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RESEARCH & CONSULTANCY

# **From Crops to Clean Energy**

## **Mapping India's Biofuel Journey**

**6<sup>th</sup> Sept. 2025**



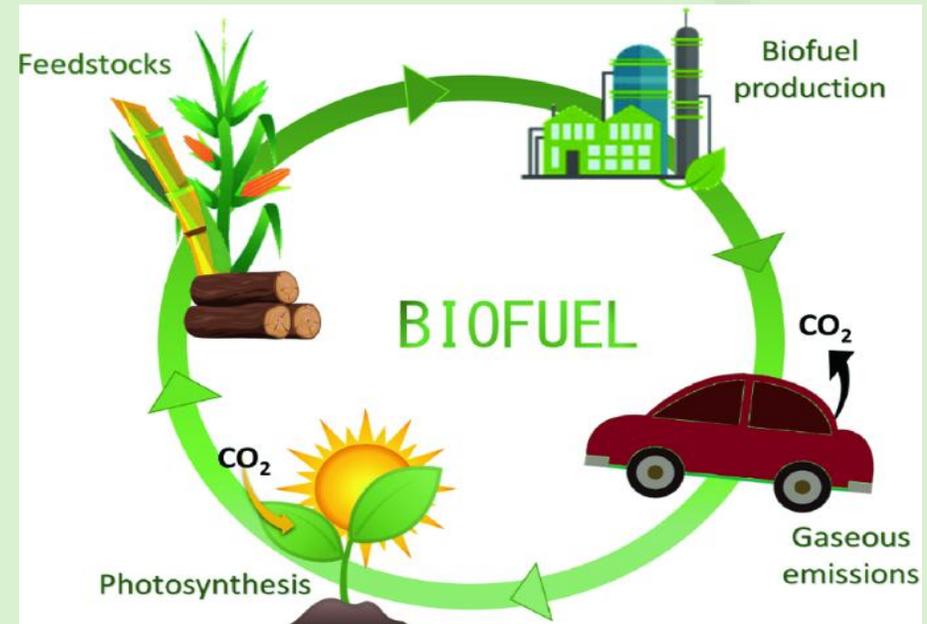
# Biofuel & Its Types

□ Any fuel that is derived from biomass - that is, plant or algae material or animal waste, Since such feedstock material can be replenished readily, biofuel is a source of renewable energy, unlike fossil fuels such as petroleum, coal and natural gas.

## □ Types

1. **Solid** – Wood , charcoal, pellets, agricultural residuals
2. **Liquids** – Bioethanol, Biodiesel , Bio – Butanol, Bio – oil
3. **Gaseous** – Biogas, Biohydrogen, Syngas

□ The two most common types of biofuels in use today are **ethanol** and **biodiesel**, both of which represent the first generation of biofuel technology.

