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India's Green Fuel Crossroads:

Navigating the Ethanol Paradox



Introduction

India's ambitious journey toward energy sovereignty through green fuels has reached a defining, and unexpectedly complex phase. The Ethanol Blending Programme (EBP), a cornerstone of this strategy, stands as a testament to early, remarkable success. By nearly achieving its E20 target—blending 20% ethanol with petrol—ahead of schedule, the initiative has bolstered energy security, curbing crude oil imports by approximately 245 lakh metric tonnes and saving a staggering ₹1.44 lakh crore in foreign exchange by August 2025. However, this very success has catalysed a new set of economic and logistical challenges, revealing the intricate balance required in managing a rapidly scaled green transition. The sector now grapples with a severe supply glut, shifting agricultural dynamics, and a pressing need for a clear, technologically sound roadmap beyond E20.



The Supply-Demand Imbalance: A System in Overdrive

The most immediate challenge facing India's ₹50,000 crore ethanol industry is a stark mismatch between production capacity and actual demand.

- **Capacity Far Outstrips Demand:** Driven by aggressive policy support, installed ethanol production capacity has soared to around 20 billion litres, with an additional 4 billion litres in the pipeline. Contrast this with the current demand under the E20 policy, estimated at just 11 billion litres for the ongoing ethanol year (November-October). This translates to a surplus capacity exceeding 50%.
- **Operational and Financial Strain:** This oversupply has severe consequences. Industry reports indicate distilleries are operating at a critically low 25–30% capacity utilisation. The approval process for new plants has been halted, yet nearly 100 new distilleries came online in 2024-25 alone, exacerbating the supply pressure. This underutilisation threatens the financial viability of recent investments, estimated in the tens of thousands of crores, and stifles further private sector enthusiasm.

The core of the problem lies in policy plateau. The industry scaled rapidly to meet the E20 target, but in the absence of a confirmed next target—be it E27, E85, or the introduction of ethanol-blended diesel—demand has flatlined while supply continues its upward trajectory.

The Feedstock Shift: From Sugarcane to Grains

A silent revolution within the revolution has been the dramatic change in the raw material, or feedstock, used for ethanol production. This shift carries significant implications for agriculture, pricing, and food security.

- **The Rise of Grain-Based Ethanol:** Government incentives have successfully diversified feedstock away from a heavy reliance on sugarcane. Today, grain-based sources constitute nearly 69% of total ethanol supply. Within this, maize (corn) has become the dominant player, contributing close to 50% of all ethanol produced. Conversely, the share of sugarcane-based ethanol has declined to about 31%.
- **Agricultural and Economic Ripple Effects:** This policy-driven demand has transformed agricultural economics. Between FY22 and FY25, the government-set price for maize-based ethanol increased at an average annual rate of 11.7%, making it an attractive cash crop for farmers. Consequently:
 - Maize production has grown at 8.77% per year.
 - The cultivated area for maize has expanded by 6.68% annually.
 - Since FY16, maize yield has skyrocketed by 48%, reaching 3.78 tonnes per hectare in FY25.

While this boosts farmer income and feedstock security, it raises long-term questions about the diversion of land and resources from other essential crops like pulses and oilseeds, potentially impacting broader food inflation and nutritional security.

The Sectoral Slowdown: Momentum Meets a Technical Ceiling

The ethanol sector's rapid growth has hit a plateau, not due to a lack of effort, but because of inherent technical and policy barriers.

- **The E20 Ceiling:** The blending target of 20% represents a technical sweet spot for most of India's existing vehicle fleet without requiring major modifications. Moving beyond this—to E27 or E30—introduces compatibility issues, particularly for older vehicles. Concerns include:
 - **Corrosion:** Higher ethanol blends can degrade certain rubber, plastic, and metal components in fuel systems and engines not designed for them.
 - **Engine Performance:** Issues with cold starting, drivability, and long-term engine wear require automotive re-engineering.
 - **Fuel Stability:** Ethanol is hygroscopic (absorbs water), which can lead to phase separation in storage, a significant challenge for fuel logistics
- **The Diesel Dilemma:** Expanding demand through diesel blending (E-diesel) is often suggested but is fundamentally more complex. Ethanol and diesel are not miscible without the addition of costly emulsifiers or stabilizers. Even then, challenges with lubricity, energy content, and emissions in compression-ignition engines remain substantial technical hurdles. Countries like Brazil have pursued biodiesel pathways (from vegetable oils) rather than ethanol-diesel blends for this reason.

The absence of a clear, technically-backed policy signal for higher blends has created an "investment pause," leaving the massive installed capacity underutilised.

Investor Implications: From Boom to Cautious Reassessment

The financial landscape for the ethanol sector has undergone a sharp transition from a high-growth narrative to one defined by consolidation and risk management.

- **Short-Term Pressures:** The current oversupply environment is compressing margins. With fixed costs spread over low output, distilleries face strained balance sheets. Investors are confronted with:
 - **Asset Stranding Risk:** Capital invested in plants running at 25-30% capacity may not generate adequate returns.
 - **Policy Uncertainty:** The lack of visibility on future offtake guarantees makes new investments untenable.
- **Long-Term Structural Opportunity:** For strategic investors, the current glut could present a future opportunity. If the government announces a credible, long-term roadmap (e.g., a phased move to E27 by 2030, mandates for flex-fuel vehicles, or pilot projects for advanced biofuels), the existing surplus capacity could quickly be absorbed. Supportive measures like production-linked incentives (PLIs) for second-generation (2G) ethanol from agricultural waste or tax benefits for capacity retrofitting could redefine the sector's economics.

The Road Ahead: Policy, Technology, and Balance

The future of India's green fuel transition hinges on strategic, multi-dimensional policymaking that addresses technical, agricultural, and economic realities in concert.

Challenge	Immediate Action Required	Long-Term Policy Direction
Oversupply & Low-Capacity Utilisation	Halt new approvals, consider temporary incentives for ethanol storage or export.	Announce a clear, phased blending roadmap (E27 by 2027, E30 by 2030) to reactivate demand.
Vehicle Compatibility	Mandate OEMs to certify all new vehicles for E27/E30. Launch public awareness campaigns for older vehicle checks.	Incentivize production and purchase of Flex-Fuel Vehicles (FFVs) capable of running on up to E85.
Food-Fuel Security Balance	Continuously dynamically adjust feedstock pricing to avoid excessive diversion from food crops.	Accelerate R&D and commercialization of 2G ethanol from crop residues (like rice straw, bagasse) to decouple fuel from food.
Diesel Blending Ambition	Fund large-scale pilot projects with OMCs and research institutions to solve stability and compatibility issues.	Develop a parallel, separate strategy for biodiesel and other drop-in green diesel alternatives.

Conclusion: A Pivot Point for Sustainable Security

India's ethanol story is far from over; it is merely entering a more mature and challenging chapter. The initial success proves the model's potential for energy security and farmer prosperity. The current crisis of oversupply is, paradoxically, a symptom of that very success. Navigating this juncture requires moving from a singular focus on blending percentages to a holistic strategy that integrates automotive industry collaboration, agricultural policy, and advanced biofuel research. By providing clear long-term signals, stable pricing mechanisms, and a commitment to solving technical barriers, policymakers can transform the present supply glut into the foundation for a resilient, technologically advanced, and truly sustainable green fuel ecosystem. For investors and stakeholders, the sector now demands not just capital, but careful analysis, patience, and a belief in the nation's long-term green imperative.





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