

Biofuels and their Challenges in India

India proposed its long-term low-emission development strategy to United Nations Framework Convention on Climate Change (UNFCCC) at the Climate Change Conference (COP27) Summit, which is the most appreciated step at the world level. Among the steps/strategies, Biofuels are one of them to achieve the long-term goal of reducing carbon emissions. India proposed a 20 percent blending rate of Ethanol with petrol and a five percent blending of biodiesel with diesel by 2025. Biofuels with great potential also have challenges.

This Briefing Paper provides a brief overview of the potential of biofuels along with their challenges in India.

Introduction

National Policy of Biofuels 2018 has recently been amended in 2022 to allow more feedstock for more production of biofuels and achieve the target of 20 percent ethanol blending in petrol by FY 2025-2026 from 2030 and many other changes have been made. These amendments promote the biofuels market and India's commitment to clean energy. Before jumping into governance and policy technicality, let us understand biofuels and their potential with current scenarios and challenges in India.

Biofuels are derived or produced from biomasses (i.e. extra or waste foods, agricultural residue, wastewater, Algae etc.) by fermentation, transesterification, thermochemical routes

or many other methods.¹ It is categorised into different generations based on its procurement and method of production, as shown in Table 1.

Table 1: Categorisation of Biofuels based on their Procurement/Production

Generation	Fuel Type	Procurement from
First	Bio-ethanol, Bio-diesel	Food crops (Like- Corn, sugarcane, animal fats etc.)
Second	Bio-CNG, Bio-ethanol, Bio-diesel	The agricultural residue (by-products of main crops), lignocellulose, Jatropha etc.
Third	Bio-diesel, jet fuels, Butanol	Algae (wastewater)
Fourth	Bio-diesel, Hydrogen, Butanol	Electro-fuels and solar fuels

Ethanol and biodiesel are two major components of sustainable transportation biofuels, blended with petrol and diesel, to reduce emissions and dependency on oil imports from other nations. In India, first-generation biofuels are produced dominantly, and major ethanol production is by sugar molasses. A recent policy change includes rice, corn and agricultural residuals to produce more Ethanol and bio-diesel of first-generation biofuels. The third and fourth generations of biofuels are more sustainable and effective, but still, it is in the research and development phase in India.

Economic Potential of Biofuel²

New renewable energy sources like biofuels offer opportunities for reducing reliance on fossil fuels and help in climate change mitigation. At the same time, biofuel can substitute two essential but very different commodities: food and energy. However, the ability to reduce reliance on fossil fuels has dramatically deepened the interest in biofuel, particularly in high petroleum-importing countries (Alston, 2009).

Similarly, India is not self-reliant in energy and transportation fuels. It costs around US\$77bn in FY [2020-2021](#) and around 84 percent of crude oil and petroleum products are imported into India each year to meet its demand.³ Amid all this, the rise of biofuels can be seen as an alternative and support the green economy. The Government of India introduced a policy on biofuels to incentivise the industry and reduce the import of crude oil and petroleum.

¹ <https://mopng.gov.in/en/refining/about-bio-fuel>

² <https://www.adb.org/sites/default/files/publication/29076/economics-wp269.pdf>

³ <https://www.ppac.gov.in/>

In a statement by the Minister of Petroleum and Natural Gas, Hardeep Singh Puri said, “We have saved foreign exchange outgo of Rs415bn through the blending of ethanol with gasoline and reduced about 2.7 million tonnes of carbon dioxide emissions.”

Table 2: Ethanol Production and Blending Rates in India

Supply Year	Quantity Supplied (Crore Litres)	Blending Percentage for PSUs (%)
2012-13	15.4	0.67
2013-14	38	1.53
2014-15	67.4	2.33
2015-16	111.4	3.51
2016-17	66.5	2.07
2017-18	150.5	4.22
2020-21	304	8.1

Source: Compiled from Ministry of Petroleum and Natural Gas (MoPNG) Statistics

From Table 2, it can be inferred that the growth of ethanol production at 304 crore litres with 8.1 percent blending rate in 2021 has the great economic potential to reduce oil dependence. The government has targeted 20 percent blending rate by 2025, and this achievement promotes India’s vision towards self-reliance in oil and fuels. As we can see, oil is now acting as a modern weapon favoured by oil export countries, and they (OPEC) try to manipulate the market and take the exorbitant profit out of it. Meanwhile, Biofuels can be seen as complementary and help to solve geopolitical and geoeconomic problems at some proportions.

As per a recent study sponsored by [MNRE](#), the current availability of biomass in India is estimated at 750 million metric tonnes per year. The study indicated surplus biomass availability at about 230 million metric tonnes per annum covering agricultural residues, corresponding to a potential of about 28 GW of electricity.

Environmental Potential of Biofuel

Conversion of waste into biofuels and electricity helps to decarbonise these sectors, 2.7 million tonnes of carbon dioxide emissions are reduced by blending Ethanol in petrol. According to the International Renewable Energy Agency (IRENA), bio-diesel and CNG emits 70 percent fewer carbons than conventional fossil fuels.

The environmental potential of biofuels can be seen as a better alternative; however, the production cost is very high compared to other conventional fuels and can also have some adverse environmental impacts. For example, water quality will be impacted by growing more biofuel crops. For instance, transforming grasslands or forests into corn or jatropha fields may intensify problems of soil erosion and discharge of excess phosphorus and nitrogen into surface and groundwater.