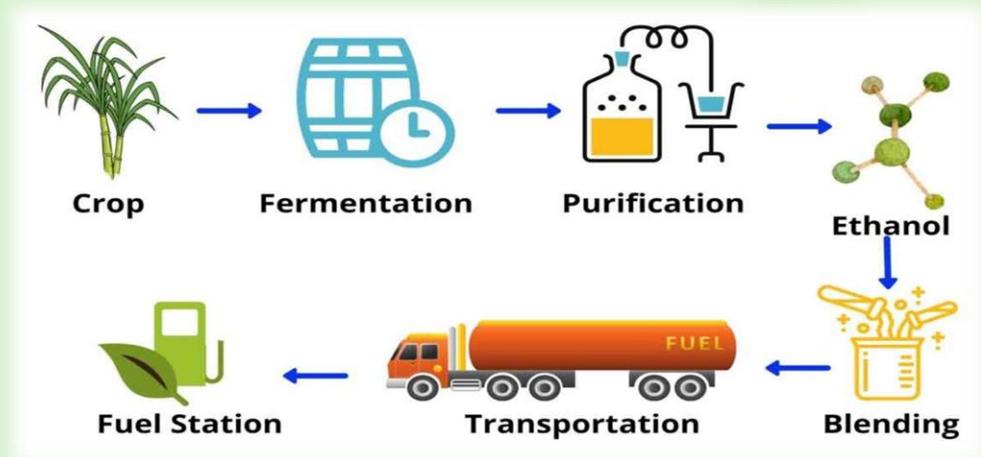


# Use Case of Biofuels

Wood	Charcoal	Pellets
<p><b>Biomass Power Plants -</b> Direct combustion of wood logs/chips to generate steam &amp; electricity in Power Generation Sector</p>	<p><b>Industrial Fuel -</b> Substitute for coal in small foundries, brick kilns, and metal industries</p>	<p><b>Co-firing in Thermal Power Plants -</b> Biomass pellets blended with coal (5–10% mandated by Govt. of India) to reduce coal usage in Power generation sector.</p>
<p><b>Gasification -</b> Wood used in biomass gasifiers to produce syngas for rural electrification/industrial heating in Rural energy</p>	<p><b>Biochar for Soil Enrichment -</b> Used as soil amendment for carbon sequestration and fertility</p>	<p><b>Industrial Boilers -</b> Used as substitute for coal/diesel/LPG in boilers and furnaces</p>
<p><b>Bio – oil / Advanced fuels -</b> Research stage: pyrolysis of wood into bio-oil, which can be upgraded to transport fuels in R&amp;D Stage</p>	<p><b>Feedstock for Activated Carbon -</b> Charcoal processed into activated carbon, useful in water purification &amp; pharma</p>	<p><b>Exports -</b> India exports pellets to Europe for renewable energy generation</p>

# Ethanol

- ❑ A renewable fuel that can be made from various plant materials, collectively known as Biomass. Ethanol is an alcohol used as a blending agent with gasoline to increase octane and cut down carbon monoxide and other smog-causing emissions
- ❑ In India, **sugarcane molasses** is a major source for ethanol and produced by the fermentation of sugars found in sugarcane and sugar beets, and starch-based crops such as corn, wheat, and barley.
- ❑ The most common blend of ethanol is **E10** (10% ethanol, 90% gasoline) and is approved for use in most conventional gasoline-powered vehicles up to **E15** (15% ethanol, 85% gasoline)



# Biodiesel

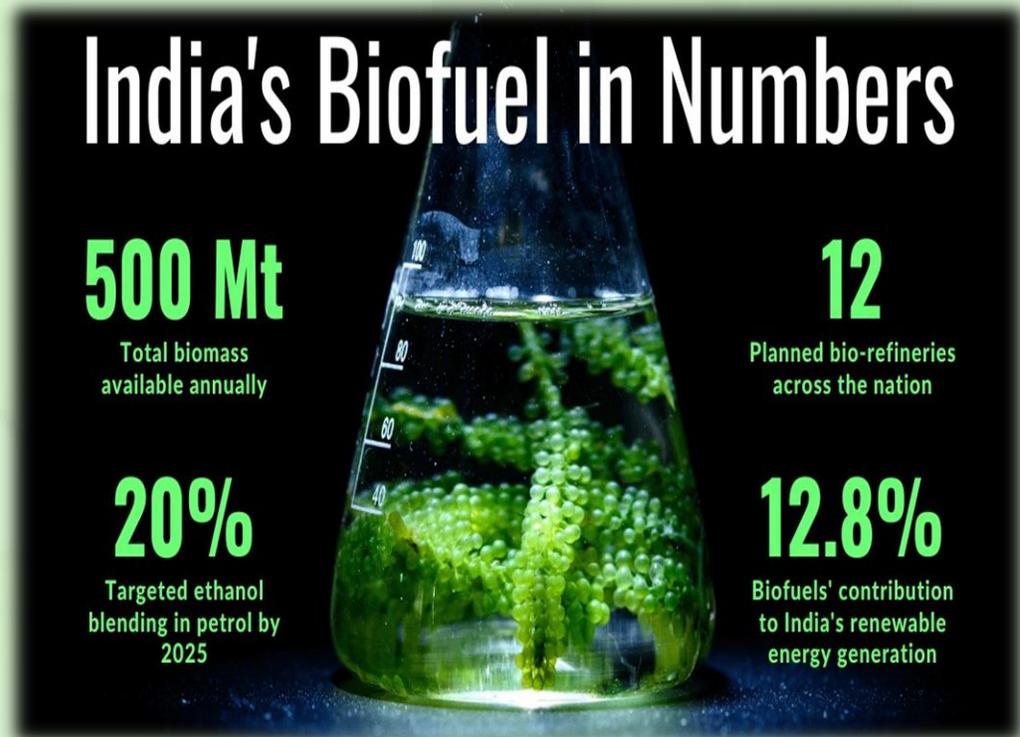
- ❑ Biodiesel is a liquid fuel produced from **renewable sources**, such as new and used vegetable oils and animal fats and is a cleaner-burning replacement for petroleum-based diesel fuel.
- ❑ Like petroleum-derived diesel, biodiesel is used to fuel compression-ignition (diesel) engines. It can be blended with petroleum diesel in any percentage, including **B100 (pure biodiesel)** and, the most common blend, **B20** (20% biodiesel and 80% petroleum diesel).
- ❑ In India it is produced from diverse feedstocks including imported palm stearin oil, non-edible oilseeds like Jatropha and Karanja, and domestically available used cooking oil (UCO), acid oils, and animal fats such as tallow.

