



Ethanol Blending for Sustainable India

This editorial is based on “[Blending dilemma: Conflicting priorities on flex-fuel need clear policy](#)” which was published in Business Standard on 21/01/2025. The article brings into picture India's ethanol-blending programme as a crucial step towards sustainability, enhancing energy security and reducing carbon emissions. However, challenges like feedstock shortages, water-intensive production, and supply chain inefficiencies must be tackled through policy support and innovation.

For Prelims: [India's ethanol-blending programme](#), [Foreign exchange](#), [PM-JI-VAN Yojana](#), [National Bio-Energy Programme](#), [National Bio-Energy Mission](#), [Food Corporation of India](#), [Global Biofuels Alliance](#), [National Green Mobility Strategy](#), [FCI](#), [Faster Adoption and Manufacturing of Electric Vehicles](#), [Minimum support price](#), [PM Krishi Sinchayee Yojana](#) .

For Mains: Key Benefits of Ethanol Blending for India, Key Issues Associated with Ethanol Blending in India.

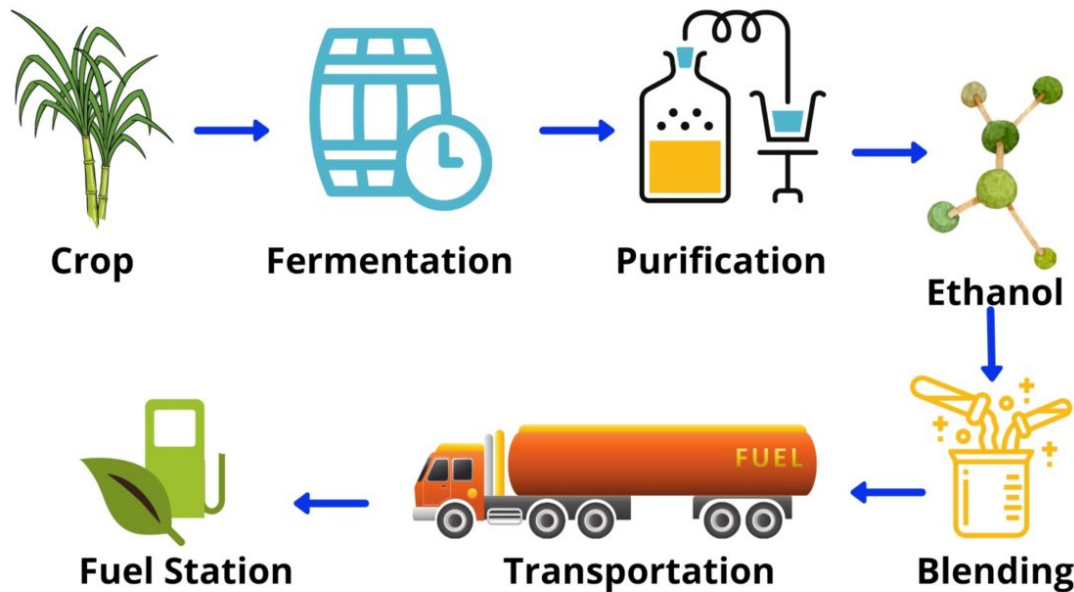
[India's ethanol-blending programme](#) is a major step towards sustainability, reducing fossil fuel dependence and curbing carbon emissions. It has enhanced energy security, **saved ₹1.1 trillion in foreign exchange**, and prevented 50 million tonnes of CO₂ emissions. However, challenges persist, including **feedstock shortages, water-intensive ethanol production, supply chain inefficiencies**, and pricing concerns. Addressing these issues through policy support, infrastructure expansion, and technological innovation is crucial for accelerating progress in this regard.

What is Ethanol Blending?

