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India's Biofuel Transition and Energy Independence: A Comparative Policy Analysis of Union Budget 2026–27

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Abstract

India's energy transition is increasingly shaped by three interconnected pressures: rising energy demand, persistent dependence on imported fossil fuels, and escalating environmental challenges such as greenhouse gas emissions and urban air pollution. The transport sector remains a major contributor to fuel demand growth, deepening India's vulnerability to global crude oil price volatility and supply disruptions. In response, India has adopted a multi-dimensional strategy that combines renewable electricity expansion, energy efficiency, and alternative fuels. Among these, biofuels have emerged as a strategic policy instrument due to their domestic production potential, infrastructure compatibility, and capacity to reduce lifecycle emissions when sustainably produced. India has achieved a major milestone by reaching the 20% ethanol blending target (E20) earlier than its original 2030 timeline, demonstrating strong policy coordination under the National Policy on Biofuels. However, achieving energy independence requires expanding beyond petrol substitution toward diesel, gaseous transport fuels, and aviation. The Union Budget 2026–27 marks a significant turning point by strengthening the biofuel agenda through the phased introduction of compressed bio-gas (CBG) blending into CNG, excise duty relief for biogas-blended CNG, continued progress toward higher ethanol blends such as E27, and reinforcement of sustainable aviation fuel (SAF) blending targets for international flights from 2027. Using a comparative policy analysis (CPA) framework, this paper evaluates the scope, feasibility, and challenges of India's expanded biofuel strategy, highlighting opportunities and implementation risks between 2025 and 2030.

Keywords: Biofuels, Ethanol Blending, CBG, SAF, Energy Independence, Union Budget 2026–27, India
JEL Codes: Q42, Q48, Q56, O13

1. Introduction

India's energy system is undergoing a structural transformation, driven by three interlinked challenges: rapidly rising energy demand, high dependence on imported fossil fuels, and growing environmental pressures arising from greenhouse gas emissions and air pollution. As one of the world's fastest-growing economies, India's energy consumption—particularly in the transport sector—has increased sharply, resulting in higher demand for petrol, diesel, and natural gas. This trend has intensified India's exposure to international crude oil price fluctuations and geopolitical supply disruptions, thereby elevating **energy security** and **energy** independence as central national priorities (IEA, 2023).

In response, India has pursued a multi-dimensional transition strategy combining renewable electricity expansion, energy efficiency, and the promotion of alternative fuels. Among these pathways, biofuels have gained prominence because they offer three strategic advantages: (i) domestic production potential using agricultural and waste resources, (ii) compatibility with existing fuel infrastructure and engines, and (iii) the ability to reduce lifecycle emissions when produced sustainably (IRENA, 2020). Biofuels are renewable fuels derived from biomass sources such as sugarcane, maize, agricultural residues, used cooking oil, animal waste, and municipal waste. They exist in liquid forms (bioethanol, biodiesel, SAF) and gaseous forms (biogas and compressed bio-gas). Globally, biofuels are increasingly positioned as transitional fuels capable of decarbonizing hard-to-abate sectors such as long-haul transport and aviation (IPCC, 2022). In developing

economies like India, they generate additional socio-economic benefits including rural employment, value addition to agricultural residues, and improved waste management systems. These combined motivations explain why biofuels are now embedded within India's broader climate and energy governance agenda.

India's biofuel strategy has historically been anchored in ethanol blending in petrol through the Ethanol Blended Petrol (EBP) programme, supported by the National Policy on Biofuels (Government of India, 2018). The most significant policy success has been the achievement of the E20 blending target ahead of schedule, reflecting strong institutional coordination across supply chains, blending infrastructure, and market incentives. This achievement demonstrates that India has developed a relatively mature ethanol ecosystem, supported by feedstock diversification, procurement mechanisms, and regulatory reforms.

