



## Ethanol Blending: A Path to Energy Security

*This editorial is based on “[Ethanol blending is proving messy](#)” which was published in *The Hindu Business Line* on 10/11/2024. The article highlights the challenges India faces in its 90% flex-fuel vehicle push, including food security concerns, policy strain, and climate impacts, stressing the need for a thorough cost-benefit analysis.*

**For Prelims:** [Ethanol blending](#), [Ethanol Blending Programme](#), [Russia-Ukraine conflict](#), [West Asian tensions](#), [COP26](#), [Renewable energy transition](#), [Global Biofuel Alliance](#), [Carbon Footprint](#), [Global Biofuel Alliance](#), [Palletisation Units in Punjab](#).

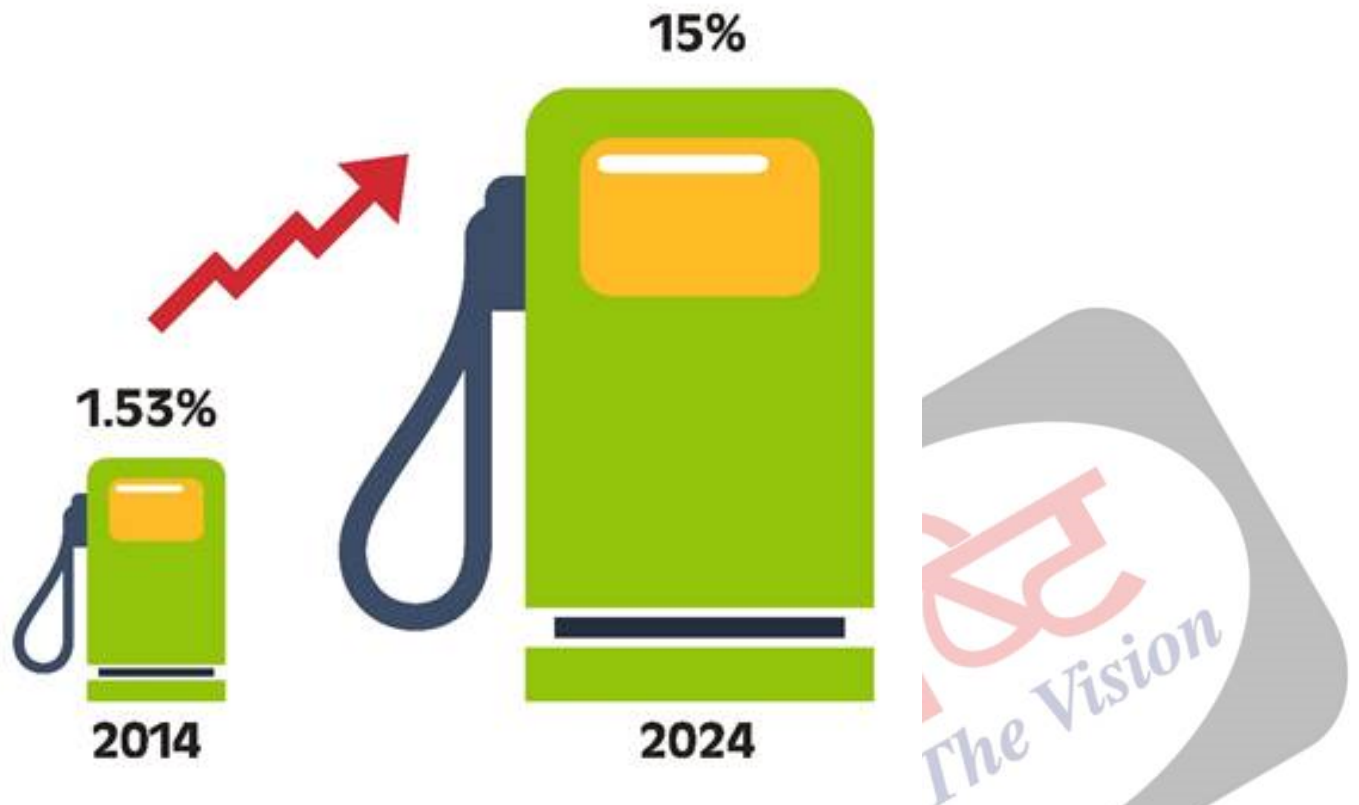
**For Mains:** Current Status of Ethanol Blending in India. Key Issues Associated with Ethanol Blending for India.

