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# DAILY CURRENT AFFAIRS DATED 26.04.2026

## GS Paper II: Current Affairs

### 1. Ethanol Blending in India and Energy Security

#### a. Introduction

India's ethanol blending programme has emerged as an important component of the country's energy security strategy. Since India imports nearly 85 per cent of its crude oil requirement, the economy remains highly exposed to international oil price volatility, pressure on foreign exchange reserves, and geopolitical uncertainty in oil-producing regions. Ethanol blending seeks to reduce this vulnerability by partially substituting petrol with a domestically produced, renewable biofuel.

At the same time, ethanol blending is not merely an energy policy. It intersects with agriculture, rural income, climate commitments, air pollution control, and technological transition in the automobile sector. Therefore, its success depends on balancing energy security with food security, water sustainability, and industrial readiness.

#### b. Meaning of Ethanol and Ethanol Blending

##### Meaning of Ethanol

Ethanol is an alcohol-based biofuel produced from biological materials. In India, it is mainly produced from sugarcane juice, molasses, maize, damaged food grains, and agricultural residues. Since its source is biomass, ethanol is considered a renewable fuel.

##### Meaning of Ethanol Blending

Ethanol blending means mixing ethanol with petrol in a defined proportion.

- **E10 Fuel:** Contains 10 per cent ethanol and 90 per cent petrol.
- **E20 Fuel:** Contains 20 per cent ethanol and 80 per cent petrol.
- **Higher Blends:** Fuels such as E85 and E100 contain much larger proportions of ethanol and require advanced engine technology and specialised fuel infrastructure.

India is presently focusing on nationwide implementation of E20 fuel as the next major milestone in its energy transition strategy.

#### c. Evolution of India's Ethanol Blending Programme

India launched the Ethanol Blended Petrol Programme in 2003. However, the programme gained stronger institutional and policy backing after the introduction of the National Policy on Biofuels in 2018.

##### Policy Evolution

- **Initial Blending Programme:** Began with limited blending targets and restricted geographical implementation.
- **National Policy on Biofuels, 2018:** Expanded feedstock options and provided a clearer policy framework.
- **Advancement of Targets:** India initially aimed to achieve 20 per cent blending by 2030, but the target was later advanced to 2025–26.

##### State Support Mechanisms

The expansion of the ethanol sector has been supported through:

- Assured procurement by Oil Marketing Companies (OMCs).
- Administered ethanol pricing.

- Financial assistance to sugar mills and distilleries.
- Policy incentives for ethanol production capacity expansion.

Thus, India's ethanol programme has evolved into a major example of a state-supported energy transition initiative.

As the programme expanded, ethanol blending began to serve multiple strategic objectives beyond fuel substitution alone.

## d. Importance of Ethanol Blending for India

### i. Contribution to Energy Security

The most important justification for ethanol blending is energy security. By replacing a part of petrol consumption with domestically produced ethanol, India can reduce its dependence on imported crude oil.

#### Strategic Importance

- Reduces vulnerability to international oil price shocks.
- Lowers exposure to geopolitical instability in oil-producing regions.
- Supports the broader objective of *Atmanirbhar Bharat* by promoting domestic fuel production.

Since ethanol can be produced from agricultural and biomass-based sources within India, it strengthens long-term strategic autonomy in the energy sector.

### ii. Reduction in Import Bill

Oil imports consume a substantial amount of India's foreign exchange reserves. Even moderate reductions in petrol consumption can generate significant savings over time.

#### Economic Benefits

- Reduces foreign exchange outflow.
- Improves macroeconomic stability.
- Minimises vulnerability to fluctuations in global crude oil prices.

Thus, ethanol blending has both energy and macroeconomic significance.

