

IEA-Advanced Motor Fuels ANNUAL REPORT 2022

India



India

Drivers & Policies

India is the third-largest oil consumer in the world after China and the United States. However, its per-capita energy consumption is among the lowest in the world, at 0.6 tons of oil equivalent (toe) as compared to the global average of 1.79 toe per capita, or one-third of the world average. Primary energy is expected to grow strongly, more than doubling from 2019 to 2050. Average growth per year ranges from 2.5% to 2.7%. As a result of strong growth, India accounts for 13% to 14% of the global primary energy consumption in 2050 across all scenarios, up from around 7% in 2019.

The share of coal in total primary energy has been broadly stable around 2019 levels (45%) over the past 40 years. However, coal's share declines in all scenarios, reaching between 6% and 34% by 2050. Renewable energy growth is strong, averaging 4%-6% per annum. As a result, renewable energy becomes the largest source of primary energy in 2050 in Accelerated and Net Zero, and the second largest in New Momentum (after coal). Renewable energy is expected to represent between 31% and 66% of total primary energy in 2050. The share of natural gas in total primary energy grows in all scenarios, increasing from 5% in 2019 to 12% in 2050 in New Momentum, supported by coal-to-gas switching in power, industry, and heavy road transport demand.

Currently, India imports approximately 86% of its petroleum product requirement. Growing concern about the import dependence for fuel requirement in tandem with environmental pollution issues has driven the need for alternative fuels. India plans to reduce import dependency in the oil and gas sectors by adopting a five-pronged strategy, which includes increasing domestic production, adopting biofuels and renewables, establishing energy efficiency norms, improving refinery processes, and demand substitution.

Since 2014, the Indian government has undertaken multiple interventions to promote biofuels through structured programs such as the Ethanol Blended Petrol (EBP) program, Biodiesel Blending in diesel, and SATAT (Sustainable Alternative Towards Affordable Transportation), an initiative for promotion of Compressed Biogas (CBG). India introduced a National Policy on Biofuels-2018 (subsequently amended in June 2022), which envisages achieving 20% blending of ethanol in petrol by Ethanol Supply Year (ESY) 2025-26 and 5% blending of biodiesel in diesel by 2030.

The major feature of the policy is the categorization of biofuels as “basic biofuels” (e.g., first-generation “1G” ethanol, biodiesel, etc.) and “advanced biofuels” (e.g., 2G ethanol, drop-in fuels, etc.) to expand the scope of raw material for ethanol production.

Advanced Motor Fuels Statistics

India's primary energy mix is dominated by fossil fuels and that will continue to be the case in the near future. Currently, oil and gas account for around 35% of India's energy consumption; this is expected to decrease to 31% by 2040. However, from existing levels, absolute consumption is expected to double for oil and to triple for gas. Energy demand across the transport sector is the highest across major sectors in terms of end usage.

The Indian government has been promoting and encouraging the use of advanced motor fuels in the transport sector. In this endeavor, the blending of biofuels, which are sustainable and have lesser emissions compared to fossil fuels, is being promoted in petrol, diesel, and natural gas. Loans for the construction of oil extraction/processing units for production of biofuels, their storage and distribution infrastructure, and loans to entrepreneurs for setting up CBG plants were classified under priority sector lending by India's Central Bank on September 4, 2020.

With a view to decarbonize the transport sector, the Indian government is promoting the use of biofuels. The “Roadmap for Ethanol Blending in India 2020–25” provides guidance to meet the target of 20% blending of ethanol in petrol by 2025–26. In line with the Ethanol Blending roadmap, India has launched E20 fuel at 84 retail outlets of oil marketing companies in 11 states and union territories.

Ethanol Blended Petrol (EBP) Program

Under the Ethanol Blended Petrol (EBP) program, the PSUOMCs (Public Sector Undertaking Oil Marketing Companies) have achieved 10.02% blending of ethanol in petrol in ESY 2021–22. Further, the government has already notified and allowed the oil marketing companies (OMCs) to sell E20 (i.e., 20% ethanol blended with petrol), as per BIS specification effective from 15 December 2022.

