



#21
SERIES

Progress of ACT-SAF Programme: feasibility and business implementation studies



ACT-SAF Series #21 Speakers



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Agenda



- Opening
- Overall update on ACT-SAF Programme
- Key outcomes of recently completed studies
- Q&A
- Closing



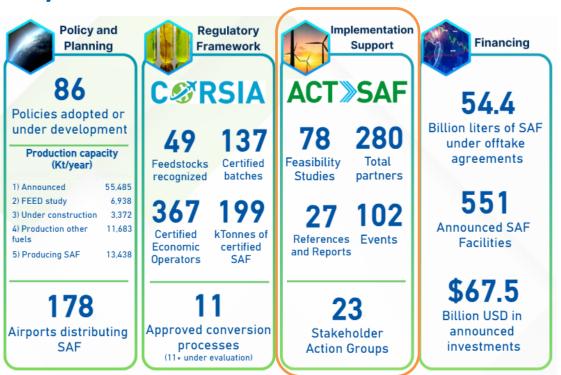




Structure & context



- Programme launched June 2022
- CAAF/3 Global Framework, BB3
- Target: 50 studies by 2028
- CAAF/4 by 2028



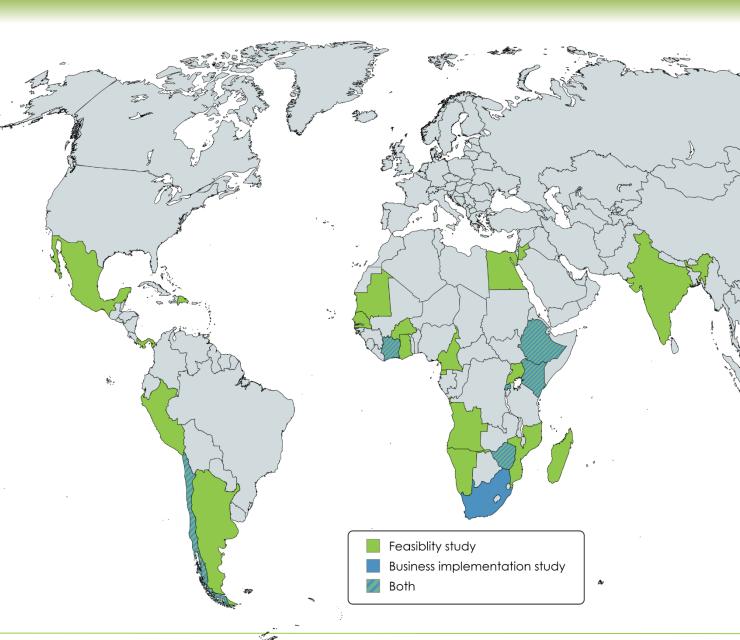




33 ICAO ACT-SAF studies



- Funding from EU, France, Netherlands,
 UK, Airbus, Italy, Switzerland, Volaris
- 11 published feasibility studies
- 3 recently delivered (2 feasibility, 1 business implementation)
- 12 ongoing studies (7 feasibility, 5 business implementation)
- 7 more planned (6 feasibility, 1 business implementation)
- Announced since last episode:
 - Angola (co-funding)
 - Namibia
 - Chile BIS
- New announcements expected soon







- SkyTalk on ICAO TV & progress video on YouTube
- More details in resolution A42-21 (mainly para 21)
- Finvest Hub launch
- Side events







Latest project launches



Côte d'Ivoire (BIS) – 4/5 Aug

Consultant: Keith Lawless

• **Eq. Guinea** – 8/9 Sept

Consultant: Alan Lecocq

Panama – 10/11 Sept

Consultant: Bruno Miller

Senegal – 15/16 Sept

Consultant: Mathilde Tannous

Mauritania – 4/5 Nov

Consultant: Manuel Schrenk

Mozambique – 17/18 Nov

Consultant: Onofre Andrade

• Ethiopia (BIS) – 27 Nov

Consultants: Jon McKechnie & Yitatek Yitbarek





Templates



- Published in 2023 (FS) &
 2024 (BIS)
- Basis for both ICAO and Partner-led studies
 - Airbus in Philippines
 - EASA in Morocco & Nigeria
- Review planned in 2026 on basis of current publications







ACT-SAF template for feasibility
studies on Sustainable Aviation
Fuels
Version 1 (July 2023)

<u>ACT-SAF guide for feasibility</u> <u>studies on Sustainable Aviation</u> <u>Fuels</u> Version 1 (July 2023)



Training & other activities



- EASA supporting 14 African states + India
- UK/ICF Southern Africa (region) & Namibia (national)
- Austria/ICAO Viet Nam
- Brazil Angola





Newsletter



- Newest edition sent Nov 2025
- New platform
- Not on the list, or want to suggest items for inclusion?
 - OfficeENV@icao.int



ENVIRONMENT



November 2025

The "ICAO Assistance, Capacity-building and Training for Sustainable Aviation Fuels (ACT-SAF) programme" is supporting States to develop their full potential in SAF, through specific training activities, development of feasibility studies, and other implementation support initiatives, with a view to accelerate the deployment of aviation cleaner energies.

