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Ethanol Blending in India: Fueling Energy Security or Stoking New Crises?

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Introduction

The Remarkable Journey: From Pilot to E20

India's ethanol blending programme has achieved what many considered improbable. In just over a decade, the country raised ethanol blending in petrol from a modest 1.53 per cent in 2014 to approximately 20 per cent by mid-2025, a pace that surpasses even Brazil's historic ethanol transition. The target, originally set for 2030 under the National Policy on Biofuels (2018), was achieved five years ahead of schedule. The scale of this achievement is reflected in the numbers. During Ethanol Supply Year (ESY) 2024-25, India blended 1,022.4 crore litres of ethanol, achieving an average blending rate of 19.24 per cent. The installed ethanol production capacity has grown from approximately 21 crore litres in 2013-14 to around 2,000 crore litres currently, creating a robust manufacturing ecosystem. This surplus capacity—with total demand estimated at 1,350 crore litres against supply offers of 1,775 crore litres—positions India to explore higher blending targets or even ethanol exports. The programme's success stems from strategic policy interventions: administered ethanol procurement prices, reduction of GST to 5 per cent, subsidies for distillery setup, and feedstock diversification across sugarcane, maize, and rice. Crucially, the government's decision to allow diversion of surplus food grains for ethanol production provided flexibility while supporting farmers.

The Gains: Who Benefits and How Much?

Foreign Exchange Savings and Energy Security

The most frequently cited achievement of the ethanol programme is its impact on India's import bill. Official estimates suggest the programme has saved over ₹1.9 lakh crore in foreign exchange since 2014-15, substituting more than 310 lakh metric tonnes of crude oil. The government has also reported net CO₂ reduction of approximately 930 lakh metric tonnes. For a country importing roughly 87 per cent of its crude oil requirements—with an annual import bill estimated at ₹22 lakh crore—these savings are strategically significant.

Strengthening Rural Economy and Farmer Incomes

Beyond energy security, the ethanol programme has revitalized the sugar industry and created new revenue streams for farmers. The programme has enabled more than ₹1.5 lakh crore in payments to farmers, with timely clearance of sugarcane arrears reaching their lowest levels ever. Between 2014-15 and 2020-21, the government disbursed approximately ₹14,600 crore in sugar export subsidies; since 2021-22, no such subsidies have been required as mills divert

surplus sugar toward ethanol production. Maize has emerged as the single largest feedstock, accounting for 47 per cent of ethanol supplies in ESY 2024-25—surpassing traditional sugarcane-based sources. This shift has improved price realization for maize farmers, though it has also raised concerns about feed costs for poultry and livestock sectors.

The Emerging Challenges: A Policy at Crossroads

Food Security and Feedstock Diversion

The most significant concern surrounding India's ethanol push is its potential impact on food security. Maize and rice have become major ethanol feedstocks, with rice from the central pool (procured at minimum support price) contributing approximately 21 per cent of ethanol supplies, maize accounting for 38 per cent, and sugarcane-based feedstock contributing only about 35 per cent of total supply. Critics argue that in a populous country expected to reach 1.67 billion by 2050, diverting food grains for fuel may pose food security challenges. The government has had to restrict ethanol production from sugarcane juice in the past (December 2023) when sugar stocks tightened, suggesting that feedstock availability is not guaranteed. The use of rice procured under MSP for ethanol also raises WTO implications, as such stocks are meant for domestic food security and cannot be exported.

Water Stress and Environmental Costs

The environmental arithmetic of ethanol production is far more complex than simply counting emissions reductions. A government study estimates that producing one litre of ethanol from sugarcane requires approximately 2,860 litres of water across the production cycle; the figure rises to 4,093 litres for maize-based ethanol and a staggering 10,790 litres for rice-based ethanol. India now has close to 500 ethanol distilleries, with grain-based capacity accounting for a growing share of incremental supply. In water-stressed regions like Maharashtra, sugarcane occupies less than 10 per cent of cropped area but consumes more than 50 per cent of irrigation water. Expanding ethanol-linked feedstocks in such regions risks intensifying pressure on already stressed water systems. Additionally, higher production requires more fertilizer, irrigation, and electricity—much of it generated from coal. Emissions therefore do not disappear entirely; part of the environmental burden shifts upstream.