Deforestation and clearing vegetation land to generate biofuel crops is not environmentally sustainable, forest and vegetation act as carbon sinks, which helps to reduce carbon from the environment. In USA and Brazil, it is observed that the deforestation rate has increased significantly after incentivisation and promotion of biofuel crops. For sustainable biofuel production, the government needs stringent and effective regulation that considers environmental impact.

However, while analysing the emission potentials of biofuels, it was found that Cellulosic Ethanol has the potential to cut greenhouse gas emissions by up to 86 percent. In contrast, Ethanol has the highest octane rating of any fuel that keeps high-compression engines running smoothly. A 100 percent sulphur dioxide reduction is possible with biodiesel, by its vegetal origin, it is sulphur-free.

Oxygen molecules in the biodiesel, primarily in the methyl or ethyl ester, aid in complete combustion. The CO emissions for biodiesel combustion in diesel engines are 40 to 50 percent lower than those for regular diesel. Compared to diesel, biodiesel reduces particulate matter emissions (PM) by 35 to 45 percent. This minimal or reduced emission pattern of biofuels acts as an alternative, cleaner fuel option with great environmental potential.⁴

Along with reduced emission patterns, biofuels have indirect benefits also. It can help to waste management, as per the MSW study, India generates 62 million tonnes of waste each year, and it is estimated that 165 million tonnes of solid waste will be generated by 2030. Biofuel production through solid waste can be a potential solution to this problem.

Challenges Associated with Biofuels

First and foremost, the challenge associated with biofuels is food security. Developing nations like India where hunger and starvation are very high. India ranked 107th out of 121 countries in the Global hunger index (GHI) 2022 and after the COVID pandemic, Food security challenges for India have increased. Including major crops like Corn, Rice and Sugar to produce more biofuels will further negatively impact India's food security.

⁴ <https://getec.unifei.edu.br/wp/wp-content/uploads/2016/10/15.pdf>

Promoting and incentivising biofuel crops will lead to deforestation and decrease the production of other crops. India is still facing this issue with sugar crops. In the USA, 40 percent of biofuels are derived from corn. Due to this, the production of corn increased at its highest peak and the other crop production decreased. This may act as an externality on the crop price, food inflation and demand in the market.

A case study of the USA (market of corn and biofuel) found that due to the high use of corn in the biofuel market, the price of corn increased from US\$2 per bushel to US\$6-7 per bushel and impacted livestock food and normal consumption. The price of other products made by corn for normal consumption has increased significantly.

Another challenge is less cost-effective research and development in producing biofuels and blending technology. First- and second-generation biofuels use thermal and fermentation-producing methods, which are less effective, while algae, solar and electro fuels are many better-advanced options for biofuels. There is a need to finance research and development of advanced third and fourth-generation biofuels.

Policy and Governance Insight of Biofuels

India is committed to its “Panchamrita” pledge to clean energy and reduce carbon emissions. To achieve this, the central government has amended the National Policy of Biofuels 2018.

Let us look back into the history of biofuel policy and governance. We learned that the Ethanol Blending Programme, implemented in India in 2003, was the nation's first significant liquid biofuel policy action. It required a five-percent ethanol blend percentage in gasoline for nine states and four union territories, and then in 2006, it was expanded to the entire nation. The 2009 implementation of the Biofuel Policy was more stringent, mandating a 20 percent blending rate for both Ethanol and biodiesel by 2017. This was not achieved and led the government to launch a new national biofuel policy in 2018.

The following are the main amendments approved to the National Policy on Biofuels (2022):⁵

- Allow more feedstocks options for the production of biofuels,
- Advance the ethanol blending target of 20 percent blending of Ethanol in petrol to ESY 2025-26 from 2030,
- Promote the production of biofuels in the country, under the Make in India programme, by units located in Special Economic Zones (SEZ)/Export Oriented Units (EoUs),
- Add new members to the NBCC to grant permission for the export of biofuels in specific cases,

⁵ <https://mopng.gov.in/files/article/articlefiles/Notification-15-06-2022-Amendments-in-NPB-2018.pdf>

- Delete/amend certain phrases in the Policy in line with decisions taken during the National Biofuel Coordination Committee meetings.

According to the recently established “Expert Committee on Roadmap for Ethanol Blending in India by 2025” suggested, 13.5 billion litres of Ethanol must be produced by 2025, a six-fold increase from the 2.7 billion litres produced in 2021. To fulfil the revised targets, the plan calls for 6.6 billion litres of biofuels to be derived from food grains and 6.8 billion litres from sugarcane. This will have a significant impact on the agriculture industry.

Conclusion

Although biofuels have many challenges, they can still ensure a healthy environment, municipal waste management, reduce import dependency on fossil fuels, employment generation and additional income for farmers through biofuel crop production and crop incentivisations.

The Government of India must look into the sustainable production of biofuels with feasible and effective regulation. Instead of focusing on first-generation biofuel production, the government must ensure the long-term development of advanced second and third-generation biofuels with some clear policy and financial support. A long-term, sustainable approach to biofuel production can help India become a champion and achieve the climate goals.

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