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Skybound sustainability: Indiaâ??s race to become SAF hub of Global South

15 October 2025 | News

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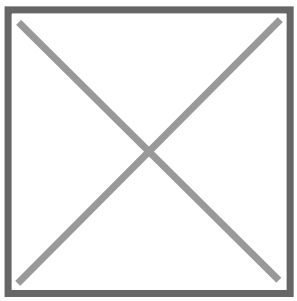
Aviation is global yet carbon-bound. Planes still rely on liquid hydrocarbons; electrification is limited, hydrogen is years away, and Sustainable Aviation Fuel (SAF) is the only immediate lever to cut emissions in a sector responsible for 2â??3 per cent of global COâ??.

â??The trajectory of SAF is nothing short of extraordinaryâ??expanding from a nascent 5 million gallons in 2021 to 24.5 million gallons in 2023, a CAGR exceeding 100 per cent. Yet this still accounts for less than 0.1 per cent of global jet fuel demand, underscoring both the scale of the challenge and the immensity of the opportunity â??â??, mentioned Dr. Nripanka Das, Author, Sustainability & Carbon Markets. â??The Sustainable Aviation Fuel Grand Challenge, announced in 2021, has set audacious targets of 3 billion gallons by 2030 and 35 billion gallons by 2050, requiring unprecedented scaling of production capacity and technological deployment. Pathways such as Fischerâ??Tropsch, approved by ASTM in 2009, already demonstrate how woody biomass, municipal solid waste, and agricultural residues can be transformed into jet fuel virtually indistinguishable from conventional Jet A. In this lies the promise of scaling an industry that not only meets aviationâ??s exacting standards but also redefines waste as the feedstock of the skies ,â?• he opined.

In 2024, SAF supplied under 1 per cent of demand, leaving the Global South exposed. Fast-growing airlines in India, ASEAN, and Africa face minimal local supply, giving India a strategic opening.

â??In 2025, real progress in SAF isnâ??t measured by headlines but by bankable projectsâ??those reaching final investment decision, securing long-term offtakes with price floors or contracts for difference, and moving into genuine EPC mobilization. Success is also measured in carbon intensity as much as in gallons produced, with lowering lifecycle emissions now as critical as expanding capacity,â?• stated Dr Jennifer Holmgren, CEO, LanzaTech.

â??In Washington, the vaunted â??One Big Beautiful Billâ?? has compressed SAFâ??s erstwhile premium of $1.75 per gallon to a modest $1.00 under 45Z, ostensibly levelling the fiscal playing field with ethanol, but in reality propelling capital to cheaper road-fuel pathways such as renewable diesel. India, by contrast, has wisely eschewed the per-gallon palliatives of subsidies in favour of mandated momentum: a 1 per cent SAF blend in international flights by 2027, 2 per cent in 2028 under CORSIA, and an aspirational trajectory toward 5 per cent thereafter. Augmented by state-level incentivesâ??capital subsidies, land concessions, and tax reimbursementsâ??New Delhi is not merely nudging an industry, it is summoning it inexorably forward, guaranteeing a market, and inscribing Indiaâ??s aviation future in cleaner, greener, and more resilient hues,â??â?? she added.



" The American model bets on the market rewarding low-carbon fuels without playing favorites; the Indian model assumes SAF wonâ??t take off without a legal runway.

The strategic takeaway is clear: in the U.S., the winners will treat thinner credits as a design constraint, focusing on relentless carbon intensity reduction, locking in ironclad offtakes, and securing feedstock certainty. In India, success will hinge on executing the mandate-to-manufacturing flywheelâ??leveraging guaranteed demand, building robust domestic supply chains, and maintaining strict capex discipline. In both markets, SAF will only scale at pace where policy certainty aligns with the discipline of bankable project finance "

