



Biofuels

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- The Ministry of Petroleum & Natural Gas (MoP&NG), Government of India has recently joined **IEA Bioenergy TCP as its 25th member**. The primary goal of MoP&NG joining IEA Bioenergy TCP is to facilitate the market introduction of advanced biofuels with an aim to bring down emissions and reduce substantial crude oil imports.
- International Energy Agency's Technology Collaboration Programme on Bioenergy (IEA Bioenergy TCP) is an international platform for cooperation among countries with the aim of improving cooperation and information exchange between countries that have national programmes in bioenergy research, development and deployment.
- IEA Bioenergy TCP works under the framework of International Energy Agency (IEA) to which India has "Association" status since 30th March, 2017.

What are Biofuels?

- Any hydrocarbon fuel that is produced from an organic matter (living or once living material) in a short period of time (days, weeks, or even months) is considered a biofuel.
- Biofuels may be solid, liquid or gaseous in nature.
 - **Solid:** Wood, dried plant material, and manure
 - **Liquid:** Bioethanol and Biodiesel
 - **Gaseous:** Biogas
- These can be used to replace or can be used in addition to diesel, petrol or other fossil fuels for transport, stationary, portable and other applications. Also, they can be used to generate heat and electricity.
- Some of the main reasons for shifting to biofuels are the rising prices of oil, emission of the greenhouse gases from fossil fuels and the interest for obtaining fuel from agricultural crops for the benefit of farmers.

Categories of Biofuels

- **First generation biofuels:**

- These are made from food sources such as sugar, starch, vegetable oil, or animal fats using conventional technology.
- Common first-generation biofuels include Bioalcohols, Biodiesel, Vegetable oil, Bioethers, Biogas.
- Though the process of conversion is easy, but use of food sources in the production of biofuels creates an imbalance in food economy, leading to increased food prices and hunger.
- **Second generation biofuels:**
 - These are produced from non-food crops or portions of food crops that are not edible and considered as wastes, e.g. stems, husks, wood chips, and fruit skins and peeling.
 - Thermochemical reactions or biochemical conversion process is used for producing such fuels.
 - Examples include cellulose ethanol, biodiesel.
 - Though these fuels do not affect food economy, their production is quite complicated.
 - Also, it is reported that these biofuels emit less greenhouse gases when compared to first generation biofuels.
- **Third generation biofuels:**
 - These are produced from micro-organisms like algae.
 - Example- Butanol
 - Micro-organisms like algae can be grown using land and water unsuitable for food production, therefore reducing the strain on already depleted water sources.
 - One disadvantage is that fertilizers used in the production of such crops lead to environment pollution.
- **Fourth Generation Biofuels:**
 - In the production of these fuels, crops that are genetically engineered to take in high amounts of carbon are grown and harvested as biomass.
 - The crops are then converted into fuel using second generation techniques.
 - The fuel is pre-combusted and the carbon is captured. Then the carbon is geo-sequestered, meaning that the carbon is stored in depleted oil or gas fields or in unmineable coal seams.
 - Some of these fuels are considered as carbon negative as their production pulls out carbon from environment.

Major Types of Biofuels

Bioethanol

- It is derived from corn and sugarcane using fermentation process.
- A litre of ethanol contains approximately two thirds of the energy provided by a litre of petrol.
- When mixed with petrol, it improves the combustion performance and lowers the emissions of carbon monoxide and sulphur oxide.

Biodiesel

- It is derived from vegetable oils like soybean oil or palm oil, vegetable waste oils, and animal fats by a biochemical process called "Transesterification."
- It produces very less or no amount of harmful gases as compared to diesel.
- It can be used as an alternative for the conventional diesel fuel.

Biogas

- It is produced by anaerobic decomposition of organic matter like sewage from animals and humans.
- Major proportion of biogas is methane and carbon dioxide, though it also has small proportions of hydrogen sulfide, hydrogen, carbon monoxide and siloxanes.
- It is commonly used for heating, electricity and for automobiles.