- **About: Ethanol blending** refers to the process of mixing ethanol, a biofuel derived from plant-based sources, with petrol to create a more sustainable and cleaner-burning fuel.
 - This reduces dependence on fossil fuels, lowers carbon emissions, and enhances energy security.
 - Ethanol is primarily produced from **sugarcane molasses, maize, rice, and other biomass sources** in India.
 - The Government of India launched the [Ethanol Blended Petrol \(EBP\) Programme](#) in **2003** to promote ethanol use in transportation fuel.
- **Government Initiatives for Ethanol Blending:**
 - [PM-JI-VAN Yojana](#) - Supports second-generation ethanol production from agricultural waste.
 - [National Bio-Energy Programme](#)- Promotes ethanol and other biofuels for sustainable energy.
 - **Interest Subvention Scheme** - Provides financial support for setting up ethanol plants.
 - **GST Reduction** - Ethanol for EBP programme taxed at **5% (reduced from 18%)** to encourage adoption.

- **Current Status & Future Roadmap:** The initial target of **10% blending by 2022** was achieved ahead of schedule, leading to an ambitious goal of **20% ethanol blending (E20) by 2025**.
 - Currently, ethanol blending stands at **15% as of 2024**. Expansion of **ethanol-dedicated fuel stations** and **E20-compatible vehicles** will play a key role in accelerating implementation.

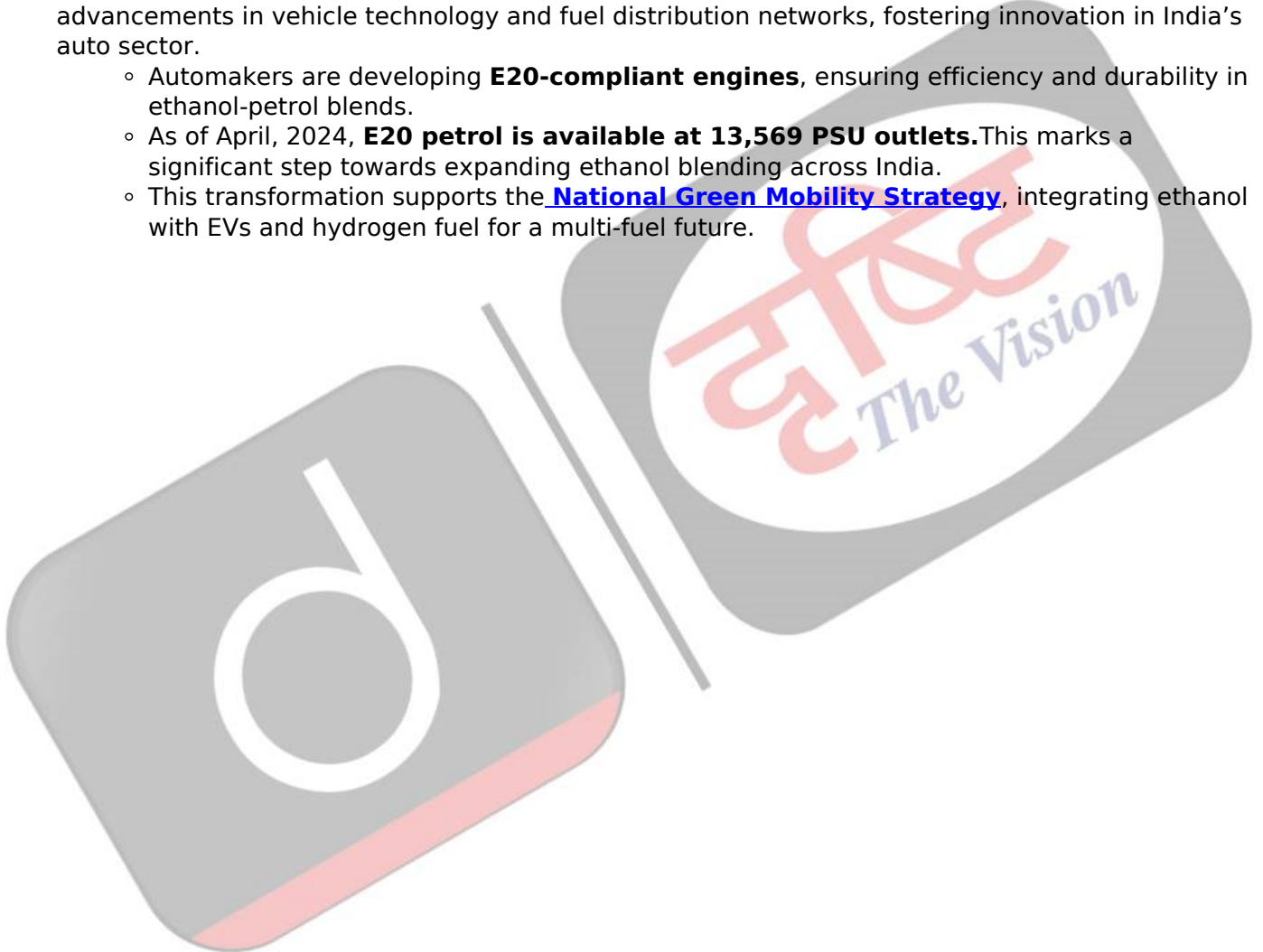
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What are the Key Benefits of Ethanol Blending for India?

