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India

Drivers & Policies

India is home to around 18% of the world's population and uses 6% of the world's primary energy, which is projected to increase to 11% by 2040. It is the third largest oil consumer in the world after the United States and China, however, per capita energy consumption is amongst 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**. India's energy consumption growth is projected to be the highest among major economies during 2017 to 2040. Robust growth in prosperity and a population with a high share of young people is driving a huge increase in India's primary energy consumption, which is expected to expand by 1.2 billion toe or 156% by 2040, making India the largest source of energy demand growth.[1]

A 2016 initiative to provide universal clean energy access to every household led to an increase in LPG consumption by 56% in 2019, as compared to 2014. India is also targeting an increased share of gas in its primary energy mix from the current 6% to 15%.

Currently, India imports approximately 83% 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 renewable energy efficiency norms, and 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 Transport), an initiative for promotion of Compressed Biogas (CBG). India introduced a National Policy on Biofuels-2018 in June 2018. By 2030, the policy envisages achieving 20% blending of ethanol in petrol and 5% blending of biodiesel in diesel. The major feature of the policy is categorization of biofuels as "basic biofuels" (e.g., first generation (1G) ethanol and biodiesel) and "advanced biofuels" (e.g., 2G Ethanol, bioCNG, and drop-in fuels) to expand the scope of raw material for ethanol production to include damaged food grains like wheat, broken rice, and rotten potatoes unfit for human consumption.

[1] BP Outlook 2019, India

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. Presently, oil and gas accounts for around 35% of India's energy consumption; it is expected to come down to 31% by 2040. However, the absolute consumption for oil is expected to double and, for gas, to triple from existing levels.[2] 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 use of advanced motor fuels in the transport sector. In this endeavor, the blending of biofuels, which are sustainable and have lesser emissions as compared to fossil fuels, is being promoted in petrol, diesel and natural gas.

Ethanol Blended Petrol (EBP) Program

Under the Ethanol Blended Petrol (EBP) program, oil marketing companies (OMCs) sell petrol blended with 10% ethanol (E10) depending upon its availability. Supplies were not forthcoming until 2013-14. In order to augment the supply of ethanol for EBP, the Government decided to administer ethanol prices. This combined with a slew of other measures, such as easing restrictions on the movement of ethanol between states; allowing more sources of feedstocks for production of ethanol including sugar, sugar cane, damaged food grain, etc.; addressing state specific issues, and attractive ethanol prices and availability of molasses in the ecosystem facilitated in improving the supply of ethanol from 154 million liters during Ethanol supply year (ESY) 2012-13 to around 1.86 billion liters during ESY 2018-19, thereby achieving 5% blending in petrol.

Table 1 Trend in ethanol procurement under EBP program

Ethanol Blending Petrol Program			
Particulars	Ethanol Supply Year (Dec to Nov)		
	2016-17	2017-18	2018-19
Ethanol procured by PSU OMCs* (in million liters)	665	1505	1886
National average blending (in percentage	2.0%	4.2%	5.0%

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

[2] BP Outlook 2019, India

2G Ethanol Program

The Indian Government has approved the "Pradhan Mantri JI-VAN (Jaiv Indhan-Vatavaran Anukool fasal awashesh Nivaran) Yojana" which will provide financial support of approximate $300 million US for the period from 2018-19 to 2023-24 for supporting 12 commercial projects and 10 demonstration projects for second generation bioethanol projects. These 12 bio-refineries shall produce around 300 to 350 million liters of ethanol annually, thus contributing significantly toward the EBP program.

Biodiesel

In June 2017, the Government allowed direct sale of biodiesel (B-100) for blending with high speed diesel to all consumers, in accordance with the specified blending limits and the standards specified by the Bureau of Indian Standards. To augment the supplies of biodiesel and tap potential sources of biodiesel produced from used cooking oil (UCO), public sector oil marketing companies under guidance of Ministry of Petroleum and Natural Gas (MoPNG) have released an Expression of Interest (EOI) for biodiesel made from UCO. It provides that the entrepreneurs setting up biodiesel plants get remunerative price and assurance of complete offtake of production by the public sector units (PSU) OMCs. The EOI has been launched in 200 cities in the country.

Compressed Biogas (CBG)

The Government is promoting the use of CBG—generally known as Bio-CNG, which is purified and compressed biogas—produced through a process of anaerobic decomposition from various waste/biomass sources.