For more details on ACT-SAF click here

ICAO ACT-SAF Projects

Delivery of ACT-SAF Feasibility Studies

The ACT-SAF programme continues advancing with the delivery of feasibility and business implementation studies. Four new feasibility studies have been published in 2025, for Chile, Ethiopia, India, and Jordan. These studies provide concise, evidence-based insights into each country's potential for sustainable aviation fuel (SAF) production and deployment, supporting national strategies and contributing to global decarbonization efforts.



India's ACT-SAF feasibility study identifies high SAF potential from agricultural residues, the alcohol-to-jet pathway as the preferred technology, and opportunities to meet domestic demand, support exports, and create jobs while reducing pollution. Read more https://example.com/here/beta/fig/4











Feasibility study in India

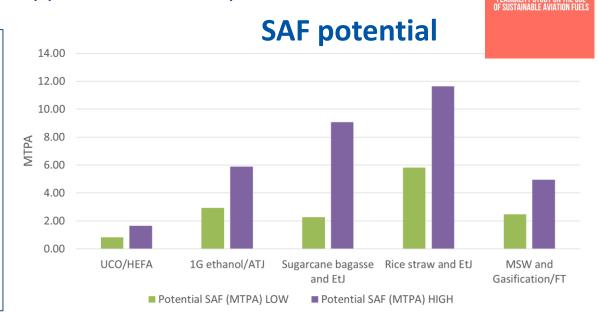


Conclusions

- Agricultural residues (sugarcane bagasse and rice straw) have the biggest potential for SAF production, likely through the alcohol-to-jet pathway
- Approximately 14 33 Mt/year SAF potential from all feedstocks evaluated (a scenario of 60% SAF blend by 2050 for all flights would require 11.8 Mt/year)
- Medium to long term (2030-2050) additional opportunity for e-fuels
- Additional ethanol through waste gas fermentation can support further SAF production

Critical success factors

- Development of a government and stakeholder driven vision with a long-term, regulated mandate to 2050
- Implementation of policies that provide financial support for SAF production, including capital grants and incentives
- Integrating SAF policies into the existing legislative framework, such as the National Biofuels Policy
- Need for harmonised policy that addresses LCA and sustainability criteria for all sectors (not limited to SAF)







India: challenges & opportunities



Opportunities

- India can cover domestic SAF demand and CORSIA obligations, with potential for exports.
- Plants can also produce other fuels to decarbonize transport.
- Abundant feedstocks enable low-cost SAF and exports.
- India's government has enacted strong policies for other biofuels
- Strategic location favors exports to Asia and Europe.
- Development of SAF provides jobs and reduce air pollution

Challenges

- Maturity of commercial production technologies is a significant obstacle
- Current policies are not adequate to drive SAF development
- Feedstocks are exported instead of used in India for SAF production.
- Favourable policies abroad drive export of SAF
- Competition between aviation and road transportation
- Lack of adequate domestic policies hinder investment.





India: delivery of the study



India presents feasibility study on sustainable aviation fuel

By Neha LM Tripathi X , New Delhi

Published on: Sept 03, 2025 06:40 am IST 🔲 🔁 👔



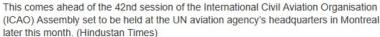






India presented a feasibility study on Sustainable Aviation Fuel (SAF) to reduce aviation emissions, aiming for 5% blending by 2030 amid rapid sector growth.





https://www.pib.gov.in/PressReleasePage.aspx?PRID=2163273

https://www.hindustantimes.com/india-news/india-presents-feasibilitystudy-on-sustainable-aviation-fuel-101756840796284.html





Ministry of Civil Aviation

Sustainable Aviation Fuel (SAF) a practical and immediate solution to decarbonize the aviation sector, says Union Minister Ram Mohan Naidu

Unveils SAF Feasibility Report - India' roadmap to emerge as global leader in Sustainable Aviation Fuels

Posted On: 03 SEP 2025 1:31PM by PIB Delhi

Ministry of Civil Aviation, in partnership with the International Civil Aviation Organization (ICAO) and with support from the European Union has officially released the Sustainable Aviation Fuel (SAF) Feasibility Study for India here today.

The launch event was addressed by Union Civil Aviation Minister Shri Ram Mohan Naidu, Secretary of Civil Aviation Shri Samir Kumar Sinha, Director General of Civil Aviation Shri Faiz Ahmed and Ms. Jane Hupe, Deputy Director Environment, Air Transport Bureau, ICAO.

Undertaken under the ICAO ACT-SAF Programme, the feasibility study assesses the potential for producing and utilizing drop-in Sustainable Aviation Fuel (SAF) in India. It evaluates domestic feedstock availability, viable production pathways, infrastructure and policy readiness and the enabling conditions needed to establish a robust domestic SAF market. Drawing upon international best practices and tailoring them to India's socio-economic and environmental context, the report provides a roadmap for sustainable fuel adoption

The study is being deliberated at a two-day workshop at Udaan Bhawan, New Delhi, with participation from ICAO, EASA, DGCA, industry partners, and multiple







Feasibility study in Ethiopia



Key feedstock identified

- Brassica carinata (HEFA): potential as a non-food feedstock in rotation with existing crops. Currently produced and marketed only at local scale. Need to improve seed varieties (increase yield) and toxicity in seedcake (use for animal feed)
- Sugarcane molasses (AtJ): potentially viable feedstock (use existing ethanol infrastructure). Planned expansion of domestic sugar production will increase molasses, but not enough to support a viable-scale SAF facility on its own. Competition with other uses, specifically in beverages.

