancement
- Gate-to-gate trajectory optimisation



Critical enablers

Build coalitions for action

- Policy and regulation
- Industry development
- Infrastructure planning and provision
- Workforce transformation
- International partnerships and collaborations

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Decarbonising the Singapore aviation sector

CAAS has worked with stakeholders to identify domestic and international aviation decarbonisation targets for the sector

Domestic and international aviation emissions reduction targets

Domestic emissions target



- Domestic emissions come from operations of vehicles, facilities, and buildings for aircraft, passenger, baggage, and cargo handling at Changi and Seletar Airports
- In 2019, domestic emissions were 404 kilotonnes of CO₂
- **CAAS will work with aviation stakeholders to reduce domestic aviation emissions from Changi and Seletar Airports operations by 20% from 2019 levels in 2030**
- In the longer term, the aviation sector will target to achieve **net zero emissions by 2050**, in line with national commitment

International emissions target



- International aviation emissions come from international flights operated by Singapore-based operators
- In 2019, international emissions from Singapore-based airlines was at 17.5 million tonnes of CO₂
- **CAAS will contribute to ICAO's goals of carbon neutral growth from 2019 and the long term global aspirational goal of net zero carbon emissions by 2050 for international aviation**



Airport Domain

Maximal efforts to reduce energy use and deploy renewables

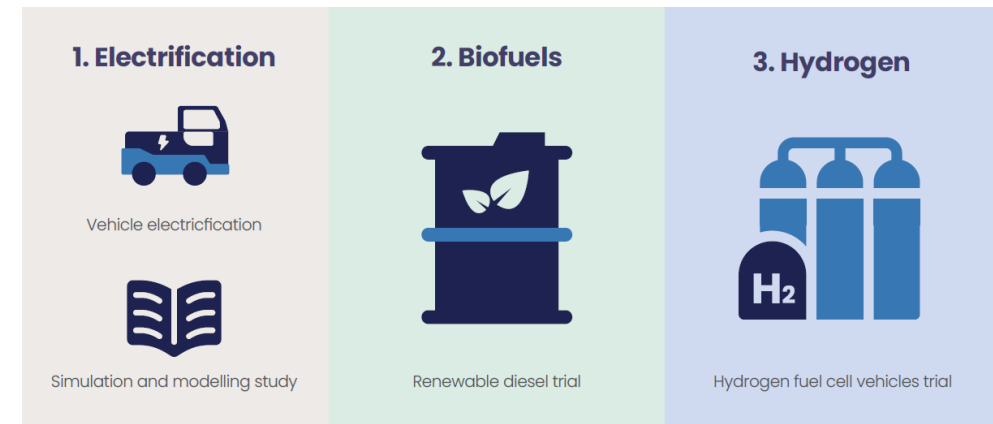
Increasing solar power deployment

- **CAAS will work with Changi Airport Group to increase solar power deployment at Changi and Seletar Airports, by installing more solar panels on available rooftop spaces of airport buildings**
 - As of end-2023, Changi Airport has more than 20MWp of installed solar capacity, generating close to 4% of its 2019 electricity consumption of about 700GWh
 - Ongoing plans to install more solar panels on available rooftop will further generate 6%
 - Solar panels will be deployed at Seletar Airport as well
- **Changi Airport will commence feasibility study on solar panel deployment on airfield**, without compromising the safety and efficiency of airport operations



Expanding cleaner energy use for airside vehicles

- **CAAS will work with the Changi Airport community to expand the use of cleaner energy for airside vehicles**, to have the entire fleet operate on cleaner energy by 2040, and for all new light vehicles and certain new heavy vehicles registered from 2025 to be cleaner energy vehicles
- Working with stakeholders to advance three main pathways:
 - Electrification: 20% of around 2,500 airside vehicles at Changi Airport are electric. There are over 100 electric vehicle charging stations across the four terminals, increasing to over 300 chargers in the next few years
 - Biofuels: In 2024, to trial the use of renewable diesel for heavy and specialised vehicles to study feasibility, cost, and operational impact
 - Hydrogen-powered airside vehicles: Work with stakeholders to conduct hydrogen fuel cell vehicle (HFCV) trials to understand the regulatory challenges, operational impact, and infrastructural changes required to support HFCV adoption