- **Energy Security and Reduced Import Dependence:** India imports over **87% of its crude oil needs**, making it vulnerable to price volatility and geopolitical risks.
 - **Ethanol blending reduces this dependence** by substituting imported petrol with domestically produced **biofuel**, enhancing **self-reliance in energy**.
 - The **Ethanol Blended Petrol (EBP) Programme** has already **saved ₹1.1 trillion in foreign exchange** over the last decade.
 - Additionally, ethanol blending helped replace **181 lakh metric tonnes of crude oil** between **2014 and 2024**.
- **Reduction in Carbon Emissions and Pollution:** **Vehicular emissions** are a major contributor to **urban air pollution and climate change**, increasing respiratory diseases and environmental degradation.
 - Ethanol has **oxygen molecules** that enable more complete combustion, reducing carbon monoxide and particulate matter emissions.
 - The **National Bio-Energy Mission** promotes ethanol as a cleaner alternative to fossil fuels, aligning with India's **Net-Zero 2070** target.
 - Since 2014, the ethanol program has **cut CO₂ emissions by 544 lakh metric tonnes**, significantly improving air quality.
- **Economic Growth and Rural Employment:** Ethanol production boosts the rural economy by providing farmers with additional income streams through **sugarcane, maize, and other biofuel crops**.
 - Increased ethanol demand encourages investment in distilleries and agro-processing industries, creating jobs and reducing distress migration.
 - The **PM-JI-VAN Yojana** incentivizes second-generation ethanol production, further strengthening the rural economy.
 - Ethanol blending has led to **₹87,558 crore disbursed to farmers** and **₹1,45,930 crore paid to distillers**, stimulating rural employment and agro-industrial growth.
- **Diversification of Cropping Patterns and Waste Utilization:** Ethanol production encourages a shift from **water-intensive crops like rice and wheat** to alternative feedstocks like maize and sorghum, promoting sustainable agriculture.

- The government has allowed [Food Corporation of India \(FCI\)](#) rice and maize for ethanol production, ensuring stable farmer incomes.
- The **price of ethanol from maize is ₹51.55/litre**, and from FCI rice, it is **₹56.87/litre**, making surplus grain utilization economically feasible.
 - The **interest subvention scheme** has attracted investment in **grain-based distilleries**, boosting ethanol supply.
- **Foreign Investment and Industrial Growth:** India's ethanol push has created a lucrative market for private investment in biofuel infrastructure, attracting both domestic and foreign capital.
 - Policies like the **Long-Term Ethanol Procurement Policy** provide revenue visibility, encouraging large-scale investment in distilleries and supply chains.
 - The [Global Biofuels Alliance \(GBA\)](#) launched at the **G20 Summit 2023** positions India as a global leader in ethanol trade and technology.
 - The ethanol industry's rapid expansion has seen **₹40,000 crore in new investments**, enhancing India's manufacturing and export potential.
- **Strengthening of Automobile and Fuel Infrastructure:** Higher ethanol blending requires advancements in vehicle technology and fuel distribution networks, fostering innovation in India's auto sector.
 - Automakers are developing **E20-compliant engines**, ensuring efficiency and durability in ethanol-petrol blends.
 - As of April, 2024, **E20 petrol is available at 13,569 PSU outlets**. This marks a significant step towards expanding ethanol blending across India.
 - This transformation supports the [National Green Mobility Strategy](#), integrating ethanol with EVs and hydrogen fuel for a multi-fuel future.