Feedstock matrix

Feedstock / conversion pathway	Feedstock evaluation	Sustainability evaluation	Economic and markets evaluation	Overall
Brassica carinata / HEFA				
Sugarcane molasses / ATJ				
Municipal solid waste / FT				
Castor / HEFA				
e-SAF / FT				
Agricultural residues / FT				





Ethiopia: challenges & opportunities



Opportunities

- Strong government commitment to low-carbon development including specific support for SAF in Biofuel Strategy
- Significant potential for agricultural feedstocks, including rotational and intercropping of nonedible oilseed crops
- Established ethanol production capacity, with potential for growth in line with growth of domestic sugar production
- Abundant renewable energy resources with potential for low-cost electricity to power SAF production, including e-SAF in longer-term
- Strategic position as a major African aviation hub with growing fuel demand

Challenges

- Competition for feedstocks with current and potential future uses including food, feed, energy and industrial applications
- Limited data to support financial viability of feedstock production and scalability to quantities required for SAF
- Lack of refining, blending and certification capacity within the country



Ethiopia: delivery of the FS and BI Study kick-off meeting



27 November 2025







Official launch of the new Study and stakeholder's discussion



Ethiopia Minister of Transport and Logistics Dr. Alemu Sime Feyisa participated, together with State Secretaries of Transport and of Agriculture, the Director General of Civil Aviation and representatives of the French Embassy and of the EU. Sequence of the new project activities for 2025/2026 SAF Business Implementation Study











"The study finds that **Jordan has credible potential to develop a SAF indus**try that supports national climate goals, strengthens energy security, and creates long-term economic value".

Key feedstock identified

- Jordan's severe water and agricultural land constraints limit the scalability of biomass-based SAF pathways. With only 5.4% arable land, crop cultivation is prioritized for food security. Thus, biomass feedstocks are largely restricted to non-edible agricultural residues and MSW.
- The study identifies MSW, agricultural residues (notably olive pits), and livestock manure as key domestic SAF feedstocks. MSW and manure have the highest potential due to availability, underutilisation, and alignment with waste reduction policies. MSW, with its rising volume and high organic content, is CORSIA eligible. Olive residues and manure add feedstock diversity without impacting food production.
- Domestic biogenic feedstocks are insufficiently available for SAF biofuel to fully meet Jordan's jet fuel demand but can contribute meaningfully, while PtL aligns with national renewable energy and hydrogen strategies and could position Jordan as a global SAF hub. However, successful PtL deployment requires dedicated supply chains for green hydrogen and captured CO₂, likely involving international collaboration.







Feedstock matrix

Qualitative assessment



Assessment matrix - per feedstock



HICA 84. case context. In "XEC, are used for animal fixed, soil enrichment, and household heating. 20 Supply Moderate - Fruits are processed at central and facilities, but now supply charas are mented to transport residues under updated waste regulations, including licensing for treatment. ^{Lic} • Price per t - Moderate price - v1 USD 84.5 for place residues 1.5. Saillover effects from feedstack use for SAF - supportion key UN SDGs. High - Supports SHF but can alox generate pharmative income concern for themers, exhances efficient excepts skain infrastructures, encourage a responsible use of fruit residues loyend "\"," thereby preventing soil

 Establish a controlled collection system & financial corresponding scheme. Development of legal frameworks for fruit residue management licensing, establish standards for fruit residue processing Assessment result table – for all JO suitable feedstocks

#	Feedstock	Availability	Sustainability	Feedstock collection	Econ./market viability	Spillover effects	Total Potential: Score
1	Municipal Solid Waste (MSW)						3.2
2	Manure						3
3	Sewage Sludge						2.7
4	Fruit Residues						2.5
5	Field Crop Residues						2.5
6	Used Cooking Oil						2
7	Jojoba						2
7	Jatropha						1.7
8	Animal fat/tallow						1.3



Biofuel

SAF

Assessment matrix – for H2 and captured CO2



Assessment take aways

- Scalability: PtL SAF offers growth beyond Jordan's biofuel feedstock limitations.
- Renewable energy use: Enables full utilization of JO's abundant solar and wind resources.
- Supply and export: PtL can allow JO to meet its jet fuel demand and to become a potential SAF exporter.
- **Energy independence: PtL** production can helps reduce JO's reliance on imported fuels.
- Further evaluation needed, to assess green hydrogen and captured carbon provision and cost







Key recommendations





JORDAN



I. Organization & planning: establish strategic direction and institutional coordination.

- SAF Roadmap defining timelines, pathways, and investment priorities.
- Stakeholder coordination informing and engaging public and private sector stakeholders.
- Policy integration including SAF in national climate and development strategies and regulations.

II. Funding & project inception support: reduce project risk to mobilize investments.

- Investment prioritization highlighting SAF in national investment planning.
- Public-Private-Partnership (PPP) framework launching SAF-focused PPPs.
- Development finance securing support from development banks and donors.