### iii. Support to Farmers and Rural Economy

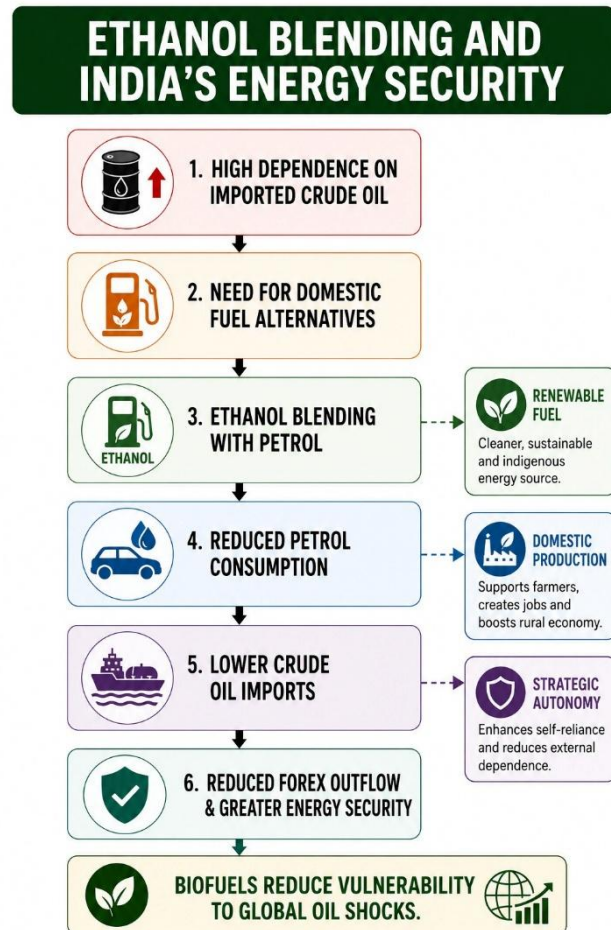
Ethanol production creates an additional market for agricultural produce and biomass.

#### Agricultural Benefits

- Provides demand for sugarcane, maize, damaged grains, and crop residues.
- Helps improve farmer incomes through value addition.
- Strengthens rural agro-processing industries.

#### Industrial Benefits

- Supports sugar mills through diversification of revenue sources.
- Encourages investment in rural biofuel infrastructure.



- Generates employment opportunities in storage, transport, and processing.

In this manner, ethanol blending connects energy policy with agricultural transformation and rural development.

#### **iv. Environmental Benefits**

Ethanol burns more cleanly than petrol and contributes to cleaner fuel usage.

#### **Environmental Contributions**

- Reduces carbon monoxide emissions.
- Helps lower certain particulate pollutants.
- Contributes to climate mitigation objectives through renewable fuel use.

Although ethanol alone cannot solve vehicular pollution, it forms an important component of India's cleaner mobility strategy.

#### **v. Reduction in Stubble Burning**

Second-generation ethanol can be produced using crop residues such as rice straw and agricultural waste.

#### **Significance for North India**

- Provides economic value to agricultural residue.
- Helps reduce stubble burning in Punjab and Haryana.
- Converts biomass waste into useful energy resources.

If scaled effectively, second-generation ethanol can simultaneously address environmental pollution and energy generation.

While ethanol offers multiple benefits, significant technological and structural limitations prevent India from directly shifting towards pure ethanol fuel.

### **e. Why India Cannot Shift Directly to E100**

#### **i. Lower Energy Content of Ethanol**

Ethanol contains lower energy per litre compared to petrol.

#### **Implications**

- Vehicles running on higher ethanol blends may provide lower mileage.
- Greater fuel volume may be required for the same travel distance.
- Economic viability depends on both fuel pricing and efficiency.

Thus, ethanol's lower energy density remains a major limitation for large-scale transition towards E100.

#### **ii. Vehicle Compatibility Constraints**

Most vehicles currently operating in India are designed only for low or moderate ethanol blends.

#### **Technical Challenges**

E100-compatible vehicles require:

- Corrosion-resistant fuel systems.
- Modified fuel injectors.
- Special sensors and engine calibration systems.
- Flex-fuel engine technology.

India's flex-fuel vehicle ecosystem is still at a relatively early stage of development.

### **iii. Infrastructure Limitations**

Higher ethanol blending requires major modifications in fuel handling systems.

#### **Infrastructure Requirements**

- Ethanol-compatible pipelines.
- Separate storage facilities.
- Modified fuel pumps and dispensing systems.
- Specialised logistics and transportation networks.