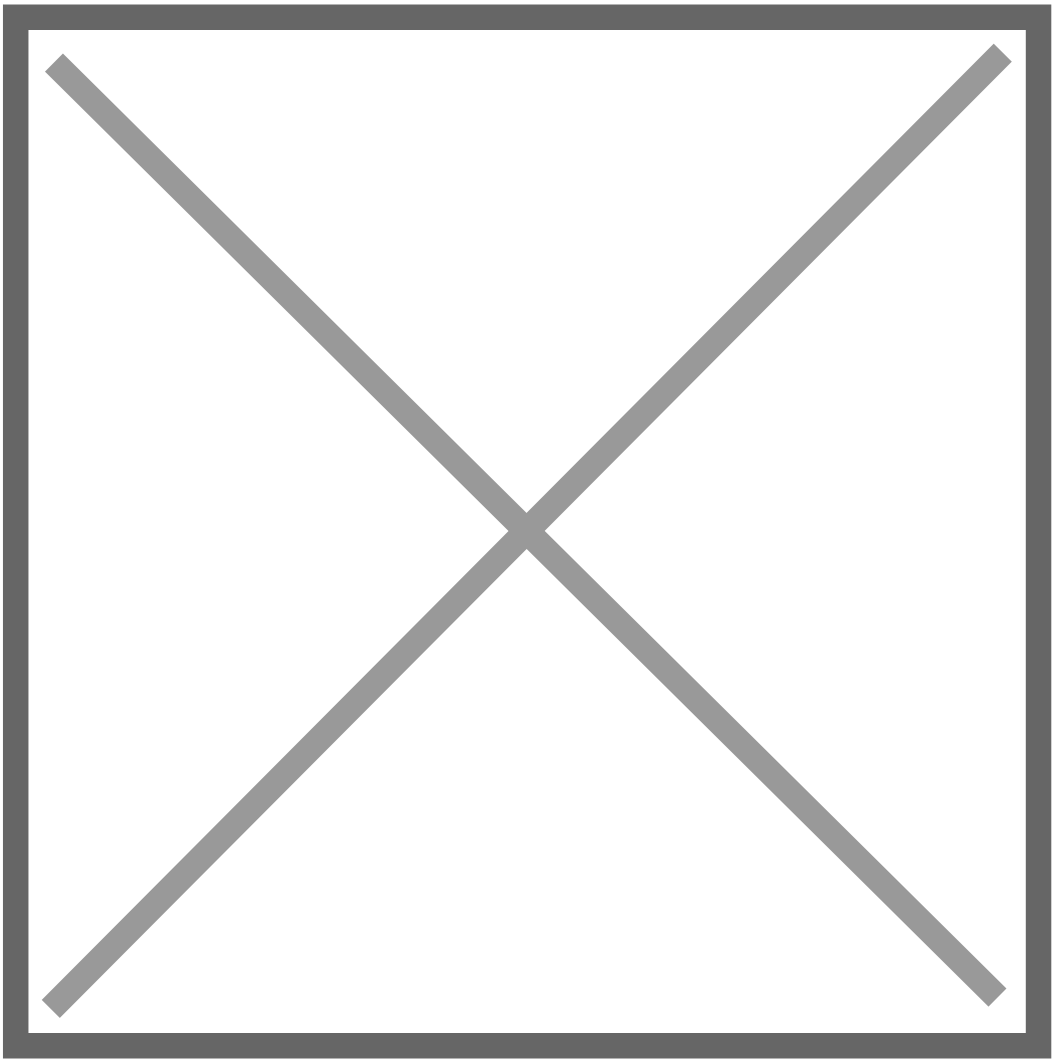
-------- Dr Jennifer Holmgren, CEO, LanzaTech

Indiaâ??s aviation sector, ferrying 240 million passengers in 2024 and poised to double by 2030, stands at a pivotal inflection point. Fuel demand is projected to soar from 16 million tonnes in 2030 to 31 million by 2040. Enter Sustainable Aviation Fuel (SAF): capable of slashing lifecycle emissions by up to 80 per cent, India could produce 8â??10 million tonnes annually by 2040â??surpassing domestic demand, catalyzing 1.4 million green jobs, and opening export avenues. Already, 88 airports operate on green energy, with Bengaluru, Delhi, Mumbai, and Hyderabad setting carbon-neutral benchmarks of global significance.

IOC is spearheading commercial SAF production at Panipat, with ISCC CORSIA certification. An initial 35,000-tonne annual output, sourced from used cooking oil from hotels, restaurants, and food manufacturers like Haldiramâ??s, will satisfy Indiaâ??s 1 per cent international blending mandate. Alcohol-to-jet pathways and export prospects, initially targeting European carriers, are also under exploration.

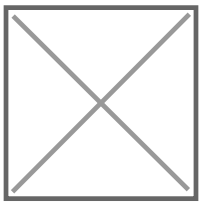
With blending mandates proliferating across Indonesia, Mexico, Canada, Europe, and Africa, and with low-carbon ethanol prospects beckoning in the United States, Praj finds itself at the cusp of a transformative expansionâ??broadening its portfolio in CBG, SAF, and ETCA while simultaneously amplifying the international dimension of its enterprise. Aircraft readiness is assured: Airbus confirms all planes can operate on a 50 per cent SAF blend, and Indian carriers have successfully executed demonstration flights. India is positioning itself not merely as a consumer, but as the SAF fulcrum of the Global Southâ??where policy, pilots, and production converge to chart a sustainable, high-flying future.