III. Feedstock regulation & infrastructure: set up processing systems and policies.

- Logistics investment supporting the establishment of collection and pre-treatment systems.
- Regulatory and legislative policies establishing clear guidance for the efficient and safe processing of eligible feedstocks and CORSIA as the sustainability framework applicable for SAF.
- CORSIA eligible feedstock proposing additional feedstocks to ICAO for CORSIA eligibility.

IV. SAF handling and distribution: prepare infrastructure and policies for SAF delivery.

- Infrastructure readiness supporting the financing and establishment of blending and SAF storage systems and integrating SAF requirements in national infrastructure and grid planning.
- Handling standards setting up SAF blending and quality protocols.

V. Market creation: generate demand signals and ensure long-term market stability.

- Demand incentives introducing mandates or market-based carbon pricing mechanisms.
- Regional collaboration developing SAF trade links in the region.







Kick-off workshop in Amman on 19-20 November 2024













JORDAN



In-person delivery workshop organized in Amman on 16 December 2025







Feasibility study in Chile



"Chile is recognized as a world leader in the development of renewable energy and has significant potential for biomass generation. This, coupled with the country's strong commitment to meeting global climate goals, would strategically position Chile as a key player in promoting the production and use of sustainable aviation fuels.".

Key feedstock identified

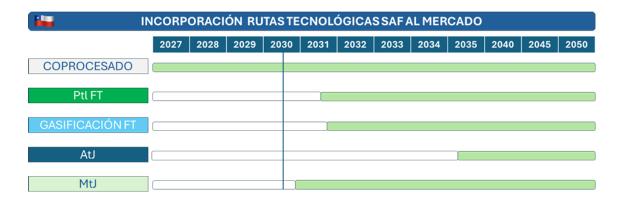
Main Raw Materials or Inputs Available for SAF Production in the Country								
Typology Raw Materials / Inputs		Origin	Quantity	Main Associated Technology				
SYNTHETIC SAF	Green H ₂	Development of the country's H2V/ Very competitive non-conventional renewables	1800 GW renewable capacity	PtL FT / MtJ (long term)				
	CO ₂	Mainly from forest residues (pulp- thermoelectric industry)	30 CO ₂ point sources greater than 100 kt	PtL FT / MtJ (long term)				
	Used cooking oils (UCO) / animal fats	UCO availability for domestic pick-up and catering. For initial SAF production (ENAP)	Subject to specific assessment	Co-processing (Short term)				
DIOCENIC SAF	Forest waste	Strong forestry-cellulose industry	3 million forest plantations / 40 million m ³ pieces for industrial use	Gasification / AtJ (long-term potential)				
BIOGENIC SAF	Municipal solid waste	Great availability in large urban centres / accompany recovery and disposal of this waste	Approximately 9.0 Mt/year MSW	Gasification				
	Agricultural waste	Mainly from the cereal industry, especially wheat straw	Approximately 1.5 Mt of wheat straw	Gasification / AtJ (long-term potential)				



Feasibility study in Chile



Technology assessment and potential in Chile



- **HEFA**: the local availability of waste oils, animal fats and other fatty substances are produced in a discrete way, which limits for the development of a large-scale HEFA industry.
- **Co-processing** is the "low-hanging fruit": The potential availability of animal oils and fats would allow processing up to 5% of the refining capacity for SAF (using about 75,000 tons of such oils and fats). The production would allow a theoretical target of 4% SAF supply in Chile to be reached by 2030.
- **Power to Liquid** route is presented as one of the main options to be analysed in detail for SAF production as Chile has extraordinary natural resources for the generation of renewable energies and the green hydrogen industry.
- Gasification FT plants represent a highly efficient option for the management of waste in landfills or final deposits.
- **Alcohol-to-Jet:** The abundant availability of residues, especially wheat straw and forest biomass, makes the potential use of this technology of interest, but not having an Ethanol industry in place, it is foreseen for a longer-term.
- **Methanol to Jet**, if ASTM approved, has great interest due to the potential development of renewable methanol in Chile, where one of its main uses would be the production of synthetic SAF or SAF PtL.

