

## Biofuel Development in India: Policies and Future Prospects

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Received: 25 November 2025 Accepted & Reviewed: 28 November 2025, Published: 30 November 2025

### Abstract

Biofuels have emerged as a vital renewable energy option to boost security, reduce greenhouse gas emission, and promote sustainable rural development in India. This research paper emphasis the current status, trends challenges and opportunities in the India biofuel sector, with a focus on exam government policies. The study highlights the increasing importance of ethanol blending programs, diversification of feedstock. but, the sector continuous to faces challenges including feedstock scarcity, high production costs, inadequate infrastructure and concern over food security. Overall, the findings indicate that although biofuels have significant potential to support India's clean energy transition, achieving long-term sustainability requires balanced policy implementation, investment in innovation and strengthened supply chain management.

**Keyword:** Biofuel, Ethanol Blending, Feedstock Availability, Food security, Biodiesel, Energy Security, Waste- to- energy.

### Introduction

India, as one of the fastest -growing economies in the world, faces a dual challenge of ensuring energy security while also addressing environment sustainability. The heavy dependence on imported fossil fuel not only place burden on the national economy but also contribute significantly to greenhouse gas emission. In this context, biofuel derived from renewable biological resources such as agriculture residues, oilseeds, sugarcane and organic waste have emerged as a promising alternative. India's vast agriculture base and availability of biomass provide a strong foundation for accelerating biofuel production.

Over the past decade, India biofuel industry has seen tremendous growth. the government of India has implemented several policies and blending mandates to promote the adoption of ethanol, biodiesel and biogas as substitute for conventional fuels. The key growth drivers for India biofuel market include government support and policies, rising energy demand, environmental benefits and its rural development. These efforts aim to reduce crude oil import, improve rural livelihoods, and support the national transitions toward cleaner and more sustainable energy systems. However, despite substantial potential, the biofuel sector in India continue to encounter challenges related to feedstock availability, technological advancements, infrastructure and economic viability.

This research paper explores the current status, opportunities and constraints of the biofuel industry in India, with particular focus on government initiatives and future prospects.

### **OBJECTIVES**

1. To study the current status and trends of biofuel production and consumption in India.
2. To analyze government policies, programs and initiatives promoting biofuel production.
3. To identify key challenges affecting the growth of the biofuel industry in India.
4. To explore future opportunities and strategies for strengthening the biofuel sector in alignment with environmental and economic goals.

### **RESEARCH METHODOLOGY**

This research adopts a descriptive and analytical research design to evaluate the current scenario and future possibilities of the biofuel sector in India. This study is primarily based on secondary data collection from credible and authentic sources.

#### Data Sources

Ministry of Petroleum and Natural Gas Data on Ethanol Blended Petrol Program and blending target.  
Government reports

1. NITI Aayog-Report on Roadmap for Ethanol Blending in India.
2. National Policy on Biofuel (2018).
3. National policies and official schemes related to ethanol, biodiesel and biogas
4. Research paper published in reputed journals
5. Press Information Bureau (PIB) official government announcements and ethanol policy updates.
6. Books, articles and statistical data form verifies databases and websites

#### Limitations of the Study

1. The study relies entirely on secondary data, which may have periodic variations
2. Rapid policy changes may affect long-term analysis accuracy

### Critical Analysis of Indian biofuel policies

#### Overview of Indian National Biofuel Policy 2009

This is the first comprehensive policy introduced by govt. to promote the use of renewable biofuel. It was launched by the Ministry of New and Renewable Energy in December 2009.

#### Key Features

1. Its emphasis on the target of 20% blending of ethanol with petrol by 2017 and 20% of biodiesel blending with diesel by 2017.
2. Encouraged use of non-food feedstock such as Jatropha and Karanja for biodiesel for biodiesel production.
3. Avoided competition with food crop to ensure food security.
4. Formation of a National Biofuel Coordination Committee headed by the Prime Minister.
5. A Biofuel Steering Committee headed by the Cabinet Security to oversee implementation.
6. Exemption from exercise duty and reduction in taxes for biofuel.
7. Financial assistance for establishing biorefineries and R&D centers.
8. Encouraged Private sector participation in production, processing, and distribution of biofuels.
9. Focus on Second generation of biofuels using crop residues and non-edible oil seeds.