Indiaâ??s Feedstock Opportunity: A Diverse Ecosystem



Indiaâ??s edge in the sustainable aviation fuel (SAF) race lies in its abundant and diverse biomass, not subsidies. Unlike nations constrained by monocultures or geography, India can channel agricultural residues, industrial by-products, urban waste, and renewable energy into multiple SAF pathwaysâ??positioning itself as both a domestic and export hub. In words of Dr. Pramod Chaudhari, Chairman Praj Group, â??*India is uniquely positioned to become the hub for SAF in the Global South. Its strategic location in the Asiaâ??Pacific, with strong air connectivity to Africa, the Middle East, and Southeast Asia, makes it*

a natural node for SAF supply and distribution. The Ethanol Blending Programme, scaled from modest beginnings to 20 per cent, demonstrates Indiaâ??s ability to mobilise feedstock, implement policy, and drive impact at scaleâ??delivering foreign exchange savings and strengthening rural economies. The foundation is further strengthened by Indiaâ??s unmatched feedstock diversity. Agricultural residues and sugarcane by-products offer abundant raw material streams for SAF production.â?•

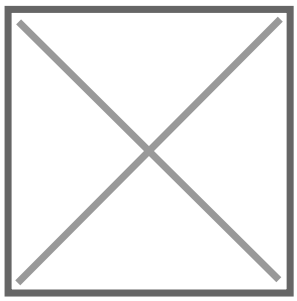


" *PrajÂ has established several Centers of Excellence in collaboration with leading research institutes, working across the entire biofuels value chainâ??right from feedstock and technology development to end-product and application development. At the heart of this ecosystem isÂ PrajÂ Matrix, our state-of-the-art R&D center, which serves as the innovation hub for developing and commercialising cutting-edge technologies for biofuels and SAF. This strong integration of research, policy, and industry not only accelerates breakthroughs but also reinforces Indiaâ??s credentials as a frontrunner in the global SAF journey*"

--- Dr. Pramod Chaudhari, Chairman, Praj Group

Agricultural residues are the cornerstone. India generates 230â??250 million tonnes annually, including rice straw, maize stalks, and sugarcane bagasse, much of which is wasted or burned. Rice straw alone contributes 80â??85 million tonnes of emissions in northern states. Redirecting even 15â??20 per cent into SAF via gasification, Fischer-Tropsch synthesis, or cellulosic ethanol-to-jet could anchor a domestic industry while tackling severe winter air pollution.â??*SAF can be blended at different levels with limits between 10 per cent and 50 per cent, depending on the feedstock and how the fuel is produced. According to the International Civil Aviation Organization (ICAO), over 360,000 commercial flights have used SAF at 46 different airports largely concentrated in the United States and Europe. An estimated 1 billion dry tons of biomass can be collected sustainably each year in the United States, enough to produce 50â??60 billion gallons of low-carbon biofuels, â?• stated Dr. Marcus Griswold, Founder at Little Green Myths. â??*

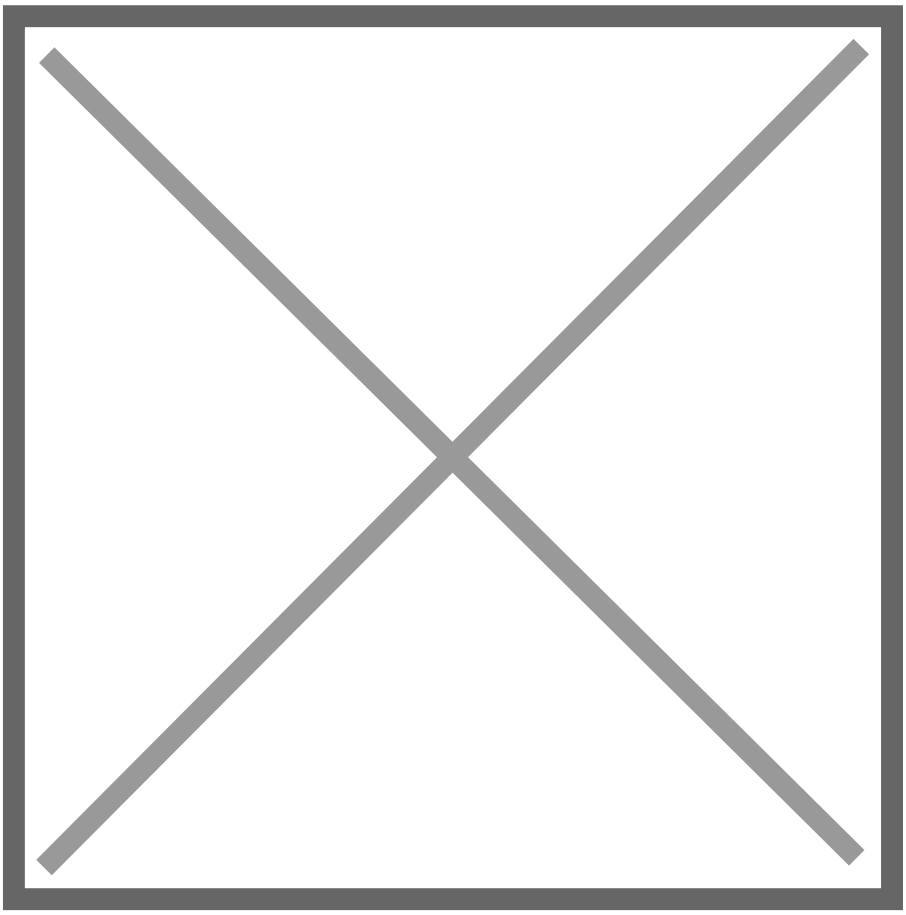
Ethanol is another pillar. Indiaâ??s fuel-blending programme has built over 5 billion litres of annual capacity, spanning 1G molasses and emerging 2G cellulosic plants. Existing infrastructure can pivot to alcohol-to-jet (ATJ) production, with Praj Industries piloting scalable ATJ technology alongside global partners.