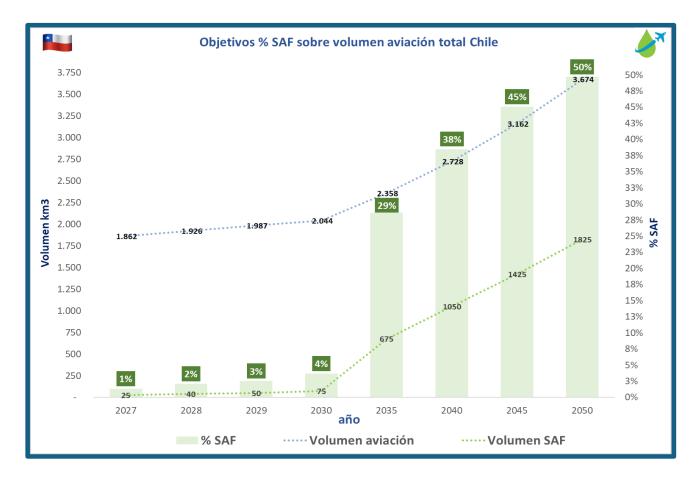


Feasibility study in Chile



CHILE EL USO DE COMBUSTIBLES DE AVIACIÓN SOSTENIBLES

Simulation model of possible future SAF potential supply in Chile





ENVIRONMENT

Feasibility study in Chile



Kick-off workshop in Santiago on 26-27 November 2024







In-person delivery workshop in Santiago on 4 November 2025









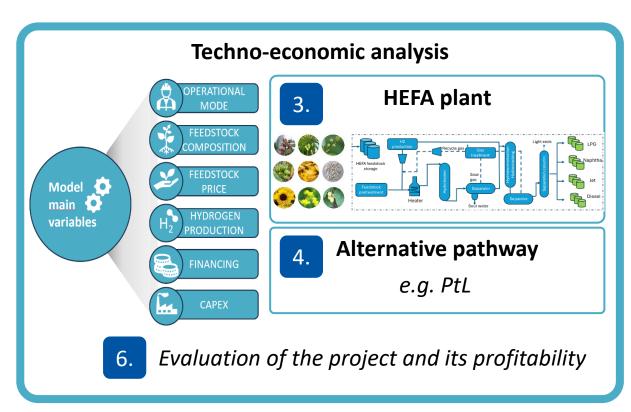




Readiness and Resources to support SAF development in Kenya

Technical assessment Evaluate the refinery

infrastructure and supply chain



Financing possibilities

Investigate potential way to finance the project



Recommendations

Suggestions for the roadmap to make sustainable aviation achievable



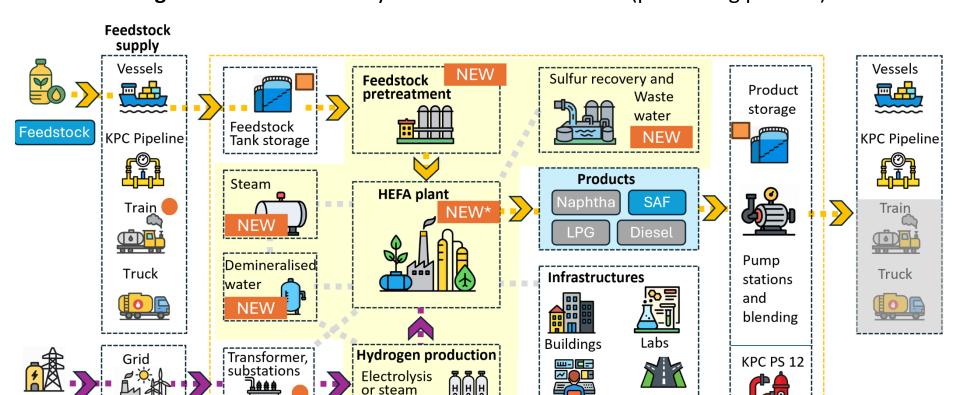
It may need to be upgraded

On hold



Most of the refinery's assets are **no easily reusable** and the overall cost advantage is limited compared to other revamping cases. The site still offers **several advantages over a greenfield development**:

- Established distribution and logistics infrastructure, providing economic value.
- **Strategic location** and already zoned for **industrial use** (permitting process).



reforming

* Few equipments may be reused

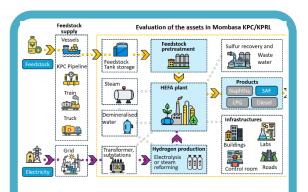
New assets to be installed:

- Feedstock pretreatment
- HEFA plant
- Hydrogen production
- Part of the utilities
- Some tanks (on hold)

Blending Jet A-1 with SAF inside the refinery allows the use of the current distribution system.



Conclusions & Outlook



HEFA technology is the most promising option in the short term.

The Mombasa refinery's existing distribution and logistics infrastructure can be utilized, but new processing units will need to be installed.

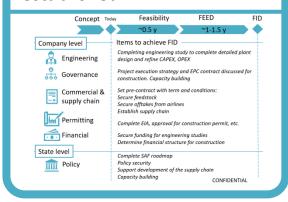
Results in this study showed that the SAF HEFA business case is profitable in certain conditions.

This indicative study represents only the first step; further studies are needed to verify, refine and validate the assumptions.

Roadmap at the company **level** is required to define the next steps and do proper stakeholder engagement to build the supply chain.

At state level roadmap and **policies** should give security to give confidence for investments.

A clear definition of which tasks should be handled within the company and at the national level should be established.



With coordinated actions to build a supply chain, clear **policies**, and sustained commitment, Kenya has the potential to become a regional leader in SAF **production**, driving both economic growth and climate progress.





In-person high-level delivery workshop in Nairobi during the 4th national SAF Steering **Committee on 25 November 2025**

Kick-off on-site visit with participation in **Kenya 3rd SAF Steering Committee Meeting** 10-23 May 2025















Feasibility study in Uganda



"Uganda has a unique combination of **biomass abundance, agricultural productivity, and strategic location** that makes it well suited for Sustainable Aviation Fuel (SAF) development. The Government of Uganda's infrastructure priorities—particularly the Hoima Oil Refinery and Kabalega Industrial Park—create the foundation for co-developing petroleum and SAF value chains".

