**BIOFUELS AND THEIR ADVANTAGES AND DISADVANTAGES**

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**INTRODUCTION:**

Biofuel is a fuel that is produced from biomass by the very slow natural processes involved in the formation of fossil fuels, such as oil. The term biofuels usually apply to liquid fuels and blending components produced from biomass materials called feedstocks. A biofuel is any liquid fuel derived from biological material such as trees, agricultural wastes, crops, or grass. Biofuels are used globally and biofuel industries are greatly expanding in Europe, Asia, and North and South America. They contain no sulphur and produce low carbon monoxide and toxic emissions. Biofuels can reduce greenhouse gas emissions and increase energy security by providing an alternative to fossil fuels. Most biofuels are used as transportation fuels, but they may also be used for heating and electricity generation.

 Biofuels are made from plant or animal products. Some are produced by the extracting of sugar or starch from crops and then fermenting it to make alcohol. Other biofuels are made by the decaying of organic matter and the capturing of the resultant gases. Biomass is organic components are the source of substitute energy and it contains all classes of biofuels like solid, gaseous and liquid fuels. Biomass for alternative energy might be engaged in various ways. Solid biofuels are mostly firewood, charcoal and fibrous matters. Fossil fuels like firewood and charcoal are extensively utilized as a primary fuel domiciliary purpose that is cooking. Fibrous type of material can be obtained from sugar cane processing and it is widely used for power generation and preparation of steam. Methane and producer gases are mainly the gaseous biofuels and these can be obtained by fermentation of domestic animal wastes and from the pyrolysis or gasification of agricultural wastes and wood. Different kind of liquid biofuels like methanol, ethanol, organic oils and the methyl esters are generally attributed as biodiesel. Solids and liquids biofuels are widely used for energy inception since of their large prosperity, tremendous energy and low price.

Production and consumption of biofuels in the United States have generally increased every year since the early 1980s. In 2021, about 17.5 billion gallons of biofuels were produced in the United States and about 16.8 billion gallons were consumed. Most of the biofuel consumption occurs as a blend with refined petroleum products such as diesel, gasoline and heating oil. But some biofuels do not require blending with their petroleum counterparts and it is referred as drop in biofuels.

**GENERATION OF BIOFUELS:**

 Each biodiesel generations have its own potential benefits and draw backs.

**First generation biofuels:**

 First generation biofuels are usually derived from vegetable oil, starch. Sugarcane ethanol, corn ethanol, starch-based biodiesel and pure plant oils are the examples of first-generation biofuels. Many biochemical treatments for vegetable oil to biodiesel or starch and sucrose to ethanol are required for processing of these elements to become a transportation fuel. These might be used as food and feed or consists of food residues which are prepared from sugar, starch, vegetable oil or animal fats using usual technology like fermentation, esterification and distillation processes. These processes are well-settled scientifically and have been utilized for hundreds of years in many uses, such as in making alcohol. The most familiar and important first-generation biofuels are bio alcohols, bio-diesel, vegetable oils, bio-gas, solid bio-fuels. The technique used to make biodiesel is called transesterification, since it is a procedure of converting one type of ester into other.

1. **Bio alcohols:**

Bio alcohols can be simply defined as alcohols produced from biological resources or biomass. Bioethanol, which is the major alternative fuel for spark ignition engines, is the most widely known and produced bio alcohol. Bio alcohols can be produced from a wide range of biomass, including crops, lignocellulosic crops or residues, and food waste. It is widely used for manufacture of cosmetics, pharmaceuticals and also for the production of alcoholic beverages and also used as a renewable energy fuel source.Bio alcohols can be produced from a wide range of biomass, it includes crops, food wastes and lignocellulosic crops or residues.