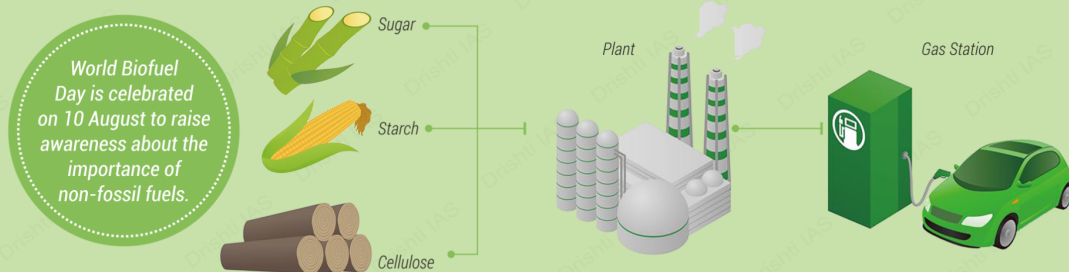
ETHANOL AS A FUEL

About Ethanol

- One of the principal biofuels
- Also called ethyl alcohol (C₂H₅OH)

Produced

- Naturally by fermentation of sugar (or corn, rice etc)
- By petrochemical processes (ethylene hydration)



Ethanol Blending

Blending ethanol with petrol to burn less fossil fuel while running vehicles.

Blending Target

- 20% ethanol blending in petrol (E20) by 2025

Currently, ethanol makes up 10% of the petrol used in vehicles.

Significance

- Reduce oil imports
- Equivalent efficiency at a lower cost than petrol
- Burns completely and cleaner than petrol
- Ethanol produced from farm residue to boost farmers' income

Challenges in Success

- High land requirement for sugarcane (+ consequent food prices issue)
- High water requirement of biofuel crops

Related Initiatives

- Roadmap for Ethanol Blending in India (Report by NITI Aayog) (2021)
- E100 Pilot Project (Network for production and distribution of ethanol) (2021)
- Pradhan Mantri **JI-VAN** Yojana (to boost 2G ethanol projects) (2019)
- The National Policy on Biofuels (2018)

What are the Key Issues Associated with Ethanol Blending in India?

- Water-Intensive Nature of Ethanol Production:** Ethanol production in India is **heavily dependent on sugarcane**, which requires enormous water resources, exacerbating water stress in already drought-prone regions.
 - This raises concerns about unsustainable agricultural practices and groundwater depletion, particularly in states like **Maharashtra and Uttar Pradesh**.
 - Alternative **feedstocks like maize and sorghum** are being promoted, but their adoption remains limited due to lower ethanol yields and farmer preferences.
 - According to **NITI Aayog**, sugarcane and paddy combined use 70% of irrigation water of the country, posing risks for long-term sustainability of ethanol.
- Impact on Food Security and Inflation:** As ethanol demand increases, more food grains like **rice and maize** are diverted for fuel, potentially driving up food prices and affecting food security.
 - The use of **FCI rice and maize** for ethanol production may **reduce surplus buffer stocks**, limiting government capacity to stabilize food prices during shortages.
 - This raises ethical concerns about using edible grains for energy when malnutrition remains a challenge in India.
 - FAO 2023 report** warned that **biofuel expansion could tighten global food supply chains**, impacting vulnerable populations.
- Limited Ethanol Production Capacity and Supply Chain Bottlenecks:** Despite rapid growth, India's ethanol production and distribution infrastructure remain inadequate to meet the **20%**

blending target by 2025.

