LECTURE-12
(BIOFUELS)

➢ INTRODUCTION

- Biofuel, is a fuel (gas, liquid or solid) derived from biomass.
- Generally, gases and liquids fuels obtained from biomass are considered as biofuels.
- The biomass may be plant or algae material or animal waste.
- Since such feedstock material can be replenished readily, biofuel is considered to be a source of renewable energy, unlike fossil fuels such as petroleum, coal, and natural gas.
- Biofuel is commonly advocated as a cost-effective and environmentally benign alternative to petroleum and other fossil fuels, particularly within the context of rising petroleum prices and increased concern over the contributions made by fossil fuels to global warming.
- Many critics express concerns about the scope of the expansion of certain biofuels because of the economic and environmental costs associated with the refining process and the potential removal of vast areas of arable land from food production.
- Crops used to make biofuels are generally either high in sugar (such as sugarcane, sugarbeet, and sweet sorghum), starch (such as maize and tapioca) or oils (such as soybean, rapeseed, coconut, sunflower etc.).
- The source and the biofuel have been depicted by the figures given below:

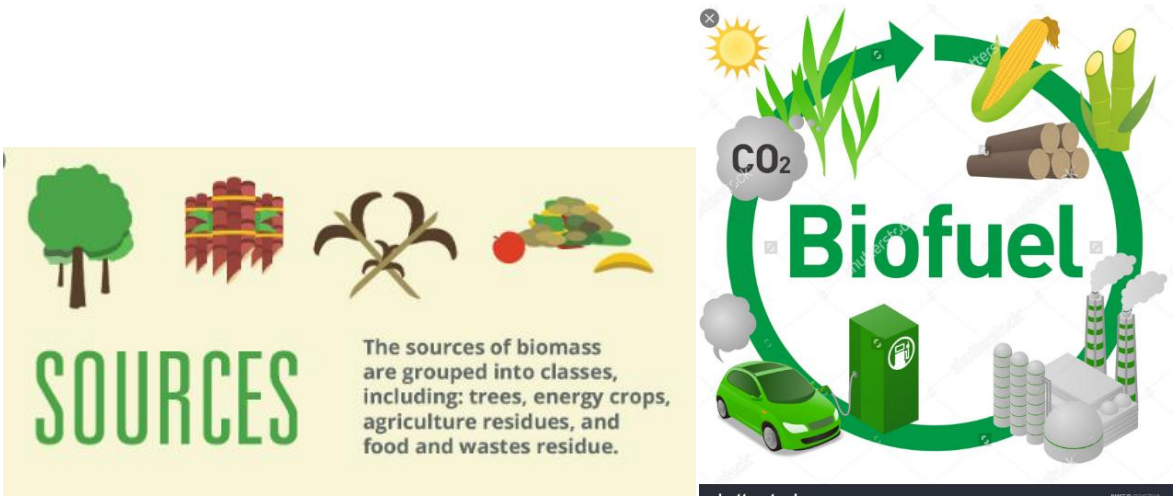


Figure-1: The source and biofuel.

- **Biofuel Types**
  - ✓ The term biofuel refers to liquid or gaseous fuels for the transport sector that are predominantly produced from biomass.
  - ✓ It is generally held that biofuels offer many benefits, including sustainability, reduction of greenhouse gas emissions, and security of supply.
  - ✓ A variety of fuels can be produced from biomass resources including liquid fuels, such as ethanol, methanol, biodiesel, and Fischer-Tropsch diesel, and gaseous fuels, such as hydrogen and methane.

- ✓ Biofuels are primarily used in vehicles but can also be used in engines or fuel cells for electricity generation.

- **Relevance of Biofuel Technology**
  - ✓ There are several reasons why biofuels are considered relevant technologies by both developing and industrialized countries.
  - ✓ They include energy security, environmental concerns, foreign exchange savings, and socioeconomic issues related to the rural sector.
  - ✓ Due to the widespread availability of biomass resources, biomass-based fuel technology can potentially employ more people than fossil fuel-based technology.
  - ✓ Demand for energy is increasing every day due to the rapid growth of population and urbanization.
  - ✓ As the major conventional energy sources like coal, petroleum, and natural gas are gradually depleted, biomass is emerging as one of the promising environmentally friendly renewable energy options.
  - ✓ Due to its environmental merits, the share of biofuel in the automotive fuel market will grow fast in the coming future.
  - ✓ The advantages of biofuels are: (a) they are easily available from common biomass sources, (b) carbon dioxide cycle occurs in combustion, (c) they are very environmentally friendly, and (d) they are biodegradable and contribute to sustainability.
  - ✓ Various scenarios have led to the conclusion that biofuels will be in widespread use in the future energy system.
  - ✓ The scenarios are to facilitate the transition from the hydrocarbon economy to the carbohydrate economy by using biomass to produce bioethanol and biomethanol as replacements for traditional oil-based fuels and feedstocks.
  - ✓ The biofuel scenario produces equivalent rates of growth in GDP and per-capita affluence, reduces fossil energy intensities of GDP, and reduces oil imports.
  - ✓ Each scenario has advantages whether in terms of rates of growth in GDP, reductions in carbon dioxide emissions, the energy ratio of the production process, the direct creation of jobs, or the area of biomass plantation required to make the production system feasible.
- **How Biofuels differ from Petroleum Feedstocks?**
  - ✓ The biggest difference between biofuels and petroleum feedstocks is oxygen content.
  - ✓ Biofuels have oxygen levels of 10 to 45% while petroleum has essentially none, making the chemical properties of biofuels very different from those of petroleum.
  - ✓ All have very low sulfur levels and many have low nitrogen levels.
  - ✓ Biomass can be converted into liquid and gaseous fuels through thermochemical and biological methods.
  - ✓ Biofuel is a non-polluting, locally available, accessible, sustainable, and reliable fuel obtained from renewable sources.
- **Biomass as a Feedstock for Biofuels**
  - ✓ Biomass is an attractive feedstock for three main reasons.
  - ✓ First, it is a renewable resource that could be sustainably developed in the future.

- ✓ Second, it appears to have formidably positive environmental properties resulting in no net releases of carbon dioxide and very low sulfur content.
- ✓ Third, it appears to have significant economic potential provided that fossil fuel prices increase in the future.
- ✓ Lignocellulosic biomethanol has such low emissions because the carbon content of the alcohol is primarily derived from carbon that was sequestered in the growing of the biofeedstock and is only being rereleased into the atmosphere.
- ✓ Carbohydrates (hemicelluloses and cellulose) in plant materials can be converted into sugars by hydrolysis.
- ✓ Fermentation is an anaerobic biological process in which sugars are converted into alcohol by the action of microorganisms, usually yeast.
- ✓ The resulting alcohol is bioethanol.
- ✓ The value of any particular type of biomass as feedstock for fermentation depends on the ease with which it can be converted into sugars.

- **Sources of Liquid Biofuels for Automobiles**
  - ✓ The sources of liquid biofuels are summarized and depicted in the Figure-2, below:

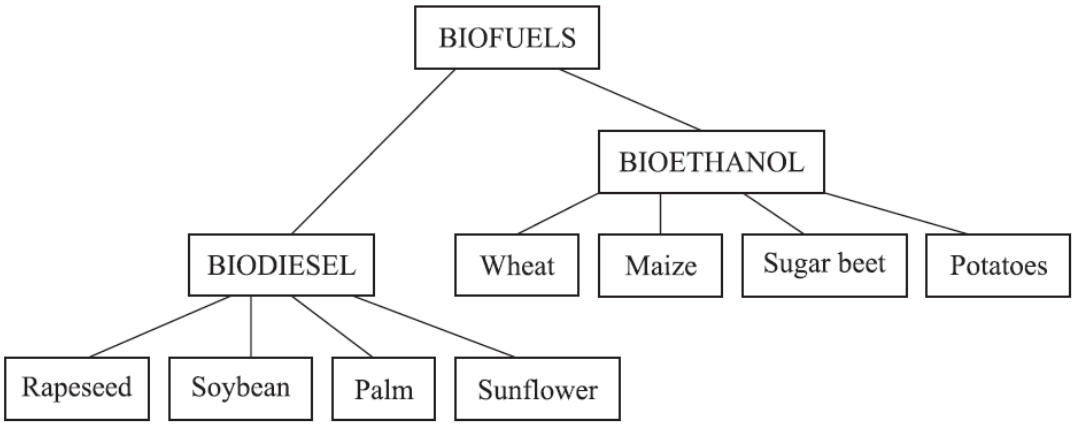


Figure-2: Sources of liquid biofuels for automobiles

➢ **Brief Notes on the Biofuels**

- ✓ **Bioethanol**
  - o Bioethanol is ethyl alcohol obtained during fermentation with sugars, starches, or cellulosic biomass.
  - o It is a petrol additive/substitute.
  - o It is possible that wood, straw, and even household wastes may be economically converted into bioethanol.
  - o Ethanol demand is increasing day by day.
  - o For the supply to be available to meet this demand, new technologies must be moved from the laboratories to commercial reality.
  - o World ethanol production is about 60% from sugar-crop feedstock. Ethanol is the most widely used liquid biofuel.
  - o Most commercial production of ethanol is from sugar cane or sugar beet, as starches and cellulosic biomass usually requires expensive pre-treatment.

- Ethanol is used as a renewable energy fuel source as well as for the manufacture of cosmetics and pharmaceuticals and also for the production of alcoholic beverages.
- Ethyl alcohol is not only the oldest synthetic organic chemical used by humans, but it is also one of the most important.

✓ **Biogas**

- **A**naerobic digestion of biowastes occurs in the absence of air; the resulting gas, called biogas, is a mixture consisting mainly of methane and carbon dioxide.
- Biogas is a valuable biofuel that is produced in digesters filled with feedstock like dung or sewage.
- The digestion is allowed to continue for a period of ten days to a few weeks.

✓ **The Fischer–Tropsch (FT) Synthesis**

- The **Fischer–Tropsch process** is a collection of chemical reactions that converts a mixture of carbon monoxide and hydrogen into liquid hydrocarbons.
- These reactions occur in the presence of metal catalysts, typically at temperatures of 150–300 °C (302–572 °F) and pressures of one to several tens of atmospheres.
- The process was first developed by Franz Fischer and Hans Tropsch in Germany, in 1925.
- The Fischere-Tropsch (FT) synthesis has been investigated over decades as an alternative route to obtain synthetic fuels from synthesis gas.
- FT is a high-performance synthesis based on metallic catalysis, mainly using ruthenium, cobalt and iron catalysts, which converts syngas in hydrocarbons and chemical precursors.
- The syngas production from biomass gasification becomes the feedstock for subsequent con-version into biofuels through the Fischer-Tropsch synthesis.
- The usage of biomass, includes the lignocellulosic residues, as a raw material in the gasification process.
- Biosyngas is high-lighted as a synthetic fuel source to replace nonrenewable, conventional fossil fuels.
- Lignocellulosic material must be considered a low-cost feedstock to the liquid biofuel production on a large scale.
- Recent understanding of reaction kinetics and thermodynamics has contributed to increasing the FT performance and economic viability.
- Fischer-Tropsch (FT) synthesis, is a crucial reaction for the transformation of non-petroleum carbon resources such as coal, natural gas, shale gas, coal-bed gas and biogas, as well as biomass into liquid fuels and chemicals.
- Temperature, pressure and catalyst behaviour can influence the FT synthesis activity.
- Catalyst factors, including the chemical state of active phases, the promoters, the size and the microenvironment of active phase, determine the CO conversion activity and the product selectivity, particularly the selectivity to C_{5+} hydrocarbons.
- FT synthesis produces hydrocarbons of different lengths from a gas mixture of H_2 and CO (syngas) resulting from biomass gasification.
- The FTS process is capable of producing liquid hydrocarbon fuels from bio-syngas.

- The process for producing liquid fuels from biomass, which integrates biomass gasification with FTS, converts a renewable feedstock into a clean fuel.
- FTS has been explained by the following Figure-3 (a, b):

Figure-3: Fischer-Tropch synthesis for biofuels.

- The products of FTS are mainly aliphatic straight chain hydrocarbons (CxHy).
- Besides the CxHy, branched hydrocarbons, unsaturated hydrocarbons, and primary alcohols are also formed in minor quantities.
- The products obtained from FTS include the light hydrocarbons methane (CH_4), ethene (C_2H_4) and ethane (C_2H_6), LPG (C_3–C_4, propane and butane), gasoline (C_5–C_{12}), diesel fuel (C_{13}–C_{22}), and waxes (C_{23}–C_{33}).
- The distribution of the products depends on the catalyst and the process parameters such as temperature, pressure, and residence time.
- The FTS has been extensively investigated and reported in the literature by many researchers .

✓ **Vegetable Oils**

- Vegetable oils from renewable oil seeds can be used when mixed with diesel fuels.
- Pure vegetable oil, however, cannot be used in direct-injection diesel engines, such as those regularly used in standard tractors, since engine cooking occurs after several hours of use.
- Conversion of vegetable oils and animal fats into biodiesel has been undergoing further development over the past several years.
- Biodiesel represents an alternative to petroleum-based diesel fuel.
- Chemically speaking, biodiesel is a mixture of monoalkyl esters of fatty acids, most often obtained from extracted plant oils and/or collected animal fats.
- Commonly accepted biodiesel raw materials include the oils from soy, canola, corn, rapeseed, and palm.
- New plant oils that are under consideration include mustard seed, peanut, sunflower, and cotton seed.
- The most commonly considered animal fats include those derived from poultry, beef, and pork.

➢ GLOBAL SCENARIO W.R.T. BIOFUELS

- In recent years, bioenergy has drawn attention as a sustainable energy source that may cope up with rising energy prices, but also may provide income to poor farmers and rural communities around the globe.
- Rising fuel prices, growing energy demand, concerns over global warming and increased openness to renewable energy resources, domestic energy security and the push for expansion into new markets for crops in the face of world trade outlooks are all factors driving interest in expanding the use of bioenergy.
- Despite keen interest in this sector, there are currently few players in this field.
- Biofuels are fuels that are usually processed from organic matter obtained from living organisms or their products (Biomass).
- They can be used as an alternative to fossil fuels.
- Increasing fuel prices, rising energy demand and global warming issues are the major reasons that drive an enormous interest in exploring natural as well as renewable sources to meet the demand for fuels and energy.
- Over the past 5 years, Biofuels are considered as an alternative to oils on worldwide basis.
- Their reduced carbon emissions in comparison to conventional fuels and their positive impacts on rural development, together with the current high oil prices, are key elements behind their market development.
- Researchers are trying to explore a wide variety of feedstocks, mainly non-edible crops and wastes for generation of cost-effective, high yield and environmental friendly bioenergy that have minimum emissions.
- Worldwide status of bioethanol production in 2017 (country wise) has been shown in Figure-4.

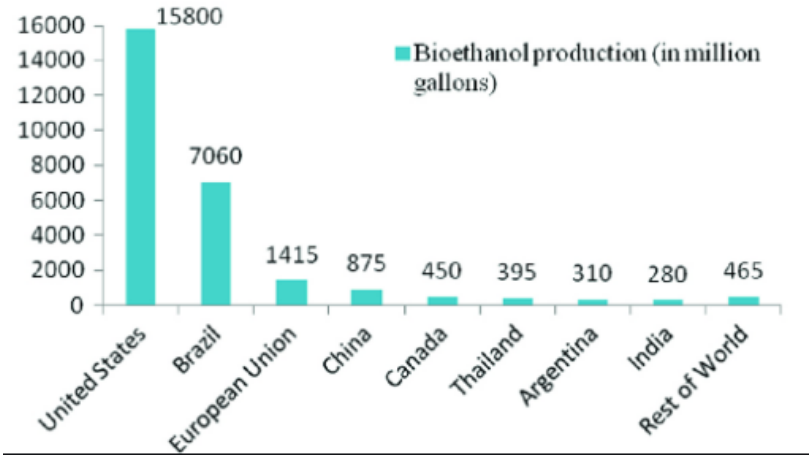


Figure-4: Global status of bioethanol production in 2017.

- United States and Brazil are world leader in the field of bioethanol production.
- However, India being one of the largest importer of energy, has very poor ranking.

- The worldwide projection of biodiesel production in 2017 (countrywise) has been depicted by the Figure-5.

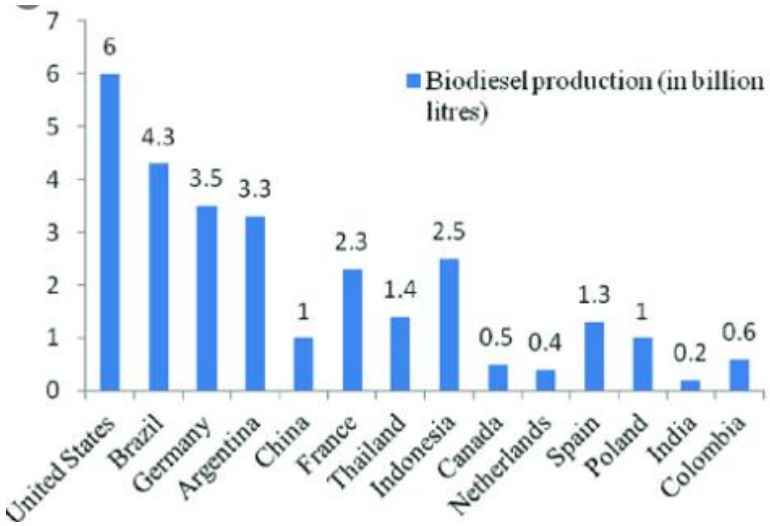


Figure-5: Global status of biodiesel production in 2017.

- Due to the large amount of diesel fuel demands worldwide and the negative environmental and health impacts of its direct combustion, biodiesel production and consumption have been globally increasing as the best short-term substitute for mineral diesel.
- However, using edible and non-edible oil feedstocks for biodiesel production has led to several controversial issues including feedstock availability and cost, greenhouse gas (GHG) emission, land use changes (LUC), and fuel vs. food/feed competition.
- Fortunately, these problems can be effectively overcome using non-crop feedstocks.
- Since 2000, the global biofuels supply has increased by many folds up to the year 2010 as evident from the **Figure-6**. This significant rise is attributed to policies such as blending mandates, which foster greater utilization.

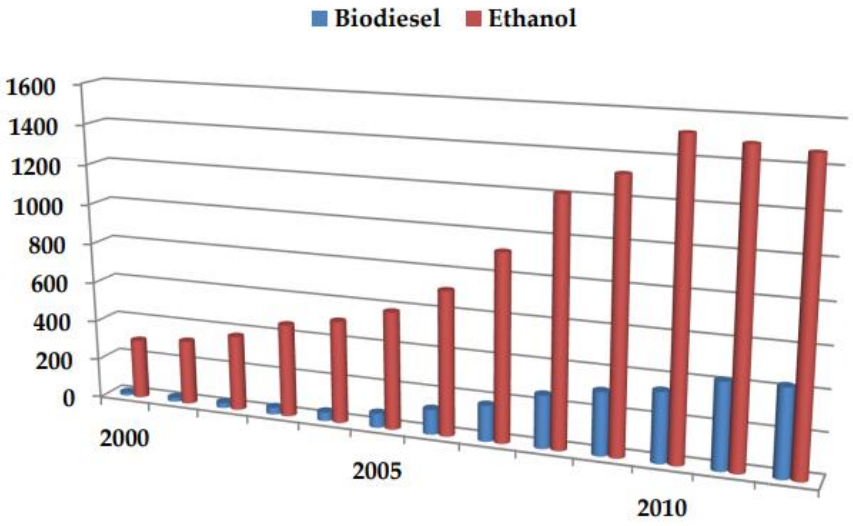


Figure-6: Global biofuel production by fuel type (thousand barrels per day).