Key feedstock identified

Feedstock	Annual Supply (Mt)	Recoverable Fraction	SAF Yield (L/t)	Potential SAF Output (ML/yr)
Sugarcane	6.0–6.4	10–30 % diverted	80–120	15–70
Maize residues	3.5–4.7 (1.4–1.9 Mt recoverable)	40 %	90–120	125–225
Cassava	1.7–2.8	10–20 % diverted	100–120	10–35
Palm oil	0.04-0.06	20–50 %	200–250	7–28
Agricultural waste (mixed)	1–3	30–50 %	90–120	90–360
MSW (biogenic fraction)	7.2 total (0.8–1.2 Mt recoverable)	50–60 %	90–120	70–140



Feasibility study in Jordan



Key findings



UGANDA



Certified Pathways and Technical Readiness:

- Alcohol-to-Jet (ATJ-SPK): Best aligned with Uganda's sugarcane and cassava sectors, where bagasse can supply heat and power.
- A 60 kbpd refinery under construction (Hoima Refinery) provides opportunity for **HEFA co-processing** and **future ATJ/FT integration**, supported by a regional pipeline network. : Viable with UCO and limited corn or palm oil; low technical risk and fastest time to market.
- Gasification—Fischer-Tropsch (FT-SPK): Applicable for MSW and agricultural residues once syngas quality management is proven.

Feasibility study in Uganda



Kick-off workshop in Entebbe on 22-23 April 2025

ICAC ESAF ICAO Eastern and Southern African Regional ... + Follow ...

7mo • 🔇

This week, the International Civil Aviation Organization launched the Uganda SAF Feasibility Study under the ACT SAF Programme, funded by the United ...more





In-person delivery workshop in Entebbe on 1st December 2025

Uganda Takes Flight Towards Net-Zero as UCAA Launches Feasibility Study for Sustainable Aviation Fuel

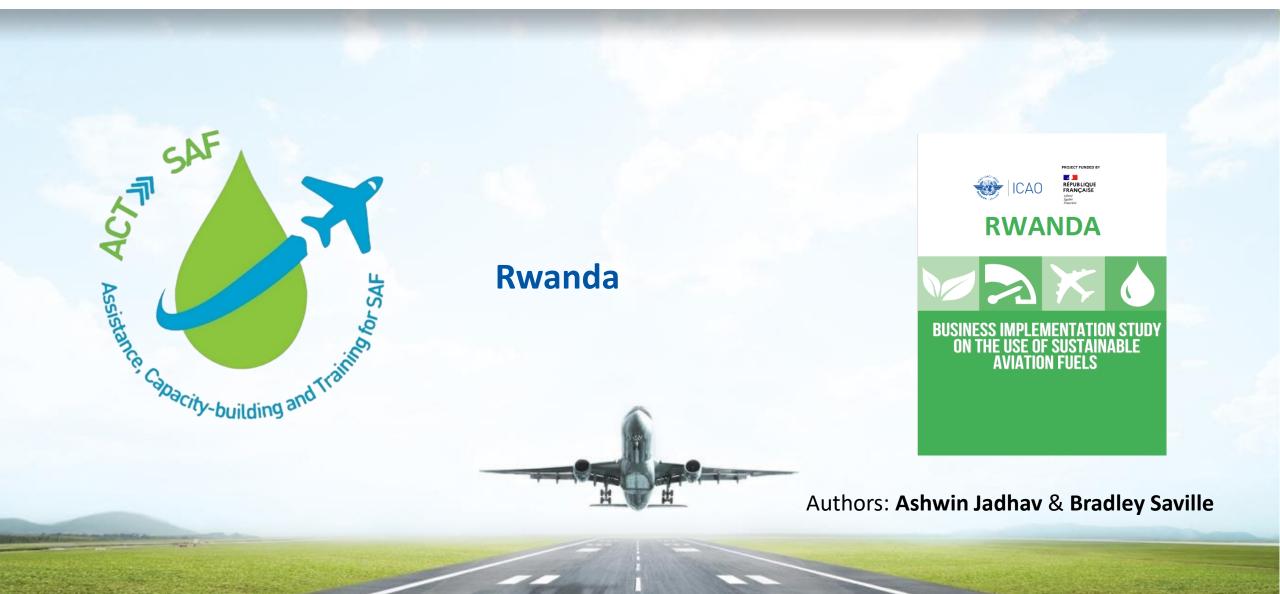












MSW Business Case (Pilot Project)

- Daily waste generated (Kigali): ~600–1,000 tonnes
 - Organic waste (~60-70%)
 - Plastics (~10-12%)
 - Paper and cardboard (~5-8%)
 - Metals and glass (~5-6%)
 - Textiles and others (~5-10%)
- Composition: 70% organic, 15–20% plastics/paper, remainder inorganic
- Disposal method: Mainly landfills with limited recycling and composting
- Pilot Project located in Kigali SEZ
- Processing 20 tonnes/day of waste
- Yielding 1,000 litres/day of SAF



- Capital Cost (CAPEX): USD 26.5 million
- Operating Cost (OPEX): USD 0.8–1.2 million/year
- Payback Period: 7–10 years
- Internal Rate of Return (IRR): Estimated IRR of 8–12%