The Government of India has taken several measures to increase the production and use of ethanol, which includes permitting procurement of ethanol produced from other non-food feedstock besides molasses (such as cellulosic) and lignocelluloses materials (such as cotton stalk, wheat straw, rice straw, bagasse, bamboo, etc.), including petrochemical route, subject to meeting the relevant BIS standards. It allows the use of sugarcane and food grains (maize and surplus stocks of rice with the Food Corporation of India) for conversion to ethanol; administered a price mechanism for procuring ethanol under the Ethanol Blended Petrol (EBP) Programme, including an enhanced ex-mill price; lowered the GST rate to 5% on ethanol for the EBP Programme; amended the Industries (Development & Regulation) Act for free movement of ethanol across states for blending, etc. These steps facilitated improvements in the blending of ethanol in petrol from 154 million liters during ESY 2012–13 to around 4336 million liters during ESY 2021–22, thereby achieving average blending of 10.02% in petrol during ESY 2021–22 (see Table 1).

To promote the establishment of distilleries in states low in ethanol, OMCs have signed Long Term Off-take Agreements (LTOA) with 131 project proponents for dedicated ethanol plants in ethanol-deficient states. This will help to avoid transporting ethanol over long distances and supply fluctuations to meet blending requirements. In addition, the government has notified various ethanol interest subvention schemes from July 2018 to April 2022 for sugar mills and molasses and grain-based stand-alone distilleries to facilitate entrepreneurs to set up new distilleries or expand existing ones in all states, including those having a shortage of ethanol. During ESY 2021–22, ethanol distillation capacity has increased from 7.2 billion litres per annum to 9.47 billion litres per annum, i.e., a 30% increase. The government has also provided separate pricing for maize-based ethanol to promote this feedstock.

Table 1. Trend in Ethanol Procurement/blending under EBP Program

Ethanol Blending Petrol Program						
Particulars	Ethanol Supply Year (Dec to Nov)					
	2016–17	2017–18	2018–19	2019–20	2020–21	2021–22
Ethanol procured/blended by PSU OMCs* (in million liters)	665	1505	1886	1730	3023	4336
National average blending (percentage)	2.0%	4.2%	5.0%	5.0%	8.1%	10.02%

*Public Sector OMCs, i.e., Indian Oil Corporation Ltd. (IOCL), Bharat Petroleum Corporation Ltd. (BPCL), and Hindustan Petroleum Corporation Ltd. (HPCL)

2G Ethanol Program

The government of India has notified the “Pradhan Mantri JI-VAN (Jaiv Indhan-Vatavaran Anukoolfasalawashesh Nivaran) Yojana,” which will provide financial assistance of approximately \$300 million USD for the period from 2018–19 to 2023–24 for supporting commercial projects as well as demonstration projects for 2G ethanol projects. India’s government has allowed the procurement of ethanol produced from other non-food feedstock besides molasses, like cellulosic and lignocellulosic materials. The 2G feedstocks include agri-residues such as rice and wheat straw, cane trash, corn cobs and stover, cotton stalk, bagasse, and empty fruit bunches (EFB). Furthering this decision, oil PSUs are setting up 2G ethanol bio-refineries in various parts of the country. A 2G ethanol plant in Panipat was dedicated to the nation on World Biofuel Day, 10 August 2022. Projects at Bhatinda (Punjab), Bargarh (Odisha), and Numaligarh (Assam) are in advanced stages of construction and are likely to become operational in 2023 and 2024.

Biodieseland Sustainable Aviation Fuel (SAF)

In June 2017, the government allowed the direct sale of biodiesel (B-100) for blending with high-speed diesel to all consumers, in accordance with specified blending limits and the standards specified by the

Bureau of Indian Standards' "Guidelines for sale of Biodiesel for blending with High Speed Diesel for transportation purposes 2019" were notified on 1 May 2019.