Airline Domain

Build ecosystem to support the use of SAF in Singapore

Requiring use of SAF and introducing a SAF levy

- Use of SAF is a critical pathway for the decarbonisation of aviation and is expected to contribute around 65% of the carbon emission reduction needed to achieve net zero by 2050
 - Experience around the world and the SAF pilot at Changi Airport have shown that SAF adoption cannot depend on voluntary use alone
- **To kickstart SAF adoption in Singapore, flights departing Singapore will be required to use SAF from 2026. We will aim for a 1% SAF target for a start, to encourage investment in SAF production and develop an ecosystem for more resilient and affordable supply**
- **Goal is to raise the SAF target beyond 1% in 2026 to 3 – 5% by 2030, subject to global developments and the wider availability and adoption of SAF**

SAF levy

- **CAAS will introduce a SAF levy for the purchase of SAF to achieve the uplift target**
- As the market for the supply of SAF is still nascent and the price of SAF can be volatile, we will adopt a fixed cost envelope approach to provide cost certainty to airlines and travellers
 - Levy will be set at a fixed quantum, based on the SAF target and projected SAF price at that point in time; for example, the quantum of the SAF levy in 2026 will be set based on the volume of SAF needed to achieve a 1% SAF target and the projected SAF price in 2026
 - Amount collected through the SAF levy will be used to purchase SAF, based on the actual price of SAF at the time of purchase
 - SAF levy will not change, even if the actual SAF price differs from what is projected. Instead, the actual uplift volume of SAF will be adjusted based on the pre-determined SAF levy and prevailing SAF price
- Levy will vary based on factors such as distance travelled and class of travel
 - As an indication, we estimate that the levy to support a 1% SAF uplift in 2026 could increase ticket price for an economy class passenger on a direct flight from Singapore to Bangkok, Tokyo and London by around S\$3, S\$6 and S\$16 respectively
 - Passengers in premium classes will pay higher levies
- Continue close consultation with stakeholders on the implementation of the SAF levy, before announcing more details in 2025 nearer the date of implementation

Centralising procurement of SAF for the Singapore air hub

- **To further manage the cost of using SAF, the procurement of SAF will be centralised, using the levies collected to aggregate demand and reap economies of scale**
- Businesses and organisations will also be invited to use the central procurement mechanism for their respective voluntary SAF purchases to reduce their carbon emissions from air travel
- Central procurement function can also take on the management and allocation of SAF credits generated from SAF use through central purchases
 - For SAF procured under the national SAF target, SAF credits will be allocated back to the airlines based on the share of SAF levies collected
 - Credits generated from SAF procured voluntarily by businesses and organisations will be allocated based on the amount of SAF bought

Anchoring SAF production in Singapore and the region

- **Work closely with industry partners to increase SAF production capacity in Singapore and the region**
- Given the tremendous increase in SAF production capacity required globally, there is scope for more local and regional SAF production
- We can tap on the wide availability of potential feedstocks in the region and the presence of an existing petrochemical sector in Singapore
- This will support the increasing demand for SAF in Singapore and the wider region



Air Traffic Management Domain

Operational improvements to increase efficiency and reduce fuel burn

Operational improvements to increase efficiency and reduce fuel burn

- **Advanced Demand-Capacity Balancing**
 - Expand suite of Air Traffic Flow Management (ATFM) solutions to include Long Range ATFM and improve coordination and management of longer-haul flights
 - Strengthen the integration between meteorology and ATM to improve reliability, timeliness and accuracy of weather forecast information for air traffic controllers
- **Performance-Based Navigation**
 - Collaborate with partner ANS Providers to implement more direct routings on a wider scale
 - Develop smart tools to facilitate the optimisation of descent flight profiles within Changi Airport to help reduce fuel burn and emissions
- **Gate-to-Gate Trajectory Optimisation**
 - Implement a decision support tool for air traffic controllers to optimise the departure intervals between aircraft, which will enhance runway efficiency and increase fuel savings
 - Collaborate with stakeholders and partner ANS Providers to work towards Trajectory-Based Operations