Since India is still stabilising E20 implementation, a rapid shift towards E85 or E100 would create operational and financial challenges.

### **iv. Food versus Fuel Debate**

A large share of India's ethanol production currently depends on sugarcane and food grains.

#### **Major Concerns**

- Diversion of crops towards fuel production may affect food availability.
- Food inflation may increase due to feedstock diversion.
- Nutritional security concerns may emerge in vulnerable populations.

Therefore, the food versus fuel debate remains central to India's ethanol policy framework.

### **v. Water Stress and Ecological Concerns**

Sugarcane is among the most water-intensive crops cultivated in India.

#### **Environmental Risks**

- Expansion of sugarcane cultivation may worsen groundwater depletion.
- Irrigation pressure may increase in water-scarce regions.
- Regional ecological imbalance may intensify.

Hence, ethanol expansion must be aligned with scientific agro-climatic planning and sustainable water management.

### **vi. Dependence on Government Support**

The ethanol sector currently relies heavily on policy support.

#### **Nature of Support**

- Administered pricing mechanisms.
- Assured procurement by OMCs.
- Subsidies and financial incentives.
- Capacity expansion support.

Without continued policy assistance, ethanol may not always remain commercially competitive against petrol, raising concerns regarding long-term fiscal sustainability.

These limitations have increased attention towards more sustainable forms of ethanol production.

## **f. First-Generation and Second-Generation Ethanol**

### **i. First-Generation Ethanol**

First-generation ethanol is produced from food-based feedstock such as sugarcane, maize, and grains.

#### **Advantages**

- Easier to produce at commercial scale.

- Existing production infrastructure already available.

#### **Limitations**

- Creates food security concerns.
- Increases pressure on water resources.
- Encourages excessive dependence on sugarcane cultivation.

#### **ii. Second-Generation Ethanol**

Second-generation ethanol is produced from non-food biomass such as crop residues and lignocellulosic material.

#### **Advantages**

- Reduces dependence on food crops.
- Helps address stubble burning.
- Utilises agricultural waste efficiently.
- More environmentally sustainable in the long term.

For India, second-generation ethanol must become the long-term strategic priority.

The transition towards higher ethanol usage also requires major changes in the automobile sector.

#### **g. Flex-Fuel Vehicles and Ethanol Ecosystem**

##### **i. Meaning of Flex-Fuel Vehicles**

Flex-fuel vehicles are designed to operate on multiple ethanol-petrol blends such as petrol, E20, E85, and E100.

##### **Features**

- Flexible fuel compatibility.
- Modified engines and sensors.
- Ethanol-resistant fuel systems.

Brazil is presently regarded as the global leader in flex-fuel technology adoption.

##### **ii. Importance for India**

Flex-fuel vehicles provide a gradual pathway towards higher ethanol usage.

##### **Requirements for Success**

- Development of compatible engines.
- Expansion of ethanol-compatible fuel stations.
- Creation of efficient storage and logistics systems.
- Consumer awareness and market acceptance.

Thus, vehicle technology and fuel infrastructure must evolve simultaneously.

The automobile transition towards cleaner fuels is also supported through India's regulatory framework on fuel efficiency and emissions.

#### **h. Link Between Ethanol and CAFE Norms**

Corporate Average Fuel Efficiency (CAFE) norms regulate the average fuel efficiency and carbon emission performance of automobile manufacturers.

### **i. Evolution of CAFE Norms in India**

India has implemented:

- CAFE I Norms
- CAFE II Norms
- Stricter future norms aimed at cleaner mobility

### **ii. Connection with Ethanol**

CAFE norms indirectly promote ethanol-compatible technologies because automobile manufacturers are encouraged to develop:

- Fuel-efficient engines.
- Cleaner fuel technologies.
- Hybrid mobility systems.
- Low-emission transportation solutions.

Thus, ethanol blending forms part of a broader decarbonisation strategy in the transport sector.

The role of ethanol is now expanding beyond road transportation into aviation fuel systems as well.

## **i. Ethanol and Sustainable Aviation Fuel**

### **i. Why Aircraft Cannot Directly Use Ethanol**

Aircraft engines require fuels with:

- High energy density.
- Low freezing point.
- High stability and safety standards.