- Looking at the broad numbers and types, the global biofuel supply equaled approximately 3:1 breakdown of ethanol to bio-diesel for the year 2013-2015 as clear from the **Figure-7**.
- Conventional biofuels produced from sugar, starch, vegetable oil, or animal fat reflected the majority of the supply.

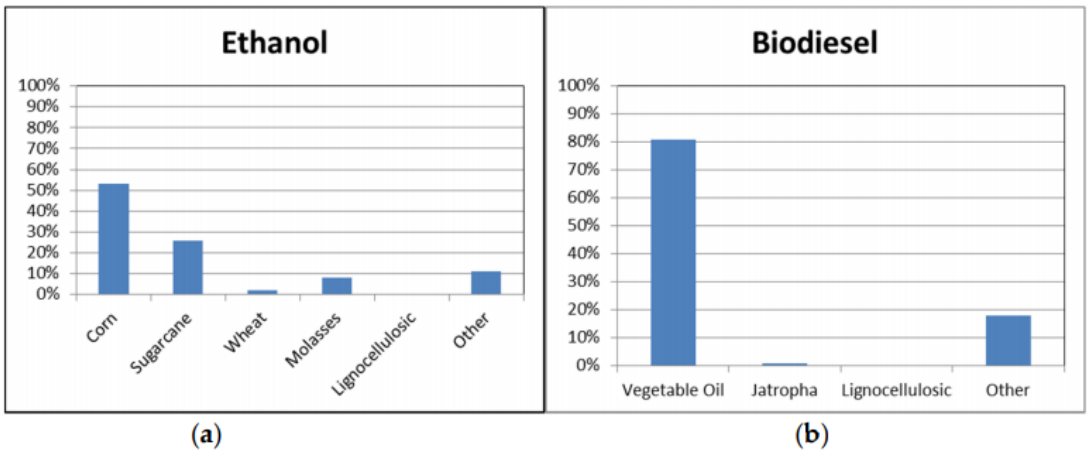


Figure-7: Shares of global ethanol (a) and biodiesel (b) production by feedstock type.

- In recent years, vegetable-based biodiesel nearly matched the ethanol supply produced from sugarcane.

➢ KEY FEEDSTOCKS FOR BIOFUEL PRODUCTION

Today about 60% of ethanol is produced from maize, 25% from sugar cane, 7% from molasses, 4% from wheat, and the remainder from other grains, cassava or sugar beets. About 77% of biodiesel is based on vegetable oils (30% soybean oil, 25% pal oil, 18% rapeseed oil) or waste cooking oils (22%). More advanced technologies based on cellulosic feedstocks (e.g. crop residues, wood, or dedicated energy crops) do not account for large shares of total biofuel production. Nevertheless, they are often seen as relevant technologies for the future as they are supposed to cause less competition with food products and emit safer levels of greenhouse gas emissions. The international biofuel sectors are strongly influenced by national policies with three major goals: farmer support, reduced greenhouse gas emissions, and/or reduced energy independency. Table-1 show biofuel production ranking and key feedstocks associated.

Table-1:Biofuel Production Ranking and Key Feedstocks

	Production ranking (base period)		Major feedstocks	
	Ethanol	Biodiesel	Ethanol	Biodiesel
United States	1 (50%)	2 (19%)	Maize	Soybean oil / diverse other oils
European Union	4 (5%)	1 (36%)	Maize / wheat / sugar beet	Rapeseed oil / waste oils
Brazil	2 (24%)	3 (12%)	Sugar cane	Soybean oil
China	3 (8%)	8 (3%)	Maize	Waste oils
India	5 (2%)	15 (0.5%)	Molasses	Palm oil
Canada	6 (1.6%)	10 (1.4%)	Maize	Waste oils
Indonesia	23 (0.2%)	4 (10%)	Molasses	Palm oil
Argentina	9 (1%)	5 (7%)	Maize / sugar cane	Soybean oil
Thailand	7 (1.5%)	6 (4%)	Molasses / cassava	Palm oil
Colombia	13 (0.4%)	9 (1.5%)	Sugar cane	Palm oil
Paraguay	15 (0.3%)	19 (0.03%)	Maize / sugar cane	Soybean oils

Note: Percentage numbers refer to the production share of countries in the base period.
Source: OECD/FAO (2019), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

1. Biodiesel includes renewable diesel (also known as Hydrotreated Vegetable Oil or HVO) in the accounting of this *Outlook* although both are different products.
2. An analysis of the potential contribution of biofuels to climate change mitigation in the transport sector (COM/TAD/CA/ENV/EPOC(2018)19/FINAL) that uses the Aglink-Cosimo model finds, however, that a substantially increased role for biofuels in decarbonisation of the transport sector would require a different set of policy incentives that would also need to be cost-effective and take into account effects on food security and the sustainability of resource use.

The diversity of feedstock options for biofuels is fairly significant with local conditions typically framing the choice. The following section and **Table-2** expand on this.

- **Lignocellulose**
  - ✓ Lignocellulosic material is derived from non-edible crops that have the advantage of limiting cropland expansion and related emissions, with appropriate practices.
  - ✓ This plentiful feedstock can be obtained from many different sources, including switchgrass, trees, and agricultural crop residues, such as rice straw, wheat straw, corn stover, and sugarcane bagasse.
  - ✓ Depending on the source, there is a large amount of available land.
  - ✓ Looking at straw for example, 2.3 billion tons of straw were available in 2011, which has the theoretical potential of making 560 million tons of ethanol.
  - ✓ Climate and water needs for lignocellulose vary depending on the source of lignocellulose that is used .
  - ✓ There is an incentive to utilize this non-food crop in lieu of traditional corn.
  - ✓ The challenge is to produce the fuel economically as the process involves breaking down fibrous plant walls into sugars, which is an expensive step.
  - ✓ Once sugars are formed, they can be fermented to produce cellulosic ethanol.
- **Algae**
  - ✓ Algae refers to a group of photosynthetic organisms, which has promising potential for biofuels in terms of high oil content, limited waste streams and minimal land requirements (compared to biomass), depending on the production pathway.

- ✓ Water is essential for algae cultivation, and can include fresh water, brackish, saline, and wastewater types.
- ✓ Methods of cultivation and recovery vary with implications for energy and environmental effects.
- ✓ Data have been limited to date, so there is a fair amount of uncertainty associated with environmental impacts of this feedstock.
- ✓ As of 2011, current environmental impacts were deemed negligible, as scaled production had not been demonstrated.

- **Corn**
  - ✓ Corn (maize) is a fundamental food staple that can be grown in a range of climates from tropical to temperate, and may be sensitive to frost.
  - ✓ Fertilizer and pesticide needs are high for this crop.
  - ✓ For feedstock and ethanol production, water needs are relatively low on the unit basis of ethanol produced.
  - ✓ The United States leads the world in using corn to produce ethanol for fuel.
- **Jatropha**
  - ✓ Jatropha is a non-food, perennial crop that can be grown on marginal land with a range of climates, soil and water conditions.
  - ✓ It is versatile in a variety of climates, highly resistant to drought, and is able to shed its leaves to conserve water.
  - ✓ There are many countries worldwide that are beginning to invest more in Jatropha.
  - ✓ The largest production is currently in Guatemala which has designated 25,000 acres of land for Jatropha growth.
  - ✓ Additional countries that are investing in this crop include Mexico, the Sudan, Ethiopia, and India.

Table-2: The Feedstocks based on Growth Attributes and Producers

Feedstock (Generation Type)	* Growth Time [47]	* Growth Temperature [47]	* Water Requirements [47]	* Major Growers [48]
Algae (Second)	Dependent on type of algae, temperature and light conditions (authors' assessments)	16–27 °C	Varies with land and sea-based production; Water intensity is generally high; temperature and pH dependent; Light intensity 1000–10,000	Emergent
Corn (First)	110–140 days	18–20 °C	500–800 mm	Brazil, USA, and China
Jatropha (Second)	90 days [49]	16–21 °C [41]	254–1016 mm [41]	Myanmar, India, China, and Indonesia [50]
Lignocellulose (Second)	Varies based on source. Grasses: 3–4 months, waste residue such as corn stover takes as long as the crop from which it is derived [31].	Varies based on source.	Usually need very little water [31]	Emergent
Palm (First)	5–6 months [51]	27–28 °C [44]	Minimum of 1800 mm [44]	Nigeria, Malaysia, and Indonesia
Rapeseed or Canola (First)	85–110 days [52]	Soil temperatures of 3–12 °C [52]	300–600 mm [53]	China, India, and Canada
Rye (Second)	Not available	1–4 °C but below 29 °C for germination [54]	Not available	Germany, Poland, and Russia
Sorghum (Second)	110–140 days	25–35 °C	450–650 mm	Nigeria, India, and Sudan
Soybeans (First)	100–130 days	18–35 °C	450–700 mm	Argentina, Brazil, and USA
Sugar beets (First)	140–200 days	20–25 °C	550–750 mm	France, USA, and Russia
Sugarcane (First)	15–16 months	32–38 °C	1500–2500 mm	Brazil, China, and India
Wheat (First)	100–130 days	15–20 °C	450–650 mm	Russia, China, and India

* The reference within the header applies, unless otherwise noted.

- **Palm**
  - ✓ Palm is a prime feedstock for biodiesel, and is produced for biofuels in Indonesia, Malaysia, and other countries of Southeast Asia.
  - ✓ Its oil is a fundamental food staple.
  - ✓ It is the largest source of vegetable oil consumed worldwide.
  - ✓ Palm trees require deep soil, a relatively stable high temperature, and continuous moisture throughout the year.
  - ✓ This feedstock grows in rainy and tropical land.
- **Soybeans**
  - ✓ Soybeans are a prime fuel and food crop, accounting for 25% and 65% of the global consumption of oil/fats as well as meal/cakes, respectively.
  - ✓ The largest producers are the USA and Brazil.
  - ✓ This crop can be grown in tropical, subtropical, and temperate climates
- **Sugarcane**
  - ✓ Globally, sugarcane is the second largest feedstock for ethanol production, and is a basic food crop that is grown in tropical climates.
  - ✓ It can have multiyear harvests tied to a single planting.
  - ✓ Sugarcane is grown in deep soil using fertilizers that are high in nitrogen and potassium, and low in phosphorous.
  - ✓ Sugarcane requires a constant supply of water throughout the growing season, with varying amounts depending on the climate conditions.
  - ✓ Brazil is traditionally the most notable producer of sugarcane-derived ethanol.
- **Sweet Sorghum**
  - ✓ Sweet sorghum is a multi-purpose and annual grass crop that is produced mostly by the USA, Nigeria, and India.
  - ✓ It is a variety of sorghum that has a high sugar content.
  - ✓ It can grow in tropical, sub-tropical, and temperate regions.
  - ✓ Relative to sugarcane, sweet sorghum is more versatile, capable of growing with limited water and in poor/shallow soil.
  - ✓ Compared to sugarcane and sugar beet alternatives, sweet sorghum is drought-resistant and has a much shorter growing cycle of four months.
  - ✓ Given its 70% water content, sorghum must be processed quickly post-harvest.
- **Notable Comparisons**
  - ✓ **Table-2** summarizes the major types of feedstock, based on growth attributes and producers.
  - ✓ Looking across the feedstock options, Jatropha, rapeseed, soybeans, and wheat have some of the shortest growth periods at 85–130 days.
  - ✓ Rapeseed and rye may be consistently cultivated in lower temperatures, whereas sugarcane must be cultivated in a higher temperature environment.
  - ✓ Algae, sugarcane and palm have higher requirements for water.

➢ CLASSIFICATION OF BIOFUELS (FIGURE-8)

- **Classification According to Food and Agriculture Organization (FAO), USA**

According to this classification, the biofuels are classified into three groups: wood fuels agro fuels and municipal by-products. This claasification is according to biofuel sources based on different characteristics, reflected by **Table-3**.

Table-3: Classification of Biofuels by different Characteristics

		woody biomass	herbaceous biomass	biomass from fruits and seeds	others (including mixtures)
		WOODFUELS	AGROFUELS		
Energy crop		- energy forest trees - energy plantation trees	- energy grass - energy whole cereal crops	- energy grain	
By-products*	direct	- thinning by-products - logging by-products	crop production by-products: - straw	- stones, shells, husks	- animal by-products - horticultural by-products - landscape management by-products
	indirect	- wood processing industry by-pro-ducts - black liquor	- fibre crop processing by-products	- food processing industry by-products	- biosludge - slaughterhouse by-products
End use materials	recovered	- used wood	- used fibre products	- used products of fruits and seeds	MUNICIPAL BY-PRODUCTS - kitchen waste - sewage sludge

- **Broad Classification of Biofuels**

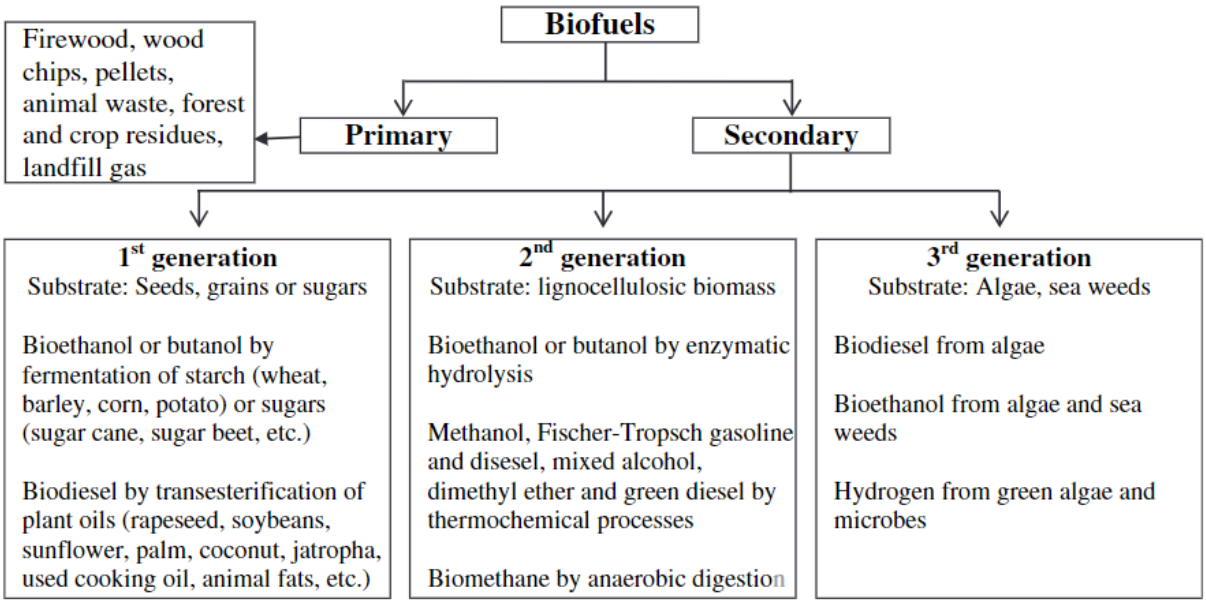


Figure-8: Broad classification of biofuels.

Biofuels are broadly classified as primary and secondary bio-fuels. The primary biofuels are used in an unprocessed form,primarily for heating, cooking or electricity production such as fuel wood, wood chips and pellets, etc.

The secondary biofuels are produced by processing of biomass e.g. ethanol, biodiesel, DME, etc.that can be used in vehicles and various industrial processes.

- ✓ **Primary Biofuels** are natural and unprocessed biomass such as firewood, wood chips and pellets, and are mainly those where the organic material is utilised essentially in its natural and non-modified chemical form. Primary fuels are directly combusted, usually to supply cooking fuel, heating or electricity production needs in small and large-scale industrial applications.
- ✓ **Secondary Biofuels** are modified primary fuels, which have been processed and produced in the form of solids (e.g. charcoal), or liquids (e.g. ethanol, biodiesel and bio-oil), or gases.

  The secondary biofuels are further devided into first, second and third-generation biofuels on the basis of raw material and technology used for their production.

- **Classification based on Generation (Suc-classification of the secondary biofuels)**

According to this classification, the biofuels have been kept in four groups based on the source materials. They are: first generation, second generation, third generation and fourth biofuels.

- **First-generation (Figure-9)**

- ✓ The first generation biodiesel is derived from food bio-feedstocks such as soybeans, palm, canola and rapeseed.
- ✓ Promotion of the first generation biodiesel caused interaction problems with human foodchains, including supply and demand balancing, land use, water management.
- ✓ Feedstocks such as sugar, starch, vegetable oil, or animal fats using conventional technology are used.
- ✓ These are generally produced from grains high in sugar or starch fermented into bioethanol; or seeds that which are pressed into vegetable oil used in biodiesel.
- ✓ Common first-generation biofuels include vegetable oils, biodiesel, bioalcohols, biogas, solid biofuels, syngas.

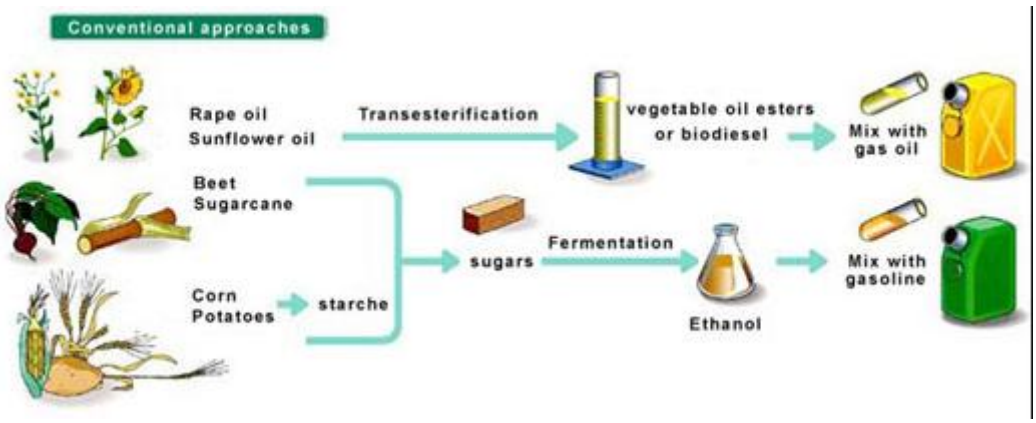


Figure-9: The first generation biofuel.

- **Second-generation (Figure-10)**

- ✓ The second generation biofuels are produced from non-food crops, such as cellulosic biofuels and waste biomass (stalks of wheat and corn, and wood).
- ✓ Second generation biofuels are also known as **advanced biofuels**.
- ✓ What separates them from first generation biofuels the fact that feedstock used in producing second generation biofuels are generally not food crops.

- ✓ The only time the food crops can act as second generation biofuels is if they have already fulfilled their food purpose.
- ✓ For instance, waste vegetable oil is a second generation biofuels because it has already been used and is no longer fit for human consumption.
- ✓ Virgin vegetable oil, however, would be a first generation biofuel.
- ✓ Because second generation biofuels are derived from different feed stock, different technology is often used to extract energy from them.
- ✓ This does not mean that second generation biofuels cannot be burned directly as the biomass.
- ✓ In fact, several second generation biofuels, like switchgrass, are cultivated specifically to act as direct biomass.