Critical Enablers

Build coalitions for action

Five critical enablers to build coalitions for action

1. Policy and Regulation

- CAAS will introduce several policies to drive tangible actions, including setting domestic aviation emissions reduction targets to spur collective action and introducing a national SAF target to drive more SAF production and adoption

2. Industry Development

- CAAS has set up S\$50 million Aviation Sustainability Programme to fund sustainable aviation projects, such as feasibility study for the deployment of solar panels on the airfield, a simulation and modelling study for the electrification of airside vehicles, and trials on the use of renewable diesel for ground handling equipment and vehicles
- CAAS has set up the International Centre for Aviation Innovation (ICAI) to drive innovation initiatives across all aspects of aviation including air traffic management, airport operations, advanced air mobility, and aviation sustainability

3. Infrastructure Planning and Provision

- New Changi Airport Terminal 5 is being designed and developed to achieve the Building and Construction Authority's Green Mark Platinum Super Low Energy standard
- Working with partners to study technical feasibility of hydrogen adoption and infrastructure requirements

Five critical enablers to build coalitions for action

4. Workforce Transformation

- Identify new and emerging sustainability-related job roles through a tripartite effort involving the government, companies and unions
- Accompanied by upskilling and job redesign efforts, relevant lifelong learning and skills-upgrading initiatives
- Work with Institutes of Higher Learning to embed aviation sustainability resources and content into the curriculum and stimulate interest through sustainability-linked internships and learning journeys

5. International Partnerships

- Work with partners to establish the Asia-Pacific sustainable aviation centre to develop capabilities for sustainable aviation policy research specific to the needs of the Asia-Pacific region
 - Includes building deeper scientific understanding of regional SAF feedstocks, validating prevailing policy recommendations against the region's context to value-add perspectives, and providing capacity-building activities
- Continue to advance multilateral and bilateral partnerships to drive sustainable aviation, e.g. Aviation Green Lane with Japan and the US, ASEAN Sustainable Aviation Action Plan