Oil and gas PSUs launched the Sustainable Alternative Towards Affordable Transportation (SATAT) initiative in October 2018. Under this initiative, public sector oil and gas marketing companies have invited EOI to procure CBG from potential entrepreneurs for the establishment of 5,000 CBG plants across the country with an estimated production of 15 MMT CBG per annum by 2023.

Research and Demonstration Focus

The Centre for High Technology (CHT), PSU OMC's R&D units under MoPNG, Department of Biotechnology (DBT) and Council of Scientific and Industrial Research – Indian Institute of Petroleum (CSIR-IIP), Dehradun are working on the program to support R&D pertaining to energy biosciences in the country through various schemes and with major emphasis on advance biofuels. The DBT-ICT center based in Mumbai has

developed Lignocelluloses technology, which is demonstrated at demo scale and is now being used for establishment of commercial plants.

Indian Oil Corporation Ltd. R&D center (IOC R&D) is doing research work in the area of multi-feed gasification and has installed a multi-feed fluidized bed gasification pilot plant (1-2 kg/hr) with various analytical and feed characterization facilities. It has developed a novel concept on integrated gasification for optimal use of available gasifier designs by segregation of feedstock according to reactivity and ash content. A 2-Tonnes per day (TPD) integrated gasification demonstration pilot plant for synthetic gas production is being set up in a second R&D campus by 2022 for validating the concept and generation of data for further scale up.

The IOC R&D has also developed a single-step compact steam methane reforming process for production of an 18% hydrogen CNG (HCNG) blend directly from CNG, which is more economical and technically attractive as compared to high pressure physical blending of hydrogen and natural gas to produce HCNG. It has developed an in-house, two-step bio-methanation process for conversion of food waste into biogas which uses high-performing bacterial inoculum responsible for the conversion of waste into biogas with high methane (>80%) content. For CO^2 capturing and conversion in value-added products, third generation biofuel technology has been developed by integrating two technologies – Lanza Tech-USA's patented anaerobic gas fermentation technology to convert carbon dioxide into acetic acid, and Indian Oil R&D's patented aerobic fermentation technology to convert acetic acid to highly valuable Omega 3-fatty acids (DHAs) and bio-diesel. This value chain makes the overall process economically feasible. Studies are in progress on the world's first pilot plant of capacity of 10 kg/day CO^2 installed at IOC R&D center. Once proven at pilot scale, commercial plants at suitable refinery locations/2G ethanol plants where pure CO^2 is available from the Mono Ethyl Glycol/2G ethanol fermentation units and hydrogen from refineries will be planned.IOCL is also setting up an ethanol production plant to produce around 128 KL per day ethanol using gas fermentation technology from pressure swing absorption off gases at Panipat Refinery.

In aviation, the first flight using 25% biojet fuel between Dehradun to Delhi was operated by Spice jet on August 27, 2018. Biojet fuel used in the flight was developed by CSIR laboratory in the Indian Institute of Petroleum, Dehradun, using Jatropha seeds. Further work is being done to look into the availability of feedstock across India for production of biojet fuel; current demand for biojet fuel; estimation of future requirements and cost of

production; formulation of standards, and specifications in line with international standards.

Currently, efforts are focused on development of cost effective and efficient enzymes for 2G bioethanol refineries, development of value added products by lignin valorization, commercial production of biojet fuel, compressed biogas from biomass, foodwaste and Municipal Solid Waste, and cost effective biofuels from industrial waste gases.

Outlook

The outlook for biofuels in India will remain promising considering the thrust of the Government on promoting biofuels and advanced biofuels as "environment friendly" fuels.

Ethanol procurement by PSU OMCs reached 1,886 million liters of ethanol in ESY 2018-19 and achieved 5% blending level, which is an all-time high in a single ESY. As the demand for petrol rises, the demand for ethanol is bound to increase, year on year, with projected requirement for 10% blending, or 3.11 MMTPA (approximately 4 billion liters annually). Recently, the Indian Government mandated PSU OMCs to run pilot for E 100 (pure anhydrous ethanol) and M 15 (15% methanol blended with petrol) fuel to increase the share of biofuel in overall fuel consumption.

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

The above mentioned initiatives have already started creating impact in the biofuel industry in India. Major developments in the advanced biofuel sector in terms of deployment in transport sector, investments, project establishment and enhanced R&D are expected in the coming years.

Additional Information Sources

- Website: www.ppac.org.in for data on fossil fuels production, consumption, Import & Export
- Website: www.mnre.gov.in for data on R&D projects.
- Website: www.siamindia.com for data on automotive industry.
- Website: www.dbtindia.nic.in