The government had constituted a committee in June 2021 to take forward the Sustainable Aviation Fuel (SAF)/Bio-Aviation Turbine fuel (Bio-ATF) program. The committee has investigated various aspects of the Bio-ATF program and recently submitted a report currently under examination by the Ministry of Petroleum and Natural Gas (MoP&NG). To promote SAF, oil marketing companies are setting up plants at three locations: 1) Mangalore Refinery and Petrochemicals Ltd., Mangaluru 16 Tons Per Day (TPD), with IIP Dehradun technology), 2) Indian Oil Corporation Ltd. (IOCL) Pune (10 TPD, with Gevo through Praj Alcohol to Jet (ATJ) technology), and 3) IOCL Panipat (236 TPD, with Lanzajet ATJ technology). These plants are likely to become operational between 2025 and 2027.

Compressed Biogas (CBG)

As part of an initiative under the National Policy on Biofuels-2018, the SATAT initiative was launched in October 2018 to promote the use of CBG along with natural gas. Under this initiative, oil and gas marketing companies (OGMCs) are inviting expressions of interest from potential investors and entrepreneurs to procure CBG for further selling to automotive and commercial customers.

As of December 2022, OGMCs have issued 3,826 Letters of Intent to potential entrepreneurs for procurement of CBG and commissioned 40 CBG plants under the SATAT initiative. The sale of CBG has been initiated from 97 retail outlets. Compressed biogas is being supplied to industrial customers, and CBG injection in the CGD network also has started.

Under this initiative, various enablers have been provided to increase the production of CBG. These include establishing an assured price for offtake of CBG with long-term agreements by OGMCs, Central Financial Assistance to CBG/biogas plants under Umbrella Scheme of National Bio Energy Programme of Ministry of New and Renewable Energy. Other developments involve the inclusion of bio-manure produced from CBG plants as Fermented Organic Manure (FOM) and Liquid Fermented Organic Manure (LFOM) under Fertilizer Control Order 1985; the inclusion of CBG projects under "White Category" by Central Pollution Control Board (CPCB) on a case-to-case basis; the inclusion of CBG projects under Priority Sector Lending by RBI; and loan products from various banks for financing CBG projects; directions from Department of Fertilizers for mandatory offtake of FOM by fertilizer companies; and other initiatives.

MoP&NG has issued guidelines for the commingling of domestic gas for supply for the Compressed Natural Gas (Transport) and Piped Natural Gas (Domestic) segments of City Gas Distribution (CGD) Networks for synchronizing CBG with CNG in the CGD Network. Under the CBG-CGD synchronization scheme, CBG sales have been initiated in 12 geographical areas of the CGD network.

Hydrogen

The National Hydrogen Mission was launched on India's 75th Independence Day, 15 August 2021. The mission aims to aid the government in meeting its climate targets and making India a green hydrogen hub. This initiative will help India to meet its production target of 5 million tons of green hydrogen by 2030 and the related development of renewable energy capacity. In addition, the Indian government has approved the National Green Hydrogen Mission with a total financial outlay of approximately 2.5 billion USD, which includes an outlay of about 2.2 billion USD in incentives for green hydrogen production and electrolyser manufacturing; the rest will be used for pilot projects, R&D, and other mission components. MoP&NG has further directed oil and gas marketing companies to introduce green hydrogen in the refineries as a feedstock at various locations. The pilot projects for setting up green hydrogen plants in the refineries have been developed.

Research and Demonstration Focus

The Centre for High Technology (CHT), PSU OMC's research and development units under the Ministry of Petroleum and Natural Gas, the Department of Biotechnology (DBT), and the Council of Scientific and Industrial Research – Indian Institute of Petroleum (CSIR-IIP), Dehradun are working on a program to support R&D pertaining to energy biosciences in the country through various schemes and with major emphasis on advanced biofuels. The DBT-ICT center based in Mumbai has developed lignocelluloses technology at demo scale and is now being used for the establishment of commercial plants.