THANK YOU





**AFRICAN AVIATION
TRANSFORMED**

AFACAC AND EASA JOINT WEBINAR SERIES ON THE ACCELERATION OF DEVELOPMENT, PRODUCTION & DEPLOYMENT OF SAF/LCAF IN AFRICA



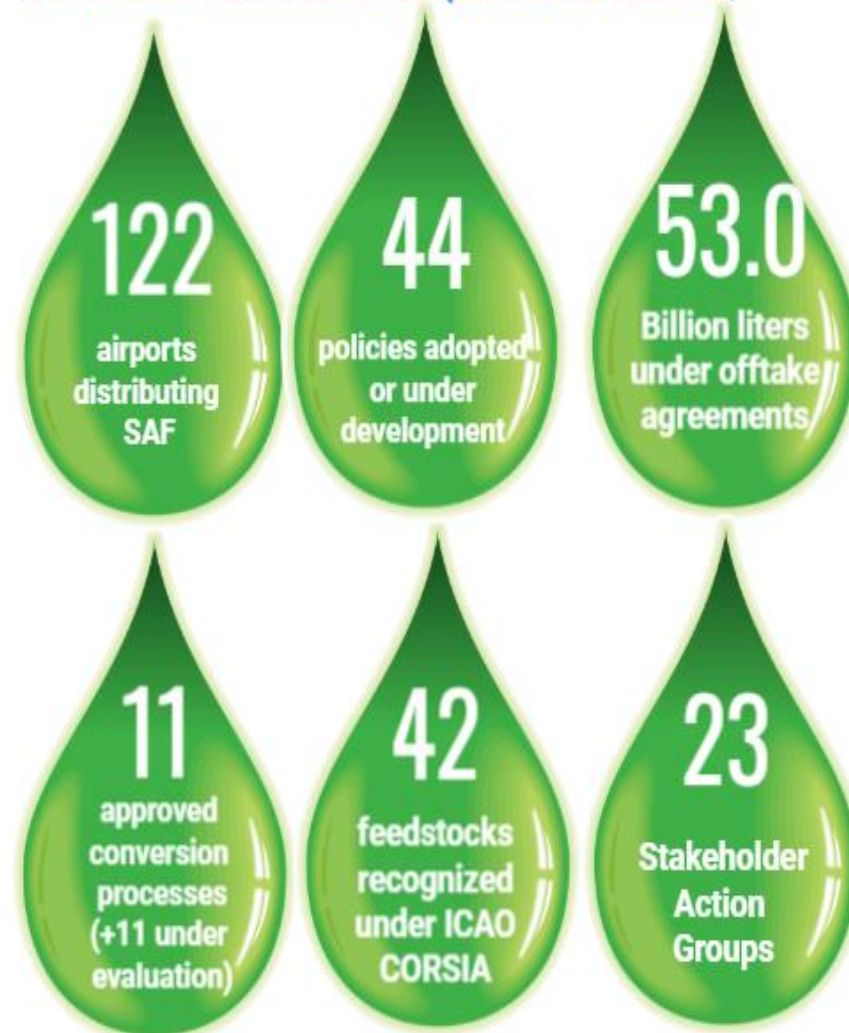
2nd Webinar on Market Outlook & SAF
Policies

18 June 2024

GLOBAL SAF/LCAF OUTLOOK – ICAO INFORMATION

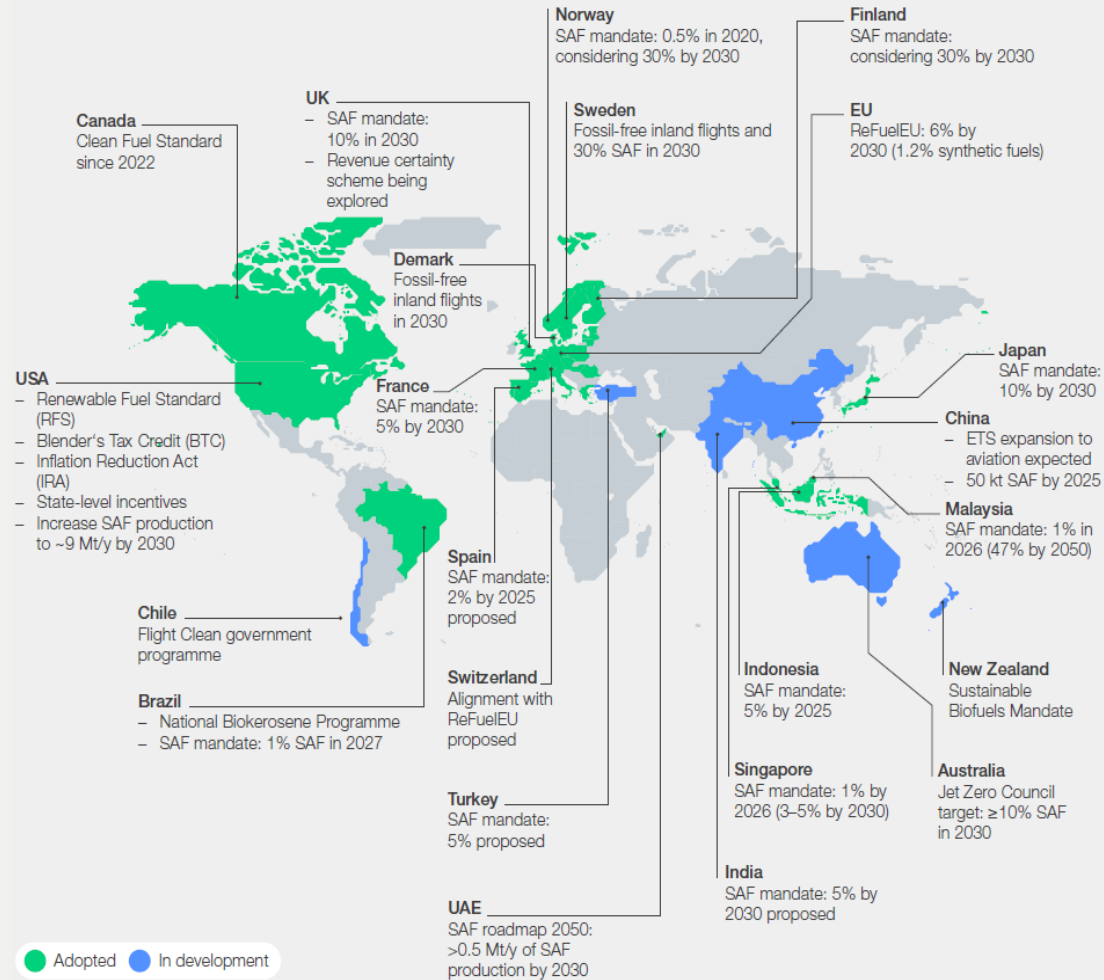
Sustainable Aviation Fuel (SAF)