India's push for **90% flex-fuel vehicles**, inspired by **Brazil**, faces significant challenges despite achieving **15% ethanol blending in 2024**. While the [Ethanol Blending Programme](#) has saved ₹1.01 lakh crore in forex, diverting food crops like **sugarcane, rice, and maize for ethanol** raises concerns over food security. The program relies on constant policy adjustments, unlike **Brazil's market-driven model**, straining both OMCs and government finances. Climate change and unpredictable monsoons further complicate blending targets, underscoring the need for a comprehensive cost-benefit analysis before scaling up flex-fuel adoption.

### What is the Current Status of Ethanol Blending in India?

- **About:** Ethanol is a type of **alcohol primarily produced from the fermentation of sugars**, often derived from crops like sugarcane, maize, or other biomass.
  - It is commonly used as a biofuel, solvent, and in various industrial applications.
  - **Ethanol Blending** refers to the practice of mixing ethanol with petrol to create an ethanol-blended fuel.
    - This **reduces the consumption of pure petrol**, decreases environmental pollution, and promotes the use of domestically produced biofuels, contributing to energy security and sustainability.
  - India, as the **world's third-largest energy consumer**, has turned to ethanol blending to reduce oil imports. Reforms in the **Ethanol Blended Petrol (EBP) Programme**, enhance energy security and support rural incomes.
    - India has reduced the GST on ethanol to **5%** and introduced an **interest subvention** scheme to boost production capacity.

# Surge in Ethanol Blending



- **Progress of Ethanol Blending in India:**

- **Initial Target:** 20% ethanol blending by 2030, later advanced to 2025.
- **Production Growth:** Ethanol production capacity has **more than doubled, reaching 1,623 crore liters by September 2024.**
- **Blending Increase:** Blending surged from **1.53% in 2014 to 15% in 2024**, with over 545 crore liters blended in 2023-24.

- **Achievements:** India's Ethanol Blended Petrol (EBP) Programme achieved remarkable progress, with blending increasing from **1.53% in 2014 to 15% in 2024**, targeting 20% by 2025.

- This initiative saved **₹1.06 lakh crore in forex, cut CO<sub>2</sub> emissions by 544 lakh metric tons**, and boosted rural income significantly

# Ethanol Blending's Decade of Impact



2014 - August 2024



Foreign Exchange Savings



₹1,06,072  
Crore

Reduction of  
CO<sub>2</sub> Emissions



544 Lakh  
metric tons

Crude Oil  
Substitution



181 Lakh  
metric tons

## Why Ethanol Blending is Crucial for India's Energy Transition?

- **Energy Security and Import Dependency:** India currently imports over **85% of its crude oil requirements**, making it vulnerable to global price volatility and geopolitical tensions.
  - The **recent Russia-Ukraine conflict and West Asian tensions** have highlighted this vulnerability, with oil prices fluctuating dramatically.
  - The ethanol blending program has already saved **₹1.06 lakh crore in foreign exchange** through reduced imports.
  - By achieving **15% blending in 2024**, India has demonstrated the program's potential to significantly reduce import dependency. With the 20% target by 2025, India could potentially save billions annually in forex reserves.
- **Economic Benefits for Agricultural Sector:** The EBP has created a sustainable revenue model for farmers and sugar mills, with **Oil marketing companies (OMCs)** paying **₹87,558 crore directly to farmers and ₹1.45 lakh crore to distillers**.
  - This additional income stream has helped address the chronic problem of sugarcane arrears, which had historically plagued the agricultural sector.
  - The program has stimulated private investment, with distillers establishing ethanol capacities of **16.2 billion litres by September 2024**.
  - The multiplier effect has boosted rural economies and created new employment opportunities in the biofuel sector.
- **Environmental Impact and Climate Commitments:** Ethanol blending significantly reduces vehicle emissions, with studies showing a **20% reduction in carbon monoxide emissions with E20 fuel**.
  - India's commitment at **COP26 to reduce carbon intensity by 45% by 2030** makes