India has taken several initiatives with respect to the greater use of hydrogen in the energy mix. The first piloted use of H-CNG (hydrogen fuel mixed with compressed natural gas) as transportation fuel occurred at Rajghat Bus Depot, New Delhi. Under this pilot, 50 buses in Delhi operated on a blended H-CNG mixture. The trial showed encouraging results in terms of significant emission reduction and fuel economy improvement.

Indian Oil Corporation Ltd. has undertaken an ambitious R&D project under the aegis of MoPNG at a cost of \$18.3 million USD. It is the first scientific project in India to address all aspects of the value chain of hydrogen-based mobility. Four demo units of hydrogen production units amounting to 1 ton per day will also be set up. Of these, three plants will be based on renewable sources (biomass gasification, reforming CBG, and solar PV-based electrolysis) to produce green hydrogen. To utilize green hydrogen produced from this demo plant, 15 fuel cell buses are being developed jointly along with India's leading heavy-duty vehicle manufacturer. The initial testing of buses is underway by OEMs; two buses will be supplied by March 2023. IOCL R&D will use these 15 indigenously manufactured/integrated hydrogen fuel cell buses to conduct a 20,000 kms field trial in Delhi NCR.

Studies are in advanced stages at the IOCL R&D center to install the world's first pilot plant with a capacity of 10 kgCO₂ per day using gas fermentation technology. Anaerobic gas fermentation technology will convert CO₂ into acetic acid, and aerobic fermentation technology will convert acetic acid into highly valuable omega-3 fatty acids (docosahexaenoic acid, or DHA) and biodiesel. This value chain makes the overall process economically feasible.

IOCL is also setting up an ethanol production plant to produce around 128 KL per day of ethanol using gas fermentation technology from pressure swing absorption off gases at Panipat Refinery.

In aviation, Spice Jet operated the first flight using 25% biojet fuel between Dehradun to Delhi on 27 August 2018. Biojet fuel used in the flight was developed by laboratory in CSIR-IIP, Dehradun, using *Jatropha* seeds. After the flight's success, the government decided to set up demonstration plants for the future growth of Bio-ATF in the country.

Currently, efforts are focused on the development of cost-effective and -efficient enzymes for 2G bioethanol refineries; the development of value-added products by lignin valorization; the commercial production of biojet fuel, compressed biogas from biomass, food waste, and municipal solid waste; cost-effective biofuels from industrial waste gases; and green hydrogen.

Outlook

The outlook for biofuels in India will remain promising, considering the government's promotion of biofuels and advanced biofuels as "environment-friendly" fuels.

Ethanol blended by PSU OMCs reached 4,336 million liters of ethanol in ESY 2021–22. OMCs achieved an average blending percentage of 10.02% during ESY2021–22. With the rollout of roadmap for 20% ethanol blending (E20) in India and the commitment shown by all stakeholders, the projected annual demand of ethanol is targeted at over 10 billion liters by 2025–26. The retailing of E100 fuel has commenced on a pilot basis at three retail outlets in Pune, Maharashtra. Based on the response of these pilot retail outlets, further expansion is planned.

The SATAT initiative will help to reduce India's dependence on fossil fuels and increase the share of gas in primary energy consumption. This initiative will help to integrate the vast retail network of companies with upcoming CBG projects. It has the potential to replace more than 50% of gas imports.

These highlighted initiatives have already begun to create impact in India's biofuel industry. Major developments in the advanced biofuel sector in terms of deployment in the transport sector, investments, project establishment, and enhanced R&D are expected in the coming years.

Additional Information Sources

- www.ppac.org.in for data on fossil fuels production, consumption, import and export
- www.mopng.gov.in for data related to petroleum sector
- www.mnre.gov.in for data on R&D projects
- <https://www.siamindia.com> for data on automotive industry
- www.dbtindia.nic.in
- www.iocl.com for data on R&D projects
- 1-BP Outlook 2023 edition, India
- Roadmap for Ethanol Blending in India 2020–25