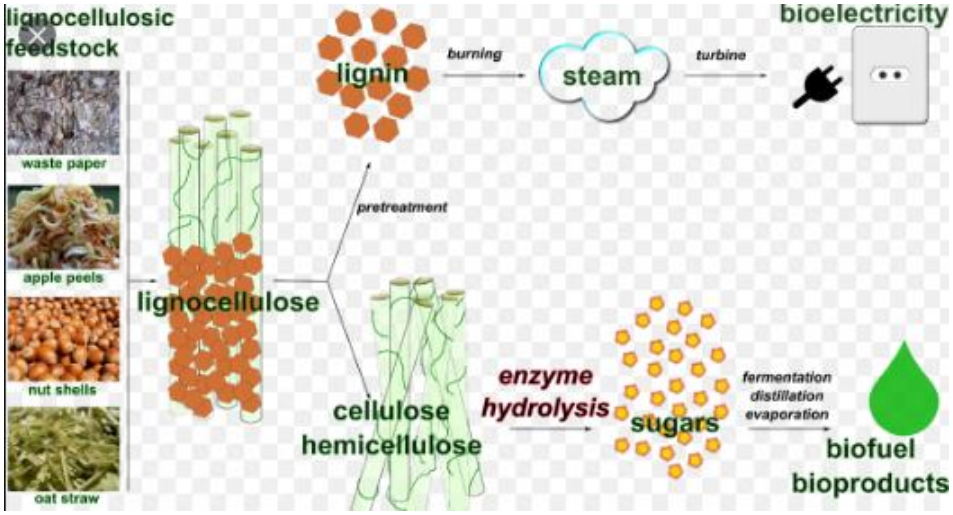


Figure-10: Second generation biofuel.

- **Third-generation (Figures-11,12,13)**
  - ✓ The term **third generation biofuel** has only recently entered the mainstream it refers to biofuel derived from algae.
  - ✓ Previously, algae were lumped in with second generation biofuels.
  - ✓ However, when it became apparent that algae are capable of much higher yields with lower resource inputs than other feedstock, many suggested that they be moved to their own category, as result the third category of bioduels was created.
  - ✓ Algae provide a number of advantages.
  - ✓ The third generation biofuels are – sometimes referred to as "oilgae".
  - ✓ Its production is supposed to be low cost and high-yielding – giving up to nearly 30 times the energy per unit area as can be realized from current, conventional 'first-generation' biofuel feedstocks.

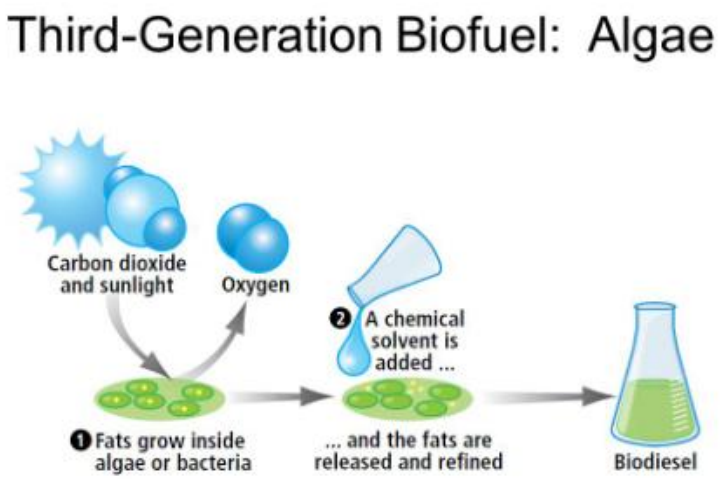


Figure-11: Third generation biofuel.

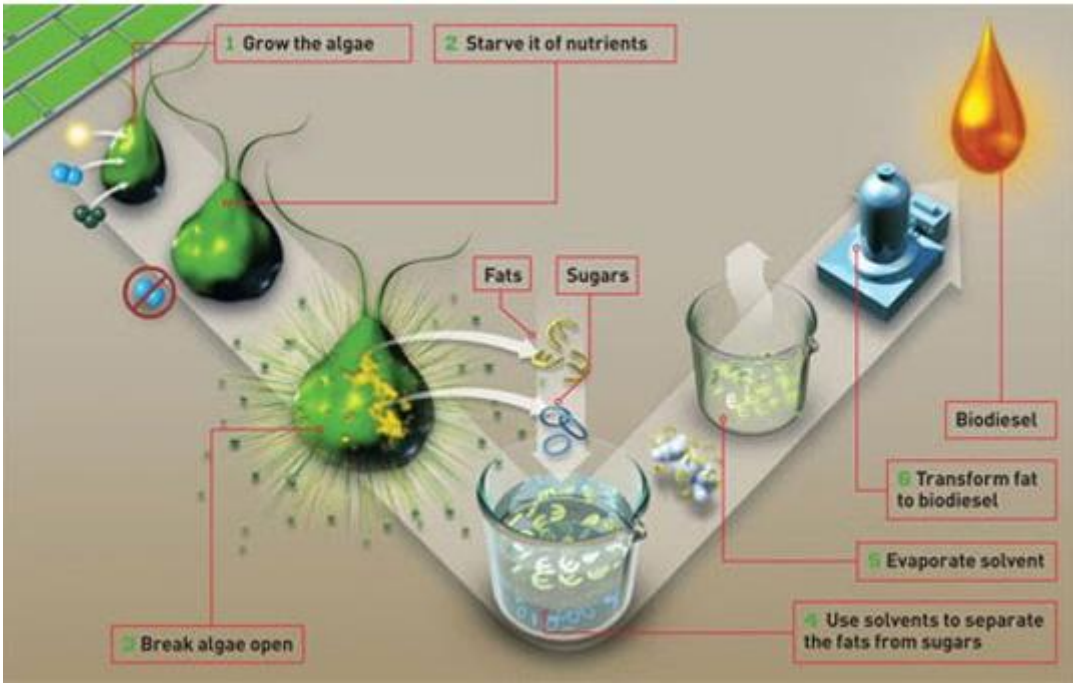


Figure-12: Algae biofuel production.

Figure-13: Algae raceways and photoreactors.

- **Fourth Generation Biofuel**
  - ✓ The ecological footprint and economic performance of the current suite of biofuel production methods make them insufficient to displace fossil fuels and reduce their impact on the inventory of Green House Gas (GHG) in the global atmosphere.
  - ✓ Engineered algae form the basis for 4th generation biofuel production which can meet this need.
  - ✓ The first generation biofuels are known to be made from agricultural products such as corn or sugarcane.
  - ✓ The second generation biofuels use all forms of (lingo)cellulosic biomass.
  - ✓ The third and fourth generation of biofuel production involves "algae-to-biofuels" technology: the former is basically processing of algae biomass for biofuel production, while the latter is about metabolic engineering of algae for producing biofuels from oxygenic photosynthetic microorganisms.
  - ✓ Figures-14, 15 describe the production of fourth generation biofuel.

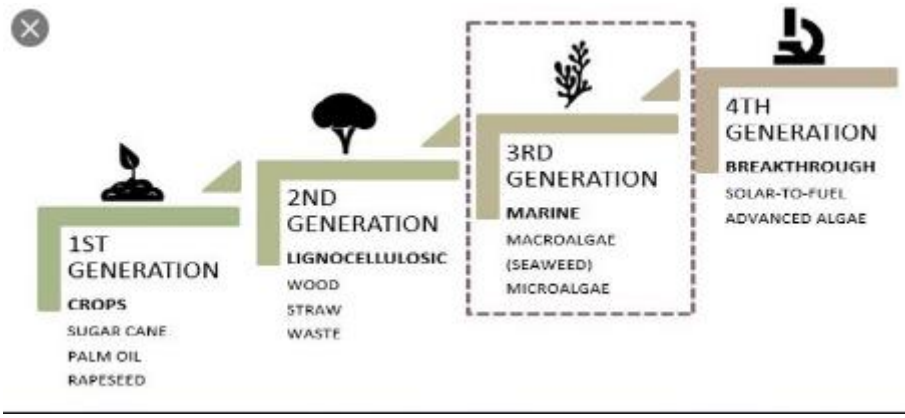


Figure-15: 4th Generation break through from solar to biofuel via advanced algae.

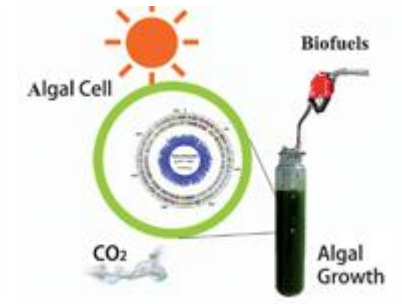


Figure-16: 4th Generation biofuel from enginered algae.

➢ ADVANTAGES AND CHALLENGES OF BIOFUELS

- Biofuels offer the promise of numerous benefits related to energy security, economics, and the environment.
- At the same time, several challenges must be overcome to realize these benefits.
- The main advantages and challenges in the production and consumption of biofuels are highlighted in the **Table- 4.**
- The key advantage of the utilisation of renewable sources for the production of biofuels is the utilization of natural bioresources (that are geographically more evenly distributed

than fossil fuels) and produced bioenergy provides independence and security of energy supply.

Table-4: Potential Benefits and Challenges of Biofuels

Benefits	Challenge
Energy Security	**Feed stock**
Domestic energy source	Collection network
Locally distributed	Storage facilities
Well connected supply-demand chain	Food-fuel competition
Higher reliability	
	Technology
Economic stability	Pretreatment
Price stability	Enzyme production
Employment generation	Efficiency improvement
Rural development	Technology cost
Reduce inter-fuels comptition	Production of value added co-products
Reduce demand-supply gap	
Open new industrial dimentions	**Policy**
Control on monopoly of fossil rich states	Land use change
	Fund for research and development
	Pilot scale demonstration
	Commercial scale deployment
Environmental gains	Policy for biofuels
Better waste utilization	Procurement of subcidies
Reduce local pollution	on biofuels production
Reduce GHGs emission	Tax credits on production
from energy consumption	and utilization of biofuels
Reduction in landfill sites	

- Utilising agricultural residual and waste substrates as raw materials will minimize the potential conflict between food and fuel and also produce the bioferlizer and biopesticides.
- Biofuels produced from lignocellulosic materials generate low net GHG emissions, hence reducing environmental impacts.
- In a report by the United States Department of Agriculture(USDA) the benefits of biodiesel use as fuel included are: it is renewable, suitable replacement for petroleum derived diesel, suitable to use in most diesel engines with no or very little modification, has the potential to reduce GHG emissions, biodegradable with little or no toxicity and can be made from agricultural or other recycled sources.
- Through experiments involving biodiesel produced from different oil types it was found that biodiesel had lower carbon dioxide and polycyclic aromatic hydrocarbons (PAHs) emissions. Biodiesel is considered a "carbon neutral" fuel, as any carbon dioxide released from its burning was previously captured from the atmosphere during the growth of the vegetative crop that was used for the production of biodiesel.
- Biodiesel is said to have a lower flash point than petroleum derived diesel so its transport is safer and easier.
- Besides having several benefits, the production and utilization ZAFRCDx of biofuels also have several challenges.
- An improved biomass waste collection network and their storage is the main challenge for establishment of commercial biofuel plant.

- A strong policy is needed for organic waste collection and blending of biofuels at higher rate.
- The subsidy for establishment of biofuel plants will accelerate the production of biofuels and tax credits for utilization will create the market for the biofuel.
- The technological improvement could help to improve the system efficiency and provide value added co-products, which will reduce the production cost.

➢ KEY ISSUES AND PERFORMANCE CONSIDERATIONS WITH BIOFUEL SUSTAINABILITY

The following highlights a number of issues and performance considerations for biofuels in the context of sustainability. Implications for ecological systems, society, and the economy are explored.

- **The Food-Fuel Debate**
  - ✓ The competition for cropland between biofuels and food came to the forefront of public agendas in connection with the volatility of global agriculture prices in 2006–2008, and 2010–2011 [56–60] (Figure-17).
  - ✓ From 2006 to 2008, for instance, cereal and oilseed prices doubled in close alignment with overall food index prices.
  - ✓ Peak prices for cereal and oilseed increased further in 2011–2012, with corn prices attaining even greater spikes in 2012–2013.
  - ✓ Sugar prices tracked more erratically, increasing by more than a factor of 2.5 between 2007 and 2011.
  - ✓ It bears noting that price fluctuations are not uncommon, as food price crises occurred in the 1950s and 1970s.
  - ✓ However, the degree of volatility and number of affected countries was quite high with the recent surge.
  - ✓ For the period between 2006 and 2011, there is broad agreement that the surge was higher than the previous two decades, but lower than what occurred in the 1970s.

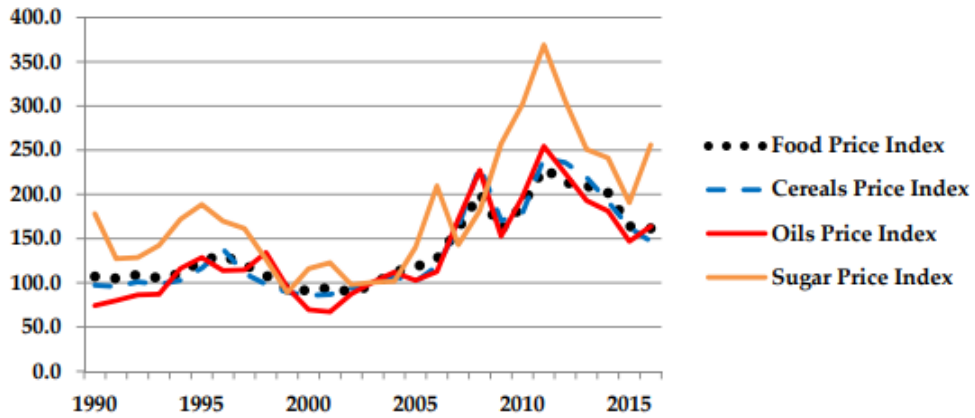


Figure-17: Food price index and key constituents. Data adapted from FAO . The Food Price Index reflects the average of five commodity group price indices.

  - ✓ During the period of food price escalation, there were also increases in biofuel production, leading to a concern about the links between food and fuel.

- ✓ In both 2008 and 2011, G20 agendas focused on basic food commodity prices.
- ✓ Concern centered largely on: (1) biofuels impacting food prices, which would disproportionately affect the poor; and (2) land conversion by fuel-based crops that could displace food-based crops or lead to new land appropriation in other areas.
- ✓ No single cause was identified.
- ✓ Analysis indicates that a number of factors were at work, including higher oil prices, weather conditions, investor speculation, and biofuel production.
- ✓ Some estimate that 20%–40% of the rise in food prices was attributable to global biofuel growth.
- ✓ Others point to the complicated mix of factors impacting land use, end-use, and markets for flexible crops.
- ✓ While social, environmental, and economic issues remain to be assessed, debates continue over how to even define and appropriately measure price volatility.

- **Emissions**
  - ✓ Emissions from biofuels became a point of contention in recent years.
  - ✓ This is largely explained by the complex and highly sensitive methods, assumptions, value choices, and localized data differences that were involved, as well as temporal and regional scoping that can affect results.
  - ✓ Not surprisingly, the literature on biofuels reflects a spectrum of competing claims about sustainability.
  - ✓ There are, for instance, claims that the net GHG emissions from biofuels can be worse than those attributed to gasoline in terms of climate effects in the lifecycle assessment scenario.
  - ✓ Alternatively, biofuels are also reported to reduce GHG emissions by 60%–94% relative to fossil fuels.
  - ✓ Looking at regional distinctions, biofuel development in less technologically advantaged countries is also singled out as producing higher GHGs than in more technologically advanced nations.
  - ✓ Here, one can see environmental nuances to biofuel adoption, as well as societal asymmetries, which can in turn produce mixed outcomes in sustainability terms.
  - ✓ Biodiesel, for instance, can favorably reduce particulate matter by nearly 88% relative to petroleum-based diesel.
  - ✓ Yet, this same fuel can also produce mixed results by releasing greater amounts of nitrogen oxides, thereby negatively impacting the environment.
- **Land**
  - ✓ Land use is another primary focus of biofuel sustainability.
  - ✓ As the global population continues to grow, the expansion of land usage can be expected from food, societal expansion, and biofuels.
  - ✓ The United Nations' Food Agriculture Organization estimates that cultivated areas of global land increased by a net 159 million hectares (Mha) or 12% since 1961, during which time irrigated land doubled and agricultural production grew by a factor of 2.5–3.
  - ✓ In this period, concerns over food shortages were met partly by the intensification of fertilizers and pesticides, in addition to new uses of digital information and genetics.

- ✓ A recent estimate indicates that less than 3% of global agricultural land is currently dedicated to cultivating biofuel crops; nonetheless, concerns over land grabbing and indirect land use change for biofuels do exist.
- ✓ Looking ahead, a number of studies on the biomass potential of land shed light on the potential for biofuel production.
- ✓ One calculation found that, of the 13.4 billion hectares (Gha) of the global total land surface, 0.7 Gha is gross available land, with 0.44 Gha reflecting the technical upper limit of what could be utilized for the production of biofuels and other bioenergy by 2050.
- ✓ Here Gha refers to the average productivity of all biologically productive areas (in hectares) on earth in a given year.
- ✓ Of the potential regions for expanding cultivable land, roughly 80% is expected in Africa and South and Central America—primarily in Angola, the Democratic Republic of Congo, Sudan, Argentina, Bolivia, Brazil, and Columbia.
- ✓ In the absence of breakthroughs, such as with agricultural yields, these countries will be pivotal in terms of the environmental, economic, and societal aspects of biofuels, and larger agricultural needs.

- **Water**
  - ✓ Similar to land, water raises questions about the limits associated with biofuels.
  - ✓ To put this into context, roughly 70% of the total world's freshwater is used for agriculture and countries are already experiencing water scarcity issues.
  - ✓ Among the nations affected are 30 developing countries.
  - ✓ By mid-century this number is projected to increase to 55 countries.
  - ✓ Biofuel development could overtax not only the available supply of water, but also the quality of the water, if produced alongside rising food production.
  - ✓ Assuming that agriculture intensifies with more fertilizers to produce fuel crops (to feed a rising population of over 9 billion by 2050), the practice of farming for biofuel feedstock could exacerbate problems in regions that are already challenged by runoff into water aquifers and rivers that create dead zones.
  - ✓ Importantly, there are some approaches to biofuel production that are seen as having a benign effect on water utilization.
  - ✓ Planting switchgrass strategically, for instance, alongside cropland and waterways could minimize nitrate contamination of groundwater.
  - ✓ At this point in time, rising energy demands combined with water resource limitations and hydrologic variability leave a fair amount to be understood in terms of spatial and temporal patterns for water requirements.
  - ✓ It is clear that this remains a key area to monitor for environmental and societal implications.
- **Biodiversity**
  - ✓ Land conversion and its use for biofuels can affect biodiversity, an environmental dimension of sustainability.
  - ✓ Clearing land and forests for cropland may eliminate or disrupt natural habitats for a wide range of species.
  - ✓ However, methods for evaluating biodiversity impacts are still nascent.

- ✓ For lifecycle assessments, the ‘biodiversity damage potential’ and the ‘potentially lost endemic species’ metric are rough gauges.
- ✓ This area has clear relevance for biofuel sustainability determination and related assessments, as with ecosystems services.
- ✓ To date, biodiversity has perhaps been best integrated into biofuel planning with respect to agricultural zoning.

