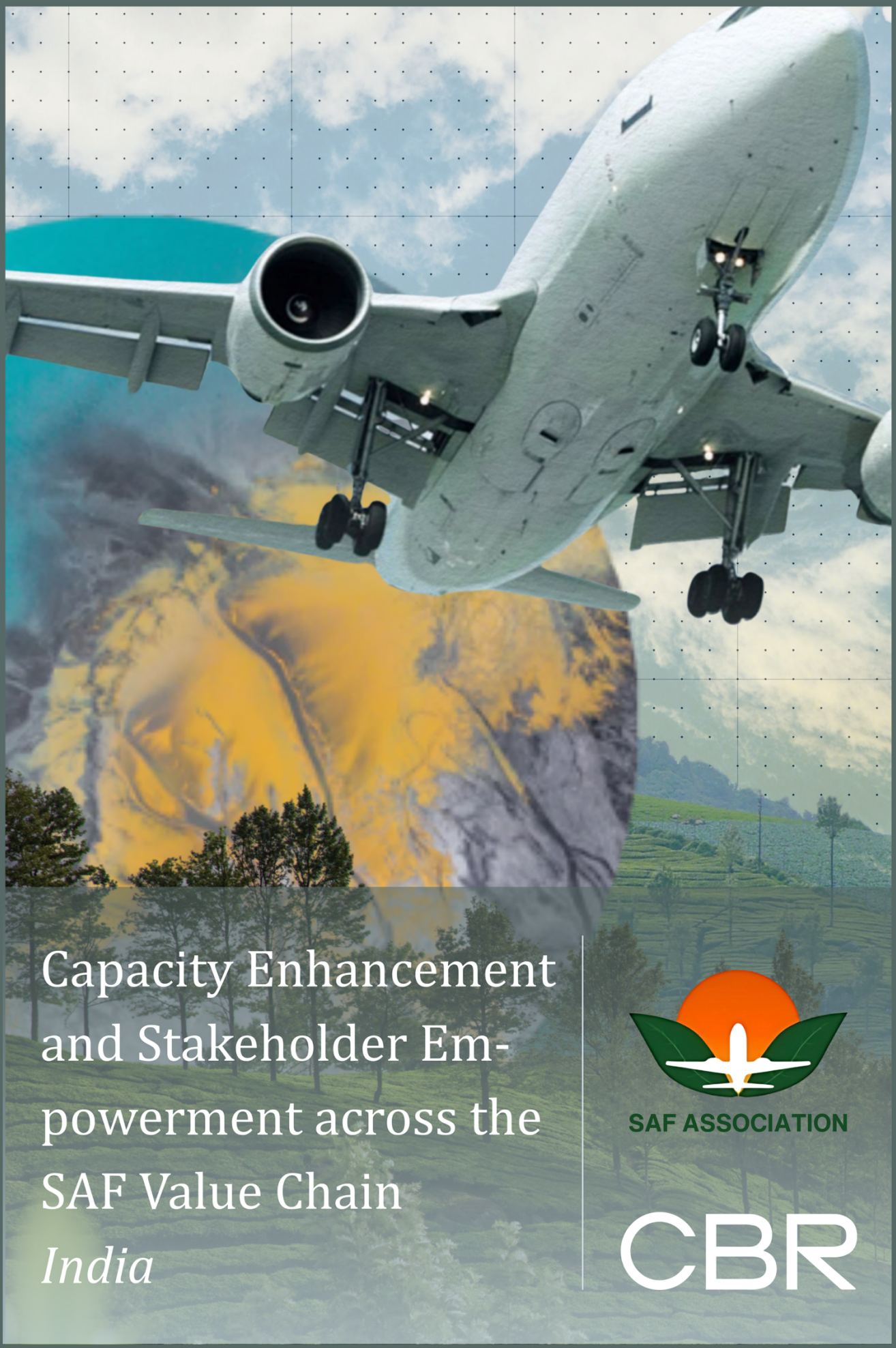

Capacity Enhancement and Stakeholder Empowerment across the SAF Value Chain

India

SAF ASSOCIATION

CBR

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Message from CBR

"India's rapidly growing economy and one of the world's fastest expanding aviation sectors represent both an opportunity and a challenge at the same time. As million more people take to the skies every year, the demand for aviation fuel will continue to rise sharply, bringing with it mounting GHG emissions. Therefore, decarbonising aviation is not just an environmental necessity, but a strategic imperative for India's long-term growth and global competitiveness.

Globally, Sustainable Aviation Fuel (SAF) has emerged as the cornerstone of efforts to reduce aviation emissions. Many nations have already embraced SAF as a strategic lever to achieving their net-zero targets, creating momentum that India could now build upon. With indicative mandates of a 1% SAF blend for international flights by 2027 and 2% by 2028, India has embarked on this transformational journey. The task ahead is to scale rapidly and sustainably.

India holds immense potential to become a global leader in SAF due to its abundant, low-cost agricultural residues, estimated at hundreds of millions of tonnes annually. Farmers will therefore be critical stakeholders in the SAF economy. By integrating them into supply chains, agricultural waste can be transformed into valuable feedstock, providing new income opportunities, supporting rural development, and fostering a thriving green economy. This inclusive model will ensure that SAF not only reduces emissions but also drives socio-economic progress.

By aligning policy frameworks, mobilizing finance, scaling technology pathways such as Alcohol-to-Jet, and strengthening supply chains, India can unlock its SAF potential. Through targeted capacity building and collaborative action, SAF can help India achieve its climate goals, strengthen its energy independence, and realize the vision of '*Atmanirbhar Bharat*'–a self-reliant, sustainable, and globally competitive India. At CBR, we support and enhance the capacity of the stakeholders with essential financial, technical and regulatory tools and concepts through various modes and modules. With our core values centered on technology innovation, integrity, and a commitment to a sustainable planet, we aim to provide strategic guidance in collaboration with the SAF Association and bring the SAF economy into reality."

Christoph Behrendt-Rieken
CEO
CBR Sustainability Partners

Message from SAF Association

About SAF Association

SAF Association is the only industry body (section 8, not for profit) actively building a comprehensive ecosystem for SAF in India and focusing on development, certification, and commercialization. SAFA connects all key stakeholders across the value chain for scaling SAF production including both bio-based and synthetic pathways and achieving its decarbonization potential of aviation. SAFA is committed to advancing net-zero aviation by accelerating SAF production and adoption, in close collaboration with policymakers, industry leaders, and civil society etc.

SAF Association invites the member across the SAF ecosystem. Members of SAF Association are Reliance, L&T, Mahindra, Tata Power Renewable Energy, TruAlt Bioenergy, ZR2 Energy, Grownet, IIT Kharagpur, Glencore, Xpansiv, SAFE, Clean Incentive, Clean Incentives and EKI Energy etc. SAF Association working to empower member by various activities such as capacity enhancement, engaging with them for policy suggestion and recommendation, assisting industry to meet CORSIA obligation, attracting investment for SAF Production and economic development, promoting research and innovation etc.