#### Challenges in Implementation

1. Limited availability of non-edible oilseeds such as Jatropha and Karanja.
2. Lack of infrastructure for large -scale collection and processing of feedbacks.
3. Poor yield and low economic viability of biofuel crops.

#### National Policy on Biofuel 2018

Replacing the earlier 2009 policy, the ministry and Petroleum and Natural Gas created a more flexible and practical framework,

#### Key features

1. Target to achieve to 20% blending of ethanol in petrol and 5% blending of biodiesel in diesel; by 2030

2. To promote the production of domestic feedstock and additional income of farmer.
3. Ethanol can be produced from a variety of feedstocks including sugarcane juice, B-heavy molasses, C-molasses, damaged food grains, maize and surplus rice
4. Categorization of Biofuels
  - a) First-generation (1G) Bioethanol from sugarcane, starch, and grains biodiesel from vegetable oils.
  - b) Second -generation (2G) Biofuels from lignocellulosic biomass such as crop residues, forest waste.
  - c) Third-generation (3G) biofuel from Algal biofuels.
5. Advanced Biofuels: Fuels derived from new technologies that provide higher efficiency and lower emissions.
6. Viability gap funding for setting up 2G bio-refineries.
7. Long-term purchase agreements by oil marketing companies to ensure assured markets.
8. A National Biofuel Coordination Committee chaired by Prime Minister oversees policy implementation.
9. State Biofuel Board are responsible for local coordination and implementation.

## CHALLENGES

Despite having significant potential, the development of biofuel sector in India faces a number of constraints:

### 1. Feedstock availability and competition

The use of food grains as feedstock for biofuels has raised serious concerns regarding food security. When crops like sugarcane, corn and wheat are diverted toward fuel production, the availability of these essential food items in the market decreases. This reduction in supply often leads to an increase in prices, making basic food products less affordable for economically weaker populations. Moreover, the shift of agriculture land from food cultivation to biofuel crops can further aggravate food shortages. This competition between food and fuel threatens nutrition security and may result in social and economic instability. Therefore, balancing biofuel production with food security needs is crucial to ensure sustainable development.

### 2. High production and processing costs

A major restraint for biofuel adoption is their high production cost compared to conventional fuels. Ethanol production requires a large amount of feedstock and energy input for biomass processing. Capital cost for commercial plants is also high. Biodiesel production has high chemical and separation costs. Unless production economics improve through technological innovations, scale etc. cost will remain a concern.

### 3. Technical constraints

Weak supply chain and infrastructure: Lack of adequate storage and distribution infrastructure for ethanol and biodiesel blend is a key bottleneck. Oil marketing companies are enhancing supply logistics but gaps exist.

### 4. Policy implementation gaps

#### Expected benefits

##### 1. Additional income to farmers

By adopting 2g technologies, agriculture residue/ waste which burnt by the farmers can be converted into ethanol and can fetch the price. this gave additional income to farmers

##### 2. Municipal solid waste management

It is estimated that, annually 62 MMT of municipal solid waste gets generated in in India one tons of such waste has the potential to provide around 20% of drop fuel in India

##### 3. Employment Generation

It generates new employment opportunities in the biofuel sector. Infrastructure investment in rural areas through setting up of 2G biorefineries

#### 4. Health Benefit

#### 5. Cleaner Environment

By reducing crop burning and conversion of agriculture wastes to biofuel there will be further reduction on Green Houses gases. Biofuel offer a path to climate change mitigation by providing a renewable alternative to fossil fuel.

#### 6. Reduce fuel import dependency

Biofuel provide an alternative to reduce the dependence on f petroleum product by promoting domestic biofuel production. Increasing domestic biofuel enhance national energy security. India is heavily dependent on crude oil imports to meet its energy needs. The rise in crude oil prices and India's increasing oil import bill is a major concern.

### OPPORTUNITES

#### 1. Emerging Advanced Biofuel

there is emerging opportunities for advanced biofuels produced from non-food feedstock like agriculture residues, municipal waste, algal biomass, etc. These second generation and third generation biofuel are more sustainable solution they do not create a fuel vs food challenge.

#### 2. Export potential

India has the opportunity to boost foreign exchange by tapping into export markets for biofuels. There is an established export market for biofuels in Europe and Asia due to stringent biofuel blending mandates. Engineering firms also exporting biofuel technologies overseas creating growth for growth.