- **Fuel Performance**
  - ✓ If biofuels and fossil fuel counterparts are contrasted, a range of differences is evident.
  - ✓ Favorable octane gains can be observed, for instance, with biofuels, along with less favorable energy fuel economies relative to fossil fuel substitutes.
  - ✓ Higher octane ratings refer to the capacity to withstand compression before igniting.
  - ✓ Specific to ethanol, the fuel economy translates into a reduction of 25%–30% in fuel miles per volumetric unit versus gasoline, whereas for biodiesel, the difference is less (relative to diesel).
  - ✓ If mid-level blends of biofuels are used at 20%–40%, octane benefits can be derived without much energy penalty of the higher blends, though engine and vehicle design changes are required with investment in infrastructure.
  - ✓ Assessing specifically the average emissions impact of biodiesel for heavy-duty highway engines, tests indicate that biodiesel minimizes emissions; however, the decrease depends on the biodiesel source and mixture. If 100% biodiesel is used, combustion produces on average nearly 70% less hydrocarbons, nearly 50% less particulates as well as carbon monoxide emissions, and 10% more NOx.
  - ✓ Furthermore, the potential for ozone formation by biodiesel is roughly half that of conventional diesel.
  - ✓ Sulfur oxide emissions, an enabler of acid rain, are negligible relative to those from conventional diesel.
  - ✓ With increased biofuel use, one must also factor for a growth in acetaldehyde emissions, which can increase smog and ozone in the atmosphere.
  - ✓ Looking somewhat differently at supply chain emissions for ethanol and biodiesel (excluding land use), ethanol has been estimated at 2–69 kg CO_2-eq/GJ versus 20–49 kg CO_2-eq/GJ for biodiesel, indicating a wider range of environmental impact of ethanol.
  - ✓ Focusing narrowly on a specific fuel type such as ethanol, additional distinctions emerge depending on the feedstock generation type used.
  - ✓ For example, ethanol produced from second-generation cellulosic feedstock requires more energy to break down lignin in cellulose.
  - ✓ However, emissions from the combustion of conventional biofuels can still be greater than in second-generation fuels due to higher overall fuel and fertilizer inputs during production.
  - ✓ Process advances through enzyme efficiency may offer opportunities to reduce the total system-level emissions from second-generation ethanol.

- **Tradeoffs of Fuel Sustainability**
  - ✓ With advanced biofuels, greater technical potential exists by drawing upon natural and anthropogenic waste, which could circumvent food-fuel concerns, reduce carbon emissions, and likely reduce pressure on land and water.
  - ✓ However, substantial investment will be required, and cost reductions are still needed at the commercial scale.
  - ✓ Specific to algae production, the feedstock utilizes less land than other biofuel inputs on a land per volumetric unit of fuel basis.
  - ✓ In conjunction with this, fewer impacts can be expected in terms of land, fertilizer, and pest control.
  - ✓ In terms of water, currently algae growth has relatively high needs, so algae-based biofuel may not be suitable for water-challenged regions.
  - ✓ Technological advances are also needed both to reduce the costs associated with the dewatering step as well as for identifying algal species that produce high yield.
  - ✓ If one considers land use with residue-based feedstock for advanced biofuels versus that required for grain and dedicated crops in conventional biofuels, the former is more favorable since no additional land is required.
  - ✓ Such a scenario avoids competition for land, and, in turn, has minimal impacts on food prices as well as GHG impacts and likely water.
  - ✓ Crop residue removal for advanced biofuels could also have positive impacts on pest and disease control.
  - ✓ Yet residue utilization can also be disadvantageous, since crop residues also conserve soil properties, enhance soil productivity, sequester carbon in soil, and conserve water.
  - ✓ Such tradeoffs merit further investigation.
  - ✓ **Table-5** presents data on a number of biofuels' attributes, including water and energy.
  - ✓ As with life cycle assessments, one must factor for variations in scoping and accounting.
  - ✓ Looking across feedstock options, water needs are highest for algae, rapeseed, and sugarcane.
  - ✓ The energy balance is highest for rapeseed-based fuel and cellulosic ethanol.
  - ✓ Somewhat differently, the energy intensity reflects biodiesel at much higher values than ethanol per volumetric unit.
  - ✓ If yields as well as fertilizer requirements are factored in, some estimates indicate that the energy return on investment for sugarcane ethanol relative to corn-based ethanol is 4–6 times larger.
  - ✓ System disturbances represent another area of consideration.
  - ✓ Broadly speaking, accidents with biofuels may be less dangerous to the environment relative to fossil fuel substitutes, since biofuels will more readily biodegrade.
  - ✓ If indirect impacts are considered, such as those associated with the use of tallow and cooking oil in biofuels, there are benign effects in the removal of such waste products from the system that could contaminate ground water.

Table-5: Comparison of Biofuel Sustainability Characteristics

Biofuel	GHG Emissions CO_2 e/MJ	Water Intensity L/L Product	Energy Intensity MJ/L	Net Energy Balance MJ/L Product
Gasoline (Baseline)	94 g *	2.8–4.6 *	35.4 [90]	28.3 *
Corn Ethanol	76 g: major contributors 31 g (ethanol production) and 17 g (fertilizer) [90]	175.4 [91]	21.3 [90]	10.1 [90]
Sugarcane ethanol	45 g (includes 16 g from land use change) [90]	526 [91]	21.3 [90]	16.4 [90]
Soybean biodiesel	59.19 g [92]	369.2 [91]	32.7 [92]	
Rapeseed/canola-based biofuel (Biodiesel)	59.19 g [92]	645.5 [91]	32.7 [92]	21.6 [93]
Cellulosic ethanol	43 g [94]	6.5 (Switchgrass) 387 (drought conditions) [95]	21.3 [90]	21 (Switchgrass) 20.4 (corn stover) 21.4 (miscanthus) [90]
Algae biodiesel		44 (enclosed production) 216 (open production) [95]	32.7 [92]	

Note: (1) Energy intensity gauges the amount of energy released from combustion of a fuel, in this case, measured in MJ released per liter of biofuel; (2) Water intensity is the amount of water required to produce a fuel, here measured in liters of water needed per liter of fuel produced—this includes the water needed in the production of the biofuels and the water needed to grow the feedstock; (3) Energy balance is the net energy in the product after deducting the total required energy to produce the fuel. * Calculated.

➢ POLICY CONSIDERATIONS

Policy has played a pivotal role for biofuels and will likely continue for the foreseeable future by encouraging or impeding sustainable approaches, reducing barriers, and highlighting information or funding needs. This section outlines policy approaches for key biofuel-producing regions. A critical review follows, outlining unsustainable system issues with policy-related trade activity.

- **Brazil**
  - ✓ In Brazil, the blending requirement for ethanol recently has been 18%–27.5%, currently 27%.
  - ✓ Rules for the biodiesel mix designate a stepped timetable to increase the mix from 7% to 10% by 2019.
  - ✓ A regional producer subsidy for ethanol is in place to more evenly balance costs of production between less and more developed growth regions.
  - ✓ In conjunction with the economic downturn, no support was provided in 2015.
  - ✓ Tax incentives exist for ethanol-conducive vehicles, which translate as a reduced tax burden for flex fuel vehicles versus that for strictly gasoline-only fueled vehicles.
  - ✓ Specific to biodiesel, the National Biodiesel Production Program (PNPB) was launched in 2004, compelling suppliers to procure vegetable oil from small producers and family farms.
  - ✓ Tax exemptions and incentives are in place for biodiesel, based on feedstock, producer size, and region, in order to encourage production and social inclusion.
  - ✓ An intricate tax policy system also exists for fuels, spanning local to federal jurisdictions that are currently set to be favorable for ethanol versus gasoline.

- ✓ However, the setting of artificially low gasoline prices to counteract inflation in recent years had a deleterious effect on biofuels.
- ✓ Support for project financing in the form of investment credit lines is also indicated, yet it is unclear how readily these funds will be available given the current economic conditions.

- **China**
  - ✓ Bioenergy is a dimension of China's strategic energy planning.
  - ✓ Biofuel programs have been implemented since the early 2000s, with direct subsidies for conventional grain-based biofuels now discontinued.
  - ✓ The 12th Five Year Plan that ended in 2015 included a goal of producing 4 million tons of fuel ethanol and 1 million tons of biodiesel.
  - ✓ Broadly, the country has a 15% biofuels target by 2020 and aims to move toward a 10% mandate.
  - ✓ In addition, a number of the provinces have mandates in place to blend 10% biofuels.
  - ✓ With China taking an active role in curbing CO_2 emissions, more policies to encourage renewables including biofuels are anticipated.
- **European Union (EU)**
  - ✓ Regulations for the use of transport-based biofuels are outlined in the 2009 EU Energy and Climate Change Package (CCP).
  - ✓ The CCP includes requirements which stipulate that 20% of the overall EU energy mix should be renewable energy in 2020.
  - ✓ Within the CCP, the Renewable Energy Directive (RED) defines sustainability requirements for liquid biofuels, encompassing GHG reductions, land management, as well as additional environmental, social and economic criteria.
  - ✓ In 2015, the European Commission established a 7% cap (energy basis) on conventional, food-based biofuels in transportation by 2020, which limits future production of Generation 1 biofuels.
  - ✓ It resides within a larger 10% target in the RED that is obligatory for all member states.
  - ✓ Advanced (non-food) biofuels are noted with a non-binding five percent national target.
  - ✓ Member states have until 2017 to implement the revised rules.
- **India**
  - ✓ In 2009, a national biofuels policy was instituted, encouraging the use of renewable energy in transport, with an aim to replace 20% of petroleum-based fuel with biofuels by the end of the 12th Five Year Plan in 2017.
  - ✓ In 2014, diesel prices were deregulated, enabling more favorable conditions for biodiesel production.
  - ✓ The government announced a blending requirement of 10% ethanol in gasoline, beginning with the October 2015/2016 sugarcane season, alongside existing rules that set minimum sugarcane pricing.
  - ✓ Discussions are now focused on amending the 2009 biofuels law, including coverage of a mandatory blend for biodiesel.

- ✓ A recent push by India to become a "Methanol Economy" and a net zero petroleum import country is an endeavor to watch in the coming years with respect to the impact on biofuels and national policy associated with alternate fuels .

- **United States**
  - ✓ The USA requires the use of a minimum volume of biofuel in transportation, but does not mandate its production.
  - ✓ This policy is enshrined in the Renewable Fuel Standard (RFS) that was established with the Energy Policy Act of 2005 and later enlarged with the Energy Independence and Security Act of 2007.
  - ✓ The Environmental Protection Agency oversees the RFS mandate, which essentially is designed to increase consumption volumes from 9 billion gallons of renewable fuel in 2008 to 36 billion in 2022.
  - ✓ The RFS outlines four categories of fuels that meet the statutory requirements, with sub-mandates existing for various advanced fuels.
  - ✓ The EPA regulates compliance with a tradeable credit system, and waiver capabilities.
  - ✓ The agency is required to announce volumetric requirements each November for the upcoming year, with the exception of biomass-based diesel, which must be announced 14 months in advance.
  - ✓ Tax credits for blending provide $1.00 per gallon of biodiesel, agri-biodiesel, or renewable diesel that is blended with petroleum diesel to produce a mixture that includes at least 0.1% diesel fuel.
  - ✓ Related tax credits exist for delivery of 100% biodiesel as an on-road fuel.
  - ✓ Feedstock incentives provide financial support to establish biomass feedstock crops for advanced biofuels facilities and produce advanced biofuels.

➢ INVESTMENT IN BIOFUELS

Looking beyond the technical aspects, sustainability/performance, and policy aspects of biofuels, another critical dimension of the biofuel outlook can be found in investment trends.

- Global investment in biofuels was estimated to equal $3.1 billion in 2015, reflecting a decline of 35% relative to 2014 and more than 80% in nominal terms since 2008.
- At the beginning of the 21st century, billions of dollars were invested in advanced biofuel projects by international oil companies, with many of the projects later being abandoned.
- Commercialization of advanced biofuels is more costly and protracted than originally anticipated.
- The decline in per barrel oil prices from $115 in June 2014 to $27 in 2015 recovered somewhat to roughly $50 in most of 2016, yet the absence of a coherent biofuel policy in the United States for much of 2015, plus necessary time and financing, have combined to deter all but a small set of investors.
- Key players that are crucial for enabling investment and other development at scale for biofuels will continue to include airlines and other, large corporations.
- Among airlines, United Airlines signed a $30 million deal in 2015 with Fulcrum Bioenergy to provide alternative jet fuel at prices that are competitive with conventional jet fuel.

- JetBlue also signed a 10-year power purchase agreement with S.G. Preston for renewable jet fuel that is produced from non-food, hydro-processed esters and fatty-acid-based feedstock.
- Outside of aviation, large companies like Dupont (known for its historical strength in chemicals and ammunition) are driving the development of cellulosic plants.
- Global production capacity for advanced biofuels at the end of 2015 was estimated to be 225 million gallons per year.
- Planned capacity would add another 390 million gallons per year, with initiatives underway in Brazil, China, Canada, the Netherlands, the United Kingdom, Sweden, France, and the USA.
- Notably, the majority of the existing capacity is in ethanol as shown in **Figure-18**.

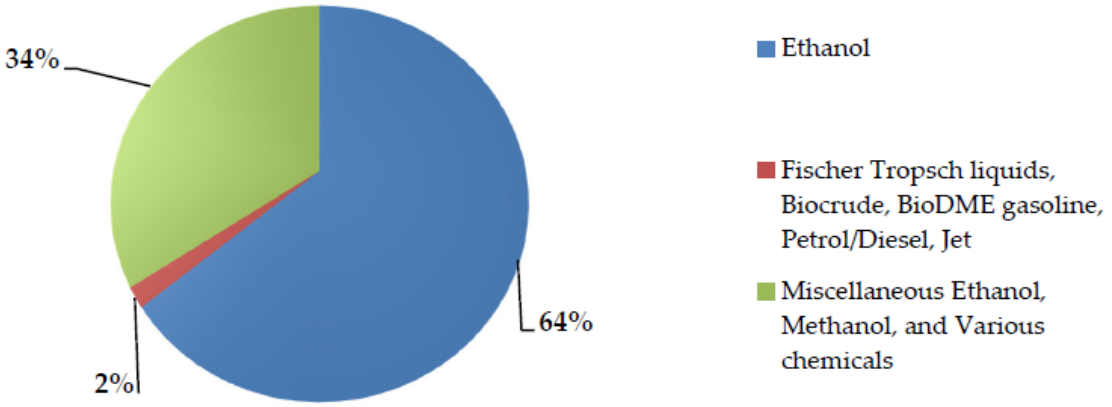


Figure-18: Advanced biofuels by fuel products—operational, 225.43 million gallons/year.

(*Note-Advanced Biofuel: Also called second generation biofuels, any biofuel produced from a sustainable feedstock that does not threaten the food supply*).

- When viewed from the standpoint of development stages for advanced biofuels, more than 80% of existing capacity is commercialized as evident from **Figure-19**, the majority of which started in 2014 or later.
- In 2015 and early 2016, two commercial-scale, advanced biofuel plants were commissioned (Finland and the United States), plus three pilot-scale demonstration plant.
- The performance of these plants could be pivotal for future development.

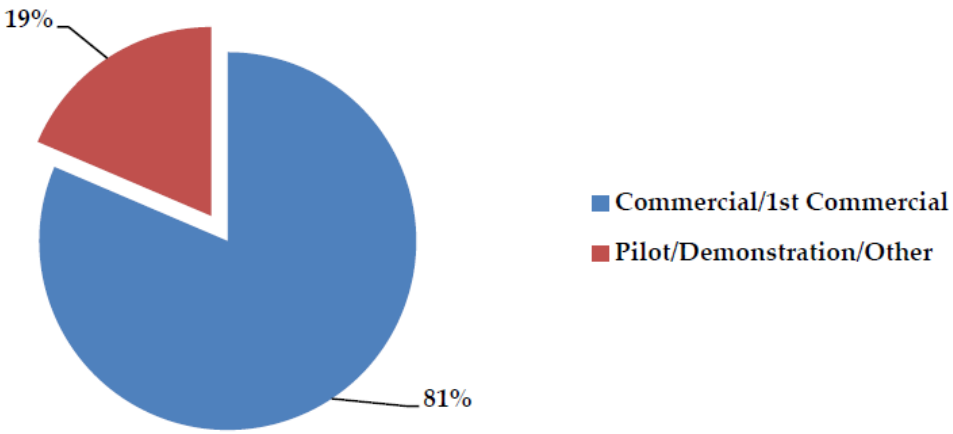


Figure-19: Advanced biofuels capacity per year—operational, 225.43 million allons/year.

- Important, continuing challenges remain for advanced biofuels in ensuring sustainability and reducing production costs.
- The most challenging aspect of algae-derived fuels, for example, is the dewatering step.
- Specific to production costs for advanced biofuels, recent estimates are significantly higher than $3 per gallon, which substantially exceeds the untaxed price of petroleum alternatives.
- One can look, for instance, at the Abengoa SA, owner of a cellulosic biofuel plant in Kansas, which suspended operation in late 2015 and filed for bankruptcy.
- The plant was built with loan guarantees of $132.4 million and a $97 million grant from the U.S. Department of Energy.
- This example underscores not only the challenges of developing economically competitive, advanced biofuels, but of managing technological progress in an emerging market.

रजिस्ट्री सं० डी० एल०-33004/99 REGD. NO. D. L.-33004/99

भारत का राजपत्र
The Gazette of India

असाधारण
EXTRAORDINARY
भाग I—खण्ड 1
PART I—Section 1
प्राधिकार से प्रकाशित
PUBLISHED BY AUTHORITY

सं. 202] नई दिल्ली, शुक्रवार, जून 8, 2018/ ज्येष्ठ 18, 1940
No. 202] NEW DELHI, FRIDAY, JUNE 8, 2018/ JYAISTHA 18, 1940

पेट्रोलियम और प्राकृतिक गैस मंत्रालय

अधिसूचना

नई दिल्ली, 4 जून, 2018

मिसिल सं.-पी-13032(16)/18/2017-सीसी.—दिनांक 4 अगस्त, 2017 की सां. आ. सं.2492 (ई) द्वारा भारत के राजपत्र में प्रकाशित भारत सरकार (कारोबार का आबंटन) तीन सौ पैंतीसवें संशोधन नियम, 2017 के तहत प्रदत्त शक्तियों का प्रयोग करते हुए केन्द्र सरकार वर्ष 2009 में नवीन और नवीकरणीय ऊर्जा मंत्रालय के जरिए लागू की गई राष्ट्रीय जैव ईंधन नीति के अधिक्रमण में एक संशोधित जैव ईंधन नीति एतद्वारा बनाती है, नामत:-

1. (1) इस नीति को राष्ट्रीय जैव ईंधन नीति-2018 कहा जाएगा।
   (2) यह नीति मंत्रिमंडल द्वारा अनुमोदन की तारीख अर्थात 16.5.2018 से प्रभावी होगी।

2. इस नीति का पाठ संलग्न है।

राष्ट्रीय जैव ईंधन नीति-2018

1.0 प्रस्तावना

संख्या पी-13032)16)18/2017-सीसी -- 1.1 भारत दुनिया की सबसे तेजी से बढ़ती अर्थव्यवस्थाओं में से एक है और आगामी कुछ दशकों तक जनसांख्यिकीय लाभ भी इसे मिलता रहेगा। विकास का उद्देश्य समावेश पर केंद्रित है, समावेश अर्थात राष्ट्रीय विकास, प्रौद्योगिकी उन्नयन एवं क्षमता निर्माण, आर्थिक विकास, इक्विटी और मानव कल्याण का साझा विजन। नागरिकों के जीवन स्तर के स्तर को बढ़ाने के लिए ऊर्जा एक महत्वपूर्ण इनपुट है। देश की ऊर्जा नीति का उद्देश्य ऊर्जा क्षेत्र में सरकार की हालिया महत्वाकांक्षी घोषणाओं को पूरा करना है, जैसे 2019 तक सभी सेन्सस (जनगणना) गांवों का विद्युतीकरण, 2022 तक 24x7 बिजली और 175 जीडब्ल्यू की नवीकरणीय ऊर्जा क्षमता, 2030 तक 33% -35% तक ऊर्जा