SAF Association has done multiple capacity building program earlier such as decarbonization of aviation sector chaired by Aviation secretary in the month of February this year and a workshop with DGCA focusing on "India Emerging as Global Hub for Sustainable Aviation Fuel" attended by various stakeholder aiming to position India as a global SAF hub.

Expected outcome of the SAF Association -

1. Actionable Policy Recommendations: Developed through collaborative consultations with government, industry, and academia.
2. SAF Investment Roadmap: Highlighting public-private financing, incentives, and de-risking mechanisms.
3. Launch of Sector Reports: Knowledge reports Including SAF market readiness, blending targets, and technology pathways.
4. Showcase of Indigenous Solutions: From Indian startups, farmers, and biofuel innovators.
5. Partnership and collaboration: Between SAF developers, airlines, fuel refiners, and international players.
6. Foster innovation and R&D collaborations across public and private sectors
7. Create inclusive growth opportunities for farmers, feedstock aggregators, and green entrepreneurs

Mr. Upendra Tripathy, IAS (R)

Former Secretary, MNRE &
Founding Director General,
International Solar Alliance

"Aviation, as one of the fastest-growing sectors of our economy, is both an enabler of progress and a contributor to climate challenges. While it connects people, trade, and ideas across borders, its environmental footprint calls for urgent and sustained action. Sustainable Aviation Fuel (SAF) is globally recognized as a key pathway to decarbonize aviation and to ensure that future growth is consistent with our shared climate goals.

India has a unique opportunity to lead in this transition. With its strong renewable energy base, vast agricultural resources, and innovation-driven industries, the country is well positioned to become a hub for SAF production and adoption. Yet achieving this potential requires more than technology. It calls for capacity enhancement, skilling, regulatory clarity, and robust financing frameworks, supported by strong collaboration between the aviation and energy sectors. From farmers and feedstock suppliers to refiners, airlines, regulators, and financiers—every actor in the SAF value chain has a role to play, with the energy sector providing the backbone for scaling production and ensuring sustainability.

This report is a timely contribution towards building that ecosystem. It highlights India's SAF potential, examines the challenges of scaling up, and suggests frameworks for capacity building, skill development, and stakeholder empowerment. It also underlines the importance of awareness, innovation, and partnerships, both domestic and international. Together, these elements can help de-risk investments, unlock opportunities, and create an enabling environment where SAF can thrive. It is not only a roadmap for India but also an invitation for collective action—to ensure that aviation continues to fuel progress while embracing sustainability."

Mr. Vinod Dhaka

Director, SAF Association and Ex DG, IGL

"The path to Sustainable Aviation Fuel (SAF) is both a challenge and an opportunity. Unlike other energy transitions, aviation cannot easily switch to electrification or alternative propulsion at scale in the near future. SAF therefore becomes the most realistic and impactful solution for reducing emissions from air travel while keeping pace with the sector's growth.

India is well positioned to take this forward. With a strong renewable energy base, an expanding biofuel sector, and increasing policy momentum, the foundations are already in place. What is needed now is practical execution—developing viable business models, building robust feedstock supply chains, securing long-term financing, and ensuring regulatory and certification frameworks support market confidence.

This report rightly emphasizes capacity enhancement and stakeholder empowerment. These are not side issues—they are central to scaling SAF. Farmers, refiners, investors, airlines, and regulators each bring critical value, and only through collaboration can the SAF ecosystem achieve its potential. The co-benefits are equally important: rural job creation, higher agricultural incomes, new green industries, and enhanced energy security for India. The report provides both direction and clarity at a moment when India must accelerate from pilots and studies to large-scale SAF deployment.

With coordinated action, I am confident India can not only meet its own aviation decarbonization needs but also emerge as a global leader in sustainable fuels."

Mr. Rohit Kumar

Secretary General
SAF Association

"The Sustainable Aviation Fuel Association (SAFA) was created with a clear purpose—to serve as India's dedicated industry body for advancing aviation decarbonization. Aviation is one of the hardest-to-abate sectors, and the pathway to net zero will not be possible without a strong push for Sustainable Aviation Fuel (SAF). Our role at SAFA is to enable stakeholders at every level to be part of this transition—farmers, feedstock providers, refiners, airlines, financiers, regulators, and policymakers alike.

Our long-term vision is for India to be recognized as the premier global hub for SAF—renowned for uncompromising quality, scalable production, and leadership in Scope 3 emission reductions across hard-to-abate sectors. By integrating economic growth with environmental responsibility, India can set the global standard for SAF infrastructure and credits, while uplifting rural India, empowering farmers, and supporting the UN SDGs.

This report on Capacity Enhancement and Stakeholder Empowerment across the SAF Value Chain reflects the mission of SAFA—to establish a robust ecosystem for SAF by fostering collaboration between industry, government, academia, and civil society. It provides the knowledge, direction, and frameworks needed to accelerate SAF adoption and strengthen India's role in the global net-zero transition."

On behalf of the SAF Association, I thank CBR for their contributions to this important initiative. Together, we can ensure that India not only decarbonizes aviation but also emerges as a global leader in sustainable aviation fuel.

Executive summary

The global aviation sector is under increasing pressure to decarbonize, with international consensus converging on Sustainable Aviation Fuel (SAF) as one of the most promising near- to medium-term solution. ICAO's[1] Long-Term Aspirational Goal, IATA's[2] net-zero by 2050 pledge, and binding mandates such as the EU's ReFuelEU Aviation regulation demonstrate the urgency and collective commitment of nations to accelerate SAF adoption. Several countries, including those in Europe, Asia-Pacific, and the Middle East, have already advanced ambitious blending targets, underscoring the global momentum toward clean skies.

India has also embarked on this mission, setting indicative SAF blending mandates of 1% for international flights by 2027 and 2% by 2028 under the amended National Policy on Biofuels. The country is uniquely positioned to scale SAF production, supported by its vast low-cost feedstock potential, which includes ~230 million tonnes of agricultural residues annually, extensive ethanol production under the E20 program, and streams such as used cooking oil through the RUCO[3] initiative.[18] Alcohol-to-Jet technology is especially promising, leveraging India's existing ethanol ecosystem to supply a sustainable and cost-competitive pathway for SAF production.

Although at an early stage, India's SAF ecosystem is evolving through an initiative from refineries like IOCL[4], BPCL[5], HPCL[6] in association with industry partners such as Praj Industries. In parallel, India has proven its aviation fuel export capability, with jet fuel exports reaching up to 0.9 Mt per month to several destinations, including Europe, the Middle East, and Southeast Asia.[25] This export track record highlights India's strong refining capacity and established global supply chains, providing a platform for future SAF trade.