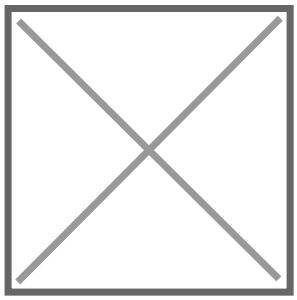
" Feedstock costs represent the largest component of biofuel production costs, typically accounting for 40-60 per cent of total production expenses depending on conversion pathway and feedstock type. Wood residues and sawmill by-products currently cost $40-80 per dry ton delivered to conversion facilities, while dedicated energy crops may cost $60-120 per dry ton depending on production systems and transportation distances. These feedstock costs translate to $0.80-2.40 per gallon of biofuel production cost, indicating the critical importance of feedstock procurement strategies and supply chain optimization for overall project economics"

--- Dr. Nripanka Das, Author, Sustainability & Carbon Markets

â??Ethanol is no longer confined to being a road-fuel blend; itâ??s a low-cost, versatile building block for an extraordinary range of products, from sustainable aviation fuel via alcohol-to-jet (ATJ) technology to textiles, cleaning agents, and everyday household goods. With advances in carbon capture and utilization (CCU), we can now make ethanol from industrial emissions, municipal waste, and even biogenic COâ??, turning liabilities into valuable feedstock. The result is a molecule that sits at the crossroads of decarbonization and circular economy. This is ethanolâ??s reinvention story: from a single-purpose fuel additive to a platform chemical powering the next wave of sustainable manufacturing ,â??â?? mentioned Dr. Holmgren.



Niche feedstocks and urban waste further broaden the portfolio. Used cooking oil (1.4â??1.5 million tonnes/year) feeds HEFA pathways, while municipal solid waste (62 million tonnes/year, 30 per cent treated) can support gasification-FT SAF routes, aligning aviation decarbonisation with Swachh Bharat and Smart Cities initiatives. *â??Airlines are betting billions and billions on jet fuel made from yesterdayâ??s French friesâ??but can cooking oil really power the future of aviation? SAF made from used cooking oil can cut emissions by up to 80 per cent compared to regular jet fuel, but right now they account for only about 1 per cent of the worldâ??s jet fuel supply. Itâ??s also important to remember that not all SAF is created equalâ??some are made from food crops that can raise other environmental concerns, while waste oils like used cooking oil are among the most effective and sustainable sources ,â??â?? advocated Justin Goldsberry; CEO and Founder of Goldsberry Management Group, LLC.*