उत्सर्जन की तीव्रता में कमी और वर्ष 2030 तक बिजली मिश्रण में गैर-जीवाश्म ईंधन आधारित क्षमता की 40% से अधिक साझेदारी का उद्देश्य है। भले ही आने वाले दशक में तेल, गैस, कोयला, नवीकरणीय संसाधनों, परमाणु और हाइड्रो ऊर्जा के योगदान में संभावित विस्तार हो, ऊर्जा भंडार में जीवाश्म ईंधन की एक ख़ासी हिस्सेदारी जारी रहेगी। हालांकि, परंपरागत या जीवाश्म ईंधन संसाधन सीमित, गैर- नवीकरणीय और प्रदूषणकारी हैं, इसलिए इनका समझदारी से उपयोग किए जाने की आवश्यकता है । जबकि दूसरी ओर, नवीकरणीय ऊर्जा संसाधन स्वदेशी, गैर प्रदूषणकारी और वास्तव में अक्षय हैं। भारत प्रचुर नवीकरणीय ऊर्जा संसाधनों से संपन्न है। इसलिए, हर संभव तरीके से इनका उपयोग प्रोत्साहित किया जाना चाहिए। राष्ट्रीय जैव ईंधन नीति – 2018, जैव ईंधन पर पहले की राष्ट्रीय नीति की उपलब्धियों पर आधारित है और नवीकरणीय क्षेत्र में उभरती हुई विकास की पुन: परिभाषित भूमिका के अनुरूप नए एजेंडे का निर्माण करती है।

1.2 विश्व बाजार में कच्चे तेल की कीमत में उतार-चढ़ाव होता रहा है। इस तरह के उतार-चढ़ाव दुनिया भर की विभिन्न अर्थव्यवस्थाओं में, विशेष रूप से, विकासशील देशों पर दबाव डाल रहे हैं। सड़क परिवहन क्षेत्र भारत के सकल घरेलू उत्पाद (जीडीपी) का 6.7% है। वर्तमान में, परिवहन ईंधन की 72% अनुमानित मांग केवल डीजल और इसके बाद पेट्रोल 23% मांग और शेष अन्य ईंधन जैसे सीएनजी, एलपीजी इत्यादि पूरी करते हैं जिसकी मांग लगातार बढ़ रही है। अस्थायी अनुमानों ने संकेत दिया है कि वित्त वर्ष 2017-18 में पेट्रोलियम उत्पादों के स्वदेशी उपभोग के लिए 210 एमएमटी कच्चा तेल आवश्यक है। घरेलू कच्चे तेल का उत्पादन केवल 17.9% मांग को पूरा करने में सक्षम है, जबकि शेष आयातित कच्चे तेल से पूरा होता है। जब तक स्वदेशी तौर पर उत्पादित नवीकरणीय फीडस्टॉक के आधार पर पेट्रो आधारित ईंधन का विकल्प/पूरक वैकल्पिक ईंधन का विकास नहीं होता तब तक भारत की ऊर्जा सुरक्षा कमजोर रहेगी। इन चिंताओं को दूर करने के लिए, सरकार ने 2022 तक आयात निर्भरता को 10 प्रतिशत तक कम करने का लक्ष्य रखा है।"

1.3 सरकार ने पांच आयामी नीति अपनाकर, जिसमें घरेलू उत्पादन बढ़ाना, जैव ईंधन और नवीकरण, ऊर्जा दक्षता मानदंड अपनाना, रिफाइनरी प्रक्रियाओं में सुधार और मांग प्रतिस्थापन शामिल करके तेल और गैस क्षेत्र में आयात निर्भरता को कम करने के लिए एक रोड मैप तैयार किया है। इसमें भारतीय ऊर्जा बास्केट में जैव ईंधन के लिए एक रणनीतिक भूमिका की परिकल्पना की गई है।

1.4 जैव ईंधन नवीकरणीय बायोमास संसाधनों और अपशिष्ट पदार्थों जैसे प्लास्टिक, नगरपालिका ठोस अपशिष्ट (एमएसडब्लू), अपशिष्ट गैसों आदि से प्राप्त किया जाता है और इसलिए पारंपरिक ऊर्जा संसाधनों की आपूर्ति द्वारा पर्यावरण के अनुकूल संपोषणीय तरीके से, आयातित जीवाश्म ईंधन पर निर्भरता कम करने और भारत की शहरी और विशाल ग्रामीण आबादी की ऊर्जा आवश्यकताओं को पूरा करने के लिए उच्च स्तर की राष्ट्रीय ऊर्जा सुरक्षा प्रदान करने की आवश्यकता है।

1.5 ऊर्जा सुरक्षा और पर्यावरण संबंधी मुददों के कारण वैश्विक स्तर पर जैव ईंधन को महत्वपूर्ण माना गया है। जैव ईंधन के उपयोग को प्रोत्साहित करने के लिए कई देशों ने अपनी घरेलू आवश्यकताओं को पूरा करने हेतु विभिन्न कार्यप्रणालियों, प्रोत्साहन और सब्सिडी के माध्यम को अपनाया है। ग्रामीण विकास और रोजगार सृजन के लिए एक प्रभावी उपकरण के रूप में, एक प्रथम उपाय के रूप में भारत में जैव ईंधन में स्वदेशी फीडस्टॉक के उत्पादन को बढ़ावा देना होगा।

1.6 पिछले दशक में, सरकार ने एथेनॉल मिश्रित पेट्रोल कार्यक्रम, राष्ट्रीय बायो डीजल मिशन, बायोडीजल अपमिश्रण कार्यक्रम जैसे सुव्यवस्थित कार्यक्रमों के माध्यम से देश में जैव ईंधन को बढ़ावा देने के लिए कई प्रयास किए हैं। पिछले अनुभवों और मांग आपूर्ति की स्थिति के आधार पर, सरकार ने मूल्य निर्धारण, प्रोत्साहन, इथेनॉल उत्पादन के लिए वैकल्पिक मार्ग खोलकर, थोक और खुदरा ग्राहकों को बायोडीजल की बिक्री, अनुसंधान एवं विकास आदि पर ध्यान केंद्रित करके इन कार्यक्रमों में सुधार किया है। इन उपायों से देश में जैव ईंधन कार्यक्रम में सकारात्मक प्रभाव पड़ा है।

1.7 भारत में जैव ईंधन का कार्यनीतिक महत्व है, क्योंकि इससे सरकार द्वारा चलाए जा रहे मेक इन इंडिया और स्वच्छ भारत अभियान जैसे प्रयासों में अच्छे परिणाम प्राप्त हो रहे हैं और यह किसानों की आय को दुगुना करने, आयात में कमी करने, रोजगार सृजन करने, अपशिष्ट से सम्पदा का निर्माण करने के महत्वाकांक्षी लक्ष्यों के साथ एकीकृत करने के लिए शानदार अवसर प्रदान करता है। इसके साथ ही, देश की मौजूदा जैव विविधता को स्थानीय आबादी के लिए सम्पदा सृजन

करने के लिए सुदूर इलाकों का उपयोग करके और स्थायी विकास के लिए योगदान करके इसका अधिकतम उपयोग किया जा सकता है।

1.8 विश्व स्तर पर, जैव ईंधन ने पिछले दशक में ध्यान आकर्षित किया है और जैव ईंधन के क्षेत्र में हुए विकास की गति के साथ तालमेल बनाए रखना जरूरी है। अंतरराष्ट्रीय परिप्रेक्ष्य और राष्ट्रीय परिदृश्य के संदर्भ में इस नीति का उद्देश्य जैव ईंधन के उत्पादन के लिए स्वदेशी फीडस्टॉक्स के प्रयोग से नए सिरे से ध्यान देना है। यह नीति नई फीडस्टॉक्स पर आधारित अगली पीढ़ी के जैवईंधन की रूपांतरण तकनीक के विकास और देश की जैव विविधता का उपयोग करके घरेलू स्तर पर उपलब्ध फीडस्टॉक को बढ़ावा देने पर भी निर्भर है। भारत में जैव ईंधन के विकास के लिए दृष्टि, लक्ष्य, रणनीति और अवधारणा का निर्धारण तकनीकी रूपरेखा, वित्तीय, संस्थागत हस्तक्षेप और सक्षम तंत्र के माध्यम से किया गया है।

2.0 विजन और लक्ष्य

2.1 इस नीति का उद्देश्य आने वाले दशक के दौरान देश के ऊर्जा और परिवहन क्षेत्रों में जैव ईंधन के उपयोग को बढावा देना है। नीति का उद्देश्य घरेलू फीडस्टॉक को बढ़ावा देना और जैव ईंधन के उत्पादन के लिए इसकी उपयोगिता के साथ-साथ एक स्थायी तरीके से नए रोजगार के अवसर पैदा करने के अलावा राष्ट्रीय ऊर्जा सुरक्षा, जलवायु परिवर्तन के अल्पीकरण में योगदान करते हुए जीवाश्म ईंधन का तेजी से विकल्प बनाना है। साथ ही, यह नीति जैव ईंधन बनाने के लिए अग्रिम तकनीकों के आवेदन को प्रोत्साहित करेगी।

2.2 पॉलिसी का लक्ष्य बाजार में जैव ईंधन की उपलब्धता को सुगम बनाना है जिससे उसके मिश्रण प्रतिशत में वृद्धि होगी। वर्तमान में पेट्रोल में इथेनॉल का सम्मिश्रण प्रतिशत लगभग 2.0% है और डीजल में बायोडीजल मिश्रण प्रतिशत 0.1% से कम है। 2030 तक पेट्रोल में इथेनॉल के 20% मिश्रण और डीजल में बायोडीजेल का 5% मिश्रण का प्रस्ताव है। यह लक्ष्य निम्नलिखित के माध्यम से हासिल किए जाएंगे:

क) घरेलू उत्पादन में वृद्धि के द्वारा की जा रही इथेनॉल / बायोडीजल आपूर्ति को बढ़ाना

ख) द्वितीय पीढ़ी (2 जी) बायो रिफाइनरीज की स्थापना

सी) जैव ईंधन के लिए नए फीडस्टॉक का विकास

घ) जैव ईंधन में परिवर्तित करने वाली नई प्रौद्योगिकियों का विकास

ई) जैव ईंधन के लिए उपयुक्त वातावरण बनाना और मुख्य ईंधन इसे एकीकृत करना

3.0 परिभाषाएं और कार्यक्षेत्र

3.1 इस नीति के उद्देश्य के लिए जैव ईंधन की निम्नलिखित परिभाषाएं लागू होंगी:

i 'जैव ईंधन' नवीकरणीय संसाधनों से उत्पादित ईंधन हैं और परिवहन, स्टेशनरी, पोर्टेबल और अन्य अनुप्रयोगों के लिए डीजल, पेट्रोल या अन्य जीवाश्म ईंधन के स्थान पर अथवा उसके साथ मिश्रण में इसका प्रयोग किया जाता है;

ii नवीकरणीय संसाधन कृषि, वानिकी, वृक्ष आधारित तेल, अन्य गैर-खाद्य तेलों और संबंधित उद्योगों के साथ-साथ औद्योगिक और नगरपालिका अपशिष्टों के बायोडिग्रेडेबल अंशों के उत्पादों, अपशिष्टों और अवशेषों के बायोडिग्रेडेबल अंश हैं।

3.2 नीति के अंतर्गत "जैव ईंधन" के रूप में ईंधन की निम्नलिखित श्रेणियां शामिल है जिसे परिवहन ईंधन के रूप में या स्टेशनरी अनुप्रयोगों में इस्तेमाल किया जा सकता है: -

i. 'बायोएथेनॉल': बायोमास से उत्पन्न इथेनॉल जैसे कि चीनी युक्त सामग्री, जैसे गन्ना, चुकंदर, मीठे चारा आदि; स्टार्च युक्त मकई, कसावा, पके आलू, शैवाल आदि; और, सेल्यूलोजिक सामग्रियों जैसे कि बगैस, लकड़ी का कचरा, कृषि और वन अवशेष या औद्योगिक अपशिष्ट जैसे अन्य नवीकरणीय संसाधन;

ii. 'बायोडीजल': गैर-खाद्य वनस्पति तेलों, एसिड तेल, खाना पकाने के तेल या पशु वसा और जैव-तेल से बने फैटी एसिड के मिथाइल या एथिल एस्टर;

iii. 'उन्नत जैव ईंधन': (1) लिगोनोक्लुलोजिक फीडस्टॉक्स (जैसे कृषि और वनों के अवशेष, जैसे चावल और गेहूं के भूसे / मकई सीओएस और स्टेवर / बैगेस, वुडी बायोमास), गैर-खाद्य फसलों (यानी घास, शैवाल) से उत्पन्न ईंधन या औद्योगिक कचरे और अवशेष प्रवाह, (2) कम सीओ$_2$ उत्सर्जन या उच्च जीएचजी में कमी और भूमि उपयोग के लिए खाद्य फसलों के साथ प्रतिस्पर्धा नहीं करते। द्वितीय पीढ़ी (2 जी) एथेनॉल, ड्रॉप-इन ईंधन, शैवाल आधारित 3 जी जैव ईंधन, जैव-सीएनजी, जैव-मेथनॉल, जैव-मेथनॉल से उत्सृजित दि मिथाइल ईथर (डीएमई) जैव-हाइड्रोजन, एमएसडब्ल्यू के साथ ईंधन में गिरावट जैसे ईंधन स्रोत/ फीडस्टॉक सामग्री "उन्नत जैव ईंधन" के रूप में मान्य होंगे।

iv. 'ड्रॉप-इन ईंधन': बायोमास, कृषि अपशिष्टों, निगम ठोस अपशिष्ट (एमएसडब्लू), प्लास्टिक अपशिष्ट, औद्योगिक अपशिष्ट आदि से उत्पादित तरल ईंधन, जो कि एमएस, एचएसडी और जेट ईंधन के लिए भारतीय मानकों पर खरा उतरता है और जो यथावत या मिश्रित रूप में बाद में, इंजन सिस्टम में किसी भी संशोधन के बिना वाहनों में उपयोग किया जाता है और वर्तमान पेट्रोलियम वितरण प्रणाली का उपयोग कर सकता हैं।

v. 'जैव-सीएनजी': जैव-गैस का शुद्ध रूप जिसकी संरचना और ऊर्जा क्षमता जीवाश्म आधारित प्राकृतिक गैस के समान है और इसे कृषि अवशेषों, पशुओं के गोबर, खाद्य अपशिष्ट, एमएसडब्लू और सीवेज पानी से उत्पन्न किया जाता है।

4.0 रणनीति और दृष्टिकोण

4.1 सरकार जैव ईंधन के उपयोग को बढ़ावा देने एवं प्रोत्साहन हेतु बहु-आयामी दृष्टिकोण को इस प्रकार अपना रही है:

- एथेनॉल मिश्रित पेट्रोल (ईबीपी) प्रोग्राम के माध्यम से कई फीडस्टॉक्स से प्राप्त एथेनॉल का उपयोग करके पेट्रोलियम में एथेनॉल का सम्मिश्रण ।
- सेकंड जनरेशन (2जी) एथेनॉल प्रौद्योगिकियों का विकास और इसका व्यावसायीकरण।
- स्टेशनरी, कम आरपीएम इंजनों में सीधे वनस्पति तेल के इस्तेमाल सहित कई फीडस्टॉक की खोज करके बायोडीजल ब्लेंडिंग कार्यक्रम के माध्यम से डीजल में बायोडीजल को सम्मिश्रित करना ।
- एमएसडब्लू, औद्योगिक अपशिष्ट, बायोमास आदि से बने ड्रॉप-इन ईंधन पर विशेष ध्यान।
- जैव-सीएनजी, जैव-मेथनॉल, डीएमई, जैव-हाइड्रोजन, जैव-जेट इंधन आदि सहित उन्नत जैव ईंधनों पर विशेष ध्यान ।

4.2 इस नीति का मुख्य बल स्वदेशी फीडस्टॉक से जैव ईंधन की उपलब्धता सुनिश्चित करना है। इस दिशा में कदम बढ़ाते हुए, देश भर में बायोमास के मूल्यांकन के लिए राष्ट्रीय बायोमास भंडार तैयार किया जाएगा।

4.3 जैव ईंधन की मांग और आपूर्ति के दरम्यान पुनः संतुलन बनाने के प्रयास तहत, सरकार का उद्देश्य जैव ईंधन के घरेलू उत्पादन, भंडारण और वितरण के संबंध में जब भी आवश्यकता पड़े सभी हितधारकों को शामिल करते हुए परामर्शी अवधारणा अपनाकर जरूरी अंतर- हस्तक्षेप करना है।

4.4 इस कार्यनीति के अंतर्गत समय-समय पर ऐसे उपयुक्त वित्तीय एवं राजकोषीय उपाय किए जाएंगे जिससे जैव ईंधन के विकास और संवर्धन को समर्थन मिले ताकि विभिन्न क्षेत्रों में इनका उपयोग बढ़े।

4.5 विभिन्न अंतिम-उपयोग अनुप्रयोगों के लिए फीडस्टॉक उत्पादन और जैव ईंधन प्रसंस्करण के सभी पहलुओं तक पहुँच के लिए अनुसंधान, विकास और प्रतिपादन का समर्थन किया जाएगा। उन्नत जैव ईंधन और अन्य नए फीडस्टॉक के विकास के लिए जोर दिया जाएगा।

5.0 अंतर- हस्तक्षेप एवं समुचित प्रक्रियाएँ

क. फीडस्टॉक की उपलब्धता एवं इसका विकास

5.1 भारत में, बायोएथेनॉल कई स्रोतों से उत्पन्न किया जा सकता है जैसे कि शर्करा युक्त सामग्री, स्टार्च युक्त सामग्री, सेल्यूलोज और पेट्रोरसायनिक मार्ग सहित लिगोनोसेलुलोज सामग्री। लेकिन, इथनॉल मिश्रित पेट्रोलियम (ईबीपी) कार्यक्रम की मौजूदा नीति गैर-खाद्य फीडस्टॉक जैसे शीरा, सेलूलोज़ और पेट्रोकेमिकल रूट सहित लिगोनोलेल्ज सामग्री से बायोएथेनॉल की खरीद की अनुमति देती है । इसी तरह, किसी भी खाद्य / गैर खाद्य तेल से बायोडीजल का उत्पादन किया जा सकता है। हालांकि, सम्मिश्रण कार्यक्रम के लिए उपयोग क्ये जाने वाला बायोडीजल वर्तमान में आयातित स्रोतों जैसे पाम स्टीयरिन से निर्मित किया जा रहा है।

5.2 देश में जैव ईंधन के उत्पादन के लिए संभावित घरेलू कच्चे माल के रूप निम्न पदार्थ उपलब्ध हैं,

एथेनॉल उत्पादन के लिए :	बी-शीरा, गन्ने का रस, घास के रूप में बायोमास, कृषि अवशेष (चावल का पुआल, कपास की डंठल, मकई के कोष, लकड़ी का बुरादा, खोई इत्यादि), शक्कर युक्त सामग्री, जैसे चुकंदर, चारा इत्यादि और स्टार्च युक्त सामग्री जैसे मकई, कसावा, सड़ा हुआ आलू आदि, अनाज जैसे गेहूं, चावल इत्यादि के खराब दाने जो कि खाने योग्य नहीं हों, आधिक्य के समय अनाज के कण । शैवाल युक्त फीडस्टॉक और समुद्री शैवाल की खेती भी एथेनॉल उत्पादन के लिए एक संभावित फीडस्टॉक हो सकती है।
बायोडीजल उत्पादन के लिए:	अखाद्य तिलहन, इस्तेमाल किया हुआ खाना पकाने का तेल (UCO), पशुओं की चर्बी, एसिड आयल, शैवाल फीडस्टॉक इत्यादि।
उन्नत जैव ईंधन के लिए :	बायोमास, एमएसडब्लू, औद्योगिक अपशिष्ट, प्लास्टिक अपशिष्ट आदि ।