However, challenges to commercialization remain formidable. These include high capital intensity, feedstock uncertainties, technology risks, fragmented supply chains, limited long-term offtake agreements, financing gaps, and skill shortages. To overcome these, strengthened policy frameworks–blending mandates, offtake guarantees, carbon crediting mechanisms, tax incentives, subsidies, and viability gap funding–are essential. Such tools will be critical to de-risk investments, scale production, and accelerate adoption.

Capacity building will play a pivotal role in positioning India as a global leader in the SAF market. In collaboration with the SAF Association, CBR can implement structured programs such as training sessions, workshops, webinars, and joint learning activities to equip stakeholders across the value chain with the necessary technical, financial, and policy expertise. These initiatives will ensure that farmers, refiners, airlines, regulators, and financiers are aligned and empowered to collectively build a robust and sustainable SAF ecosystem and define the risk-sharing principles among the project partner consortia to address the bankability barriers.

This report provides a first and high-level assessment of India's SAF potential, the challenges ahead, and the frameworks required for capacity building and market scaling. With coordinated policy, investment, and institutional support, India can not only decarbonize its aviation sector but also position itself as a leading global hub for SAF production and exports.

[1] International Civil Aviation Organization
[2] International Air Transport Association
[3] Repurpose Used Cooking Oil
[4] Indian Oil Corporation Ltd.
[5] Bharat Petroleum Corporation Ltd.
[6] Hindustan Petroleum Corporation Ltd.

Introduction

India's SAF potential

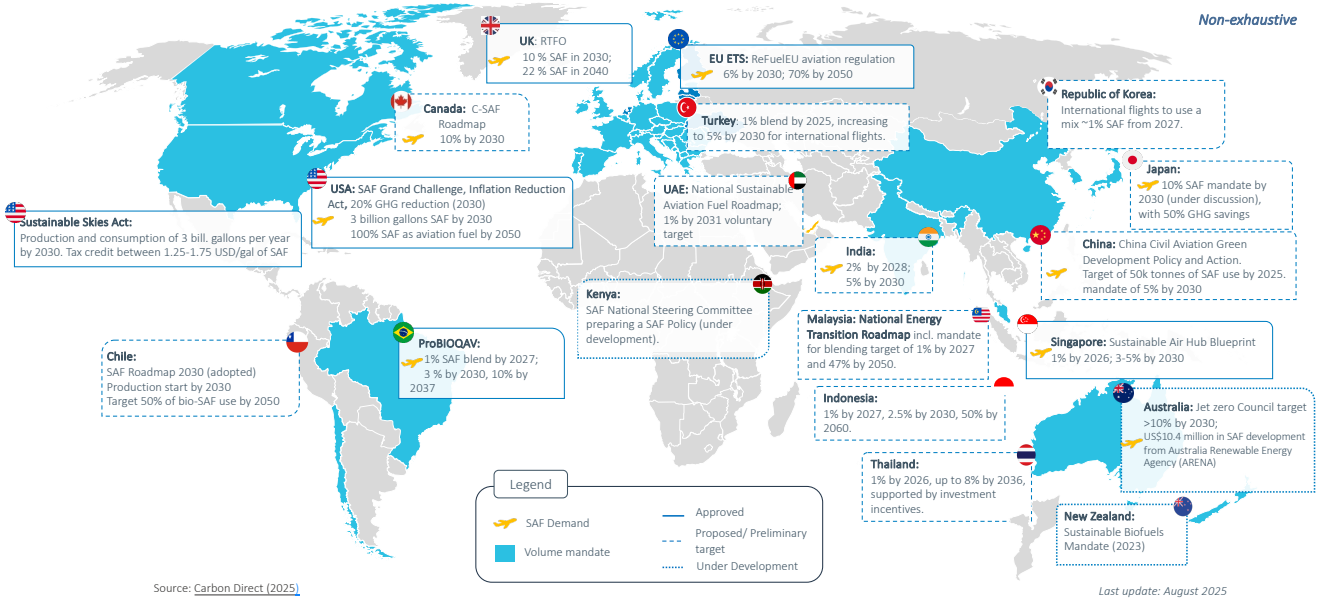
India's aviation sector has witnessed rapid expansion over the past decade, emerging as one of the fastest-growing markets globally. Between 2012 and 2019, carbon emissions from Indian carriers rose from 11.56 million tonnes (Mt) to 18.90 Mt, reflecting a steep growth trajectory in both domestic and international operations.[1] Disruptions caused by the COVID-19 pandemic led to temporary declines—domestic emissions fell to 6.02 Mt in 2020—but recovery has been swift. With forecasts by Airbus and Boeing projecting 7–9% annual passenger traffic growth and a four-fold fleet expansion by 2043, India is expected to remain the world's fastest-growing aviation market.[3,4] Without corrective measures, CO_2 emissions will continue to rise in line with traffic growth, making decarbonization a strategic imperative.

In this context, India's actions could also be viewed through the lens of global commitments: the ICAO has adopted LTAG[7] to achieve net-zero carbon emissions from international aviation by 2050, with SAF identified as the central piece of the basket of measures for decarbonization.[5,6] Aligning India's aviation growth with LTAG will therefore require rapid scaling of SAF production, policy support, and international collaboration to ensure the sector's competitiveness while advancing global climate goals.

India's current SAF production capacity is nascent but expanding, a trend which is quite common across the world. In 2025, Indian Oil Corporation's Panipat refinery became the country's first facility certified to produce SAF from UCO[8] with an expected capacity of 30,000 tonnes per year by 2026.[19] Praj Industries has established an ATJ demonstration facility in Pune [14], while other Indian refineries like BPCL and HPCL are also planning for several SAF production units across India.[17,23] Collaborations such as the IOCL–LanzaJet MoU indicate a longer-term push to scale advanced SAF pathways.[15] Based on these recent developments, India is expected to lead the global SAF market, requiring strong regulatory frameworks and awareness creation, structured financing and others.

