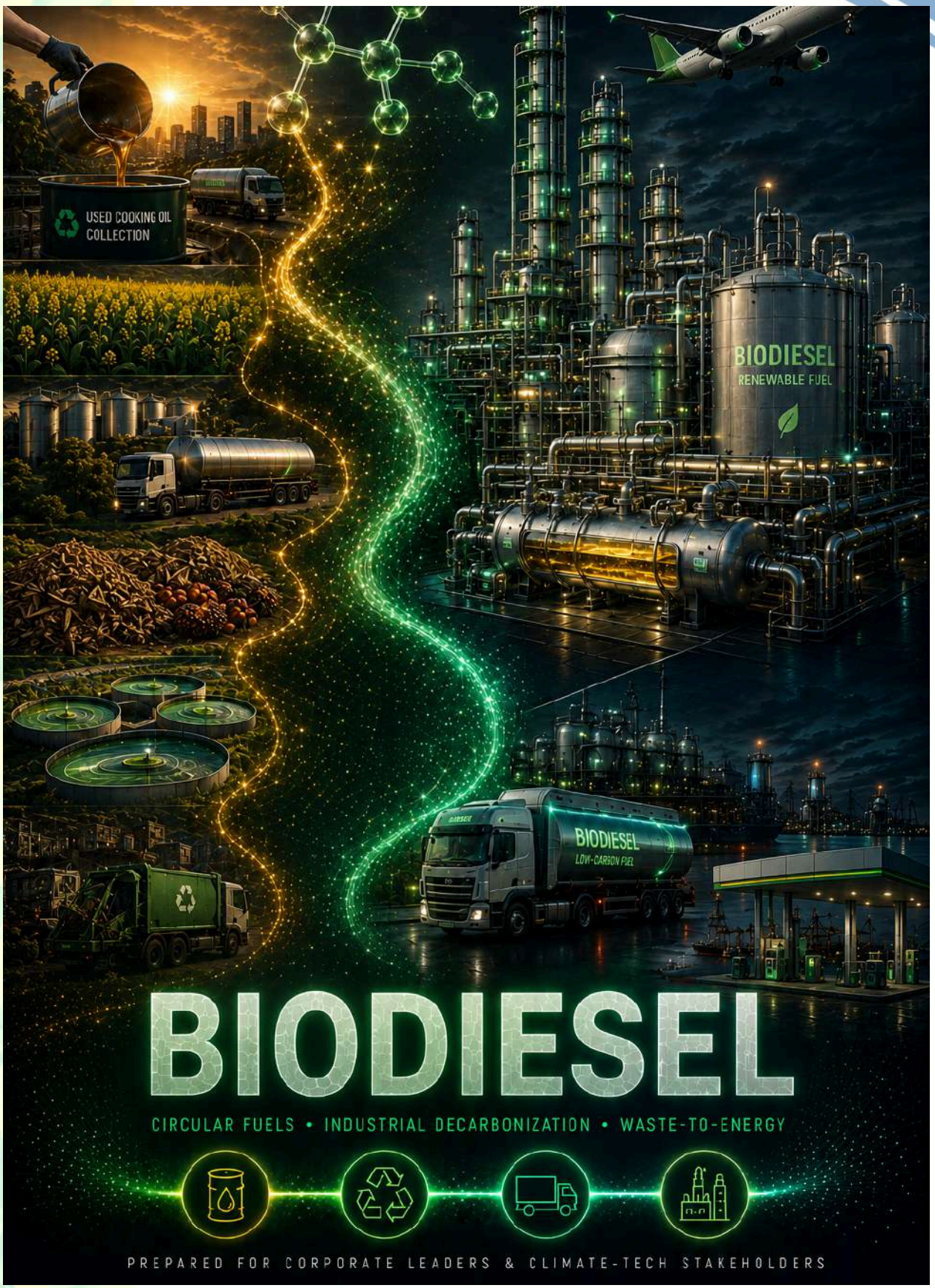
USED COOKING OIL
COLLECTION
BIODIESEL
RENEWABLE FUEL
BIODIESEL
LOW-CARBON FUEL
BIODIESEL
CIRCULAR FUELS • INDUSTRIAL DECARBONIZATION • WASTE-TO-ENERGY
PREPARED FOR CORPORATE LEADERS & CLIMATE-TECH STAKEHOLDERS

CO3@EAI

Bio Energy
Biodiesel

This section provides key inputs on the Indian Biodiesel Opportunities for corporate leaders.