Biobutanol

- It is produced in the same way as bioethanol i.e.through the fermentation of starch.
- The energy content in butanol is the highest among the other gasoline alternatives. It can be added to diesel to reduce emissions.
- It serves as a solvent in textile industry and is also used as a base in perfumes.

Biohydrogen

- Biohydrogen, like biogas, can be produced using a number of processes such as pyrolysis, gasification or biological fermentation.
- It can be the perfect alternative for fossil fuel.

Advantages of Biofuels

- **Availability:** biofuels are produced from biomass and thus are renewable.
- **Source material:** Whereas oil is a limited resource that comes from specific materials, biofuels can be manufactured from a wide range of materials including crop waste, manure, and other byproducts.
- **Environment Pollution:** Biofuels do not release as much carbon as fossil fuels do but fertilizers that are used in the growing bio fuels lead to greenhouse emissions. Also, biofuels can help in managing the municipal solid wastes i.e. the waste can be

converted into fuel.

- **Security:** Biofuels can be produced locally, which decreases the nation's dependence upon foreign energy. By reducing dependence on foreign fuel sources, countries can protect the integrity of their energy resources and make them safe from outside influences.
- **Economic stimulation:** Because biofuels are produced locally, biofuel manufacturing plants can employ hundreds or thousands of workers, creating new jobs in rural areas. Biofuel production will also increase the demand for suitable biofuel crops, providing economic stimulation to the agriculture industry.

Disadvantages of Biofuels

- **Efficiency:** Fossil Fuels produce more energy than some of the biofuels. E.g. 1 gallon of ethanol produces less energy as compared to 1 gallon of gasoline (a fossil fuel).
- **Cost:** Pumping fossil fuels from the ground is a difficult and expensive process leading to high costs. Production of biofuels require land, this impacts cost of biofuels as well as that of food crops. Also, though growing engineered biofuel crops can benefit farmers commercially but the excess number of such crops can also lead to loss of biodiversity.
- **Food shortages:** There is concern that using valuable cropland to grow fuel crops could have an impact on the cost of food and could possibly lead to food shortages.
- **Water use:** Massive quantities of water are required for proper irrigation of biofuel crops as well as to manufacture the fuel, which could strain local and regional water resources.

International Initiatives on Sustainable Biofuels

Production of sustainable biofuels is required to reduce their impact on environment and economy.

- **Roundtable on Sustainable Biomaterials (RSB):**
 - It is an international initiative which brings together farmers, companies, governments, non-governmental organizations, and scientists who are interested in the sustainability of biofuel production and distribution.
 - In April 2011, it launched a set of comprehensive sustainability criteria - the "**RSB Certification System.**" Biofuels producers that meet these criteria are able to show buyers and regulators that their product has been obtained without harming the environment or violating human rights.
- **Sustainable Biofuels Consensus:**

It is an international initiative which calls upon governments, the private sector, and other stakeholders to take decisive action to ensure the sustainable trade, production, and use of biofuels.

- **Bonsucro:**

- It is an international not for-profit, multi-stakeholder organization established in 2008 to promote sustainable sugar cane.
- Its stated aim is to reduce 'the environmental and social impacts of sugarcane production while recognising the need for economic viability'.
- It does that through setting sustainability standards and certifying sugar cane products including ethanol, sugar and molasses.

Evolution of Biofuels in India

1975	India began examining the feasibility of blending ethanol with petrol. Six technical committees and four study groups were set up for the same.
1980	The Indian Oil Corporation conducted trials on 15 passenger cars & 21 two & three wheelers using 10% and 20% anhydrous ethanol blends.
2002	The government mandated blending of 5% ethanol in nine states and four union territories with a Rs 0.75 excise duty exemption. A Committee on Development of Biofuels was also constituted.
2003	The committee recommended strengthening the ongoing programme of blending of ethanol with petrol & launching a National Mission on Biodiesel based on jatropha plantation. Meanwhile the National Auto Fuel Policy recommended commercialisation of biofuel vehicles.
2004	Problems related to feedstock supply of molasses forced the Indian government to suspend mandatory blending of ethanol in petrol.
2005	The resurgence in sugar and molasses production in 2005 resulted in renewed interest in ethanol programme. The government fixed the purchase price of ethanol by oil companies at Rs 18.25 per litre.
2006	The government announced a Biodiesel Purchase Policy , fixing the purchase price for oil companies at Rs 25 per litre.
2007	The National Biofuels Draft Policy came to light. A Biofuel Mission focusing specifically on pongamia and jatropha plants was also launched.
2009	National Biofuel Policy, 2009 launched.