However, India's energy independence challenge extends far beyond petrol substitution. Diesel remains dominant in freight transport, natural gas continues to expand in urban transport (CNG), and aviation turbine fuel remains almost entirely petroleum-based. These segments represent major areas of continued fossil fuel dependence. Consequently, India's future fuel strategy must address not only petrol blending but also gaseous transport fuels and aviation fuels. The Union Budget 2026–27 emerges as a strategic policy inflection point because it expands the biofuel agenda beyond ethanol and signals a transition toward a more integrated bioenergy framework. Key budget announcements include the phased introduction of CBG blending into CNG, excise duty relief for biogas-blended CNG, continued progress toward higher ethanol blending such as E27, and reinforcement of SAF blending targets for international flights starting from 2027 (MoPNG, 2022). This shift reflects India's broader ambition to reduce import dependence while strengthening climate commitments under global sustainability frameworks. Despite strong policy momentum, India's biofuel transition faces structural and implementation challenges. First, scaling ethanol blending beyond E20 toward E27 raises concerns about feedstock availability, land-use pressures, and potential food-versus-fuel competition, particularly for first-generation biofuels (IRENA, 2020). Second, CBG blending introduces complex logistics and governance constraints because it relies on decentralized biogas plants, waste collection systems, and gas grid integration. Third, SAF adoption is constrained globally by high production costs, limited feedstock, and certification barriers, making rapid scale-up difficult (IPCC, 2022). These realities highlight the need for critical policy evaluation and academic analysis. This study is novel in three ways. First, unlike earlier research that focuses primarily on ethanol blending and first-generation biofuels, this paper evaluates India's biofuel strategy as an integrated transition framework spanning petrol (E20/E27), gaseous fuels (CBG blending in CNG), and aviation fuels (SAF). Second, the paper connects the Union Budget 2026–27 with the broader energy independence narrative, arguing that budget reforms represent a structural shift in India's energy policy architecture rather than short-term fiscal announcements. Third, the study provides a forward-looking policy discussion on the biofuel blending roadmap (2025–2030), identifying institutional and economic conditions necessary for scaling advanced biofuels.

The study is guided by the following research questions:

1. How does Union Budget 2026–27 strengthen India's biofuel strategy toward energy independence?
2. What major reforms and fiscal incentives are introduced for ethanol (E20/E27), CBG blending in CNG, and SAF adoption?
3. What opportunities and constraints exist for scaling biofuels across petrol, gaseous fuels, and aviation in India?
4. What roadmap and institutional mechanisms are required to ensure sustainable, inclusive, and commercially viable biofuel expansion between 2025 and 2030?

2. Literature Review

India's pursuit of biofuel-driven energy independence has intensified over the last decade, shaped by progressive policy reforms, blending mandates, and evolving national priorities. The EBP programme has emerged as the cornerstone of this transition. Under the National Policy on Biofuels (2018, amended 2022), ethanol blending targets were initially set at 20% by 2030, but were later advanced to the Ethanol Supply Year (ESY) 2025–26. Blending levels reached nearly 20% ahead of schedule, indicating policy effectiveness in stimulating ethanol production capacity and strengthening distribution networks.

The success of ethanol blending is attributed to robust policy instruments such as administered pricing, tax incentives (notably GST reductions), and interest subvention schemes for distillery expansion. These instruments improved production economics, expanded capacity, and enabled higher procurement by public sector oil companies. Beyond energy substitution, ethanol blending has contributed to rural income enhancement, reduced foreign exchange outflows, and supported agricultural value chains.

However, scholars increasingly argue that ethanol alone cannot deliver deep decarbonization and energy independence, especially as transport energy demand expands. As a result, attention has shifted toward gaseous biofuels. Under the SATAT initiative, the government has introduced blending obligations for CBG with

CNG/PNG, aiming to create demand certainty and stimulate decentralized biogas production. The phased blending design—moving from voluntary adoption toward mandatory obligations—reflects a governance approach balancing flexibility with long-term market integration.

In parallel, SAF has emerged as a critical component of aviation decarbonization. SAF can significantly reduce aviation emissions, but its production requires high investment, stable feedstock supply, and complex certification standards. India's commitment to initiate a 1% blending mandate for international flights by 2027 demonstrates ambition but also highlights implementation risks such as cost competitiveness and supply security. Overall, the literature suggests that India's biofuel success depends on aligning blending mandates with financing mechanisms, infrastructure readiness, and sustainability safeguards (IEA, 2023; IPCC, 2022).

3. Research Methodology

This study employs a **comparative policy analysis (CPA)** framework to evaluate biofuel reforms and blending mandates introduced in Union Budget 2026–27. CPA is suitable for examining how policy instruments align with broader national objectives such as energy security, emission reduction, and rural development. The research adopts a qualitative descriptive and comparative design, relying on official budget documents, policy briefs, and sectoral recommendations.

3.1 Data Sources

Data are drawn from government and budget documents outlining Union Budget 2026–27 biofuel provisions. Sectoral reports and media coverage on CBG blending obligations and stakeholder responses. Industry association recommendations such as ISMA and Indian Biogas Association. Secondary academic literature on India's blending trajectory and socio-economic impacts.

3.2 Analytical Framework

Comparative thematic analysis is applied across ethanol, CBG, and SAF based on: Policy objectives and rationale. Blending targets and timelines. Fiscal measures and incentives. Stakeholder perspectives and policy integration

4. Results and Discussion

4.1 Ethanol Blending as the Foundation of Biofuel Transition

India's ethanol blending trajectory demonstrates strong policy maturity. Blending rates rose from 1.5% in 2014 to 20% in October 2025, reflecting rapid institutional learning and policy consistency. The expansion of feedstock sources beyond molasses to maize, damaged food grains, and surplus rice indicates diversification efforts to ensure supply resilience. Ethanol remains central because it benefits from existing oil marketing company infrastructure and standardized blending systems.