1. **Bio-diesel:** Biodiesel is a renewable, biodegradable fuel manufactured domestically by using vegetable oils, animal fats. Biodiesel is a liquid fuel produced by transesterification process (a process that converts fats and oils into biodiesel and glycerine). Commonly used raw materials for biodiesel production are vegetable seed oil, soyabean oil and animal fats.
2. **Vegetable oil:** The uses of vegetable oils as fuel have economic, environmental and energetical related benefits. Although, it can rarely be considered in authorized energy statistics but it is already the fourth leading resource of energy in the world. Vegetable oils generates heat approximately 90 % like that of diesel fuel. It can easily convert as biodiesel from this biomass, widely accessible and can frequently be used directly in diesel engines with little modification.
3. **Biogas:** Biogasis a viable and essential form of energy in agricultural and rural areas, obtained from the processing of organic waste through anaerobic digestion. In addition to biogas (comprising mainly methane and carbon dioxide, plus other trace gases), the process also produces a stabilized organic waste, digestate (also known as biofertilizer), which can be used as a soil conditioner or biofertilizer. The biodegradation rate of organic residues is related to the microbial activity in the anaerobic system. This activity depends on the type of raw material, the pH of the medium, the total level of solids, the temperature of the process and other parameters that determine the digestion period for the production of biogas and biofertilizer.
4. **Solid biofuel**: Solid biofuels is a product obtained from sum of charcoal, fuelwood, black liquor, animal waste, municipal waste which can be produce energy for heating, cooking, heating and generating electricity.

**Second-Generation Biofuels:**

 Second-generation biofuels are fuels made from lignocellulosic or woody biomass, or agricultural residues/waste. These are also known as advanced biofuels. These are produced from non-food crops including the waste from food crops, agricultural residues, wood chips and waste cooking oil, substantial amounts of biomass have to be provided that will need an analysis of active and potential biomass sources well before the start-up of large-scale production. Lignocellulose process means to plant waterless material that is forest material. It is obtainable in large quantities raw material on the world for the construction of biofuels, mostly bioethanol. It is made of carbohydrate polymers (cellulose, hemicelluloses), and an aromatic polymer (lignin). Poplar trees are required to undergo a pre-treatment process, and a sequence of elemental reactions that crash lignin. Lignin is the ingredient of the cell walls of all dry earth plant. Lignin is the only polymer that is not collected of carbohydrate (sugar) monomers. Lignin is an aromatic functionality and unique in that sense it is the only large-scale biomass source for 2nd generation. It is collected of up to three different phenyl propane monomers depending on the species. Thermochemical or biochemical reactions which are the initial steps that unlock the sugars surrounded in fibres of the plant. After the completion of the reaction, plant ethanol is obtained which is resembles that of 1st generation ethanol manufacture. The following fuels are acquired from the second-generation biofuels,

1. **Hydrotreated vegetable oil:** It is a used as a diesel substitute that has very popular fuel properties like high cetane, non-aromatic and does not contain sulphur.
2. **Pyrolysis oils/biocrude:** This is obtained by ash pyrolysis (rapid heating to about 1000 ºF followed by rapid cooling). Refining and upgrading generate liquid fuels for transportation or stationary applications (boilers, turbines).
3. **Cellulosic ethanol:** It is obtained via fermentation of sugars derived from the cellulose and hemicellulose fractions of lignocellulosic biomass.
4. **Biobutanol:** It is prepared in a process like to ethanol but with different microorganisms. Presently, the fuel yield is lower than that of ethanol, but biobutanol can be used as a call on replacement for gasoline without blending.
5. **Biomass to liquids (BTL) technology:** It is started with gaseous cation to prepare a synthesis gas (syngas) followed by Fischer-Tropsch process to gasoline, diesel and jet fuel.
6. **Alcohol:** Methanol, dimethyl ether (DME) and mixed alcohols can also be prepared from syngas via catalytic synthesis. Alcohols are also obtained by fermentation of syngas by some specialized microorganisms.
7. **Biosynthetic natural gas (Bio-SNG):** Any way renewable natural gas can also be obtained via gasification and then followed by catalytic methanation and purification. Biogas can be made by an anaerobic digestion with microorganisms. This gas is composed of mainly methane and carbon dioxide. It can then be used as compressed natural gas (CNG) or liquefied natural gas (LNG) in vehicles or injected into the existing natural gas cylinder.

**Third-Generation Biofuels:**

 Third-generation biofuels are fuels made from algae. Algae can be produced in ponds or tanks on land, and out at sea. Algal fuels have high yields, can be grown with minimal impact on freshwater resources, can be produced using saline water and wastewater, have a high ignition point, and are biodegradable and relatively harmless to the environment if spilled. Production requires large amounts of energy and fertilizer, the produced fuel degrades faster than other biofuels, and it does not flow well in cold temperatures. By 2017, due to economic considerations, most efforts to produce fuel from algae have been abandoned or changed to other applications. Microalgae are very little in size and typically measured in a scale of micrometres. These species are generally grown at faster rate in water bodies or ponds and contains more lipids than macroalgae. In case of algae the main advantage is the short harvesting cycle whereas for usual crops having harvesting cycle of once or twice in a year. Algae can be cultured in a various method and it can be developed in any of the following ways:

1. **Open ponds:** This is a simple way in which algae is developed in the open-air ponds. Algae can be cropped simply and have low assets costs but are less proficient than other systems. Other organisms can pollute the pond so they are much concern even if from potentially damage having a fear to kill the algae.
2. **Closed-loop systems:** This system is alike open ponds, but it is not uncovered to the atmosphere and use a disinfected supply of carbon dioxide. It has large potential because it may be directly linked to carbon dioxide released into the atmosphere in every use.
3. **Photo-bioreactors:** These are the most advanced and thus most difficult systems to implement, that comes with result in high capital costs. The proficient photobioreactors are necessary to grow and spout the potentials of algae. Although, till now, sufficient amount of photobioreactors have been projected but only a little of them can be practically used for mass making of algae. One of the most important factors that bound their realistic application of algal mass cultures is mass transfer.

**Fourth-Generation Biofuels:**

Electro fuels and solar fuel are the fourth-generation biofuels. Electro fuels are made by storing electrical energy in the chemical bonds of liquids and gases. The primary targets are butanol, biodiesel, and hydrogen, but include other alcohols and carbon containing gases such as methane and butane. A solar fuel is a synthetic chemical fuel produced from solar energy. Fourth generation biofuels depend on the conversion of vegoil and biodiesel into gasoline.

**ADVANTAGES OF BIOFUELS:**

1. **Cost**

The cost of biofuels in the market are much higher. They produce fewer emissions During burning, fewer emissions are produced. As the demand for biofuels increases, it is also possible that they will become cheaper in the future.

1. **Durability**

When biodiesel is utilized as a combustible fuel, its increases engine durability. There is also no need to convert the engine. This allows the engine to run for longer periods with less maintenance. Engines designed to operate on biofuels produce lower emissions than other diesel engines.

1. **Renewable Resources**

Most of the sources such as manure, corn, soybeans, switchgrass, waste from crops and plants are renewable and the use of biofuels in nature is efficient. Also, these crops can be planted again.

1. **Reduction in Greenhouse Gas Emissions**

Biofuels decreases about 65% of greenhouse gases. When fossil fuels burn, they produce large amounts of greenhouse gases in the atmosphere, such as carbon dioxide. The greenhouse gases bring about global warming by trapping sunlight. Furthermore, the burning of coal and oil raises the temperature.

**5. Pollution**

Biofuels can bring less pollution to the planet. They emit less carbon dioxide and other emissions when burned than standard diesel. Its use also leads to a significant reduction of particulate matter emissions, the term used to explain solid particles and liquid droplets in the air.

### DISADVANTAGES OF BIOFUELS:

### Monoculture

Monoculture refers to the practice of producing the same crops year after year, rather than producing various crops through a farmer’s fields over time. While this might be economically attractive for farmers but growing the same crop every year may deprive the soil of nutrients that are put back into the soil through crop rotation.

###  2. Use of Fertilizers

### Biofuels are produced from crops, and these crops need fertilizers to grow better. Because, Fertilizers contain nitrogen and phosphorus.

**3. Shortage of Food**

Biofuels are extracted from plants and crops that have high levels of sugar in them. However, most of these crops are also used as food crops. Even though waste material [from plants](https://www.conserve-energy-future.com/houseplants-survive-winter-cold.php) can be used as raw material, the requirement for such food crops will still exist. It will take up agricultural space from other crops, which can create a number of problems.

**4. Industrial Pollution**

Large scale industries meant for churning out biofuel are known to emit large amounts of emissions and cause small scale [water pollution](https://www.conserve-energy-future.com/ways-reduce-your-water-bill.php) as well.

**5. Global Warming**

The biofuels, which are mostly hydrogen and carbon, burning them produce carbon dioxide, which [contributes to global warming](https://www.conserve-energy-future.com/globalwarmingcauses.php).

**6. Water Use**

Large quantities of water are required to irrigate the biofuel crops, and it may impose strain on local and regional water resources, if not managed wisely. In order to produce corn-based ethanol to meet local demand for biofuels, massive quantities of water are used that could put unsustainable pressure on local water resources.

**7. Weather Problem**

Biofuel is less suitable for use in low temperatures. It is more likely to attract moisture than fossil diesel, which creates problems in cold weather and increases microbial growth in the engine that clogs the engine filters.