Highlights

- Policy-supported growth opportunity driven by blending targets, waste oil mandates, and energy security goals
- Waste-to-fuel ecosystem converting used cooking oil, animal fats, and agri-waste into transport fuel
- Growing industrial and fleet demand for low-carbon diesel substitutes under ESG pressure
- Relatively mature conversion technology enabling faster plant deployment compared to newer biofuel pathways

Key recommendations for corporate leaders include:

- Design a combination that is built for redundancy by choosing a technology that can utilize multiple feedstocks and building supply chains around diverse feedstocks such as edible oil waste, used cooking oil, animal fat
- Form long-term offtake partnerships with OMCs, logistics fleets, and industrial buyers

Opportunity Snapshot: Biodiesel

Diesel substitute/blend from used sustainable sources such as non-edible oils, cooking oil (UCO) etc

Market Signal

- India targeting ~**5% biodiesel blending** (policy push via SATAT & National Biofuel Policy)
- Strong demand from t**ransport fleets, OMCs, and industrial users**
- **Annual Market size by 2030:** 5,000 - 7,000 ₹ Cr

What Makes or Breaks It?

- Used cooking oil sourcing through **HoReCa and aggregator networks**
- **>95% conversion efficiency** in transesterification to control production costs
- Long-term offtake **agreements with aOMCs**(IOC/BPCL/HPCL) and bulk fleet/industrial users.

Why It Matters NOW?

- **Cost competitive alternative** fuel with rising diesel prices
- **Waste- to-fuel model** using used cooking oil and agri residues
- **Lower lifecycle emissions** than conventional fossil fuels.

Well Aligned Opportunity for

- **Fuel distributors and aggregators**
- **Agri/oil processing companies**
- **Waste management and UCO collection players**

Key Challenges

- Requires city-level aggregation networks, currently the **supply is fragmented**
- **Margin volatility** due to diesel linked pricing
- Strict BIS fuel standards for OMS offtake

Business Model

- Set up plants near urban UCO clusters
- Partner with aggregators/restaurants for feedstock sourcing
- Supply to OMCs and bulk fuel consumers

Introduction and Business Case

Biodiesel—typically FAME (Fatty Acid Methyl Ester) produced from used cooking oil (UCO), non-edible oilseeds, waste fats and agricultural by-products—has emerged as a strategic renewable fuel in India's transition toward cleaner energy.

Diesel accounts for nearly half of India's petroleum consumption in heavy transport, railways, Agricultural machinery, construction & mining. These segments cannot electrify rapidly, ensuring long-term demand stability for biodiesel as a complement to diesel. Biodiesel plants present economically viable operations at scale, but only when feedstock for such large scale operations is secured.

If the feedstock supply challenges are taken care of - we do admit that this is a BIG IF - biodiesel is one of the few renewable fuels in India that can deliver significant national benefits across energy, environment, industry and livelihoods, thus presenting a high-impact and attractive business opportunity.

Market Potential for Biodiesel in India

Year	Market Size (₹ Cr)	Capacity Outlook	Drivers
2025	2000	0.17 million tonnes	Reduces dependence on imports.
2030	5,000-7,000	0.40 million tonnes	Broadening the demand base.
2040	10,000-15,000	1 million tonnes	Lower lifecycle CO_2 emissions.

Market Segments and Applications

Segment	Applications	Business Model	Key Drivers
Advanced biodiesel (HVO / renewable diesel)	Road diesel blending, heavy-duty transport	Large-scale refinery production + long-term offtake	Low-carbon fuel mandates & premium pricing
Waste- & residue-based biodiesel	Transport fuel, industrial diesel	Feedstock-secured production	Sustainability criteria & lower carbon intensity
Agri-origin biodiesel	Road transport, agriculture machinery	Vertical integration (farm → fuel)	Abundant oilseed supply & rural policy

			support
Rendering & by-product biodiesel	Transport fuel blending	Waste conversion + supply contracts	Circular economy economics
Refinery co-processing biodiesel	Drop-in diesel replacement	Brownfield refinery integration	Low capex SAF/biofuel scale-up
Merchant biodiesel producers	Blended diesel markets	Spot market + short-term contracts	Biodiesel blending mandates
Export-oriented biodiesel	International fuel markets	Trade & arbitrage model	Regional policy differentials
Forest & non-food biomass biodiesel	Transport, industrial fuel	Technology-driven production	Food-vs-fuel risk mitigation
Low-carbon credit-optimized biodiesel	Transport fuels	Fuel + carbon credit monetization	LCFS & carbon pricing regimes
Integrated biofuels platforms	Multi-fuel (biodiesel, RD, SAF)	Portfolio diversification model	Risk hedging across policies & markets