Recent Initiatives

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- **Initiatives by Department of Biotechnology, Ministry of Science and Technology:**
 - The department successfully developed **2G Ethanol** and transferred the technology to Oil Marketing Companies (OMCs).
 - Developed **Indigenous Cellulolytic Enzyme** for the production of biofuels.
 - Demonstrated micro algae based sewage treatment technology.
 - It has strengthened the international collaboration to accelerate innovation in Sustainable Biofuel through multilateral programs like **Mission Innovation and Biofuture Platform**.
 - It is training & encouraging young researchers in the field of Bioenergy through Fellowships/Awards.
 - **Pradhan Mantri JI-VAN Yojana, 2019:** The objective of the scheme is to create an ecosystem for setting up commercial projects and to boost Research and Development in 2G Ethanol sector.
 - **Ethanol blending:**
 - The **2018 Biofuel Policy** has the objective of reaching 20% ethanol-blending and 5% biodiesel-blending by the year 2030.
 - The Government has reduced GST on ethanol for blending in fuel from 18% to 5%.
 - The Ministry of Petroleum & Natural Gas is making all efforts to increase ethanol supply for petrol.
 - **GOBAR (Galvanizing Organic Bio-Agro Resources) DHAN scheme, 2018:** It focuses on managing and converting cattle dung and solid waste in farms to useful compost, biogas and bio-CNG, thus keeping villages clean and increasing the income of rural households. It was launched under **Swachh Bharat Mission (Gramin)**.
 - **Repurpose Used Cooking Oil (RUCO)** launched by Food Safety and Standards Authority of India (FSSAI) aims for an ecosystem that will enable the collection and conversion of used cooking oil to biodiesel.
 - **National Policy on Biofuels, 2018:**
 - The Policy categorises biofuels as "**Basic Biofuels**" viz. First Generation (1G) bioethanol & biodiesel and "**Advanced Biofuels**" - **Second Generation (2G)** ethanol, Municipal Solid Waste (MSW) to drop-in fuels, **Third Generation (3G) biofuels**, bio-CNG etc. to enable extension of appropriate financial and fiscal incentives under each category.
 - It expands the scope of raw material for ethanol production by allowing use of sugarcane juice, sugar containing materials like sugar beet, sweet sorghum, starch containing materials like corn, cassava, damaged food grains like wheat, broken rice, rotten potatoes, unfit for human consumption for ethanol production.
 - The Policy allows use of surplus food grains for production of ethanol for blending with petrol with the approval of **National Biofuel Coordination Committee**.

- With a thrust on Advanced Biofuels, the Policy indicates a viability gap funding scheme for 2G ethanol Bio refineries of Rs.5000 crore in 6 years in addition to additional tax incentives, higher purchase price as compared to 1G biofuels.
- The Policy encourages setting up of supply chain mechanisms for biodiesel production from non-edible oilseeds, Used Cooking Oil, short gestation crops.
- Roles and responsibilities of all the concerned Ministries/Departments with respect to biofuels have also been captured in the Policy.

Way Forward

- Promotion of the use of biofuels in transportation in the countries like India will help in reducing the crude import bill.
- Biofuels can help in rural and agricultural development in the form of new cash crops.
- Efforts for producing sustainable biofuels should be made by ensuring use of wastelands and municipal wastes that get generated in cities.
- A properly designed and implemented biofuel solution can provide both food and energy.
- A community-based biodiesel distribution programme that benefits local economies, from the farmers growing the feedstock to local businesses producing and distributing the fuel to the end consumer, can be tried.