ICAO SAF Tracker tools (click for details)



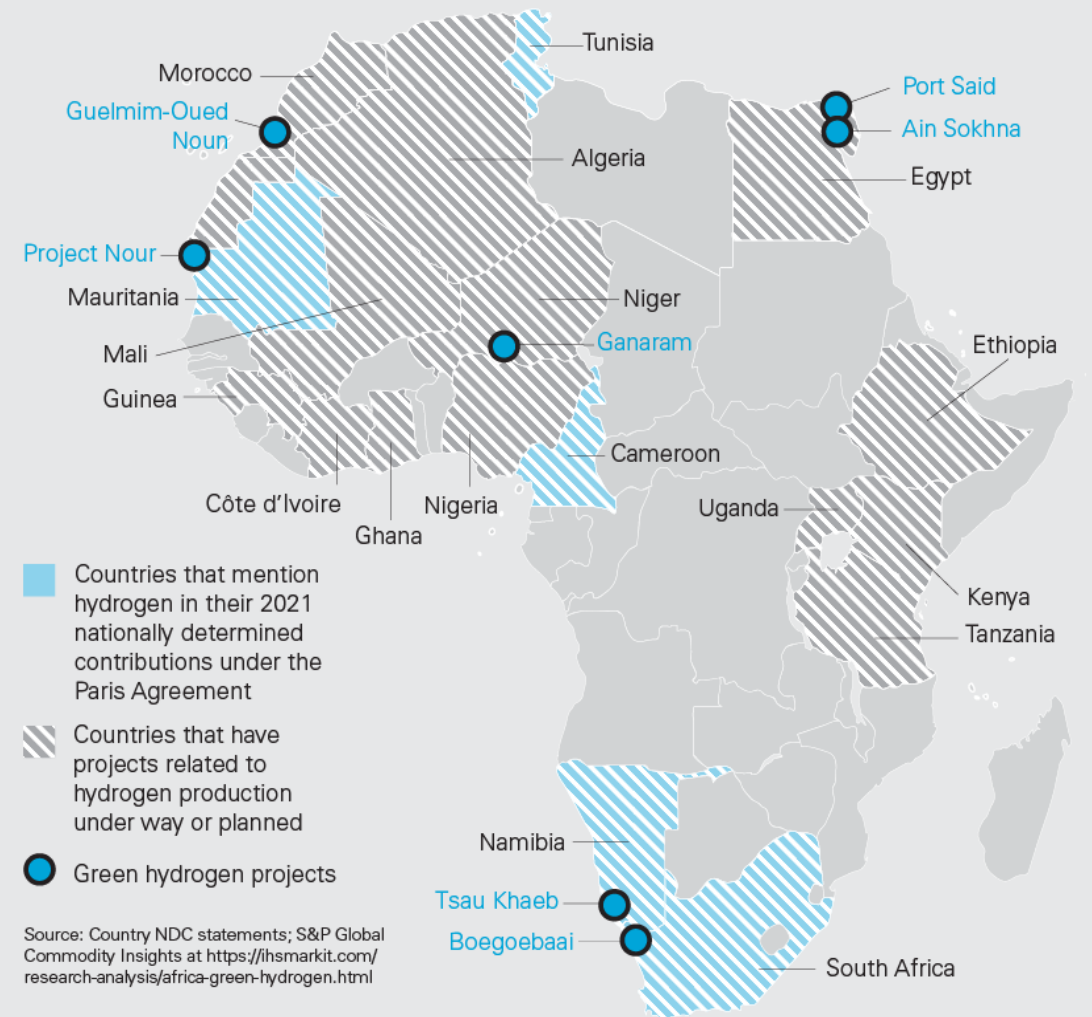
GLOBAL SAF/LCAF POLICY OUTLOOK

Discussed and adopted SAF policies cover ~75% of fuel demand globally and will affect regional competitiveness