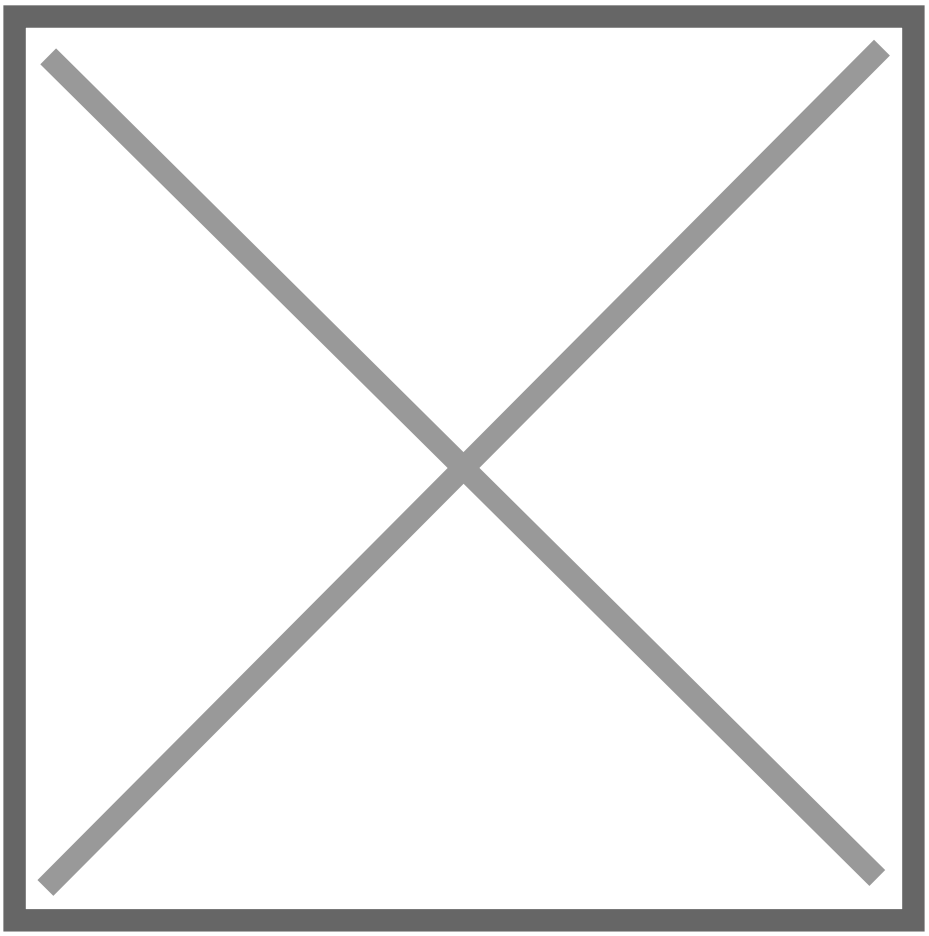
" We are on the cusp of new scaling for sustainable aviation fuel (SAF) in both the United States and India. But unlike solar and wind energy, renewable fuels carry a significant premium vs conventional fuels. Covering SAFâ??s cost above conventional jet fuel is a key factor to grow the sector. There must be a way to cover both the infrastructure capital investments and the ongoing operational costs of producing SAF.

In the recent past, the U.S. Department of Energy Loan Office oversaw a loan program that offered funding for SAF refineries at favorable rates. Today there are no government programs to provide low-cost debt. The U.S. still offers incentives to cover operations in the form of credits for agricultural products (the renewable fuel standard â?? RFS) and for producers combining the product with fossil-based fuel (the blenders tax credit, and 45Z clean fuel production credit). Individual states are also providing incentives for regional consumption such as California and Illinois. There is no U.S. SAF mandate"

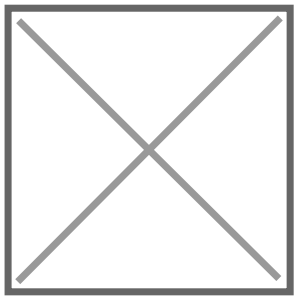
---- Adam Klauber, Vice President Sustainability and Digital Supply Chain, World Energy

Looking ahead, cheap green hydrogen and captured COâ?? enable a Power-to-Liquids future. Indiaâ??s record-low solar tariffs ($0.025/kWh) and $2.4 billion Green Hydrogen Mission create early positioning for synthetic SAF, potentially a decade from commercial scale.

In the words of Suzanne McKenzie, Sales Director, Lifecycle Oils, UK, â?? The sustainability credentials of SAF depend heavily on what it is made from. Second-generation biofuels (derived from waste like UCO) offer substantial environmental advantages over first-generation biofuels made from virgin crops such as palm oil or rapeseed oil. First-generation biofuels are controversial from a sustainability perspective because they can compete with products that would end up in the food chain. This can drive up prices and expand agricultural land use. â??



Suzanne further opined that considering the growing biofuel feedstock crops to be carbon-intensive, and is associated with deforestation, land conversion, biodiversity loss, and high water consumption. - repurposing a waste stream like UCO, could Â completely sidestep the significant carbon emissions associated with agricultural production and land-use change. UCO-derived biofuels can slash lifecycle carbon footprints by an estimated 80 per centÂ when benchmarked against conventional fuels, and 40 per cent when compared to first- generation biofuels. She further highlights the pressure to decarbonise aviation is translating directly into binding SAF mandates and targets worldwide, which is driving a substantial increase in demand for the fuel. â??*The UK mandate legally requires a 2 per cent blend of SAF in all jet fuel from 2025, rising to 10 per cent by 2030. Similarly, the EU's ReFuelEU Aviation regulation starts at a 2 per cent minimum blend in 2025 and increases to 6 per cent by 2030â?•, she opined.*



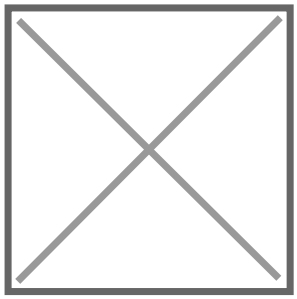
"Across the Asia-Pacific region, we're also seeing strong policy signals and emerging targets on SAF. Japan is exploring a 10 per cent SAF share by 2030 for departing flights, and Singapore is introducing a 1 per cent SAF target for 2026, which could rise to 3-5 per cent by 2030. South Korea and India are both considering a 1 per cent target for 2027. The trend is clear â?? countries worldwide see SAF as the best way to cut aviation emissions in the mid-term.