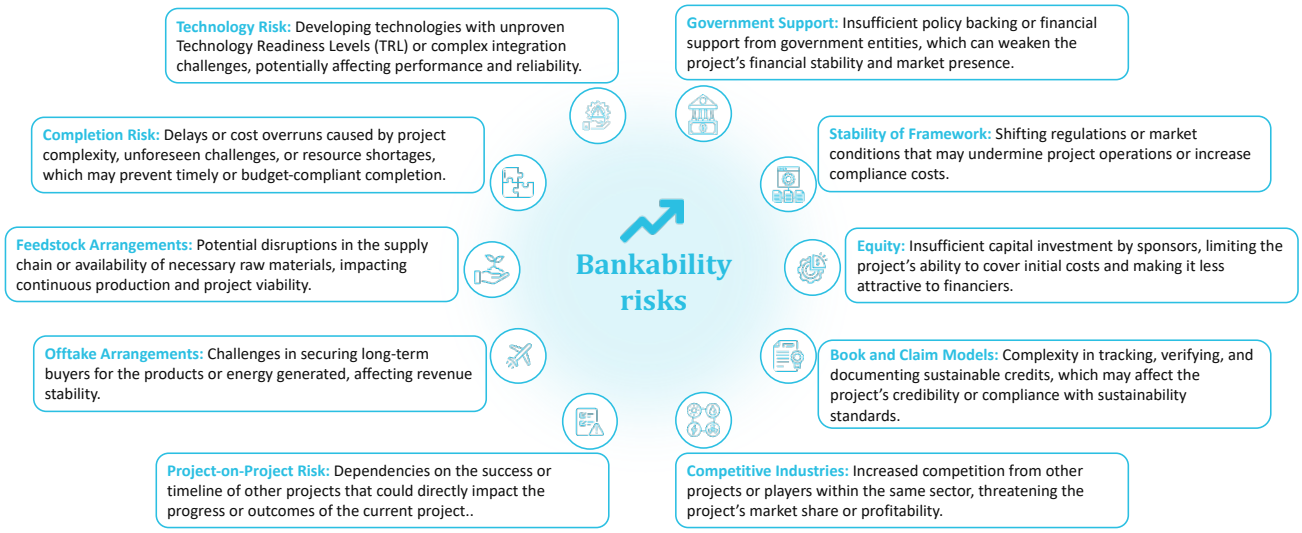
With regards to feedstock, India is boon with an immense availability of diverse feedstocks, which is an opportunity for India to emerge as global leader in SAF market by overcoming the associated challenges. India generates an estimated 230 million tonnes of agricultural residues annually, and its ethanol blending program provides a potential base for ATJ production. [18] However, logistical bottlenecks and inconsistent feedstock quality puts a constrain on its scalability. The

Global regulatory landscape



[7] Long-Term Aspirational Goals
[8] Used cooking oil

Multi-faceted risks for bankability from various directions (non-exhaustive)



RUCO initiative by FSSAI[9] has created a structured channel for UCO collection, but aggregation from small-scale vendors remains difficult, challenging the scalability of HEFA pathway.[10] Future SAF pathways, such as PtL[10] fuels, depend heavily on large-scale deployment of green hydrogen and carbon capture technologies, both of which are still in early stages of deployment in India.

On the policy front, the National Policy on Biofuels of 2018, which was amended in 2022, provides a framework for advanced biofuels and expanded feedstock eligibility.[9] The National Biofuels Coordination Committee has set indicative blending targets of 1% SAF in 2027 and 2% in 2028 for international flights. In addition, states like Uttar Pradesh have initiated draft SAF policies offering fiscal and infrastructure incentives to attract investors.[22] A well-structured national SAF policy could play a critical role to stimulate the SAF market and to attract the investments. With the ongoing development of India's national SAF policy, precise regulatory alignment with ASTM[11] standards and robust sustainability certification are essential for effective access to global markets.

Moreover, the stakeholder ecosystem is diverse, involving policymakers (MoPNG[12], MoCA[13], DGCA[14], NITI Aayog[15]), state governments authorities, fuel producers (such as IOCL, BPCL, HPCL, MRPL[16], CPCL[17], Reliance, Nayara Energy), technology providers (like Praj Industries and LanzaJet), airlines (such as Air India, IndiGo, and SpiceJet), and airports (such as Delhi, Mumbai, Hyderabad, Bengaluru, Cochin and others). There are already few states advancing in building the regional SAF ecosystem such as Uttar Pradesh, Maharashtra, and Karnataka. However, there are other states which need to identify their potential based on various assessments such as feasibility study and define their strategic goals and action plans for SAF deployment. India's membership in the Global Biofuels Alliance underscores its intent to position itself as a regional hub for sustainable fuels. Through strategic engagement and collaboration with other countries, India could emerge as a global leader of SAF suppliers.

Aligning India's SAF ecosystem development with global targets

Globally, the aviation sector has committed to ambitious decarbonization pathways. The IATA has pledged to achieve net-zero carbon emissions by 2050, while the ICAO administers the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).[5,6,7] CORSIA requires airlines to monitor, report, and offset emissions above a 2019 baseline, creating a compliance-driven demand for SAF as an eligible mitigation

[9] Food Safety and Standards Authority of India
[10] Power to Liquid
[11] American Society for Testing and Materials
[12] Ministry of Petroleum and Natural Gas
[13] Ministry of Civil Aviation India
[14] Directorate General of Civil Aviation
[15] National Institution for Transforming India
[16] Mangalore Refinery and Petrochemicals Limited
[17] Chennai Petroleum Corporation Limited

measure. The European Union's ReFuelEU Aviation regulation further accelerates SAF adoption by mandating 2% SAF blending by 2025, rising to 70% by 2050 for all the flights departing from EU. [8] In addition to that, UAE and several other Asian countries like Malaysia, Singapore, Thailand, and Indonesia have already aligned themselves on national level with strong blending targets in upcoming years.

For India, alignment with these international mandates is critical for maintaining global competitiveness. Airlines operating international routes will need access to SAF to comply with CORSIA[18], while exporters of SAF must meet stringent EU sustainability standards.

Global carbon pricing mechanisms—already in force in the EU and under discussion in Asia-Pacific—will increase the cost of conventional jet fuel. It will not only account for the true cost of carbon emissions but also ensure that it is aligned with the level of the green premium, making SAF economically more viable over time. Under the EU ETS[19], airlines must purchase allowances for CO_2 emissions, which significantly raises operating costs for fossil-based fuels.[16] Similar instruments being considered in Asia-Pacific would further tighten the cost differential. As carbon costs surge, SAF—credited with substantial lifecycle emission reductions—will become increasingly attractive, offering airlines both benefit of complying with growing international sustainability standards and long-term cost stability.

India's domestic commitments also shape its SAF trajectory. The Government of India has set a net-zero target by 2070, with SAF identified as a strategic decarbonization tool for the aviation sector. Blending targets of 1% by 2027 and 2% by 2028 are initial steps, but longer-term scenarios suggest SAF demand could reach 0.8 Mt annually by 2030 and scale to multi-million tonnes per year capacity by 2040, depending on mandate expansions.[11]

Currently, India has reached its jet fuel export potential of up to 0.9 Mt/month to several corners of the world, including Europe, Middle East, Southeast Asian countries, among others.[25] Having a robust supply chain network, with its large and low-cost feedstock base and the growing refining capacity, India could position itself as a competitive SAF exporter to markets such as Europe and Asia-Pacific, where binding mandates will create significant demand. Leveraging public–private partnerships, international technology collaborations, and financing support will be crucial to building a resilient infrastructure facility for both domestic consumption and exports.