Sources: ICAO,¹⁵ ACI,¹⁶ IEA,¹⁷ Eurocontrol,¹⁸ Biomass Magazine,¹⁹ S&P Global²⁰

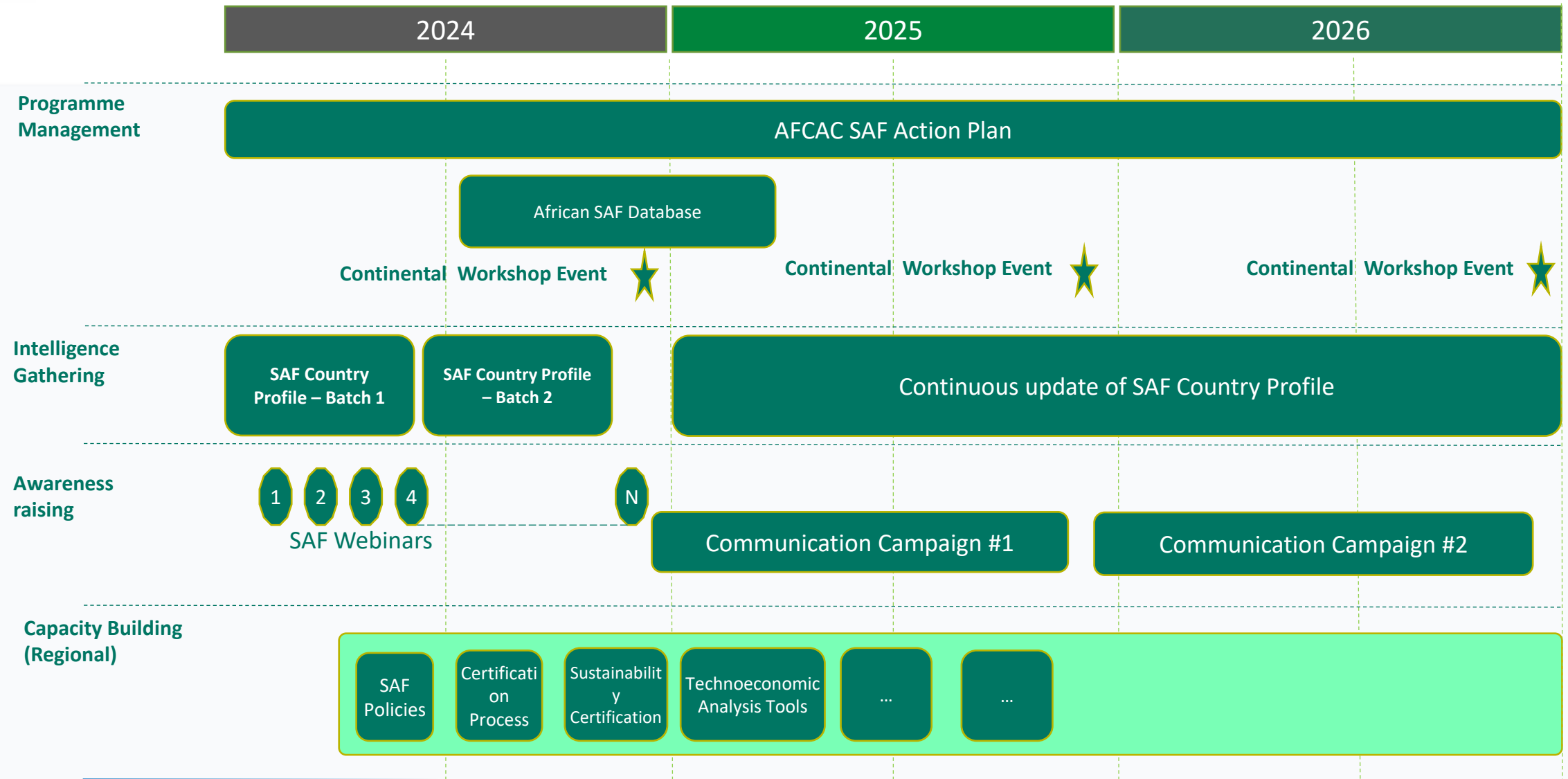
Figure 1: African countries that mention hydrogen in their NDCs under the Paris Agreement, and hydrogen projects under way or planned