Raw ethanol does not meet these aviation requirements.

### **ii. Alcohol-to-Jet Technology**

Ethanol can be converted into Sustainable Aviation Fuel (SAF) through the Alcohol-to-Jet process.

#### **Process**

In this method, ethanol is chemically processed into jet-compatible hydrocarbons suitable for aviation use.

#### **Importance**

- Aviation is one of the hardest sectors to decarbonise.
- Battery technology remains unsuitable for long-distance aviation.
- Hydrogen-based aviation systems are still under development.
- SAF is considered one of the most practical near-term solutions.

However, expanding ethanol-based aviation fuel may intensify competition for agricultural feedstock already required for road transport and food systems.

Therefore, sustainable feedstock management becomes essential for balancing multiple energy demands.

The broader debate ultimately raises an important question: can ethanol alone guarantee India's energy security?

### **j. Can Ethanol Alone Ensure Energy Security?**

Ethanol cannot provide complete energy security on its own. While it can reduce dependence on petrol imports, India requires a diversified and multi-dimensional energy strategy.

#### **Need for Energy Diversification**

India's long-term energy security must include:

- Solar energy.
- Wind energy.
- Green hydrogen.
- Nuclear energy.
- Electric mobility.
- Domestic oil and gas exploration.
- Bioenergy and energy efficiency measures.

Thus, ethanol should be viewed as one pillar within India's broader energy transition framework rather than as a standalone solution.

The challenge before policymakers is therefore to integrate ethanol expansion with sustainability, technological readiness, and agricultural balance.

### **k. Way Forward**

#### **i. Stabilisation of E20 Implementation**

India should first ensure successful nationwide implementation of E20 before aggressively moving towards higher blends.

#### **ii. Promotion of Second-Generation Ethanol**

The long-term focus must shift towards crop residue-based ethanol production.

#### **Priority Areas**

- Agricultural waste utilisation.
- Stubble burning reduction.
- Sustainable biomass supply chains.

#### **iii. Development of Flex-Fuel Ecosystem**

India must gradually build a complete flex-fuel ecosystem involving:

- Compatible vehicles.
- Ethanol-ready pumps.
- Storage infrastructure.
- Engine modification capabilities.
- Efficient fuel logistics.

#### **iv Balancing Energy and Food Security**

Ethanol policy should not compromise food security, water sustainability, or nutritional stability.

#### **Policy Priorities**

- Discourage sugarcane expansion in water-stressed regions.
- Promote scientific crop planning.

- Encourage region-specific feedstock strategies.

A balanced and sustainability-oriented approach is therefore essential for the long-term success of India's ethanol strategy.

### **Conclusion**

Ethanol blending has emerged as an important instrument for strengthening India's energy security, climate strategy, and rural economy. It can reduce crude oil imports, support farmers, lower certain vehicular emissions, and promote domestic biofuel production.

However, a direct transition towards E100 remains constrained by technological limitations, infrastructure gaps, lower energy density, feedstock competition, food security concerns, and water stress. Excessive dependence on food-based ethanol may also create ecological and economic vulnerabilities.

Therefore, India's most practical approach lies in consolidating E20 implementation, promoting second-generation ethanol, gradually developing flex-fuel vehicles, and integrating ethanol within a diversified energy transition strategy. Such a balanced pathway can help ethanol contribute meaningfully to energy security without creating new pressures on agriculture, food systems, or environmental sustainability.

## Reader's Note — About This Current Affairs Compilation

Dear Aspirant,

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While every effort has been made to balance depth with brevity, please keep the following in mind:

### 1. Orientation & Purpose

This compilation is curated primarily from the UPSC Mains perspective — with emphasis on conceptual clarity, analytical depth, and interlinkages across GS papers.

However, the PrepAlpine team is simultaneously developing a dedicated Prelims-focused Current Affairs Series, designed for:

- factual coverage
- data recall
- Prelims-style MCQs
- objective pattern analysis

This Prelims Edition will be released separately as a standalone publication.

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- lists
- tables
- visual cues

—all optimised for retention.

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### 4. Monthly Current Affairs Release

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