- Supply chain inefficiencies, including transport challenges and storage constraints, make uniform ethanol availability difficult across all regions.
- **Many states lack sufficient distilleries and blending facilities**, making them dependent on ethanol imports from other states.
- **Technological and Vehicle Compatibility Challenges:** India's vehicle fleet is largely designed for **E10 fuel**, and transitioning to **E20 and beyond** requires modifications in engine design and fuel systems.
 - Higher ethanol content can cause **corrosion and reduced fuel efficiency**, leading to long-term maintenance challenges for consumers.
 - Automobile manufacturers are working on **E20-compatible engines**, but existing vehicles may face performance issues unless retrofitted.
- **Financial Viability and Price Volatility:** Ethanol production is subject to **price fluctuations** due to variable sugarcane and grain output, **impacting industry profitability and investment stability**.
 - Distilleries depend on government-fixed procurement prices, which may not always align with market dynamics, creating uncertainty for investors.
 - The **energy content of ethanol is lower than that of gasoline**, requiring more fuel for the same mileage, which can offset cost benefits for consumers.
- **Environmental Concerns in Ethanol Production:** While ethanol reduces carbon emissions in vehicles, its production process—**especially from sugarcane and molasses**—leads to **high water usage, deforestation, and industrial waste discharge**.
 - Ethanol distilleries generate large amounts of waste water. This wastewater, known as **vinasse**, contains high concentrations of organic matter, residual sugars, and other pollutants.
 - If not properly treated, **it can pose significant environmental risks**, including water pollution and depletion of oxygen in aquatic ecosystems.
- **Heavy Dependence on Government Subsidies:** Ethanol production in India is **heavily reliant on government incentives**, including **interest subvention schemes, differential pricing, and tax exemptions**.
 - Any policy reversal or reduction in financial support could make **ethanol production economically unviable** for distillers and farmers.
 - The **Pradhan Mantri JI-VAN Yojana** has been extended until 2028-29 to boost second-generation ethanol, but adoption remains slow due to **high capital costs**.
 - Policy fluctuations in ethanol blending targets, **such as the shift from 2030 to 2025**, create implementation challenges for industry stakeholders.

What Measures to Strengthen Ethanol Blending and Accelerate Implementation?

- **Expanding Feedstock Diversification Beyond Sugarcane:** Dependence on sugarcane for ethanol is unsustainable; India must promote **maize, sorghum, bamboo, and agricultural waste** as alternative feedstocks.
 - Strengthening the **Pradhan Mantri JI-VAN Yojana** with better R&D funding can accelerate second-generation ethanol production.
 - The government should also integrate **PM-KISAN** to provide financial incentives for farmers shifting to biofuel crops.
 - Expanding ethanol production from **damaged food grains and municipal waste** can further enhance availability.
 - A structured **minimum support price (MSP) framework** for ethanol-linked crops can ensure stable raw material supply.
- **Strengthening Rural Distilleries and Decentralized Production:** A decentralized ethanol production model with **small-scale distilleries in rural areas** can improve supply-chain efficiency and reduce transportation costs.
 - Linking ethanol units with **FPOs (Farmer Producer Organizations)** can empower local farmers and enhance direct procurement of feedstock.
 - The government should provide **low-interest loans under Mudra Yojana** for small entrepreneurs to set up ethanol plants.
 - Establishing **bio-refinery clusters** in grain-producing states will balance regional ethanol

availability.