- ethanol blending a crucial tool in achieving climate goals.
- Recent data shows that ethanol blending has already resulted in an estimated **reduction of CO2 emissions by 544 lakh metric tons**.
- The program aligns with **India's broader [renewable energy transition strategy](#)**, complementing solar and wind initiatives.
- **Technological Innovation and Industrial Growth:** The push for ethanol blending has catalyzed **innovation in automobile technology**, with major manufacturers developing **flex-fuel engines**.
  - The **recent announcement of flex-fuel vehicles getting [GST concessions](#)** has accelerated R&D investments in this sector.
  - The program has spurred growth in biotechnology and chemical processing industries, with **new second-generation ethanol plants being established**.
  - The development of **grain-based distilleries** has created a new industrial ecosystem, generating employment and technological advancement.
  - The recent approval of **using rice straw and corn cobs for second-generation ethanol production addresses stubble burning issues**.
- **Strategic Geopolitical Positioning:** India's ethanol program strengthens its position in global climate negotiations and enhances cooperation with Brazil and other biofuel-producing nations.
  - The recent **[Global Biofuel Alliance signed in 2023](#)** facilitates technology transfer and expertise sharing.
  - The program demonstrates **India's commitment to sustainable development**, attracting green investments and international partnerships.
  - India's leadership in biofuel adoption positions it as a **model for developing nations in energy transition**.
- **Market Development and Price Stability:** The establishment of a guaranteed ethanol market has **created price stability in the sugar sector**, historically known for volatility.
  - The program has created a predictable demand curve for agricultural produce, helping in better crop planning.
  - The **fixed pricing mechanism**, while different from Brazil's model, provides certainty for investments in the sector.

## What are the Key Issues Associated with Ethanol Blending for India?

- **Food Security vs. Fuel Production Conflict:** Government recently lifted cap on sugar diversion for ethanol production starting in November 2024.
  - The December 2023 government directive **halting cane juice diversion to ethanol highlights the precarious balance**
  - The country's net sugar consumption might touch an unprecedented **30 million tonnes** in the 2024-25 season and more diversion is expected towards ethanol.
  - This **food-fuel conflict becomes more acute during poor monsoon years**, raising questions about the program's sustainability.
- **Water Resource Strain:** Sugarcane, the primary ethanol feedstock, requires approximately **2,500 litres of water per kilogram of sugar produced**.
  - The increased cultivation for ethanol has led to severe groundwater depletion in major producing states like **Maharashtra and Uttar Pradesh**.
  - Recent studies have reported that the life cycle water footprint for ethanol production in India is **between 230-7150 litres of water per litre of ethanol** depending on the residue and processing technology, adding to the strain on water resources.
- **Economic Viability and Price Mechanisms:** Unlike **Brazil's market-driven model**, India's administered pricing mechanism for ethanol creates artificial economics.
  - The recent increase in procurement prices from **₹43-59 to ₹49-66 per liter (FY19-FY23)** strains OMCs' finances.
  - The differential pricing for **various feedstocks (sugarcane juice, B-heavy molasses, grains)** creates market distortions.
- **Impact on Alternative Food Industries:** The diversion of **maize to ethanol has severely impacted the poultry and animal feed sectors**, with prices rising by 20%.
  - Recent demands for **duty-free maize imports from the poultry industry** highlight the supply chain disruption.
  - The **starch industry**, using **maize** as raw material, reports production cuts due to

feedstock shortages.

- The projected diversion of maize annually threatens India's position as a net maize exporter.
  - India typically exports between **2 to 4 million metric tonnes of corn annually**. However, in 2024, exports are projected to plummet to just **450,000 tonnes**, while the country is set to import a record **1 million tonnes, primarily from Myanmar and Ukraine**.
- **Environmental Trade-offs:** While ethanol reduces vehicle emissions, the **entire lifecycle assessment shows complex environmental impacts**.
  - Recent studies indicate **increased water pollution from distillery discharge despite zero liquid discharge norms**.
  - The **carbon footprint of ethanol production**, including land-use changes and transportation, partially offsets emission benefits.
    - Recent studies show that **life cycle GHG emissions of ethanol production were found to be 123.10 kg CO<sub>2</sub>-eq/kg** of anhydrous ethanol.
    - The main source of GHG emission was the **electricity used in the process stage (97.83%)**.
  - Also, intensive sugarcane cultivation leads to **soil degradation and affects biodiversity in agricultural regions**.
- **Technological and Vehicle Compatibility:** The existing vehicle fleet requires significant modifications for higher ethanol blends beyond E20.
  - Current vehicles that are not specifically designed for E20 fuel can face issues like **increased corrosion of engine components**, potential damage to rubber seals and gaskets due to ethanol's corrosive nature, decreased fuel efficiency
  - **Consumer acceptance remains uncertain given the lower energy content** of ethanol-blended fuels.