Typical Project Capacities & Investments Required in India

Project Type	Typical Capacity	Indicative CapEx (₹ Cr)	Notes
Medium	30 KLPD	6 - 8	Medium-scale operation
Large	100 KLPD	15 - 20	Large-scale operation

Underlying Technologies & Processes

Element	Options	Key Traits
Feedstocks	Used Cooking Oil (UCO), non-edible oil crops (Tree-borne Oils - TBO), animal fats, palm stearin and industrial by-product oils	Requires strong pre-treatment, Dehulling & expelling, strong acidic esterification
Conversion pathways	Transesterification (Base-catalyzed), Two-step Esterification, Enzymatic (Lipase-based) Conversion, Hydrotreating (HVO / Renewable Diesel)	Low-FFA oils react quickly, transesterification at mild conditions, No catalyst, Thermal cracking
Blending	5% - 20% blending of HEFA (Hydroprocessed Esters and Fatty Acids),	Easy rollout, no engine changes, Larger renewable

	ATJ (Alcohol-to-Jet), PtL / e-SAF (Power-to-Liquid / e-Kerosene)	penetration, Major emission gains. Requires large-scale feedstock, Limited OEM uniform approval, Needs engine testing.
Infrastructure	Feedstock collection, production, storage & logistics, blending	Pre-filtration, Decorticators, Oil expellers, Acid esterification, Multi-feedstock compatibility, Moisture-free design
Policy drivers	Sets a target of 5% biodiesel blending, Repurpose Used Cooking Oil initiative, OMC Procurement Programs	Blending Targets, Approval of Multiple Feedstocks, Depot-Level Blending Mandate, RUCO Traceability, Feedstock Source Verification, sector-specific policy provisions

Key Challenges

Challenge Area	Key Issues	Business Impact	India Specific	Strategic Implications
Feedstock Availability & Cost Volatility	Limited availability of used cooking oil (UCO), non-edible oils, waste fats; fragmented collection systems	Raw material cost fluctuation reduces margins and production stability	Dependence on imports for some feedstocks; UCO aggregation ecosystem still developing	Strong sourcing networks, waste collection partnerships, and diversified feedstock strategy essential
Policy Support & Blending Mandate Uncertainty	Lack of strong mandatory biodiesel blending compared to ethanol blending	Demand growth slower; revenue visibility limited	National Biofuel Policy supports biodiesel but implementation varies	Need clearer mandates, incentives, and consistent pricing mechanisms
Offtaker & Pricing Challenges	Dependence on Oil Marketing Companies (OMCs) procurement programs	Pricing tied to policy decisions; limited private market adoption	Indian fuel market dominated by OMCs; contract execution variability	Diversify customers (industrial users, mining, logistics fleets)
Competition	EV adoption,	Long-term	India's	Focus on niche

from Alternative Decarbonization Technologies	green hydrogen, and other biofuels competing for investment	demand uncertainty impacts investor confidence	electrification push may reduce diesel demand over time	applications (heavy-duty transport, generators, marine)
Operational & Quality Compliance Challenges	Feedstock variability affecting fuel quality; storage and oxidation issues	Higher operational costs and compliance requirements	BIS standards and certification requirements must be maintained	Invest in quality control systems and technology upgrades

Prominent Players in the Indian Market

Company / Entity	Focus Areas
Emami Agrotech	Large-scale FAME production, feedstock sourcing (edible & non-edible oils), exports, OMC supply contracts
Indian Oil Corporation (IOCL)	Procuring & blending biodiesel (UCO based)
Bharat Petroleum Corporation (BPCL)	Procurement, blending trials, supplier tie-ups
Pan Oleo Energy	Large scale producers of biodiesel and other chemicals.
Godavari Biorefineries	Biorefining (ethanol, chemicals) and diversification into biofuels value chains
Praj Industries	Enzymatic biodiesel tech (Ecodiezel™), plant design, integrated biorefinery solutions