Meeting this demand will require significant scaling of SAF production â?? and demand is already outstripping supply. Current forecasts predict that by 2030, global demand for SAF will be around 15 million Mt, and by 2035, this looks set to reach 40 million Mt. In 2024, global SAF production was around 1 million Mt, with current predictions suggesting global capacity will only grow to around 18 million Mt by 2035. "

--- Suzanne McKenzie, Sales Director, Lifecycle Oils, UK

â??Venturing into Sustainable Aviation Fuel is not just about aligning India with the global targets under the Carbon Offsetting and Reduction Scheme for International Aviation; it is about leading from the front,â??â?? mentioned Vijay Nirani, Managing Director, TruAlt Bioenergy. â??Unlike countries such as Singapore or the UAE, where access to agricultural land is limited, Indiaâ??s natural strengths in terms of vast agricultural base, give us the chance to turn this challenge into a defining advantage for our industry as well as environment,â??â?? he added.

Compared with peersâ??Brazilâ??s sugarcane focus, Southeast Asiaâ??s palm reliance, Africaâ??s residue abundance but limited infrastructureâ??India uniquely combines biomass density, refining and engineering capability, and growing aviation demand. The task now is acceleration: Converting latent feedstock abundance into a globally competitive SAF industry, bridging the supply gap for the Global South.

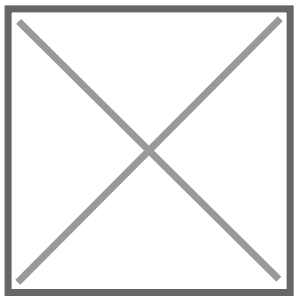


" *At TruAlt Bioenergy, we plan to establish a facility producing 10 crore litres of SAF annually, positioning us among the worldâ??s largest ethanol-to-SAF producers. With CORSIAâ??s mandatory offsetting for international flights from 2027 and Indiaâ??s 1 per cent SAF blending target, we are committed to scaling production capacity. Our ambition is to help India meet regulatory milestones while advancing sustainable aviation fuel adoption on a global scale.â?•*

--- Vijay Nirani, Managing Director, TruAlt Bioenergy

Policy Architecture and Industrial Capability: Laying the SAF Foundations

Indiaâ??s sustainable aviation fuel (SAF) strategy exemplifies a rare convergence of policy precision and pragmatic precedent. Beginning with a 1 per cent blend in 2027 for international flights, rising to 2 per cent in 2028, these targets echo ethanolâ??s early E5 trajectory, signaling credibility to investors. With state-owned oil marketing companiesâ??IOC, BPCL, and HPCLâ??underwriting demand, the sector gains sovereign-grade certainty in a capital-intensive space, translating policy intent into actionable investment confidence.



" The good news is: the demand is definitely there; however, the biggest challenge for SAF adoption is scalingâ??waste oils are limited, production costs remain high, and infrastructure isnâ??t yet built to handle wider adoption. Furthermore, governments and policy support worldwide is helping, with U.S. incentives,

European reporting rules, and efforts in some countries in Asia to expand SAF production and adoption. Still, the gap between ambition and availability is a major challenge because thereâ??s only so much used cooking oil that can go around, and much of it is already accounted for in other industries. "