5.3 ईबीपी कार्यक्रम के तहत एथेनॉल की खरीद के लिए कच्चे माल का दायरा बढ़ाया जाएगा। इस नीति में बी-शीरे और सीधे गन्ने के रस से एथेनॉल के उत्पादन की अनुमति होगी। इस नीति में मानव उपभोग हेतु अयोग्य खराब खाद्यानो जैसे गेहूं, टूटे चावल आदि से एथेनॉल का उत्पादन करने की भी अनुमति होगी। एक कृषि फसल वर्ष के दौरान जब कृषि और किसान कल्याण मंत्रालय द्वारा यह अनुमान लगाया जाए कि खाद्यान्न की पैदावार आपूर्ति से काफी अधिक होगी तो इस नीति के तहत प्रस्तावित राष्ट्रीय जैव ईंधन समन्वय समिति के अनुमोदन के आधार पर, इस अतिरिक्त खाद्यान्न की मात्रा को एथेनॉल में परिवर्तित करने की अनुमति होगी। एथेनॉल उत्पादन के लिए इस मार्ग के खुलने से न केवल खाद्यान्न आधारित डिस्टिलरीज की स्थापित क्षमता का उपयोग करने में मदद मिलेगी, अपितु न्यूनतम निवेश के साथ पूरी तरह से विकसित 1जी तकनीक का इस्तेमाल करके इसमें उन सभी कच्चे सामग्रियों को भी शामिल किया जा सकेगा, जिनसे एथेनॉल का उत्पादन किया जा सकता है।

5.4 औद्योगिक स्थापना को बढ़ावा देने के लिए अतिरिक्त उपलब्ध बायोमास वाले स्थानों की पहचान और ऊर्जा घास और बेकार जमीन पर छोटी अवधि की फसलों का उपयोग जैसे फीडस्टॉक का उत्पादन इस दिशा में निर्णायक होगा। देश में अधिशेष बायोमास वाले स्थानों की पहचान करने पर विशेष बल दिया जाएगा।

5.5 जैव ईंधन उत्पादन के लिए स्वदेशी फीडस्टॉक की आपूर्ति बढ़ाने में ग्राम पंचायत और समुदाय महत्वपूर्ण भूमिका निभाएंगे। फ़ीडस्टॉक पीढ़ी के लिए बंजर भूमि के उपयोग से संबंधित मामलों में, ग्राम पंचायत/तालुकों के स्थानीय समुदायों को पौधों के लिए गैर-खाद्य तिलहन/फसलों जैसे पोंगामिया पिन्नता (करंज), मेलिया अजादिरचट्टा (नीम), एरंड, जाट्रोपा केरकस, कॉलोफिलम इनोफिलम, सिमरोबा ग्लॉका, हिबिस्कस कैनबिनस आदि के पौधारोपण के लिए प्रेरित किया जा सकता है। पूरे देश में बायोएथेनॉल के उत्पादन के लिए अतिरिक्त फीडस्टॉक बनाने के लिए लघु रोटेशन फसल जैसे कि मीठे ज्वार और ऊर्जा घास जैसे मिसकेनथुस जाईगंटम, स्विचग्रास (पैनिकम विग्राटम), विशालकाय रीड (अरुंडो डोनाक्स) इत्यादि को बंजर भूमि में लगाया जा सकता है।

5.6 जहाँ वर्षा निर्भर परिस्थितियों के चलते केवल एक ही फसल में उगाई जाती है, वहाँ के किसानों को तिलहन के साथ ही अपनी सीमान्त भूमि पर अलग-अलग बायोमास की विविध प्रजातियों को अंतर फसल एवं दूसरी फसल के रूप में लगाने के लिए प्रोत्साहित किया जाएगा।

5.7 स्थानीय निकायों, राज्यों और संबंधित हितधारकों के साथ बेहतर तालमेल रखकर सम्बद्ध समुदायों के लिए समुचित आपूर्ति श्रृंखला तंत्र, फीडस्टॉक कलेक्शन केंद्र और उचित मूल्य तंत्र विकसित किए जाएंगे।

5.8 एमएसडब्लू, औद्योगिक अपशिष्ट, प्लास्टिक कचरा आदि जैसे कचरे की पर्याप्त मात्रा देश भर में उपलब्ध संग्रह तंत्र के साथ उपलब्ध है। यह जैव-सीएनजी, ड्रॉप-इन ईंधन, जैव-मेथनॉल, डीएमई, जैव-हाइड्रोजन आदि जैसे जैव ईंधन पैदा करने के लिए फीडस्टॉक के रूप में कार्य करेगा।

ख. सम्मिश्रण और बायोरिफाइनरी कार्यक्रम

5.9. एथेनॉल मिश्रित पेट्रोल कार्यक्रम

5.9.1 वर्तमान में, ईबीपी कार्यक्रम के लिए एथेनॉल चीनी उद्योग के उप-उत्पाद के रूप में शीरा उत्पाद से आ रहा है। गन्ना और चीनी उत्पादन के वर्तमान स्तर (क्रमशः 350 एमएमटी और 26-28 एमएमटी प्रति वर्ष) में उपलब्ध अधिकतम शीरा लगभग 13 एमएमटी है, जो लगभग 300 करोड़ लीटर अल्कोहल / एथेनॉल का उत्पादन करने के लिए पर्याप्त है। वर्तमान में, शराब / एथेनॉल का उत्पादन करने के लिए सी-भारी शीरा का इस्तेमाल किया जा रहा है।

5.9.2 चीनी की उपलब्धता के अनुसार एथेनॉल उत्पादन के लिए बी-भारी शीरा रूट को अपनाने के लिए प्रोत्साहित किया जाएगा। एक एमएमटी शुगर के उत्सर्ग पर 60 करोड़ लीटर इथनॉल का उत्पादन किया जा सकता है। इस विकल्प का उपयोग करने से एथेनॉल उत्पादन में सहयोगी डिस्टिलरीज़ में सुधार हो सकेगा। मिश्रण प्रतिशत को बढ़ाने के लिए सीधे गन्ने के रस से एथेनॉल उत्पादित किए जाने की अनुमति होगी।

5.9.3 एथेनॉल के उत्पादन के लिए अन्य वैकल्पिक कच्ची सामग्रियां जैसे कि शुगर युक्त सामग्री- चुकन्दर, ज्वार, आदि तथा स्टार्च युक्त जैसे - मकई, कसावा, सड़ा हुआ आलू आदि जैसे सामग्रियों का पहली पीढ़ी की पूर्णरूपेण विकसित प्रौद्योगिकियों का उपयोग करके किया जाएगा। राष्ट्रीय जैव-ईंधन समन्वय समिति के निर्णय के अनुसार खाद्यान की अधिशेष उपलब्धता होने पर खाद्यानों जैसे मक्का आदि से एथेनॉल उत्पादित किए जाने की अनुमति होगी।

5.10 दूसरी पीढ़ी (2 जी) एथेनॉल

5.10.1 शीरे के माध्यम से एथेनॉल उत्पादन की अपनी सीमाएं हैं और मद्यपान और केमिकल उद्योगों में इसका प्रतिस्पर्धात्मक उपयोग होने से ईबीपी कार्यक्रम के लिए यह उपलब्ध हो पाएगा, इसकी संभावना में संदेह है। यह वारंट पारंपरिक शीरा रूट और गन्ना रस रूट से अलग एथेनॉल के अन्य स्रोतों की तलाश करता है।

5.10.2 भारत में किए गए कुछ अध्ययनों में प्रति वर्ष **120 -160** एमएमटी की अतिरिक्त बायोमास उपलब्धता का संकेत दिया गया है, जिसे परिवर्तित करने पर प्रति वर्ष **3000** करोड़ लीटर एथेनॉल प्राप्त किया जा सकता है। अतिरिक्त बायोमास / कृषि अपशिष्ट जो सेल्यूलोसिक और लिग्नोकेल्लोसिक किस्म की सामग्री है, इसको दूसरी पीढ़ी (**2** जी) की प्रौद्योगिकियों का उपयोग करके एथेनॉल में परिवर्तित किया जा सकता है। भारत सरकार ने ग्रामीण अर्थव्यवस्था और ईबीपी कार्यक्रम को आगे बढ़ाने में बायोमास की भूमिका को मान्यता दी है और शीरे के अलावा पेट्रोकेमिकल मार्ग सहित अन्य गैर-खाद्य फीडस्टॉक जैसे सेल्यूलोजिक और लिग्नॉसेल्यूलोजी सामग्री से उत्पादित एथेनॉल की खरीद की अनुमति दी है बशर्ते कि संबंधित बीआईएस मानकों का अनुपालन होता हों। इस नीति के तहत कार्रवाई के लिए निम्नलिखित क्षेत्रों की परिकल्पना की गई है:

5.10.3 प्रोत्साहन: वैश्विक रूप से, 2 जी इथेनॉल उद्योग प्रोत्साहनों के माध्यम से संचालित किया जाता है क्योंकि अभी इस प्रौद्योगिकी को व्यावसायिक पैमाने पर सिद्ध होना है और इस प्रकार उत्पादित एथनॉल अधिक पर्यावरण सापेक्ष है। यह 2 जी एथनॉल बायो रिफाइनरीज के बुनियादी ढांचागत विकास को संचालित करने में एक प्रमुख साधन होगा।

5.10.4 ऑफटेक आश्वासन: सार्वजनिक क्षेत्र की तेल विपणन कंपनियाँ निजी हितधारकों को आश्वस्त बाजार प्रदान करने और 2 जी एथनॉल अभ्युपायों में सहायता देने के लिए 15 वर्ष की अवधि के लिए 2 जी एथनॉल आपूरकों के साथ एथनॉल खरीद समझौते (ईपीए) पर हस्ताक्षर करने के लिए सहमत हो गई हैं। सार्वजनिक क्षेत्र की गैस विपणन कंपनियों द्वारा जैव-सीएनजी को 2जी इथनॉल बायो रिफाइनरीज में प्रमुख उप-उत्पाद और परिवहन ईंधन होने के कारण ऑफटेक आश्वासन के तहत लाया जाएगा।

5.11. बायोडीजल सम्मिश्रण कार्यक्रम

5.11.1 फीडस्टॉक उपलब्धता से संबंधित बाधाओं के कारण देश में डीजल में बायोडीजल का समग्र सम्मिश्रण 0.5 प्रतिशत से कम रहा है। इसके अलावा, सम्मिश्रण कार्यक्रम के लिए जो भी बायोडीजल आ रहा है वह आयातित स्रोतों से तैयार होता है। इस कार्यक्रम की दीर्घकालिक सफलता के लिए इस प्रकार के बायोडीजल उत्पादन के लिए घरेलू कच्चे माल का सुनिश्चय करना अत्यावश्यक है।

5.11.2 घरेलू उत्पादित/अपशिष्ट कूकिंग ऑयल (यूसीओ/डब्ल्यूसीओ) में बायोडीजल उत्पादन के स्रोत होने की संभावना है। लेकिन विभिन्न छोटे भोजनालयों/विक्रेताओं और व्यापारियों के माध्यम से खाद्य स्ट्रीम के लिए यूसीओ के उपयोग के तौर तरीके में बदलाव लाना है। खाद्य प्रवाह में यूसीओ के प्रवेश को रोकने और बायोडीजल उत्पादन के लिए इसकी आपूर्ति बढ़ाने के लिए उपयुक्त संग्रहण तंत्र विकसित करने के लिए कड़े मानदंड बनाने पर फोकस किया जाएगा।

5.12 अन्य जैव ईंधन (ड्रॉप-इन-ईंधन, जैव-सीएनजी, जैव-हाइड्रोजन,जैव-मेथनॉल, डीएमई,आदि)

5.12.1 नीति आयोग द्वारा बनाए गए अपशिष्ट से ऊर्जा कार्यबल ने अनुमान लगाया है कि भारत में हर वर्ष 62 एमएमटी नगरीय ठोस अपशिष्ट (एमएसडब्लू) होता है। रिफ्यूज्ड उत्सर्जित ईंधन, बायो गैस/बिजली और कृषि में सहायता के लिए इस अपशिष्ट में खाद सहित ड्रॉप-इन-ईंधन तैयार करने और बिजली उत्पन्न करने की भारी क्षमता है।

5.12.2 विश्वभर में, कचरे को ड्राप-इन-ईंधन, जैव-सीएनजी, जैव-हाइड्रोजन आदि जैसे जैव ईंधनों में परिवर्तित करने के लिए उपलब्ध प्रौद्योगिकियां नवप्रवर्तनशील चरण में हैं और इन्हें व्यावसायिक स्तर पर साबित होने की जरूरत है। ऐसे कचरे का जैव-सीएनजी में रूपांतरण एक मॉडल है जिसे ग्रामीण इलाकों में ऊर्जा की मांग को पूरा करने और पर्यावरण संबंधी मसलों को करने के लिए प्रोत्साहित किया जाएगा। इस नीति के अनुरूप प्रति यूनिट संसाधित अपशिष्ट से बायो-सीएनजी का अधिक उत्पादन करने वाली प्रोद्योगिकियां प्रोत्साहित की जाएंगी। विभिन्न प्रोत्साहनों और ऑफटेक आश्वासन के माध्यम से उन्नत ईंधनों के उत्पादन के लिए ऐसे संयंत्र लगाने में भी वृद्धि की जाएगी। इसी तरह, रिफाइनरियों सहित कई उद्योगों में हाइड्रोजन का उपयोग सबसे महंगे ईंधन के रूप में पता लगाया गया है। बायोमास और अपशिष्ट से उत्पादित वायो-हाइड्रोजन, अन्वेषण करने के लिए दिलचस्प प्रस्ताव होगा।

5.12.3 विश्वभर में, परिवहन ईंधन के रूप में मोटर स्प्रिट के साथ सम्मिश्रण में मेथनॉल के उपयोग का पता लगाया गया है। इसी प्रकार कृषि अपशिष्टों, प्राकृतिक गैस, उच्च राख कोयला आदि सहित विभिन्न स्रोतों से ही इसका उत्पादन किया

जा सकता है। इस समय भारत मेथनॉल का विशेष आयातक है। अतिरिक्त बायोमास उपलब्धता में जैव-मेथनॉल और बायो-बॉटियनॉल के उत्पादन की संभावना है और भारतीय परिवहन व्यवस्था में उसके अनुप्रयोग का पता लगाया जाएगा।

5.12.4 डाय-मिथाइल ईथर (डीएमई) मेथनॉल के 2 अणुओं से पानी के 1 अणु को निकालकर प्राप्त किया जाता है, जो एक रासायनिक प्रक्रिया है, जो आमतौर पर उत्प्रेरक की सहायता से प्राप्त होती है। आरएंडडी संस्थानों द्वारा प्रोपेन के विकल्प के रूप में घरेलू एलपीजी में (डीएमई) का उपयोग किया जा रहा है। डीएमई धीमे आरपीएम डीजल इंजनों में डीजल के लिए एक विकल्प भी हो सकता है और इसलिए व्यापक उपयोग, औद्योगिक अनुप्रयोग और संभावित ईंधन के रूप में डीएमई की स्वीकृति मेथनॉल के औद्योगिक उत्पादन को बढ़ावा देने के लिए उचित है।

5.12.5 उच्च तेल घटक, सीमित अपशिष्ट स्ट्रीम और न्यूनतम भूमि आवश्यकताओं (बायोमास की तुलना में), उत्पादन मार्ग पर निर्भरता की दृष्टि से शैवाल (3 जी) से जैव ईंधन के उत्पादन की काफी अच्छी संभावनाएँ हैं। वर्तमान में, इस तरह के ईंधन का उत्पादन अपने प्रारंभिक चरण में है और वाणिज्यिक व्यवहार्यता के संबंध में आगे की परीक्षण की आवश्यकता है। तकनीकी-व्यावसायिक व्यवहार्यता प्राप्त करने के लिए शैवाल आधारित जैव ईंधन और इस विषय पर अपेक्षित आर एंड डी को प्रोत्साहित किया जाएगा।

ग. वित्त व्यवस्था

5.13 सरकार वित्तीय संस्थानों द्वारा उधार देने के उद्देश्य से प्राथमिक क्षेत्र के तौर पर जैव ईंधनों के बायोडीजल के उत्पादन व भंडारण और वितरण के बुनियादी ढांचे के लिए तेल निष्कासन/निष्कर्षण और प्रसंस्करण इकाइयों की घोषणा करने पर विचार करेगी।

5.14 कार्बन वित्तपोषण के अवसरों सहित जैव ईंधन विकास के लिए बहु-पक्षीय और द्विपक्षीय वित्त पोषण के स्रोतीकरण को प्रोत्साहित किया जाएगा।

5.15 जैव ईंधन क्षेत्र में संयुक्त उद्यम और निवेश को प्रोत्साहित किया जाएगा। जैव ईंधन प्रौद्योगिकियों में 100% विदेशी प्रत्यक्ष निवेश (एफडीआई) को स्वचालित अनुमोदन मार्ग के माध्यम से प्रोत्साहित किया जाएगा, बशर्ते कि इस प्रकार उत्पादित जैव ईंधन घरेलू उपयोग के लिए ही हो।

घ. वित्तीय और राजकोषीय प्रोत्साहन

5.16 सरकार जैव ईंधन के लिए व्यवहार्यता अंतरण वित्तपोषण, सब्सिडी और अनुदान सहित वित्तीय प्रोत्साहनों का विस्तार करने पर विचार करेगी। सरकार उन्नत जैव ईंधन के रूप में द्वितीय पीढ़ी (2 जी) इथनॉल, ड्रॉप-इन ईंधन, बायो-सीएनजी, शैवाल आधारित 3 जी जैव ईंधन, जैव-मेथनॉल, डीएमई, जैव-हाइड्रोजन आदि का वर्गीकरण करेगी। वित्तीय प्रोत्साहन देने के लिए एक राष्ट्रीय जैव ईंधन फंड पर विचार किया जा सकता है।

5.17 2जी इथनॉल बायो रिफाइनरीज स्थापित करने के लिए स्टेकहोल्डर्स को प्रोत्साहित करने के लिए इस पॉलिसी में टैक्स क्रेडिट, संयंत्र खर्च पर अग्रिम मूल्यह्रास, 1 जी इथनॉल के साथ-साथ अंतर मूल्य निर्धारण, व्यवहार्यता गैप फंडिंग (वीजीएफ) आदि के रूप में वित्तीय प्रोत्साहन के साथ प्रारंभिक "उन्नत बायो ईंधन" उद्योग को प्रोत्साहित करने पर विचार करना है। "उन्नत जैव ईंधन" कार्यक्रम को आगे बढ़ाने के लिए योजनाएं शुरू की जाएंगी।

5.18 जैव ईंधन फीडस्टॉक के निर्माण और शुद्ध या मिश्रित रूप में जैव ईंधन के उपयोग पर सीओ 2 उत्सर्जन की बचत के लिए कार्बन क्रेडिट पैदा करने के अवसरों का पता लगाया जाएगा।

5.19 नाबार्ड और अन्य सार्वजनिक क्षेत्र के बैंकों को वित्त पोषण, साफ्ट ऋण आदि के माध्यम से वित्तीय सहायता प्रदान करने के लिए प्रोत्साहित किया जाएगा।

ङ. अनुसंधान एवं विकास और प्रदर्शन

5.20 दूसरी पीढ़ी के विकास और घरेलू फीडस्टॉक का उपयोग करने वाले उन्नत जैव ईंधनों के लिए मजबूत प्रौद्योगिकी फोकस आवश्यक है। यह पॉलिसी इनोवेशन को प्रोत्साहित करती है और अनुसंधान एवं विकास गतिविधियां करते समय विकसित / उभरती प्रौद्योगिकियों का उपयोग करते हुए जैव ईंधनों के क्षेत्र में अनुसंधान एवं विकास (आर एंड डी) और

प्रदर्शन पर बल देती है। अनुसंधान और विकास गतिविधियां जैव ईंधन उत्पादन, बागान, प्रसंस्करण और रूपांतरण प्रौद्योगिकियों के लिए नए कच्चे माल के विकास के क्षेत्र में होंगे। विभिन्न अंत-उपयोग अनुप्रयोगों और उप-उत्पादों के उपयोग की क्षमता बढ़ाने के लिए दक्षता सुधार और नवाचार को प्रोत्साहित किया जाएगा। स्थानीय फीडस्टॉक्स के आधार पर स्वदेशी अनुसंधान एवं विकास तथा प्रौद्योगिकी विकास को उच्च प्राथमिकता दी जाएगी। जहां संभव हो पेटेंट पंजीकृत किए जाएंगे। स्पष्ट रूप से परिभाषित लक्ष्य और उपलब्धियों के साथ बहु संस्थानों को शामिल करते हुए बायोईंधनों के क्षेत्र में अनुसंधान कार्यक्रम में सहयोग किया जाएगा।

5.21 गहन अनुसंधान एवं विकास कार्य के अभिज्ञात क्षेत्रों में शामिल है.