ESY	Approx. total ethanol production (BL)	Full-grade ethanol supplied for blending (BL)
2015	0.4	0.5%
2016	0.5	1%
2017	0.6	1-2%
2018	1.9	3-4%
2019	2.5	4-5%
2020	2.5-3.0	5%
2021	3.0-3.5	6-7%
2022	4.0	7-8%
2023	5.1	10-12%
2024	6.3	13%
2025	10.5	17-19%

**Table- Ethanol Production and Blending in India**

Source: Ministry of Petroleum and Natural Gas, NITI Aayog-Roadmap for Ethanol Blending in India, 2011, PIB, 2023-24

ESY is Ethanol Supply Year

### **Biodiesel Blending program in India**

Biodiesel is a renewable biodegradable fuel derived primarily from non-edible vegetable oilseed such as Jatropha, Karanja, Ponogamia, castor, animal fats and waste cooking oil. Biodiesel can be used pure b100 or blend with petroleum diesel in different ratio such as b5 b10 or b20, where the number indicate the percentage of biodiesel in the blend it can be used in existing diesel engine with little or no modification.

Biodiesel Blending Program in India was initiated by the Government of India to promote the alternative to conventional diesel. The program aims to blend a certain percentage of biodiesel with petroleum diesel, to reduce dependence on imported crude oil and minimizing greenhouse gas emissions. blending B5 ratio. Later, under the National Policy on Biofuels (2018), the government proposed an ambitious goal to achieve 5% biodiesel blending in diesel by 2030.

The Oil Marketing Companies like Indian Oil Corporation, Bharat Petroleum and Hindustan petroleum are responsible for the procurement and blending of biodiesel with conventional diesel. In addition, the Repurpose Used Cooking Oil (RUCO) initiative by the Food Safety and Standards Authority of India (FSSAI) aims to collect and concert waste cooking oil into biodiesel.

### **History of biodiesel blending program**

- In 2003 the Ministry of Petroleum and Natural Gas launched the Biodiesel Blending Program as a pilot project. The initial target was to blend 5% biodiesel (B5) with conventional diesel in selected district across the country.
- In 2005, the government extended the program to 20 selected districts indifferent states,
- The government implemented NPB institutionalized the biodiesel blending target and encouraged private-sector participation. And encouraged private-sector participation.
- A major policy reform came with the National Policy on Biofuel 2018, which set an indicative target of 5% biodiesel blending by 2030 and extended the range of raw material to include used cooking oil, animal fats, and waste oils. The policy also introduced the Viability Gap Funding for advanced biofuel technologies and fiscal incentives for biodiesel producers.
- in 2022, the policy was amended to promote domestic production of biodiesel through initiatives like Make in India and Repurpose Used Cooking Oil (RUCO) BY FSSAI
- Challenged to the BBP
- In India, the current GST rate applicable to biodiesel and its mixture is 12%
- However, there is a reduced rate of 5% for biodiesel when it is supplied to oil market companies for blending with high-speed diesel.

### **Ethanol Blending Program**

Ethanol is a biofuel produced from sugarcane, molasses, corn and damaged grain. It is an alcohol-based fuel that can be blended with petrol to reduce the consumption of biofuel.

- The ethanol blending program launched in 2003, aims to blend ethanol with petrol with the aim of promoting the use of renewable and eco-friendly fuels. Initially, the government mandated 5% ethanol blending (E5) with petrol in nine state and four territories where ethanol is easily available. Over the time, the program expanded to more regions as ethanol production capacity increased.

- In 2006 the govt. extended the EBP to twenty states and seven union territories, depending on availability of ethanol.
- In 2013 the govt allowed ethanol production from multiple sources, including sugarcane juice and damaged food grain
- The National Policy on Biofuels 2018 further strengthened the program by setting a target of achieving 20% ethanol blending by 2030, which was later advanced to 2025-26 due to rapid progress.
- In 2021 the government introduced a road map for ethanol blending detailing steps for expanding production, improving infrastructure and encouraging investment in both sugar-based and grain-based distilleries.
- The GST rate on ethanol supplied for ethanol blending with petrol was also reduced with 18% to 5%.

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