Key challenges for SAF market ramp-up & capacity enhancement potential

The successful scale-up of SAF in India is constrained by a set of interlinked bankability challenges identified across the value chain: high capex intensity, uncertain feedstock availability, technology maturity risks, lack of long-term offtake agreements, limited policy clarity, fragmented supply chains, insufficient infrastructure, inadequate financing mechanisms, workforce skill gaps, and low stakeholder awareness. These barriers need to be meticulously identified, assessed and then accurate risk mitigation strategies need to be designed and implemented to ensure the bankability of SAF projects, and build comfort on equity and debt investor side. Addressing these barriers at an early stage is critical not only to align India's aviation sector with global decarbonization pathways but also to ensure the creation of a competitive domestic SAF industry. The following sections discuss these barriers and its relevance in much detail.

SAF project development and financing challenges

SAF projects face significant development and financing challenges due to their capital-intensive nature and the inherent risks of first-of-a-kind (FOAK) projects. Large-scale SAF plants require investments of several hundred million or sometimes up to billion dollars, with high uncertainties related to feedstock costs, technology reliability, and long-term off-take agreements. These uncertainties lead to what is often termed as "valley of death" in project financing—where concepts proven at pilot or demonstration scale fail to attract sufficient funding for commercialization. This makes investors cautious and poses significant challenges to finance such FOAK projects like SAF projects.

The Front-End Loading (FEL) approach provides a systematic project management framework to mitigate

[18] Carbon Offsetting and Reduction Scheme for International Aviation
[19] Emissions Trading System

these risks, comprising stages from prefeasibility and feasibility to detailed engineering and execution. It also assists investors in comparing the projects. However, in the nascent market, it is of prime importance to have project developers experienced in heavy-asset project management, to avoid cost overruns, delays, or scope creep. Completion risks—including plant readiness, performance yield, and compliance with emissions standards—pose further constraints to bankability, which could be strategically addressed.

A collaborative financing mechanism is essential for the successful development of SAF projects in India, given their heavy capital intensity and complex risk profile. SAF projects span multiple phases—from feasibility studies and pilot demonstrations to large-scale commercial deployment—each requiring distinct financial instruments. A diverse set of financial players, each with varying risk–return expectations, can provide tailored forms of support across these stages. For example, development banks, concessional loans, and blended finance models can help de-risk early phases, while private equity and commercial banks can play a greater role once projects reach higher levels of maturity.

One of the most critical points in the project lifecycle is the "launch to bank" stage, where robust technical validation, feasibility assessments, and structured due diligence enhance project credibility. At this juncture, commitments through long-term offtake agreements with airlines and fuel producers are vital to reassure investors and improve bankability. Equally important is the development of DSLs[20]—integrated regional supply chains linking feedstock sourcing, logistics, refining, and airport distribution. DSLs reduce project uncertainty by ensuring steady input flows and reliable market outlets.

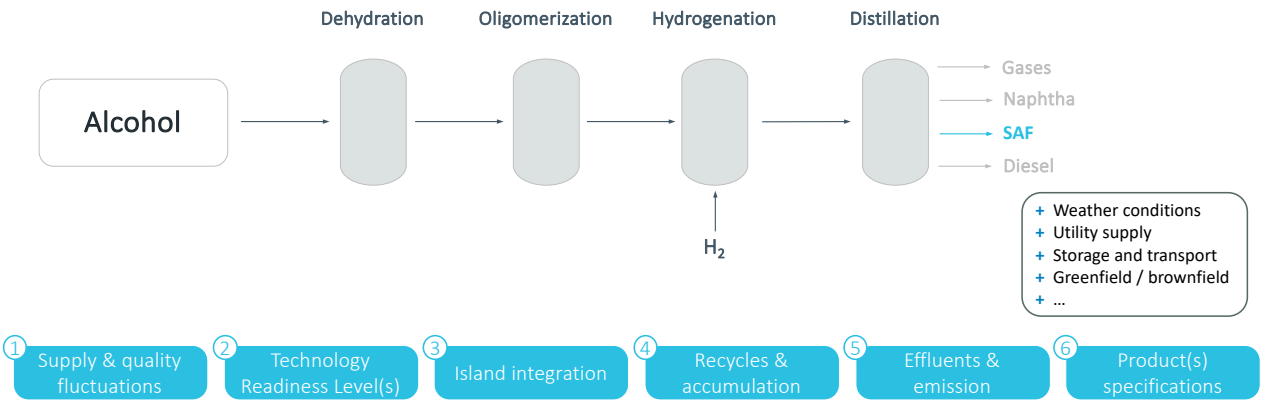
A particularly significant dimension of DSL development in India is feedstock sourcing from farmers, which must be well organized and sustainably managed. Farmers will play a pivotal role in providing agricultural residues and other bio-based inputs, making their integration into the SAF value chain essential for both environmental and socio-economic outcomes. To achieve this, broad stakeholder involvement is required, supported by awareness creation and targeted capacity-building programs. This integrated approach not only enhances the financial viability of SAF projects but also contributes to rural development and long-term energy security.

Technical risks

SAF technologies globally are at varying TRLs[21] and will be further developed. While pathways such as HEFA (TRL 9), [22] and ATJ are mature (TRL 8-9), others like PtL and FT[23] are still scaling up or in demonstration phases. These technologies, when combined with multiple process "islands" (e.g., biomass gasification, syngas

High complexity of technology islands and the associated integration risk in a SAF plant poses a multitude of technical risks which need to be carefully assessed and mitigated.

Exemplary Block Flow Diagram: Alcohol-to-Jet



A first assessment of a block flow diagram reveals potential technical risks that can be addressed early on.

[20] Direct Supply Lines
[21] Technology Readiness Levels
[22] Hydro-processed Esters and Fatty Acids
[23] Fischer-Tropsch

cleaning) or other connected processes in a single facility, create significant integration risk.

FOAK[24] projects often encounter unforeseen technical challenges—the so-called "unknown unknowns"—that derail business cases. Without representative-scale demonstrations under real conditions, risks such as catalyst deactivation, fluctuating feedstock properties, emissions variability, and product off-specification cannot be adequately addressed. These factors raise both capital and operating costs, undermining investor confidence. To ensure the bankability of the projects, systematic technical de-risking strategies such as integrating process simulations and transparent reporting will be crucial to overcome FOAK barriers and enable broader commercialization of SAF in India and beyond.

Policy and regulatory

India has taken initial steps through the National Policy on Biofuels (notified in 2018, amended in 2022) and the announcement of 1% blending of SAF for international flights by 2027 and 2% by 2028. [20, 21] However, there is requirement of comprehensive national SAF Roadmap that defines long-term blending trajectories, technology priorities, and financing mechanisms. This lack of policy certainty is a critical barrier for investors, who require visibility on demand and supply-side incentives. It is also a barrier for the offtakers, who need to evaluate and identify the most promising decarbonization solution.