(क): बायो ईंधन फीडस्टाक उत्पादन

(ख): अभिज्ञात फीडस्टॉक से उन्नत अंतरण प्रोद्योगिकियां

(ग): बायो ईंधनों के आशोधनों सहित अन्त्य प्रयोक्ता अनुप्रयोगों की प्रोद्योगिकियां

(घ): बायो ईंधनों के उप उत्पादों का उपयोग

5.22 जैव ईंधन उत्पादन के लिए प्रायोगिक/ प्रदर्शन परियोजनाएं स्थापित की जाएंगी। अनुसंधान संगठनों, आर एंड डी के लिए संस्थानों और प्रदर्शन परियोजनाओं की स्थापना, उच्च प्रौद्योगिकी वाले क्षेत्रों में विशेष केंद्रों के लिए अनुदान प्रदान किया जाएगा। मौजूदा अनुसंधान एवं विकास केन्द्रों को मजबूत किया जाएगा और व्यापक उपयोग/अनुप्रयोग के लिए अनुसंधान संगठन, संस्थाओं और उद्योगों के बीच संबंध स्थापित किए जाएंगे। सरकार अनुसंधान एवं विकास तथा प्रौद्योगिकी के क्षेत्र में उद्योग की भागीदारी को प्रोत्साहित करेगी, जिसमें उद्योग को सुविधा प्रदान करने के बारे में जानकारी प्रदान की जाएगी।

5.23 कम से कम जीएचजी उत्सर्जन के लिए अंतरराष्ट्रीय मंचों पर हमारी प्रतिबद्धताओं को देखते हुए जैव ईंधन क्षेत्र में उभरती हुई प्रौद्योगिकी के जीवन चक्र विश्लेषण (एलसीए) महत्वपूर्ण है। प्रोत्साहित कार्य निष्पादन एलसीए रिपोर्ट का वादा और जलवायु परिवर्तन पर हमारी प्रतिबद्धताओं के अनुसार, प्रदर्शन/ व्यावसायिक स्तर पर परवर्ती तैनाती के लिए प्रायोगिक चरण में प्रौद्योगिकियों को स्वच्छ प्रौद्योगिकी के रूप में प्रोत्साहित किया जाएगा।

5.24 राष्ट्रीय, द्विपक्षीय और बहुपक्षीय अनुसंधान कार्यक्रमों के माध्यम से ज्ञान को जोड़ने के लिए संबंधित मंत्रालयों के साथ-साथ अकादमिक और उद्योग के प्रतिनिधियों वाले जैव ईंधन के क्षेत्रों में अनुसंधान और विकास को बढ़ावा देने के लिए एक संकेंद्रित समूह का गठन किया जा सकता है।

च. गुणवत्ता मानक

5.25 विभिन्न जैव ईंधन और अंत उपयोग अनुप्रयोगों के लिए मानकों और प्रमाणीकरण की शुरुआत के साथ-साथ परीक्षण विधियों, प्रक्रियाओं और प्रोटोकॉल का विकास प्राथमिकता पर किया जाएगा। भारतीय मानक ब्यूरो (बीआईएस) ने पहले से ही स्वैच्छिक और मिश्रित रूप अनुप्रयोगों के लिए बायोएथनॉल, बायोडीजल के मानकों का विकास किया है। उच्च सम्मिश्रण स्तर के लिए विनिर्देशों का विकास चल रहा है।

5.26 भारतीय मानक ब्यूरो (बीआईएस) मौजूदा मानकों की समीक्षा करेगा और उन्हें अपडेट करेगा, साथ ही विभिन्न अंत-उपयोग अनुप्रयोगों के लिए उपकरणों और प्रणालियों के नए मानकों को विकसित करेगा। उत्पाद के प्रदर्शन और विश्वसनीयता के लिए दिशा-निर्देश सभी प्रासंगिक हितधारकों के परामर्श से भी विकसित और संस्थागत होंगे

5.27 यह नीति आवश्यक कौशल सेटों के विकास को प्रोत्साहित करेगी ताकि जैव ईंधन उद्योग की नई मांगों के अनुकूल होने के लिए प्रशिक्षित और कुशल जनशक्ति उपलब्ध हो।

छ. जैव ईंधनों का वितरण एवं विपणन

5.28 तेल विपणन कंपनियां जैव ईंधनों का भंडारण, वितरण और विपणन जारी रखेंगे। जैव ईंधनों की आवश्यकताओं को पूरा करने के लिए वे भंडारण, वितरण और विपणन बुनियादी ढांचे को बनाए रखने और सुधारने के लिए मुख्य रूप से जिम्मेदार

होंगे। सरकार गुणवत्ता मानक सुनिश्चित करने, सम्मिश्रण प्रतिशतता के बारे में उपभोक्ता जागरूकता, वारंटी की आवश्यकता आदि जैसे घटकों के आधार पर जैव ईंधनों के वितरण और विपणन के लिए अन्य कंपनियों को अनुमति देने पर भी विचार कर सकती है।

ज. जैव ईंधनों का मूल्य निर्धारण

5.29 इस उद्देश्य के लिए गठित एक समिति की सिफारिश के आधार पर वर्तमान में ईबीपी कार्यक्रम के लिए पहली पीढ़ी के एथनॉल आधारित शीरे की कीमत का निर्धारण सरकार द्वारा निर्धारित किया जा रहा है। डीजल में मिश्रण के लिए बायोडीजल की खरीद के लिए ओएमसी द्वारा मूल्य निर्धारित किया जा रहा है। बाजार की स्थितियों, घरेलू बाजार में जैव ईंधन की उपलब्धता, आयात प्रतिस्थापन आवश्यकता आदि सहित विभिन्न कारकों के आधार पर सरकार प्रशासित कीमतों या बाजार निर्धारित कीमतों से पहली पीढ़ी के जैव ईंधन को प्रोत्साहित करना जारी रखेगी। उन्नत जैव ईंधनों को और प्रोत्साहित करने के लिए एक अंतर मूल्य दिया जाएगा। उन्नत जैव ईंधन के लिए अंतर मूल्य निर्धारण के लिए तंत्र का निर्णय राष्ट्रीय जैव ईंधन समन्वय समिति द्वारा किया जाएगा।

6.0 जैव ईंधनों का आयात एवं निर्यात

6.1 जैव ईंधन का देशी उत्पादन व्यावहारिक और युक्तियुक्त प्रोत्साहनों के एक सेट से प्रोत्साहित किया जाएगा। जैव ईंधनों का आयात काफी हद तक हतोत्साहित होगा। जैव ईंधन के आयात की अनुमति देने का निर्णय देश में जैव ईंधनों की उपलब्धता, अंतरराष्ट्रीय कीमतों और अन्य कारकों के आधार पर राष्ट्रीय जैव ईंधन समन्वय समिति द्वारा लिया जाएगा।

6.2 इस नीति ने फीडस्टॉक उत्पादन के लिए बंजर भूमि का उपयोग करते हुए जैव ईंधन के लिए स्वदेशी फीडस्टॉक की आपूर्तियों को बढ़ाने के लिए प्रोत्साहित किया है। तथापित, घरेलू फीडस्टॉक की उपलब्धता और सम्मिश्रण की आवश्यकता के आधार पर, जैव डीजल के उत्पादन के लिए फीडस्टॉक के आयात को आवश्यकता की सीमा तक अनुमति होगी। प्रस्तावित इस नीति के तहत राष्ट्रीय जैव ईंधन समन्वय समिति द्वारा फीडस्टॉक आयात की आवश्यकताओं का निर्णय लिया जाएगा।

6.3 चूंकि घरेलू जैव-ईंधनों की उपलब्धता देश की आवश्यकता से बहुत कम है इसलिए जैव-ईंधनों के निर्यात की अनुमति नहीं होगी।

7.0 स्टेक धारकों की भूमिका

7.1 सभी हितधारकों अर्थात मंत्रालयों / विभागों, राज्य सरकारों, किसानों, व्यवसाय और उद्योग और व्यावसायिकों की निम्नलिखित क्षेत्रों में सक्रिय भागीदारी सुनिश्चित की जाएगी:

i) बंजर भूमि पर टिकाऊ तरीके से फ़ीडस्टॉक का उत्पादन

ii) किसानों को अपने सीमांत भूमि पर फ़ीड स्टॉक की किस्मों को विकसित करने के लिए प्रोत्साहन

iii) फीडस्टॉक के लिए उपयुक्त आपूर्ति श्रृंखला की स्थापना

iv) फीडस्टॉक स्टोरेज इंफ्रास्ट्रक्चर

v) एकल खिड़की की मंजूरी और शीघ्र स्वीकृति

vi) जैव ईंधन संयंत्रों के लिए कर प्रोत्साहन, सब्सिडी वाली बिजली, पानी की आपूर्ति, एक्सेस सड़कों इत्यादि जैसे प्रोत्साहन

क. राज्यों की भूमिका

7.2 जैव ईंधन कार्यक्रम का सफलतापूर्वक कार्यान्वयन राज्यों की सक्रिय भागीदारी पर काफी हद तक निर्भर करता है। जिन राज्यों ने अपने यहां जैव ईंधन बोर्ड स्थापित किए हैं उनके अनुभवों को उपयोग करके अन्य राज्यों में जैव ईंधन बोर्ड स्थापित किए जाएंगें तथा राज्य सरकारों को अपने यहां जैव ईंधन के विकास एवं बढ़ावे के लिए इन एजेंसियों/बोर्डों को उपयुक्त रूप से सशक्त बनाने के लिए प्रोत्साहित किया जाएगा। अन्य स्टेक धारकों को भी कार्यक्रम हेतु नामंकित किया जाएगा।

7.3 राज्य सरकारें को अखाद्य तिलहन पौधों की रोपण या जैव ईंधन के अन्य फीडस्टॉक्स हेतु भूमि के प्रयोग तथा इस प्रकार के पौधों को उगाने के लिए परती तथा खाली पडी सरकारी भूमि के आवंटन पर भी निर्णय लेने की आवश्यकता होगी। समस्त मूल्य श्रृंखला में जैव ईंधन परियोजनाओं को सहारा देने के लिए आवश्यक बुनियादी ढ़ांचे का भी निर्माण करना होगा।

7.4 जैव ईंधन पौधों को लगाने के लिए एकल खिड़की की मंजूरी देने हेतु राज्यों को भी प्रोत्साहित किया जाएगा। राज्य सरकारें राजकोषीय प्रोत्साहनों, कर छूट, सब्सिडी वाली बिजली की आपूर्ति, प्राथमिकता से सब्सिडी दरों पर भूमि आवंटन के साथ शुरुआती कुछ जैव ईंधन संयंत्रों को सहारा देने के लिए प्रतिबद्ध रहेंगी।

ख. मंत्रालयों/विभागों की भूमिका

7.5 देश में जैव ईंधन कार्यक्रम के प्रभावी कार्यान्वयन हेतु विभिन्न मंत्रालयों और विभागों की भूमिका को निम्न सारणीबद्ध किया गया है :

मंत्रालय/विभाग	भूमिका
पेट्रोलियम एवं प्राकृतिक गैस मंत्रालय	• जैव ईंधन के विकास के हेतु समग्र समन्वय मंत्रालय • राष्ट्रीय जैव ईंधन नीति और इसका कार्यान्वयन • जैव ईंधन के आवेदन पर अनुसंधान, विकास और प्रदर्शन • जैव ईंधन का विपणन और वितरण • जैव ईंधन के मिश्रण का स्तर • मूल्य निर्धारण और खरीद नीति का विकास और कार्यान्वयन • विवाद निवारण • उन्नत जैव ईंधन अनुसंधान और क्षमता निर्माण के लिए अंतरराष्ट्रीय सहयोग को बढ़ावा देना • परिवहन ईंधन के लिए एमएसडब्लू
ग्रामीण विकास मंत्रालय	ग्रामीण आजीविका कार्यक्रमों मनरेगा आदि के साथ बागवानी, आपूर्ति श्रृंखला गतिविधियां।
कृषि और सहयोग विभाग (कृषि और परिवार कल्याण मंत्रालय)	अन्य मंत्रालयों के साथ समन्वय करके जैव ईंधन के लिए वृक्षारोपण और नर्सरी के जरिए संयंत्र सामग्री का उत्पादन।
पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय (एमईईएफ और सीसी)	• वन भूमि पर जैवईंधन वृक्षारोपण और जैव ईंधन से संबंधित पर्यावरण संबंधी मुद्दे • बागानों और आपूर्ति श्रृंखला के रखरखाव में समुदायों की भागीदारी
विज्ञान और प्रौद्योगिकी मंत्रालय (जैवप्रौद्योगिकी विभाग तथा विज्ञान एवं प्रौद्योगिकी विभाग)	• विविध फीडस्टॉक्स पर अनुसंधान एवं विकास और जैव ईंधन विकास के लिए प्रौद्योगिकियों में सुधार। • जैव ईंधन (बायोफ्यूल) क्षेत्र में नवाचार और अत्याधुनिक अनुसंधान को बढ़ावा देना। • बायोरिफ़ाइनरी और वैल्यू वर्धित उत्पादों के लिए प्रौद्योगिकियों का विकास।
सड़क परिवहन और राजमार्ग मंत्रालय	• परिवहन क्षेत्र में जैव ईंधन के उपभोग / उपयोग को बढ़ावा दें।
रेल मंत्रालय	• जैव ईंधन की खपत / उपयोग को प्रोत्साहन ।
उपभोक्ता मामलों के विभाग (एम ओ सीए, एफ व पी डी)	• अनांतिम उपयोग हेतु जैव ईंधन की गुणवत्ता नियंत्रण को सुनिश्चित करने के लिए विनिर्देशों, मानकों और कोडों को निर्धारित करना ।
भारी उद्योग और सार्वजनिक उद्यम मंत्रालय	• बाजार में उपलब्ध जैव ईंधन के अनुकूल बनाने के लिए उपस्कर निर्माताओं को सलाह देना।
नवीन और नवीकरणीय ऊर्जा मंत्रालय	• बायोमास / शहरी, औद्योगिक और कृषि कचरे से बायोगैस के माध्यम से ऊर्जा उत्पन्न / उत्पन्न करना।
आवास और शहरी गरीबी उन्मूलन मंत्रालय	• एमएसडब्लू की उपलब्धता हेतु नगर निकायों और राज्यों के साथ समन्वय करना। यह शहरी क्षेत्रों में पालिकाओं के ठोस अपशिष्ट सहित जैवईंधन हेतु आवश्यक फीड स्टॉक है, जिसके लिए इस मंत्रालय द्वारा नीतियों को जारी किया जा रहा है।
उपभोक्ता, खाद्य एवं सार्वजनिक वितरण मंत्रालय, खाद्य और सार्वजनिक वितरण विभाग	• एथेनॉल डिस्टिलरीज स्थापित करने के लिए चीनी क्षेत्र में उपयुक्त वित्तीय प्रोत्साहन देने के लिए डीएफपीडी

8.0 अंतरराष्ट्रीय सहयोग

8.1 जैव ईंधन के क्षेत्र में नए सिरे से ध्यान देने के कारण, राष्ट्रीय प्राथमिक के अनुसार अंतरराष्ट्रीय स्तर पर वैज्ञानिक और तकनीकी सहयोग स्थापित किए जाएंगे । इसमें अनुसंधान एवं विकास संस्थानों और उद्योगों से जुड़े संयुक्त अनुसंधान और प्रौद्योगिकी विकास, क्षेत्रीय अध्ययन, पायलट पैमाने के सयंत्र और प्रदर्शन परियोजनाओं में सहयोग शामिल होगा। प्रौद्योगिकियों को साझा करने और वित्तपोषण के लिए उपयुक्त द्विपक्षीय और बहु-पार्श्व सहयोग कार्यक्रम विकसित किए जाएंगे।

9.0 संस्थागत तंत्र

क. केंद्र में जैव ईंधन नीति संस्थागत तंत्र

9.1 व्यावसायिक नियमों के आबंटन के तहत, देश में जैव ईंधन के विकास और उन्नयन के विभिन्न पहलुओं के साथ व्यवहार करते हुए विविध मंत्रालयों को जिम्मेदारी सौंपी जा रही है। शामिल व्यापक दृष्टिकोण / कार्य क्षेत्र के कारण विभिन्न विभागों और एजेंसियों के बीच तालमेल आवश्यक है। यह जैव ईंधन विकास, उन्नयन और उपयोग के विभिन्न पहलुओं पर नीति मार्गदर्शन और प्रारंभिक समीक्षा के लिए एक सशक्त समिति की अपेक्षा है।

9.2 पेट्रोलियम और प्राकृतिक गैस मंत्री की अध्यक्षता वाली राष्ट्रीय जैव ईंधन समन्वय समिति (एनबीसीसी) स्थापित करने की परिकल्पना की गई है। संबंधित मंत्रालयों के प्रतिनिधि इस समिति के सदस्य होंगे। समग्र समन्वयन, प्रभावी अंत-से-अंत के कार्यान्वयन तथा जैव ईंधन कार्यक्रमों की निगरानी प्रदान करने हेतु समिति समय-समय पर बैठक आयोजित करेगी। राष्ट्रीय जैव ईंधन समन्वय समिति की निम्न प्रकार संरचना होगी:

अध्यक्ष : पेट्रोलियम और प्राकृतिक गैस मंत्री

सदस्य:

i. सचिव, पेट्रोलियम और प्राकृतिक गैस मंत्रालय

ii. सचिव, ग्रामीण विकास विभाग, ग्रामीण विकास मंत्रालय

iii. सचिव, कृषि, सहयोग और किसान कल्याण, कृषि और किसान कल्याण मंत्रालय

iv. सचिव, पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय

v. सचिव, विज्ञान और प्रौद्योगिकी विभाग, विज्ञान और प्रौद्योगिकी मंत्रालय

vi. सचिव, व्यय विभाग, वित्त मंत्रालय

vii. सचिव, सड़क परिवहन और राजमार्ग मंत्रालय

viii. अध्यक्ष, रेलवे बोर्ड

ix. सचिव, खाद्य और सार्वजनिक वितरण विभाग, उपभोक्ता, खाद्य और सार्वजनिक वितरण मंत्रालय

x. सचिव, भारी उद्योग विभाग, भारी उद्योग और सार्वजनिक उद्यम मंत्रालय

xi. सचिव, जैव प्रौद्योगिकी विभाग, विज्ञान और प्रौद्योगिकी मंत्रालय

xii. सचिव, नवीन और नवीकरणीय ऊर्जा मंत्रालय

xiii. सचिव, आवास और शहरी गरीबी उन्मूलन मंत्रालय

xiv. मुख्य कार्यकारी अधिकारी, नीति आयोग

xv. संयुक्त सचिव (रिफाइनरी), पेट्रोलियम और प्राकृतिक गैस मंत्रालय - सदस्य सचिव सचिव, पेट्रोलियम और प्राकृतिक गैस मंत्रालय