## Future of Biodiesel in India



# India's Biofuel Market

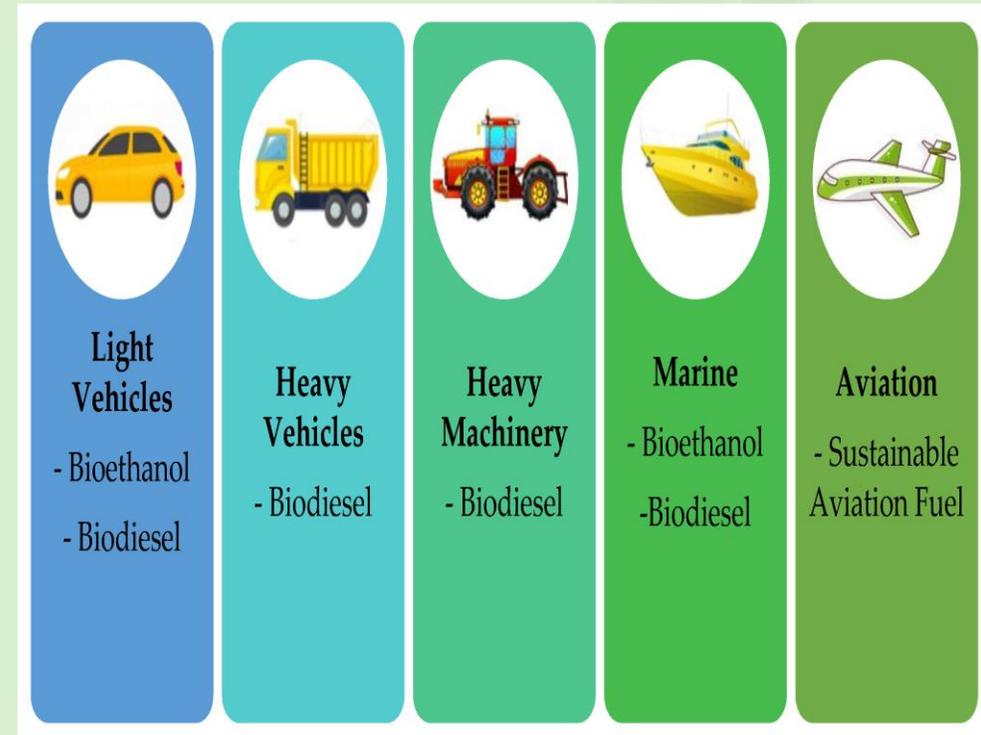
□ The India biofuel market size reached **\$5.82 Billion in 2024**. Expecting the market to reach **\$9.87 Billion by 2033**, exhibiting a growth rate (CAGR) of 6.05% during 2025-2033.



□ The Indian Biofuel market is driven by government policies promoting ethanol blending, rising crude oil import costs, and increasing demand for cleaner energy alternatives. Agricultural residue utilization, advancements in biofuel production technologies, and incentives for bioethanol and biodiesel production further support market growth, aligning with sustainability goals and energy security initiatives.

# Why Biofuel Matter for India

- ❑ Electric mobility faces limitations in sectors like **long-haul trucking, shipping, aviation**, and rural industries due to battery constraints and lack of reliable grid access whereas Biofuels, presents a renewable and locally sourced alternative.
  
- ❑ For India, with its vast agricultural and urban waste output, biofuels offer a dual benefit: **generating clean energy** in the form of ethanol, biodiesel, and compressed biogas (CBG), while **mitigating environmental issues like stubble burning, landfill emissions, and waste mismanagement**. Harnessing this potential can reduce fossil fuel dependence and promote sustainability.