Source: Country NDC statements; S&P Global Commodity Insights at <https://ihsmarkit.com/research-analysis/africa-green-hydrogen.html>

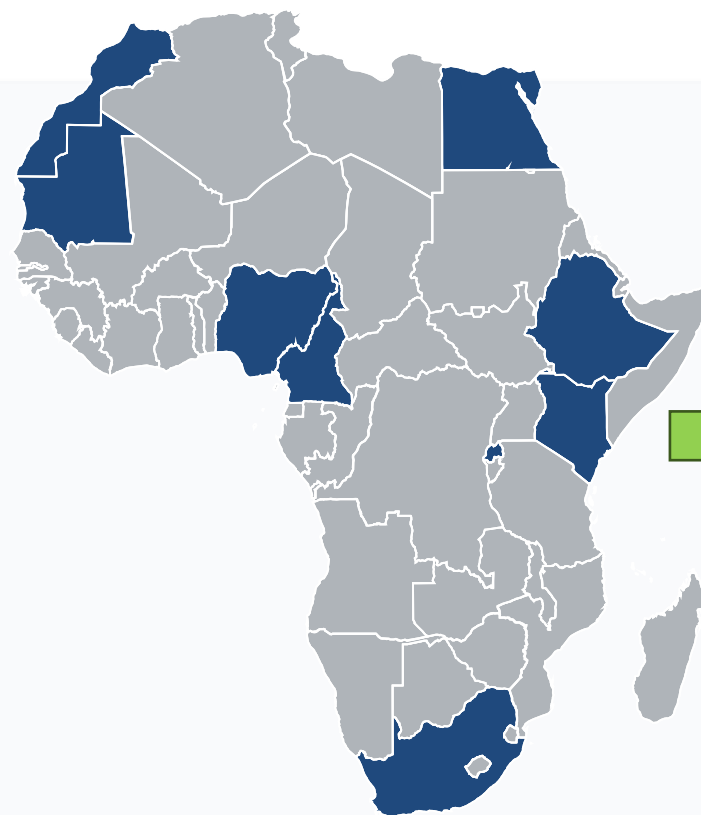


COUNTRY PROFILES - UPDATES



COUNTRY PROFILES - UPDATES

1. Egypt
2. Kenya
3. Nigeria
4. South Africa
5. Cameroon
6. Ethiopia
7. Mauritania
8. Morocco
9. Rwanda



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