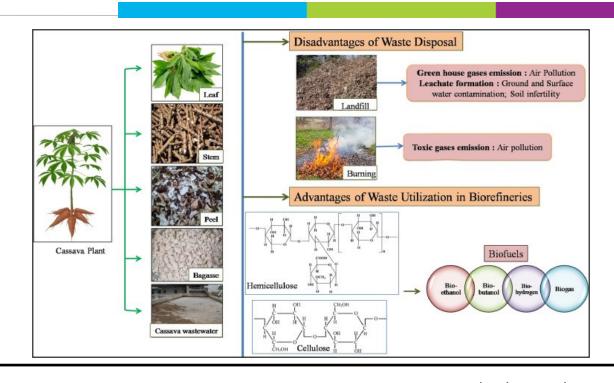
ENVIRONMENT Business implementation study in Rwanda ACT >> SAF



Agricultural Waste Business Case (Pilot Project)

Сгор Туре	Common Residue	Estimated Annual Residue (tons/year)	Notes
Maize	Stalks, cobs	300,000–400,000	High residue-to-grain ratio
Rice	Husks, straw	100,000–150,000	Concentrated in Eastern Province
Sorghum	Straw	80,000-100,000	Seasonal but abundant
Sugarcane	Bagasse	50,000-70,000	Mainly from Kabuye Sugar Works
Cassava	Peels	60,000–90,000	Waste from rural and peri- urban processing
Bananas	Pseudostem, peels	500,000+	One of the most available and underused biomass types

- Processing 30 tonnes/day of residue
- Yielding 1,200 litres/day of SAF



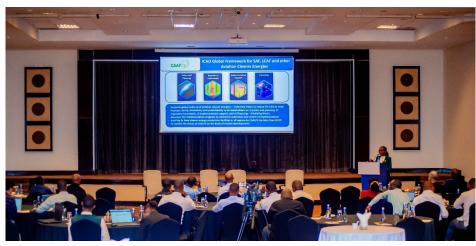
- Capital Cost (CAPEX): USD 26.7 million
- Operating Cost (OPEX): USD 1.0-1.2 million/year
- Payback Period: 7–9 years
- Internal Rate of Return (IRR): Estimated IRR of 9–13%