However, moving beyond E20 toward E27 introduces sustainability and economic concerns. Higher blending requires increased ethanol production, which may intensify land-use pressures and feedstock competition if first-generation sources dominate. Therefore, scaling must be supported by stronger sustainability governance and accelerated deployment of second-generation ethanol technologies.

4.2 Budget 2026–27 as a Strategic Shift Toward Gaseous Biofuels

A major policy contribution of Union Budget 2026–27 is the introduction of phased mandatory blending obligations for CBG in CNG/PNG. Unlike ethanol, which relies on centralized procurement and blending networks, CBG depends on decentralized biogas plants and waste supply chains. This introduces new governance requirements such as municipal coordination for waste collection, standardization of pricing mechanisms, and integration with gas distribution systems. The proposed excise duty relief—excluding the biogas component while computing excise duty on biogas-blended CNG—signals fiscal intent to enhance commercial viability. Yet, whether such fiscal support can overcome supply-side bottlenecks remains uncertain, particularly given the fragmented nature of biomass supply chains.

4.3 SAF Targets and the Challenge of Aviation Decarbonization

The reinforcement of SAF indicative blending targets represents India's entry into aviation biofuels as a policy priority. The commitment to 1% SAF blending for international flights from 2027 aligns with global decarbonization efforts. However, SAF is significantly more complex than ethanol or CBG due to high production costs, limited feedstock, and strict certification requirements. Without clarity on procurement mechanisms, pricing structures, and long-term supply contracts, SAF adoption may remain slow.

4.4 Comparative Budget Allocation and Policy Emphasis

Budgetary allocations under the Bio-Energy Programme have historically remained modest but show increasing prioritization in 2024–25. Importantly, ethanol blending progress has not been driven primarily by direct budget outlays, but by structural incentives such as GST reductions, pricing guarantees, and interest subvention. In contrast, CBG and SAF require stronger investment support because they involve new infrastructure and higher technological risk. Thus, the policy shift from direct outlays toward mandates and fiscal rationalization reflects a governance transition—from budget spending to regulatory-driven market creation.

4.5 Policy Direction in Budget 2026-27

Reports on the Union Budget 2026–27 show allocations for renewable energy and bioenergy programmes but do not list a separate, explicit line-item only for biofuels in the main budget documents currently available. Data indicate increased support for bioenergy schemes overall, such as a modest rise in bioenergy outlay (from ₹175 crore to ₹275 crore), rather than a specific allocation identical to the previous ₹250 crore for biofuel pipeline infrastructure seen in Budget 2025 (IEEFA, 2026).

4.6 Previous explicit biofuel allocation in Budget 2025

In the Union Budget 2025, the government allocated ₹250 crore for the development of pipeline infrastructure specifically for compressed bio-gas (CBG), reported within MoPNG budget documents (The Economic Time, 2025),

4.7 Subsidy Trends and Fuel Support in Budget 2026-27

The 2026-27 budget shows that fuel subsidy expenditure (which includes petroleum, diesel, etc.) is projected to *decline* compared to the previous year:

Table 1, Subsidy Trends and Fuel Support in Budget

Category	FY 2025-26 Revised Estimate	FY 2026-27 Budget Estimate	Change
Food, Fertiliser & Fuel Subsidy	₹4,29,735 crore	₹4,10,495 crore	↓ 4.47 %
Petroleum Subsidy Component	~₹15,121 crore	~₹12,085 crore (*estimated*)	↓

This suggests a policy emphasis on fiscal discipline and reducing direct fuel subsidies, which indirectly supports cleaner fuels like biofuels by limiting subsidies on fossil fuels and making alternative fuels relatively more cost-competitive.

4.8 Industry & Stakeholder Budget Proposals for Biofuels

Industry bodies and stakeholders submitted detailed proposals to the Government ahead of the Union Budget 2026–27, seeking enhanced fiscal support and policy incentives for the biofuels sector. The Indian Sugar & Bio-Energy Manufacturers Association (ISMA), for example, urged the Government to provide substantial budgetary outlays for advanced biofuels, including second-generation ethanol, sustainable aviation fuel (SAF), and related technologies. ISMA has recommended a total support fund of around ₹15,000–20,000 crore to back pilot projects, technology scaling, green hydrogen and SAF capacity, coupled with tax rationalisation measures such as GST cuts on flex-fuel vehicles and ethanol fuel inputs to lower end-user costs and catalyse adoption, (The Economics Time, 2026)

a) Indian Biogas Association (IBA)

The IBA *asked* the government to create a ₹10,000 crore capital subsidy fund for biogas and CBG projects under the 2026 Budget. They also proposed: Increasing Central Financial Assistance (CFA) to ₹6 crore per 4.8 TPD of CBG capacity (up by 50%) Raising the upper project cap to ₹25 crore Mandatory blending of fermented organic manure into fertilisers (5% by 2028; 10% by 2030)

b) Indian Sugar & Bio-Energy Manufacturers Association (ISMA)

ISMA has requested ₹15,000–20,000 crore in budget support to promote: Second-generation ethanol projects Sustainable aviation fuel (SAF) capacity Pilot demonstration and advanced biofuel technologies.