Innovation Perspectives

Innovation	Business Opportunity	For Senior Management
Feedstock-control platforms	Feedstock marketplaces, long-term supply monopolies	Structural cost and CI advantage
Advanced biodiesel (HVO) scale-up	Refinery conversion & HVO hubs	Higher blending limits, premium pricing
Carbon-intensity optimization	Carbon-optimized fuel portfolios	Unlocks credit-driven margins

Multi-fuel biorefineries	Integrated low-carbon fuel complexes	Risk diversification across mandates
Waste-to-fuel circular models	Municipal waste partnerships	Secures cheap feedstock
Brownfield refinery repurposing	Refinery transition strategies	Lower capex, faster deployment
Export arbitrage strategies	Global biofuel trading desks	Policy-driven margin uplift
Non-food biomass pathways	Advanced feedstock R&D platforms	Avoids food-vs-fuel backlash
Digital traceability & certification	Data-led fuel certification services	Regulatory compliance moat
Credit stacking business models	Carbon-backed biodiesel platforms	Multiple revenue streams

Concentric & Satellite Opportunities

- Continuous High-Yield Transesterification OEM: Modular reactor skids for ultra-fast, continuous conversion, minimizing catalyst and improving ester yield.
- Crude Glycerin Purification and Valorization Hubs: Co-located units refining crude glycerin co-product into high-grade chemical inputs (e.g., propylene glycol).
- Integrated Multi-Feedstock Pre-treatment Systems: Acid esterification and degumming units handling high Free Fatty Acid (FFA) wastes (UCO) with optimal catalyst efficiency.
- Sustainable Feedstock Aggregation Networks: Digitized reverse-logistics for collection, grading and spec-locked delivery of Used Cooking Oil (UCO) and other non-food lipids.
- Next-Gen Oilseed/Algae Cultivation and Harvest Tech: Providers licensing high-yield, non-food competing oilseed crops or advanced photobioreactors for scalable algal oil production.
- Algae-bacteria bioreactors: R&D and manufacturing of consortium systems for nutrient-rich wastewater to lipids; dual wastewater treatment.
- Busbar & connector fabrication: Precision copper/aluminum stamping for cell-to-pack wiring; high-current designs
- Biodiesel Cold Flow Additive/Formulation R&D: Satellite labs developing proprietary additives and blend recipes to significantly improve fuel performance in cold weather.
- Specialized Biodiesel Blending & Distribution Hubs: Optimized tank farms and logistics infrastructure near markets for blending and ensuring quality control of B20/B100 fuels for fleet customers.

Key Takeaway for Senior Management

Takeaway	Details
Feedstock ecosystems are the true competitive battlefield	• Biodiesel profitability depends more on used cooking oil and waste-fat aggregation than plant efficiency • ***Examples**:* restaurant collection networks, municipal grease recovery, industrial waste oil contracts • **Innovation focus:** digital feedstock marketplaces, IoT collection tracking, smart logistics routing
Quality standardization determines long-term market access	• Transport fleets and OMCs require consistent fuel specifications • ***Sub-components**:* ester purity control, filtration systems, compliance testing, certification labs • **Innovation focus:** automated quality analytics and traceability platforms
Digital plant intelligence improves lifetime IRR	• Predictive maintenance and process analytics increase uptime, decrease unit costs and enhance profitability. • ***Examples**:* automated process monitoring and optimization, intelligent plant control systems

Next Steps for Corporate Leaders

Biodiesel is gaining traction as a near-term, drop-in solution for decarbonizing logistics, heavy vehicles, diesel gensets, and industrial heat with minimal infrastructure change. Feedstock diversification (used cooking oil, animal tallow, palm stearin, distillers' corn oil, and other residual lipids), transesterification technology maturity, and the emergence of carbon markets are strengthening viability — though global supply remains constrained by feedstock competition and cost differentials against fossil diesel. As Scope 1 and logistics-related Scope 3 emissions face increasing scrutiny, biodiesel offers an immediately actionable pathway for fuel substitution.

This could be an attractive climate tech opportunity for industries and firms in specific sectors and industries keen on catering to this market.

Connect with Team EAI to know more about this opportunity and take your corporate's initial steps. Send a note to consult@eai.in or talk to Muthukrishnan - 9952910083