Robust governing structures are needed to guide India's SAF development. A dedicated SAF Committee and TWG[25] at the national level could strengthen institutional coordination, streamline certification processes, and align domestic mandates with international schemes such as ICAO's CORSIA. Establishing a vision, mission, and action plan for SAF development could provide clarity for stakeholders while embedding SAF into India's broader net-zero by 2070 strategy.

Policy frameworks play a pivotal role as key market enablers by simultaneously driving demand and supporting supply within the SAF sector. On the demand side, mechanisms such as blending mandates, offtake guarantees, and carbon crediting encourage market uptake and create stable demand signals for SAF producers. On the supply side, targeted interventions including capital subsidies, tax incentives, and viability gap funding help reduce financial barriers, enhance production capacity, and improve the economic viability of SAF projects. Additionally, the policy should also focus on creating demand for SAF and market enabling activities, through various ways such as mandates. Beyond market stimulation, these policy initiatives also foster employment generation opportunity across the SAF value chain, estimated at around 1.1-1.4 million jobs [11], ranging from rural feedstock collection and refining to logistics and technical services, thereby contributing to broader socio-economic development and growing a green economy.

With the help of such comprehensive frameworks, India could soar in international SAF adoption trends and become eligible for opportunities in export markets where binding mandates are already in place.

Talent and skills

The transition to a SAF-based aviation sector will require significant workforce development. Jobs will be created across feedstock logistics, bio-refining operations, process engineering, certification, project finance, and environmental management. At the same time, existing workers in conventional fuel sectors may need to be reskilled or redirected. According to the IEA's report on Skills Development and Inclusivity for Clean Energy Transitions, capacity-building efforts should focus on both technical skills (e.g., chemical engineering, refinery operations) and cross-cutting competencies (e.g., project management, sustainability assessments).[13] The government and industry stakeholders should note the criticality of the capacity enhancement activities, as it plays a major role in the development and deployment of the SAF ecosystem.

Key recommendations for India include:

- Establishing a **National SAF Skills Taskforce,** involving government, industry, and academia, for SAF governance.
- Designing **industry-responsive training programs** at universities, vocational institutions, and through apprenticeships.
- Implementing **upskilling and reskilling initiatives** for existing refinery and logistics workers.
- Creating **international exchange programs** to transfer expertise from regions with more mature SAF ecosystems.

[24] First-of-a-kind

[25] Technical Working Group

In the case of India, it will be important to address these gaps through a set of India-specific activities, consisting of well-structured and targeted recommendations. Building strong skills and expertise will enable efficient operations, cost optimization, and accelerated deployment of SAF. Building human capital is therefore as critical as infrastructure or technology deployment.

Infrastructure

SAF production requires integrated infrastructure for feedstock collection, pre-processing, refining, storage, blending, and airport distribution. In India, several challenges persist:

- **Feedstock collection**: Agricultural residues and used cooking oil are widely dispersed and often informally managed, leading to inconsistencies in supply and quality.
- **Pre-processing hubs**: Reliable pre-treatment facilities are needed to standardize feedstock before conversion.
- **Project-on-project risk**: SAF projects often depend on parallel developments in hydrogen, carbon capture, or power infrastructure, which may delay timelines.
- **Strategic blending facilities**: India's refineries might need a dedicated blending and storage infrastructure for SAF, providing requirements towards the integration into the existing jet fuel supply chain.[12]

Developing regional Direct Supply Lines—covering feedstock procurement, conversion, logistics, and airport fuelling—can minimize risks and build resilience. Investments in multimodal logistics, storage solutions, and green hydrogen hubs will be essential to underpin India's SAF ramp-up.

Creating awareness

Awareness and stakeholder alignment are often underestimated but are crucial for successful SAF deployment. Projects require strong buy-in not only from airlines and refiners but also from local municipalities, environmental agencies, and communities. Ensuring smooth permitting processes, addressing environmental concerns, and communicating benefits transparently are critical success factors.

Some of the key awareness-building activities includes:

- Mapping and establishing **strong connection with stakeholder** across the SAF value chain.
- Establishing **university collaborations** to develop young talent.
- Developing **documentation, reporting, and dissemination frameworks** to share lessons learned and build credibility.
- Strengthening **public relations campaigns** to highlight the economic, environmental, and social benefits of SAF adoption.

A collaborative approach involving government, industry, academia, and civil society will help build trust and momentum, while ensuring that SAF projects are aligned with broader sustainability and community goals.

Suggested frameworks for capacity building activities in India

Skill development roadmap

Building a robust skill base is essential for the growth of India's SAF ecosystem. A national skill development roadmap should address the entire SAF value chain, ensuring that expertise is built not only in technical domains but also in global regulatory and standards, financial, and managerial aspects.

At the technical level, dedicated training programs and series of webinars could be organized to cover modules on SAF production pathways, feedstock handling, fuel upgrading, and integration with existing refining assets for the promising pathways. Specialized training in SAF certification (ASTM pathways, sustainability verification, and Book & Claim systems) will be critical to align India's SAF production with internationally recognized standards. Similarly, structured programs on SAF supply chain management could focus on developing SAF Direct Supply Line, including feedstock aggregation, pre-processing, SAF production, storage, blending, and airport logistics.

Beyond technology, project financing and bankability assessment requires capacity-building for project developers, financiers, and public officials. Training in structuring business cases, risk mitigation strategies to attain FID, and blended financing models will assist in overcoming the challenges of "valley of death", such as financial constraints and cashflow issues, that many SAF projects face. Parallel to this, guidance in policy design and regulatory frameworks can not only smoothen the adaption of SAF in India aviation sector but also strengthen state-level energy and civil aviation

departments, enabling them to support national blending targets.

State-specific skill-building is equally important. States with abundant agricultural residues, should organize focused training on feedstock logistics, SAF policy establishment. Whereas states having refining hubs must prioritize project development and management skills. Awareness and roadmap design activities–conducted through regional workshops and university collaborations–could ensure localized strategies align with the national SAF vision. By sharing goals and ambitions, multiple states could also potentially collaborate to strategically develop the roadmap. This approach could minimize the project risks and foster the development of SAF ecosystem to meet national SAF demand.

Research & innovation support

Innovation should underpin India's SAF roadmap. Government-supported research clusters at leading institutes such as premium universities, CSIR[26] laboratories in association with industrial technology developers should focus on further process optimization, feedstock diversification, and advanced catalytic technologies. Public funding and competitive grants can incentivize early-stage R&D, particularly in power-to-liquid fuels and carbon capture integration. Dedicated SAF innovation hubs could serve as platforms for pilot-scale testing, reducing technical risk and supporting the transition from laboratory to market deployment, including laboratory research, pilot scale project, demonstration project, pre-commercial scale and commercial scale project. Partnerships with international research networks will accelerate knowledge transfer and improve India's positioning in global SAF innovation.