Table 2. Budget 2026-27 Biofuel Policy Summary (Current)

Aspect	Status / Proposal (Budget 2026-27)
Ethanol blending (E20)	Sustained focus, continuation of policy momentum (no separate line item but supported as ongoing mandate)
E27 and advanced ethanol	Industry demands additional support (~₹15,000–₹20,000 crore) but not yet officially announced (ETEnergyworld.com)

CBG & Biogas	Industry proposal for ₹10,000 crore subsidy fund
SAF	Advocated by industry (ISMA) for dedicated budget support; formal government budget provisions not yet detailed (ETEnergyworld.com)
Fuel subsidy trend	Total fuel subsidy projected to decrease indicating fiscal discipline and potential push toward alternative fuels (IBC24 News)

Direct budget allocations for biofuels in 2026-27 are less visible than in some previous years (e.g., 2025 budget's ₹250 crore proposal for CBG pipeline infrastructure). Fiscal policy appears to be moving toward regulatory mandates and incentives (e.g., blending obligations and tax measures) rather than standalone budgetary expenditure. Stakeholders are advocating for large capital subsidy funds (₹10,000–₹20,000 crore) to support scaling of CBG, second-generation ethanol, and SAF — indicating industry expectations of the budget's direction. Reduction in petroleum subsidy is consistent with a policy strategy to make biofuels more competitive indirectly.

Table 3 Biofuel Support Context – Budget 2026-27

Budget Year	Biofuel Policy / Support
2025-26	₹250 crore for CBG pipeline infrastructure (MoPNG) (ETEnergyworld.com)
2026-27	Fiscal discipline on fuel subsidies (↓ petroleum subsidy) (IBC24 News)
Proposals (Industry)	₹10,000 crore biogas/CBG subsidy (IBA) (The Times of India)
	₹15,000–₹20,000 crore support for advanced biofuels (ISMA) (ETEnergyworld.com)

Official budget line items exclusively for biofuels in 2026-27 are not yet detailed in published summaries. Fuel subsidy is projected to decrease, signaling a fiscal environment potentially favorable to alternative fuels. Industry demands indicate strong expected funding support for biogas/CBG and advanced biofuels like 2G ethanol and SAF in the budget.

5. Conclusion

India's biofuel transition has entered a new phase of policy maturity, with ethanol blending serving as the strongest foundation of progress. The achievement of the E20 target in October 2025 demonstrates the effectiveness of long-term policy consistency, feedstock diversification, and institutional coordination. However, the future pathway toward higher blends such as E27 will require stronger sustainability safeguards, especially to avoid excessive dependence on first-generation feedstocks and to accelerate second-generation ethanol deployment.

The Union Budget 2026–27 marks a strategic turning point by extending the biofuel agenda beyond petrol substitution toward gaseous fuels and aviation decarbonization. The phased introduction of mandatory CBG blending in CNG/PNG signals an important shift toward decentralized bioenergy systems, though its success will depend on resolving supply-chain fragmentation, pricing clarity, and gas distribution integration. Similarly, the indicative SAF blending target for international flights from 2027 reflects India's ambition to enter global aviation decarbonization pathways, but high costs and certification barriers may slow adoption without clear procurement and incentive mechanisms.

6. Policy Implications and Roadmap

India's expanded biofuel strategy offers significant opportunities, but success depends on resolving structural challenges.

1. Sustainability safeguards for ethanol scaling: Moving toward E27 requires ensuring that ethanol expansion does not create food insecurity or ecological stress. A stronger emphasis on 2G ethanol and residue-based supply chains is essential.
2. Institutional integration for CBG blending: Waste-to-energy systems require coordination among municipalities, private operators, gas distribution companies, and regulators. Standardized pricing and guaranteed offtake contracts will be necessary.
3. Investment ecosystem for SAF: SAF adoption requires capital-intensive production and global certification alignment. Policy instruments such as long-term purchase agreements, viability gap funding, and refinery integration incentives will be critical.
4. Balanced policy mix: India must balance fiscal incentives, environmental sustainability, rural development, and industrial competitiveness. Biofuel expansion must be governed not only as a technological transition but as a market and governance transition.

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