- **Enhancing Vehicle Compatibility and Fuel Infrastructure:** Mandating **E20-compatible vehicles** by 2025 must be complemented by **incentives for retrofitting older vehicles** to avoid consumer backlash.
 - Collaborating with **automobile manufacturers and IITs** to develop cost-effective engine modifications can ease the transition.
 - Expanding **ethanol-dedicated fuel pumps** across India, especially in non-sugarcane-producing states, will ensure uniform accessibility.
 - Public transport systems should be mandated to use **ethanol-blended fuels**, integrating [Faster Adoption and Manufacturing of Electric Vehicles \(FAME\)](#) with **biofuel policies** for hybrid solutions.
- **Improving Pricing Stability and Market-Linked Procurement:** A dynamic **Ethanol Price Stabilization Fund** should be created to insulate ethanol producers from raw material price fluctuations.
 - Moving towards a **market-driven ethanol procurement mechanism**, similar to the power sector's **Renewable Energy Certificates (REC)**, can encourage private sector participation.
 - A **carbon credit system** linked to ethanol production can provide financial incentives for industries adopting green fuel.
 - Flexible pricing mechanisms based on **seasonal variations in crop yield and crude oil prices** can make ethanol production more predictable.
- **Addressing Water Sustainability in Ethanol Production:** Shifting towards **water-efficient biofuel crops** through incentives under [PM Krishi Sinchayee Yojana](#) can reduce excessive water consumption in ethanol production.
 - Promoting **drip irrigation and micro-irrigation systems** for ethanol-linked crops will enhance sustainability.
 - Encouraging ethanol plants to implement **zero-liquid discharge (ZLD) systems** can reduce industrial water pollution.
 - Integrating ethanol plants with **wastewater treatment facilities** under **Namami Gange** can ensure responsible water usage.
- **Accelerating Investment and Private Sector Participation:** A dedicated **Ethanol Infrastructure Development Fund (EIDF)** with tax incentives can attract private investments in ethanol plants.
 - Linking ethanol production with [Make in India](#) can encourage domestic manufacturing of distillery equipment and fuel additives.
 - **Viability gap funding (VGF)** should be extended to private ethanol plants in non-traditional biofuel states.
 - Expanding **FDI opportunities in biofuel research and development** will bring in global expertise and capital.
 - Enabling **public-private partnerships (PPPs) in ethanol logistics and distribution** will enhance nationwide supply efficiency.
- **Strengthening Policy Coordination and Governance Framework:** State governments should be encouraged to launch **ethanol-specific industrial policies** to attract investments.
 - Strengthening **interstate ethanol transport regulations** will prevent logistical disruptions and price disparities.
 - A **single-window clearance system for ethanol plant approvals** will reduce bureaucratic delays.
 - Linking **Ethanol Blended Petrol (EBP) Programme** with [National Green Hydrogen Mission](#) can create a long-term clean fuel roadmap.

Conclusion

India's ethanol-blending initiative holds immense potential for **enhancing energy security, reducing carbon emissions, and boosting rural economies**. However, overcoming challenges such as **feedstock shortages, water usage, and infrastructure limitations is critical to achieving the 20% blending target by 2025**. Strengthening policy support, expanding decentralized production, and improving vehicle compatibility will accelerate progress.

Drishti Mains Question:

Discuss the significance of ethanol blending in India's energy strategy. Highlight the key challenges faced in its implementation and suggest measures to address them.

UPSC Civil Services Examination, Previous Year Questions (PYQ)

Q. Given below are the names of four energy crops. Which one of them can be cultivated for ethanol? (2010)

- (a) Jatropha
- (b) Maize
- (c) Pongamia
- (d) Sunflower

Ans: (b)

Q. According to India's National Policy on Biofuels, which of the following can be used as raw materials for the production of biofuels? (2020)

1. Cassava
2. Damaged wheat grains
3. Groundnut seeds
4. Horse gram
5. Rotten potatoes
6. Sugar beet

Select the correct answer using the code given below:

- (a) 1, 2, 5 and 6 only
- (b) 1, 3, 4 and 6 only
- (c) 2, 3, 4 and 5 only
- (d) 1, 2, 3, 4, 5 and 6

Ans: (a)