# How Biofuels Will Help India

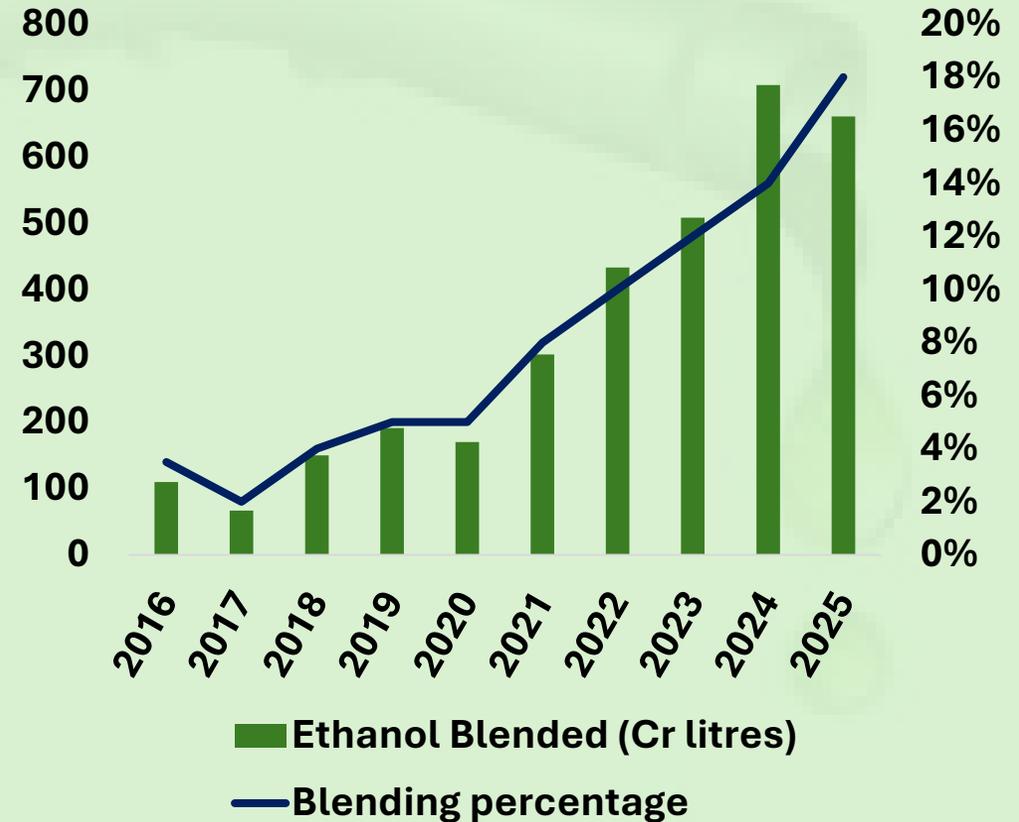
- ❑ **Reduces Oil Import Dependence** – India imports ~85% of its crude oil; biofuels cut this reliance and save foreign exchange.
- ❑ **Supports Rural Economy** – Provides an assured market for farmers' surplus crops, enhancing rural incomes, 18 Million jobs in rural areas and reducing sugar surplus stress.
- ❑ **Lower Carbon Emissions** – Biofuels emit less CO<sub>2</sub> compared to fossil fuels and can be close to carbon-neutral over their lifecycle.
- ❑ **Potential for Advanced Biofuels** – Second- and third-generation biofuels promise higher yields with lower land-use conflicts.

# Recent Investments in Biofuel Sector

Date	Investor / Lender	Project / Company	Investment
Jun-25	Hindustan Petroleum (HPCL)	24 Compressed Biogas (CBG) plants	INR 2,000 Cr
May-25	Hindustan Petroleum (HPCL)	2G Ethanol refinery, Bathinda	INR 1,400 Cr (est.)
Apr-25	Reliance (RIL) & Govt. of Andhra Pradesh	First of 500 CBG plants	INR 139 Cr for 1st plant program & ~65,000 Cr across 500 plants
Dec-24	Bharat Petroleum (BPCL)	Integrated 1G+2G ethanol plant, Bargarh	INR 1,557 Cr
Jul-24	AM Green (Greenko group)	Two 2G bioethanol plants	INR 8,300 Cr
Feb-24	PFC Assam Bio Refinery Pvt Ltd	Assam bamboo-based 2G biorefinery	INR 3,037 Cr loan & project cost ~INR 4,200 Cr
Aug-22	Indian Oil (IOCL)	2G Ethanol plant near Panipat refinery	INR 900 Cr

# Ethanol Blending With Petrol

- From <5% blending and under 150 crore L in 2016, India is now on track to achieve nearly **20% blending** and 700 crore L **by 2025**.
- This trajectory highlights how a country can leverage agricultural resources, waste materials, and industrial capacities to transition towards a cleaner and more self-reliant energy system.



Source: NITI Ayog

# Ethanol Is Costlier Than Petrol

- ❑ As of August 2025, India's Oil Ministry has rejected demands to reduce the price of ethanol-blended petrol (E20), citing a rise in ethanol procurement costs that now exceed those of petrol.
- ❑ The current average cost of ethanol, including transportation and GST, stands at ₹71.32 per litre, while petrol costs ₹94.77 per litre in Delhi (inclusive of tax and commissions), though **ethanol's lower energy content provides less mileage**. The ministry emphasized that efficiency declines are minor and multifactorial, and pointed out that earlier calls for cheaper blends were based on outdated data when ethanol was cheaper.





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# Thank You

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