Besides technological innovations, India's SAF ecosystem has its unique set of challenges and demand for an innovative approach to develop an India specific national SAF roadmap. It could be developed through an inspiration from proven roadmaps and an adequate methodology to design them. For the same, the relevant stakeholders of India should be well equipped with the relevant skills and concepts through the capacity building activities.

De-risking through industry engagement

Active industry engagement is essential for building market confidence and creating investment-ready SAF projects – it would be an essential approach in designing a risk sharing principles and structuring the project partner consortium, contracts, etc. Establishing project partner consortia at national, international and state levels can bring together airlines, fuel producers, technology providers, and financiers under coordinated platforms. Ministries such as MoPNG, MoCA, and MNRE as well as DGCA should facilitate structured dialogues, ensuring cross-sectoral integration. Industry associations (e.g., SAF Association, IATA, ICAO and others) can host multi-stakeholder (e.g., technology providers, certification bodies, project developers) forums, while state-level chambers of commerce can provide localized engagement. These mechanisms will help align off-take agreements, clarify technology choices, and harmonize regulatory priorities. Creating such dialogue platforms will reduce transaction costs, foster transparency, and strengthen collaboration across the SAF value chain.

Unlocking investments through public–private partnerships

Scaling SAF deployment requires strong public–private partnerships (PPPs) to pool resources, share risks, and build large-scale infrastructure. PPPs have proven to be powerful instruments in advancing new technologies—from renewable energy to digital infrastructure—by aligning public policy support with private sector innovation and investment. Governments could support with land access, incentives programs, while private partners bring in technology, project execution capabilities, and market access through airlines. PPP frameworks should also encourage inter-state collaboration models that match feedstock-rich states with refining hubs and major airports. This will help establish DSLs, streamline logistics, and ensure reliable supply chains. Structured PPPs can also mobilize international climate finance, support joint ventures with global SAF leaders, and accelerate deployment by curating exchanges between stakeholders. Ultimately, PPP models will be pivotal in building a bankable SAF ecosystem that meets both domestic targets and export ambitions.

[26] Council of Scientific and Industrial Research

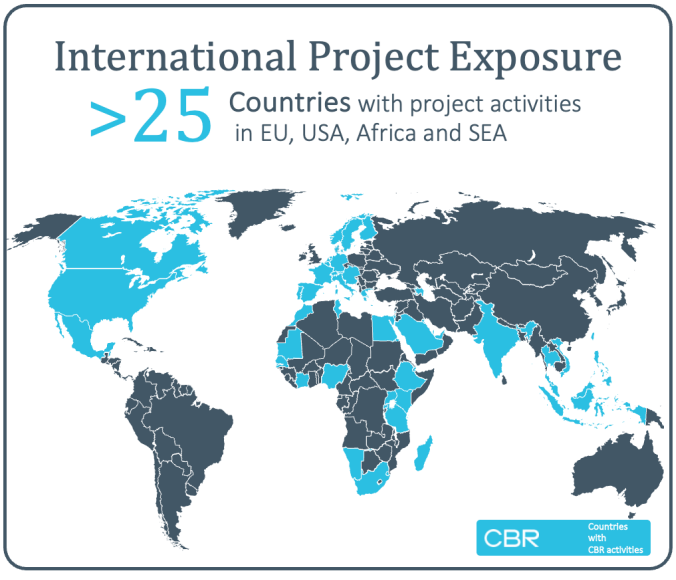
CBR Sustainability Partners

CBR Sustainability Partners is a specialized advisory firm positioned at the intersection of regulation, technology, and industry experience—the three pillars that form its foundation. Through its regulatory expertise, CBR supports clients in navigating complex international frameworks such as ICAO's CORSIA, EU mandates, and national biofuel policies, ensuring compliance while enabling access to global markets. The technology pillar focuses on assessing, validating, and accelerating advanced fuel and decarbonization technologies, ranging from Alcohol-to-Jet and Fischer–Tropsch pathways to emerging Power-to-Liquid solutions. The third pillar, industry experience, builds on deep engagement with the aviation, fuels, and infrastructure sectors, allowing CBR to translate technical and policy insights into actionable business strategies.

In the SAF business, CBR has developed strong capabilities in bridging gaps between stakeholders across the value chain. The firm advises on SAF project development, from feedstock assessments and techno-economic analysis to structuring bankable business models and facilitating financing. CBR also supports airlines, refiners, and technology developers in identifying pathways to meet blending mandates, align with global decarbonization targets, and establish long-term offtake strategies.

CBR's expertise is underpinned by a project portfolio that spans feasibility studies, strategy development, and technology scouting for clients in both established and emerging markets. The firm has been actively involved in capacity building activities, including workshops, training sessions, and webinars across several African and Asian countries, bringing together several relevant stakeholders, such as government officials, airlines, and technology and feedstock providers to set a structured roadmap for market development.

CBR also brings significant experience in working with civil aviation authorities, airport authorities, domestic and international airlines, and OEMs[27] such as Airbus, and engaged into crucial national activities, such as drafting SAF national roadmaps. This exposure allows CBR to connect global best practices with local needs, fostering cross-border collaboration and ensuring that SAF deployment strategies are technically sound, financially viable, and aligned with long-term climate objectives. By combining regulatory insight, technological expertise, and extensive industry experience, CBR positions itself as a trusted partner in accelerating SAF ecosystem development and supporting the broader aviation sector in its transition to a sustainable future.



[27] Original Equipment Manufacturer

CBR Service Portfolio: Covering the entire technical project life cycle

Collaboration of CBR and SAF Association led India's SAF ecosystem development

The collaboration between CBR and the SAF Association represents a cornerstone in advancing India's SAF ecosystem. By combining CBR's regulatory, technical, industry expertise and SAF knowledge base with the SAF Association's multi-stakeholder network, this partnership creates a powerful platform to accelerate market development. Together, they are positioned to design training programs, facilitate stakeholder dialogues, and provide strategic advisory support that aligns India's SAF initiatives with international standards and mandates. This joint effort not only strengthens India's domestic capacity but also enhances its prospects as a regional hub for SAF production and exports, ensuring that stakeholders across the aviation value chain are equipped with the skills, resources, and policy frameworks necessary for long-term success.

SAF training programs, webinars, and workshops for key stakeholders

A critical enabler of SAF deployment is the development of knowledge and skills across the value chain. SAF Association and CBR can jointly design and organize region specific SAF training programs, workshops, webinar series, while the joint learning programs are tailored to airlines, airport authorities, fuel producers, policymakers, feedstock providers, aggregators, project developers, technology providers and financial institutions. In addition, the activities are tailored and organized in the best possible way, based on stakeholder requirements and feedback. These programs are structured in a thematic playbook, which covers various SAF related key themes, such as SAF production pathways and technologies, certification standards, DSL concept, business case development, policies and roadmaps, financing strategies, and international market compliance requirements. By equipping stakeholders with technical and managerial know-how, these initiatives will build the foundation for a robust SAF ecosystem in India.