Vehicle Compatibility and Consumer Concerns

As India moves toward E20 and beyond, vehicle compatibility has emerged as a contentious issue. While the government maintains that BS6 Phase-2 compliant vehicles and those marked with E20 stickers can handle up to 20 per cent blends, concerns about reduced fuel efficiency, engine wear, and water contamination in fuel have been raised, particularly in coastal areas. The government has acknowledged that ethanol blending remains an "ongoing experiment," with results expected by next year, as stated before the Supreme Court. Experts note that ethanol has roughly one-third less energy per litre than pure gasoline, requiring vehicles to burn more fuel to generate the same power, limiting the extent to which blends reduce oil demand.

The Economics of Surplus Capacity

India's ethanol production capacity has grown to roughly 20 billion litres, while current E20 demand absorbs only about half of this capacity. This surplus reflects cumulative policy incentives—including government-backed soft loans and interest subvention—that catalysed investments exceeding ₹40,000 crore. The challenge has shifted from building supply to finding demand. Industry bodies are urging higher blending targets—E22, E25, and eventually E85—to improve capacity utilisation. However, critics argue that the ethanol programme has become less about energy security and more about absorbing surplus production capacity and managing cyclical sugar surpluses.

The Import Substitution Illusion

A fundamental critique of the ethanol programme questions whether it genuinely reduces India's external dependence. While ethanol substitutes some petrol, crude oil is imported not only to make petrol but also diesel, LPG, aviation fuel, naphtha, and petrochemical feedstocks. Even replacing 20 per cent of petrol volume cannot produce a proportional reduction in crude imports. Moreover, the domestic production of ethanol requires imported

inputs: fertilizers such as urea, DAP, and potash require imported natural gas. Higher policy support for ethanol feedstocks may also reshape cropping patterns toward sugarcane, maize, and rice—and away from oilseeds and pulses, where India already relies heavily on imports. In essence, ethanol may reduce crude oil imports without proportionately reducing overall external dependence; the dependence simply shifts.

The Road Ahead: Balancing Ambition with Prudence

Beyond E20: A Cautious Approach

The government has set a target of increasing blending to 30 per cent by 2030, and industry is pushing for even higher blends. Industry executives note that India already has enough capacity to meet higher targets; moving to E25 could unlock demand for an additional 300 crore litres of ethanol, improving plant utilisation. However, the next phase must be guided by data from the E20 "experiment." As the government acknowledged before the Supreme Court, impact assessment is still underway. Prematurely moving to higher blends without fully understanding the consequences for vehicle compatibility, fuel efficiency, and feedstock sustainability could create new problems.

Rebalancing Feedstock Strategy

The shift toward grain-based ethanol, while addressing sugar surpluses, raises long-term sustainability concerns. Experts recommend focusing on second-generation (2G) ethanol from agricultural waste—crop residues like rice straw—and eventually third-generation (3G) ethanol from algae, which avoids food-versus-fuel conflicts. Indian Oil Corporation has started a pilot project on "Rice-Parali" (rice straw) at Panipat, suggesting that this path is already being explored.

Strengthening Flex-Fuel Ecosystem

For higher ethanol blends to succeed, India must accelerate the flex-fuel vehicle ecosystem. The government has already introduced E85 fuel for flex-fuel vehicles, and auto manufacturers are developing compliant platforms. However, consumer adoption will depend on clear regulatory support, transparent pricing signals, and confidence that higher blends will not damage vehicles.

Policy Clarity and Pricing Rationality

Industry voices have flagged stagnant ethanol prices, lower allocations, and policy imbalance as reasons for idle capacity even after large capital commitments. A transparent glide path to higher blending targets, along with procurement prices that reflect feedstock economics, is essential for sustaining investment confidence. At the same time, the government should avoid incentivizing ethanol production to the point where it distorts cropping patterns and food markets.

Conclusion

India's ethanol blending programme represents a bold experiment at the intersection of energy security, agricultural policy, and environmental sustainability. The achievement of E20 five years ahead of schedule reflects impressive policy execution and capacity building. However, the programme has reached a point where simple expansion is no longer sufficient. The next phase of India's ethanol journey requires moving beyond blending targets toward a holistic assessment of water use, cropping incentives, import substitution, and long-term resource allocation. Reducing crude imports is not necessarily the same as reducing external dependence, nor is expanding production the same as improving efficiency. India stands at a crossroads: it can either continue along the current trajectory, potentially intensifying water stress and food security concerns, or it can recalibrate its approach toward more sustainable feedstocks, transparent economics, and integrated energy planning. The lessons from the E20 experiment must inform these decisions. As one expert noted, the question is whether India will "digitally empower 146 million farmers—or let the digital divide deepen rural poverty." A similar tension now defines the ethanol programme: it can be a genuine energy transition pathway, or it can become an expensive subsidy program for surplus agricultural capacity.

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