--- Justin Goldsberry, CEO and Founder of Goldsberry Management Group, LLC

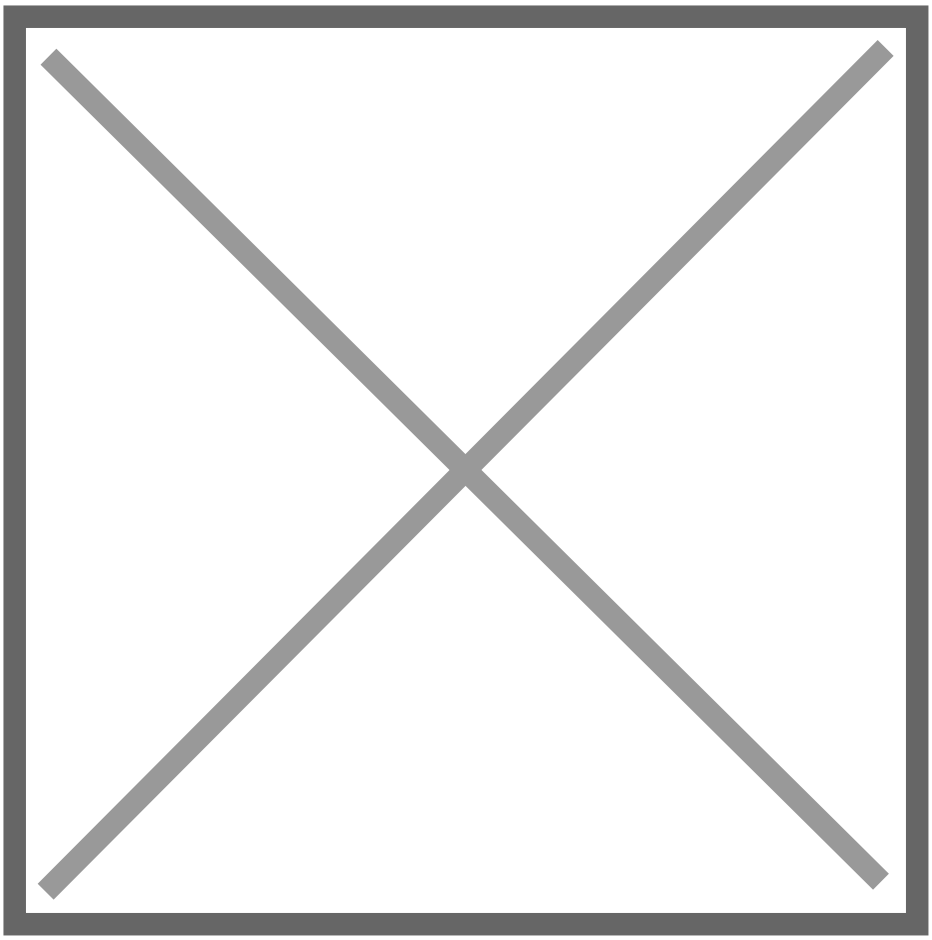
Global compatibility forms the second pillar. By harmonizing BIS standards with ASTM International, HEFA, ATJ, and Fischerâ??Tropsch pathways gain immediate export legitimacy, while carbon accounting aligned with ICAOâ??s CORSIA ensures acceptance in Europe and the U.S. Without Western-style subsidies, India relies on engineering-led efficiency and procurement certaintyâ??a model attractive to airlines wary of politically tethered supply chains. Catalytic finance, through NABARD credit, green bonds, or viability gap funding, remains essential to bridge upfront capital gaps.

Industrial capability provides the third lever. TruAlt Bioenergyâ??s planned 10-crore-litre SAF facility positions India among the worldâ??s largest ethanol-to-jet producers. Prajâ??s Centers of Excellence and R&D hub, Praj Matrix, integrate innovation across the biofuels value chain. Indiaâ??s EPC sector delivers biofuel plants at 20â??30 per cent lower capex than Western peers, while startups like GPS Renewables provide blockchain-based feedstock traceability.

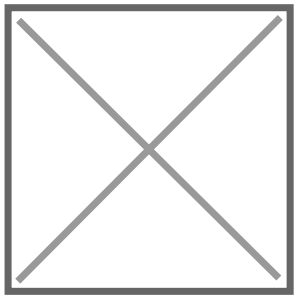
Together, these leversâ??demand certainty, global compatibility, and industrial depthâ??position India as the SAF systems integrator for the Global South, bridging domestic aviation growth with regional decarbonisation leadership.

Strategic Leveraging for Indiaâ??s SAF Ascension

Indiaâ??s ambition to become the sustainable aviation fuel (SAF) hub for the Global South requires more than incremental moves. It demands flagship investments, diversified technologies, climate integration, and regional market creation. While blending mandates and pilot projects signal intent, the real inflection point lies in scaling multiple production pathways and leveraging Indiaâ??s geopolitical position.