Liaison with national and international delegations for SAF exports

India has the potential to become a regional hub for SAF exports, leveraging its large feedstock base and growing refining capabilities. CBR, in collaboration with SAF Association, can facilitate coordination between national institutions and international delegations, ensuring that Indian SAF producers meet internationally recognized sustainability certification standards required in export markets such as the EU and Asia-Pacific or alternatively develop a robust domestic certification system aligned with global requirements. This role includes aligning domestic production with global mandates, harmonizing certification processes,

Formats and activity themes for effective partner knowledge sharing

1. Stakeholder mapping • Identification of all relevant stakeholders within the national SAF value chain, stakeholder activation and onboarding	**2. SAF readiness evaluation** • Evaluation of key dimensions influencing SAF production readiness, incl. feedstocks, technological capabilities, policies, market dynamics, etc.	**3. SAF capacity building: Workshops** • Support at country and state level by co-organizing SAF conferences/workshops and/or taking part in SAF related conferences
4. SAF capacity building: Webinars • Capacity building support at country and regional level by providing online webinars about key topics of SAF	**5. SAF Taskforce and TWGs setup** • SAF vision & mission 2030 & beyond, strategic agenda, strategic goals, action plan, project management, timeline, resource planning, etc.	**6. National SAF roadmap support** • Elaboration of national and/or continental SAF roadmaps including setting targets, identifying concrete actions, investments, and priorities
7. Direct supply line scenarios • Technical, commercial and organization support in the establishment of a direct supply line scenarios creating investable SAF projects	**8. Feedstock potential analysis** • Analysis and recommendation on feedstock availability, economics and activation matched with SAF conversion pathways to create informed position	**9. SAF technology adoption study** • State-of-the-art technology options to produce SAF, reflecting the national/regional context and recommendations on technology adoption focus
10. SAF policy and regulation workshop • Existing regulatory schemes and policies, SAF policies & options and the discussion of a structured approach to SAF policies	**11. Mapping of status/action planning** • Keeping the SAF status and action matrices updated as an orchestrated PMO approach of the individual Technical Working Groups	**12. SAF state profiles** • Elaboration of SAF specific state profile covering various dimensions related to the status of the state specific SAF value chain

and creating diplomatic channels that promote market access.

Provide policy advisory support to government bodies

Effective policy and regulatory frameworks are essential to address India-specific challenges and boost the SAF market scale up. SAF Association and CBR could provide policy advisory services to ministries and state governments, drawing on global best practices and proven methodologies. Support would include drafting blending mandates, defining SAF roadmaps, recommending incentive schemes, and creating mechanisms for demand aggregation. This support will help governments create a stable policy environment that fosters investor confidence and accelerates SAF deployment.

Assist in SAF project development from pre-FID stage

SAF projects require intensive preparation during the pre-FID[28] stage, including feasibility studies, risk assessments, financial modelling, stakeholder consultations, preparation of due diligence documents, etc. SAF Association and CBR can support developers by providing expertise in project structuring, technology selection, and due diligence, thereby defining the mitigation strategies of bankability risks. This approach ensures projects are technically sound, financially viable, and aligned with regulatory requirements before reaching investment milestones.

Develop SAF business models supporting agriculture and rural development

Farmers will play a pivotal role in shaping India's SAF ecosystem. Integrating the agricultural sector into the country's energy transition will be essential, driving sustainable growth while strengthening India's green economy. By designing business models that link feedstock collection from farmers with refinery operations, SAF projects can generate new income streams in rural areas while enhancing waste valorisation. SAF Association and CBR can facilitate farmer cooperatives, create sustainable supply chain linkages, and promote rural employment, ensuring that SAF deployment also contributes to inclusive development and energy security.

[28] pre-Final Investment Decision

Identify and engage financiers or lenders for SAF projects

Mobilizing finance remains one of the greatest challenges for SAF. SAF Association and CBR can play a pivotal role in identifying suitable financiers and lenders, including development banks, climate funds, and private investors. By enhancing project bankability through due diligence support and risk mitigation frameworks, they can attract capital into SAF projects and establish long-term financing models. This role also includes facilitating PPPs to de-risk investments and builds confidence across the financial sector.

Conclusion

India has committed to achieving net-zero emissions by 2070, with SAF recognized as a key pathway to decarbonize the aviation sector. The government has set initial blending mandates of 1% for international flights by 2027 and 2% by 2028, supported by the National Policy on Biofuels. While these targets mark important early steps, a comprehensive roadmap for scaling SAF production and deployment remains essential to translate ambition into actionable outcomes.

High capital intensity, technology risks, and feedstock uncertainties limit project bankability and project scale up, demanding robust risk mitigation strategies such as PPP and long-term financing models. The agriculture sector is a backbone of India's economy; it can support – with its vast biomass availability – the development of SAF ecosystems. If effectively harnessed, it offers a reliable and cost-competitive feedstock base, supporting both domestic consumption and export competitiveness of SAF.

Given the extensive preparation required at the pre-FID stage of project development, including feasibility studies, risk assessments, financial modelling, and stakeholder engagement, specialized institutional support is vital. Organizations such as the SAF Association and CBR can support all the stakeholders with capacity building activities, project structuring, technology selection assessments, and due diligence support, ensuring that SAF projects are technically sound, financially viable, and aligned with regulatory requirements before reaching investment milestones.

India can unlock the full potential of SAF through coordinated efforts toward designing essential policy framework, financing mechanism, and through institutional support. India can advance its decarbonization goals and position itself as a global leader in sustainable aviation.

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Report Summary

The global aviation sector faces mounting pressure to decarbonize, with Sustainable Aviation Fuel (SAF) emerging as the most viable near- to medium-term solution. Nations worldwide are advancing ambitious SAF targets, and India has joined this momentum with blending mandates of 1% by 2027 and 2% by 2028. Supported by abundant feedstock, strong refining capacity, and proven export networks, India holds significant potential to lead in SAF. However, challenges such as financing, supply chains, and skills gaps remain, requiring coordinated policy, investment, and capacity building.

The collaboration between CBR and the SAF Association will assist in developing India's SAF ecosystem by combining regulatory expertise, technical support, and multi-stakeholder engagement. The collaboration will design region or stakeholder-specific training programs, workshops, and webinars for airlines, fuel producers, policymakers, financiers, and feedstock providers such as farmers, ensuring strengthened capacity across the SAF value chain. The partnership will also facilitate SAF exports by aligning with global certification standards, liaison with international stakeholders, advise government bodies on policies and incentives, and support project developers with due diligence and overcoming the financing bottlenecks. Development of SAF ecosystem will foster rural development, boost the green economy, enhance the bankability of SAF projects, and position India as a global SAF leader.

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