## What Steps can India take to Boost Ethanol Blending?

- **Diversification of Feedstock Sources:** Implement a comprehensive policy to promote **second-generation (2G) ethanol production** using agricultural residues and waste materials.
  - Establish collection centres for crop residues with automated baling and storage facilities at block levels, **similar to palletisation units in Punjab**.
  - Incentivize farmers with **direct payments for crop residue collection**.
  - Create public-private partnerships for establishing 2G ethanol plants, with the current successful example of **Panipat's paddy straw plant producing 100 kiloliters daily**.
- **Storage and Infrastructure Development:** Create a **dedicated ethanol pipeline network connecting major production clusters to consumption centers**, starting with high-priority corridors.
  - Establish regional ethanol storage hubs with modern facilities including **anti-corrosion technologies and safety measures**.
  - Develop specialized **railway wagons for ethanol transport**. Create emergency storage facilities to manage seasonal supply fluctuations.
- **Technology and Research Support:** Establish dedicated ethanol research centers in agricultural universities focusing on **developing high-yield, drought-resistant crops specifically for ethanol production**.
  - Invest in **developing enzymes and fermentation technologies** suited to Indian feedstock varieties and climatic conditions.
  - Support **automobile manufacturers in developing cost-effective flex-fuel technologies** through research grants and tax incentives.
- **Price Mechanism Reform:** Implement a dynamic pricing mechanism **linked to international crude oil prices and domestic feedstock costs**.
  - Create a **transparent formula-based pricing system** reviewed quarterly to ensure producer viability and consumer affordability.
  - Establish a **price stabilization fund to manage volatility**, funded through a small cess on petroleum products.
- **Supply Chain Optimization:** Create an **integrated digital platform for real-time tracking of ethanol movement** from distilleries to blending centers.

- Establish **zonal storage and distribution hubs** to optimize transportation costs and reduce carbon footprint.
- Implement **smart logistics solutions using AI/ML for demand prediction** and inventory management.
- Develop specialized ethanol handling facilities at ports for export potential. Create emergency response mechanisms for supply disruptions.
- **Regulatory Framework Enhancement:** Establish a **single-window clearance system for ethanol projects** under a dedicated regulatory authority.
  - Streamline environmental clearance processes while **maintaining strict compliance standards**.
  - Create standardized quality control protocols for ethanol production and blending across the country.
- **Sustainable Agricultural Practices:** Promote **crop rotation and intercropping systems** that support ethanol feedstock production without compromising food security.
  - Implement **precision farming techniques** for sugarcane cultivation to improve water use efficiency.
  - Develop **micro-irrigation systems specifically designed for ethanol feedstock crops**.
  - Create farmer producer organizations focused on sustainable feedstock production.
- **Capacity Building and Skill Development:** Establish specialized training centers for ethanol plant operators and maintenance personnel.
  - Create **certification programs for ethanol handling** and safety procedures.
  - Develop vocational courses in agricultural colleges focused on biofuel feedstock management.
- **International Cooperation:** Strengthen technical collaboration with countries like **Brazil and USA for technology transfer and best practices**.
  - Develop joint research programs with international institutions on advanced biofuel technologies.
  - Create bilateral agreements with Brazil for **knowledge exchange on flex-fuel vehicle technology**.
    - **Biofuels are part of Brazil's National Energy Plan** which helps set direction for energy supply and demand across the country. **India can significantly learn from this.**
- **Environmental Monitoring and Management:** Implement real-time monitoring systems for environmental impacts of ethanol production.
  - Develop **water recycling and zero liquid discharge systems** for distilleries with incentive mechanisms.
  - Establish **carbon credit mechanisms** for ethanol producers meeting sustainability criteria.

## Conclusion:

India's **ethanol blending program**, while promising, faces challenges in **balancing food security, environmental sustainability, and economic viability**. A comprehensive approach involving feedstock diversification, technological advancements, and policy reforms is crucial to ensure the program's long-term success. India's journey towards a sustainable and energy-secure future hinges on a well-calibrated ethanol blending strategy.

### **Drishti Mains Question:**

Discuss the significance of ethanol blending in India's energy security and environmental goals. What challenges does India face in achieving its ethanol blending targets?

## 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)**