ENVIRONMENT Business implementation study in Rwanda ACT > SAF



Kick-off workshop in Kigali on 28-29 April 2025







In-person delivery workshop in **Kigali on 28 November 2025**





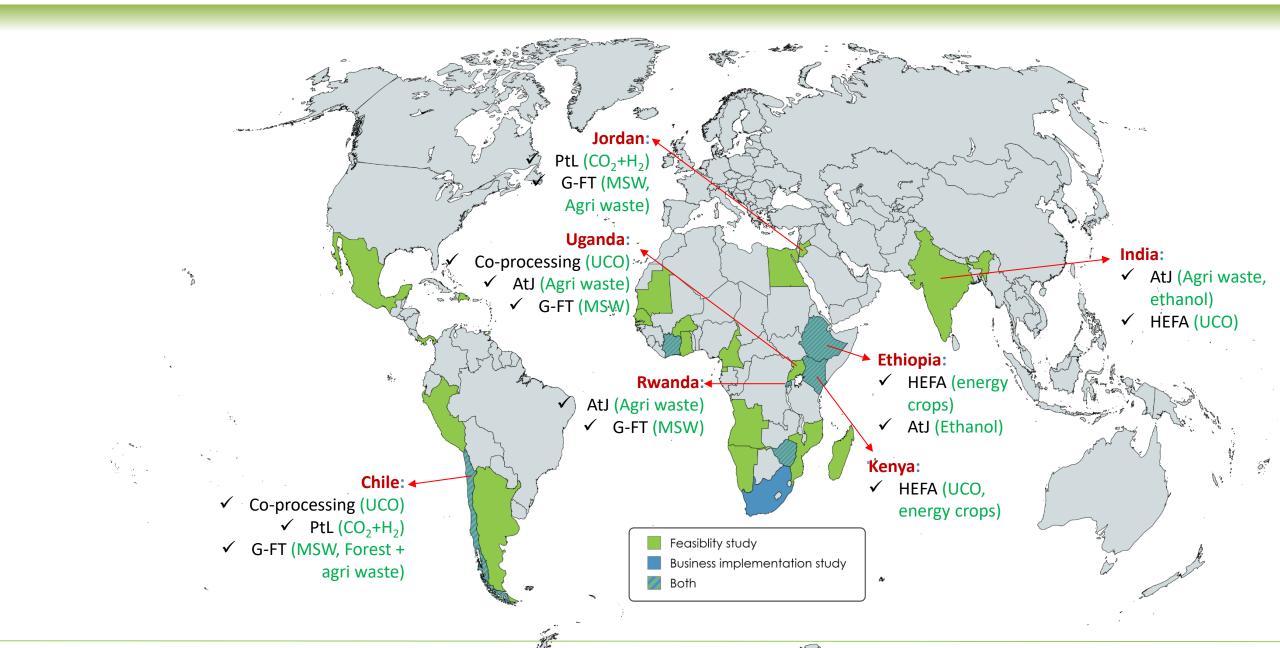






Pathways with identified higher potential ACT >SAF







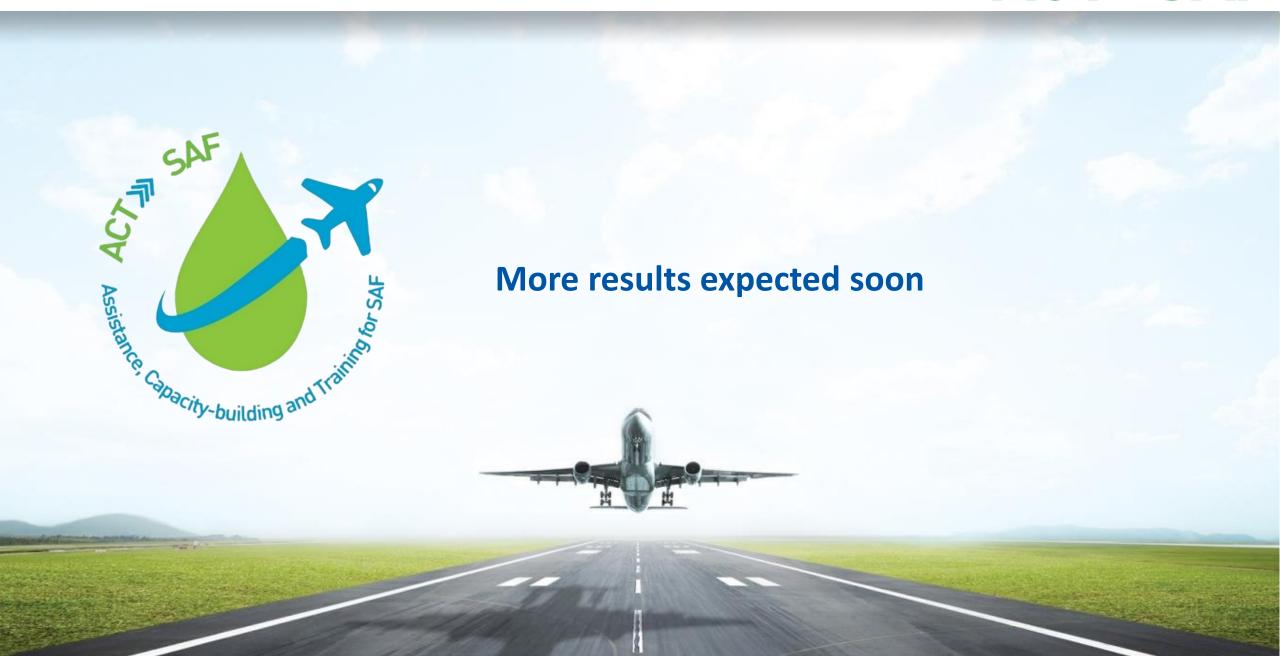
Barriers identified



- Feedstock challenges: Fragmented feedstock supply chains with geographically dispersed resources and logistical limitations. Need for aggregation hubs and improved waste management. Competition with food uses (e.g. oil crops). Need for expansion of CORSIA LCA values.
- **Policy needs:** Limited SAF policies, e.g. blending mandates or tax incentives in place. Existing SAF-specific policies are often non-existent, fragmented, or insufficient to reduce the green premium. Role for national SAF roadmaps, linked to State Action Plans.
- **Institutional coordination:** Need broader government & private engagement, e.g. through national SAF councils, committees or inter-ministerial taskforces. Recognition of co-benefits of SAF (e.g. waste management).
- **Financial challenges**: Market uncertainty with high CAPEX and OPEX, lack of domestic investors experienced in SAF and uncertain airline willingness-to-pay. Need for concessional finance (DFIs, climate funds), PPPs and/or finance enablers (e.g. ICAO Finvest Hub).









Five studies finished but pending final presentation and publication



- South Africa Launched Nov 2024
 Consultants: Farai Chireshe and Philippe Marchand
- Zimbabwe Launched Nov 2024
 Consultants: Farai Chireshe and Philippe Marchand
- Peru Launched Apr 2025
 Consultant: Freddy Navarro
- Ghana Launched May 2025
 Consultant: Damiana Serafini
- Argentina Launched May 2025
 Consultant: Matteo Prussi















Q&A





Based on CAEP/13 recommendations, in June 2025 the ICAO Council approved amendments to various CORSIA Standards on SAF

ICAO document
"CORSIA Default Life
Cycle Emissions
Values for CORSIA
Eligible Fuels"



 Updated default ILUC values and core LCA values

Already covered during ACT-SAF Series #20

ICAO document
"CORSIA Methodology
for Calculating Actual
Life Cycle Emissions
Values"



- Requirements for sourcing of <u>electricity</u> <u>used in CEF production</u>
- Methodologies to account for GHG emission reductions from <u>Soil Carbon</u> <u>Accumulation (SCA)</u>
- Methodologies for <u>geological carbon</u>
 <u>capture and sequestration (CCS)</u>
- Extension of low LUC risk practices to 2035

ICAO document
"CORSIA eligibility
framework and
requirements for
SCSs"



- Clarification on the role of the SCS in evaluating compliance of wastes, residues and by-product feedstocks
- Alignment of the <u>economic operator</u> definition

Next ACT-SAF Series (early 2026)
Electricity sourcing requirements for CEF production