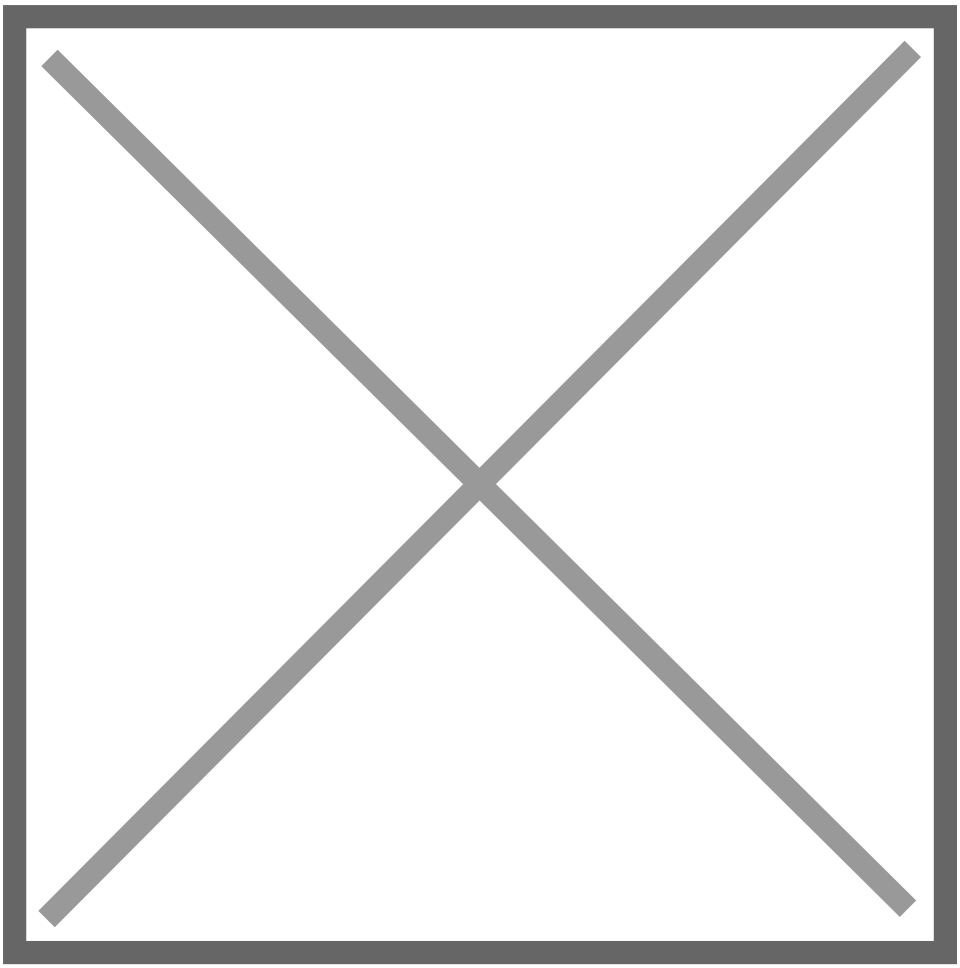
"There must be a way to cover both the upfront infrastructure costs and the ongoing operational expenses of producing sustainable aviation fuel. Globally, countries like the U.S. rely on a mix of loan programs, tax credits, and state-level incentives, even without a federal SAF mandate â?•, mentioned Adam Klauber, VP Sustainability and Digital Supply Chain, World Energy. â??India is taking a similar approach, combining national SAF blending targets with regional incentivesâ??land subsidies and fuel tax reliefâ??to encourage investment. But mandates alone arenâ??t enough; without enforceable penalties for underperformance, the sector risks stagnation. To move SAF from promise to scale, India must marry financial scaffolding with policy teeth, ensuring both capital and operational viability for producers across the ecosystem," he added.



"Producing enough Sustainable Aviation Fuel (SAF) to power planes is no small feat. The biomass requirements are immense, and land-use concernsâ??like corn cultivation in the U.S.â??cannot be ignored. Beyond COâ??, we must also account for the full spectrum of emissions when the fuel is burned. Derived from renewable or recycled sources such as oilseeds, algae, fats, and agricultural residues, SAF can cut carbon emissions by up to 70 per cent compared to conventional jet fuel. Blends range from 10 per cent to 50 per cent, and over 360,000 commercial flights have already operated on SAF across 46 airports, mostly in the U.S. and Europe."

--- Dr. Marcus Griswold, Founder, Little Green Myths

India could produce 8â??10 million tonnes of sustainable aviation fuel (SAF) annually by 2040, positioning the country to meet domestic demand and become a key exporter. The ICAO ACT-SAF feasibility study evaluates Indiaâ??s capacity to produce drop-in SAF, examining feedstock availability, production pathways, infrastructure readiness, and policy frameworks, providing a roadmap suited to Indiaâ??s socio-economic and environmental context. With over 750 million tonnes of biomass, including 230 million tonnes of surplus agricultural residues, India aims for phased blending of 1 per cent by 2027, 2 per cent by 2028, and 5 per cent by 2030. The initiative is expected to cut 20â??25 million tonnes of emissions annually and create new agricultural value chains.



Â Northern India alone burns over 50 million tonnes of crop residues annually, releasing 150 million tonnes of COâ??; redirecting even part of this into SAF creates a dual win for climate and energy security. A domestic SAF credit market aligned with ICAOâ??s CORSIA, coupled with EPC exports and technology licensing to Africa, Southeast Asia, and Latin America, enhances Southâ??South impact.

Startups like GPS Renewables strengthen sustainability traceability. With the National Green Hydrogen Mission targeting 5 million tonnes annually by 2030 and ultra-low solar tariffs (~$0.03/kWh), India could become competitive in e-SAF. Anchored by double-digit aviation growth and policy credibility, India is poised to emerge as the SAF hub of the Global South.

----- Suchetana Choudhury (suchetana.choudhuri@agrospectrumindia.com)