9.3 जैव ईंधन के कार्य समूह– जैव ईंधन कार्यक्रम के कार्यान्वयन के मोनीटरन हेतु एक कार्य समूह गठित किया जाएगा। इस कार्य समूह की रचना निम्न प्रकार होगी—

अध्यक्ष: संयुक्त सचिव (रिफाइनरी), पेट्रोलियम और प्राकृतिक गैस मंत्रालय

सदस्य :

i) एमओपीएंडएनजी द्वारा नामांकित जैव ईंधनों के क्षेत्र में प्रख्यात विशेषज्ञ

ii) जैव ईंधनों के क्षेत्र में अनुसंधान और शैक्षणिक संस्थानों के तकनीकी विशेषज्ञ

iii) उपर्युक्त 9.2 में उल्लेखित प्रासंगिक मंत्रालयों / विभागों के प्रतिनिधि

iv) ओएमसी के प्रतिनिधि

v) पीसीआरए के प्रतिनिधि

vi) उद्योग, सीएसआईआर लैब, राष्ट्रीय शर्करा संस्थान और जैव ईंधन संघ से विशेषज्ञ/ प्रतिनिधि

ख. राज्य स्तर पर जैव ईंधन संस्थागत तंत्र

9.4 राष्ट्रीय जैवईंधन नीति के प्रावधानों और रूप रेखा के अनुरूप राज्य स्तरीय जैव ईंधन विकास बोर्ड की स्थापना को यह नीति प्रोत्साहित करती है। छत्तीसगढ़, उत्तरप्रदेश, कर्नाटक, राजस्थान और उत्तराखंड जैसे पांच राज्यों में इस प्रकार के बोर्ड कार्य कर रहे हैं। राज्य सरकारें इन बोर्डों को अनुदान देती हैं जो इनके कार्य के लिए पूर्णत: जवाबदेह है। जैव ईंधन पर राष्ट्रीय नीति के व्यापक उद्देश्यों के अनुसार अन्य राज्यों को अपने यहां जैव ईंधन को बढ़ावा देने के लिए इसी प्रकार के बोर्ड स्थापित करने के लिए प्रोत्साहित किया जाएगा। मौजूदा बोर्डों को सहयोगात्मक गतिविधियों को बढ़ावा देने हेतु प्रोत्साहित किया जाएगा ताकि जैव ईंधन कार्यक्रम में अधिक से अधिक राज्य भाग ले सकें।

संदीप पौण्डरीक, संयुक्त सचिव

MINISTRY OF PETROLEUM AND NATURAL GAS

NOTIFICATION

New Delhi, the 4th June, 2018

F. No.P-13032(16)/18/2017-**CC.—**In exercise of the powers conferred under Government of India (Allocation of Business) Three Hundred and Thirty Fifth Amendment Rules, 2017 published in the Gazette of India vide S.O. No.2492 *(*E) dated the 4th August, 2017, the Central Government, through Ministry of Petroleum & Natural Gas, in supersession of National Policy on Biofuels, promulgated through the Ministry of New & Renewable Energy, in 2009, hereby makes a revised policy on biofuels, namely: **—**

1. **(1)** This policy may be called National Policy on Biofuels,- 2018.

(2) This policy shall be effective from the date of approval by the Cabinet i.e. 16-05-2018.

2. The Text of the policy is annexed.

National Policy on Biofuels - 2018

1.0 PREAMBLE

1.1 India is one of the fastest growing economies in the world and will continue to enjoy the demographic dividend for few decades. The Development Objectives focus on Samavesh – Inclusion, shared vision of National development, technology upgradation & capacity building, economic growth, equity and human well-being. Energy is a critical input towards raising the standard of living of citizens. The energy strategy of country aims to chart the way forward to meet the Government's recent ambitious announcements in the energy domain such as electrification of all census villages by 2019, 24x7 electricity & 175 GW of renewable energy capacity by 2022, reduction in energy emissions intensity by 33%-35% by 2030 and share of non-fossil fuel based capacity in the electricity mix is aimed at above 40% by 2030. Even if there is likely expansion in the energy contribution of oil, gas, coal, renewable resources, nuclear and hydro in the coming decade, fossil fuels will continue to occupy a significant share in the energy basket. However, conventional or fossil fuel resources are limited, non-renewable, polluting and, therefore, need to be used prudently. On the other hand, renewable energy resources are indigenous, non-polluting and virtually inexhaustible. India is endowed with abundant renewable energy resources. Therefore, their use should be encouraged in every possible way. This National Policy on Biofuels - 2018 builds on the achievements of the earlier National Policy on Biofuels and sets the new agenda consistent with the redefined role of emerging developments in the Renewable Sector.

1.2 The crude oil price has been fluctuating in the world market. Such fluctuations are straining various economies the world over, particularly those of the developing countries. Road transport sector accounts for 6.7% of India's Gross Domestic Product (GDP). Currently, diesel alone meets an estimated 72% of transportation fuel demand followed by petrol at 23% and balance by other fuels such as CNG, LPG etc. for which the demand has been steadily rising. Provisional estimates have indicated that crude oil required for indigenous consumption of petroleum products in FY 2017-18 is about 210 MMT. The domestic crude oil production is able to meet only about 17.9% of the demand, while the rest is met from imported crude. India's energy security will remain vulnerable until alternative fuels to substitute/supplement petro-based fuels are developed based on indigenously produced renewable feedstock. To address these concerns, Government has set a target to reduce the import dependency by 10 per cent by 2022."

1.3 Government has prepared a road map to reduce the import dependency in Oil & Gas sector by adopting a five pronged strategy which includes, Increasing Domestic Production, Adopting biofuels & Renewables, Energy Efficiency Norms, Improvement in Refinery Processes and Demand Substitution. This envisages a strategic role for biofuels in the Indian Energy basket.

1.4 Biofuels are derived from renewable biomass resources and wastes such as Plastic, Municipal Solid Waste (MSW), waste gases etc. and therefore seek to provide a higher degree of national energy security in an environmentally friendly and sustainable manner by supplementing conventional energy resources, reducing dependence on imported fossil fuels and meeting the energy needs of India's urban and vast rural population.

1.5 Globally, biofuels assume importance due to growing energy security and environmental concerns. To encourage use of biofuels several countries have put forth different mechanisms, incentives and subsidies suiting to their domestic requirements. As an effective tool for rural development and generating employment, the primary approach for biofuels in India is to promote indigenous feedstock production.

1.6 Over the last decade, Government has undertaken multiple interventions to promote biofuels in the Country through structured programmes like Ethanol Blended Petrol Programme, National Biodiesel Mission, Biodiesel Blending Programme. Learning from the past experiences and demand supply status, Government has revamped these programmes by taking steps on pricing, incentives, opening alternate route for ethanol production, sale of biodiesel to bulk and retail customers, focus on R&D etc. These steps have impacted the biofuels programme in the Country positively.

1.7 Biofuels in India is of strategic importance as it augers well with the ongoing initiatives of the Government such as Make in India & Swachh Bharat Abhiyan and offers great opportunity to integrate with the ambitious targets of doubling of Farmers Income, Import Reduction, Employment Generation, Waste to Wealth Creation. Simultaneously, the existing biodiversity of the Country can be put to optimum use by utilizing drylands for generating wealth for the local populous and in turn contribute to the sustainable development.

1.8 Globally, biofuels have caught the attention in last decade and it is imperative to keep up with the pace of developments in the field of biofuels. This policy aims to bring in renewed focus taking into context the international perspectives and National scenario primarily by utilization of indigenous feedstocks for production of biofuels. The

Policy also dwells on the development of the next generation biofuel conversion technologies based on new feedstocks and promote domestically available feedstock exploring, utilizing the Country's biodiversity. Vision, Goals, Strategy and Approach to the development of biofuels in India is set out through technological framework, financial, institutional interventions and enabling mechanisms.

2.0 THE VISION AND GOALS

2.1 The Policy aims to increase usage of biofuels in the energy and transportation sectors of the country during the coming decade. The Policy aims to utilize, develop and promote domestic feedstock and its utilization for production of biofuels thereby increasingly substitute fossil fuels while contributing to National Energy Security, Climate Change mitigation, apart from creating new employment opportunities in a sustainable way. Simultaneously, the policy will also encourage the application of advance technologies for generation of biofuels.

2.2 The Goal of the Policy is to enable availability of biofuels in the market thereby increasing its blending percentage. Currently the ethanol blending percentage in petrol is around 2.0% and biodiesel blending percentage in diesel is less than 0.1%. An indicative target of 20% blending of ethanol in petrol and 5% blending of biodiesel in diesel is proposed by 2030. This goal is to be achieved by

(a) reinforcing ongoing ethanol/biodiesel supplies through increasing domestic production

(b) setting up Second Generation (2G) bio refineries

(c) development of new feedstock for biofuels

(d) development of new technologies for conversion to biofuels.

(e) creating suitable environment for biofuels and its integration with the main fuels.

3.0 DEFINITIONS AND SCOPE

3.1 The following definitions of biofuels shall apply for the purpose of this Policy:

i. 'Biofuels' are fuels produced from renewable resources and used in place of or in blend with, diesel, petrol or other fossil fuels for transport, stationary, portable and other applications;

ii. Renewable resources are the biodegradable fraction of products, wastes and residues from agriculture, forestry, tree based oil other non-edible oils and related industries as well as the biodegradable fraction of industrial and municipal wastes.

3.2 The scope of the Policy encompasses following categories of fuels as "Biofuels" which can be used as transportation fuel or in stationery applications:—

i. 'bioethanol': ethanol produced from biomass such as sugar containing materials, like sugar cane, sugar beet, sweet sorghum etc.; starch containing materials such as corn, cassava, rotten potatoes, algae etc.; and, cellulosic materials such as bagasse, wood waste, agricultural and forestry residues or other renewable resources like industrial waste;

ii. 'biodiesel': a methyl or ethyl ester of fatty acids produced from non-edible vegetable oils, acid oil, used cooking oil or animal fat and bio-oil;

iii. 'Advanced biofuels': Fuels which are (1) produced from lignocellulosic feedstocks (i.e. agricultural and forestry residues, e.g. rice & wheat straw/corn cobs & stover/bagasse, woody biomass), non-food crops (i.e. grasses, algae), or industrial waste and residue streams, (2) having low CO_2 emission or high GHG reduction and do not compete with food crops for land use. Fuels such as Second Generation (2G) Ethanol, Drop-in fuels, algae based 3G biofuels, bio-CNG, bio-methanol, Di Methyl Ether (DME) derived from bio-methanol, bio-hydrogen, drop in fuels with MSW as the source / feedstock material will qualify as "Advanced Biofuels".

iv. 'drop-in fuels': Any liquid fuel produced from Biomass, agri-residues, wastes such as Municipal Solid Wastes (MSW), Plastic wastes, Industrial wastes etc. which meets the Indian standards for MS, HSD and Jet fuel, in pure or blended form, for its subsequent utilization in vehicles without any modifications in the engine systems and can utilize existing petroleum distribution system.

v. 'bio-CNG': Purified form of bio-Gas whose composition & energy potential is similar to that of fossil based natural gas and is produced from agricultural residues, animal dung, food waste, MSW and Sewage water.

4.0 STRATEGY AND APPROACH

4.1 Government is adopting a multi-pronged approach to promote and encourage use of biofuels by

- o Blending ethanol in petrol through Ethanol Blended Petrol (EBP) Programme using ethanol derived from multiple feedstocks
- o Development of Second Generation (2G) ethanol technologies and its commercialization
- o Blending biodiesel in diesel through Biodiesel Blending Programme exploring multiple feedstocks including straight vegetable oil in stationery, low RPM engines
- o Focus on drop-in fuels produced from MSW, industrial wastes, biomass etc.
- o Focus on advanced biofuels including bio-CNG, bio-methanol, DME, bio-hydrogen, bio-jet fuel etc.

4.2 The major thrust of this policy is to ensure availability of biofuels from indigenous feedstock. As a step in this direction, a National Biomass Repository will be created by conducting appraisal of biomass across the Country.

4.3 While attempt will be made to rebalance the biofuel demand and supply side, Government aims to undertake necessary interventions as and when required with respect to domestic production, storage and distribution of biofuels adopting a consultative approach by involving all stakeholders.

4.4 Strategy will include adopting appropriate financial and fiscal measures periodically to support development and promotion of biofuels thereby enlarging their utilization in different sectors.

4.5 Research, development and demonstration will be supported to cover all aspects from feedstock production and biofuels processing for various end-use applications. Thrust will also be given to development of advanced biofuels and other new feedstocks.

5.0 INTERVENTIONS AND ENABLING MECHANISMS

A. Feedstock Availability & its Development

5.1 In India, Bioethanol can be produced from multiple sources like sugar containing materials, starch containing materials, celluloses and lignocelluloses material including petrochemical route. However, the present policy of Ethanol Blended Petrol (EBP) Programme allows bioethanol to be procured from non-food feed stock like molasses, celluloses and lignocelluloses material including petrochemical route. Similarly, biodiesel can be produced from any edible/non edible oil. However, biodiesel coming for the blending programme is presently being manufactured from imported sources like palm stearin.

5.2 Potential domestic raw materials for production of biofuels in the Country are,

For Ethanol Production :	B-Molasses, Sugarcane juice, biomass in form of grasses, agriculture residues (Rice straw, cotton stalk, corn cobs, saw dust, bagasse etc.) , sugar containing materials like sugar beet, sweet sorghum, etc. and starch containing materials such as corn, cassava, rotten potatoes etc., Damaged food grains like wheat, broken rice etc. which are unfit for human consumption, Food grains during surplus phase. Algal feedstock and cultivation of sea weeds can also be a potential feedstock for ethanol production
For Biodiesel Production :	Non- edible Oilseeds, Used Cooking Oil (UCO), Animal tallow, Acid Oil, Algal feedstock etc.
For Advanced Biofuels :	Biomass, MSW, Industrial waste, Plastic waste etc.

5.3 The scope of raw material for procurement of ethanol under EBP Programme will be increased. The policy will allow production of ethanol from B Molasses as well as directly from sugarcane juice. The policy will also allow production of ethanol from damaged food grains like wheat, broken rice etc. which are unfit for human consumption. During an agriculture crop year when there is projected over supply of food grains as anticipated by the Ministry of Agriculture & Farmers Welfare, the policy will allow conversion of these surplus quantities of food grains to ethanol, based on the approval of National Biofuel Coordination Committee proposed under this Policy. Opening of this route for ethanol production will not only help in utilizing the installed capacities of grain based distilleries but also cover all the

raw materials from which ethanol can be produced harnessing fully developed 1G technologies with minimum investment.

5.4 Identification of locations with surplus available biomass and generation of feedstock such as energy grasses and short gestation crops by utilizing wastelands will be pivotal for promoting Industrial set up. Focus shall be laid on identifying surplus biomass pockets in the country.

5.5 Village Panchayat and communities will play crucial role in augmenting indigenous feedstock supplies for biofuel production. In cases relating to usage of wastelands for feedstock generation, local communities from Gram Panchayats/ talukas will be encouraged for plantations non-edible oil seeds bearing trees/ crops such as Pongamia pinnata (Karanja), Melia azadirachta (Neem), castor, Jatropa Carcus, Callophylum Innophylum, Simarouba glauca, Hibiscus cannabbinus etc. Short Rotation Crops such as sweet sorghum and energy grasses e.g. *Miscanthus gigantum*, switchgrass (*Panicum vigratum*), giant reed (*Arundo donax*) etc. will also be planted in wastelands for generating additional feedstock for bioethanol production across country.

5.6 Farmers will be encouraged to grow variety of different biomass as well as oil seeds on their marginal lands, as inter crop and as second crop wherever only one crop is raised by them under rain fed conditions.

5.7 Suitable supply chain mechanisms, feedstock collection centres and fair price mechanisms for the engaged community will be developed in coordination with Local Bodies, States and concerned stakeholders.

5.8 Ample quantity of wastes such as MSW, Industrial waste, Plastic waste etc. is available across country with established collection mechanism. This will serve as a feedstock for generating biofuels such as bio-CNG, drop-in fuels, bio-methanol, DME, bio-hydrogen etc.

B. Blending & Bio-refinery Programme

5.9. Ethanol Blended Petrol Programme

5.9.1 Currently, ethanol for EBP programme is coming from molasses route as a by-product of sugar Industry. At the present levels of cane and sugar production (about 350 MMT & 26-28 MMT per annum respectively), the maximum quantity of molasses available is about 13 MMT, which is sufficient to produce about 300 crore litres of alcohol/ethanol. Currently, C- Heavy Molasses is being used to produce alcohol/ethanol.

5.9.2 Adoption of B- heavy Molasses route for ethanol production will be encouraged as per availability of sugar. One MMT of Sugar sacrificed can produce 60 crore litres of ethanol. By utilizing this option participation by distilleries for ethanol production would improve. Ethanol will also be allowed to be produced directly from sugarcane juice to increase blending percentage.

5.9.3 Other alternate raw materials for production of ethanol such as sugar containing materials like sugar beet, sweet sorghum, etc. and starch containing materials such as corn, cassava, rotten potatoes etc. using first generation fully developed technologies will be promoted. During surplus availabilty of foodgrains, ethanol will also be allowed to ve produced from foodgrains like corn etc, as per decision of National Bio Fuel Coordination Commiittee.

5.10 Second Generation (2G) Ethanol

5.10.1 Ethanol production through Molasses route has limitations and its competitive usage in Potable liquor & Chemical industries leaves little scope to enhance its availability for EBP Programme in a big way. This warrants exploring other sources of ethanol, apart from conventional molasses and sugarcane juice route.

5.10.2 Few studies undertaken in India have indicated a surplus biomass availability to the tune of 120 -160 MMT annually which, if converted, has the potential to yield 3000 crore litres of ethanol annually. Surplus biomass / agricultural waste which has cellulosic and lignocellulosic content, can be converted to ethanol using second generation (2G) technologies. Government of India recognized the role of biomass in taking the rural economy & EBP programme forward and has allowed procurement of ethanol produced from other non-food feedstock besides molasses, like cellulosic and lignocelluloses materials including petrochemical route, subject to meeting the relevant BIS standards. Following areas for action have been envisaged under the policy:

5.10.3 Incentives**:** Globally, 2G ethanol industry is driven by incentives as the technology is yet to be proven at commercial scale and the ethanol so produced is more environment friendly. This will be a major instrument in driving the infrastructural growth of 2G Ethanol Bio refineries.

5.10.4 Offtake Assurance: Public Sector Oil Marketing Companies have agreed to sign Ethanol Purchase Agreements (EPAs) with 2G Ethanol suppliers for period of 15 years to provide assured market to Private stakeholders and support 2G Ethanol initiatives. Bio-CNG, being one of the major by-product in 2G Ethanol Biorefineries and transport fuel, will be brought under offtake assurance by the Public sector Gas marketing companies.

5.11. Biodiesel Blending Programme

5.11.1 The overall blending percentage of biodiesel in diesel has been less than 0.5 percent in the country due to constraints pertaining to feedstock availability. Moreover, whatever biodiesel is coming for the blending programme is manufactured from imported sources. Thus ensuring domestic raw material for biodiesel production is integral for long term success of this programme.

5.11.2 In-house produced Used/Waste cooking oil (UCO/WCO) offers potential to be a source of biodiesel production. However, the same is marred by diversion of UCO to edible stream through various small eateries/vendors & traders. Focus will be laid upon laying down the stringent norms for avoiding the entry of UCO in food stream and developing a suitable collection mechanism to augment its supply for biodiesel production.

5.12 Other Biofuels (Drop-in-fuels, Bio-CNG, Bio-Hydrogen, Bio-methanol, DME, etc.)

5.12.1 Task force on Waste to Energy created by NITI Aayog has estimated generation of 62 MMT of Municipal Solid Waste (MSW) annually in India. This waste has a huge potential of producing drop-in fuels and generate power including Refused Derived fuel, biogas/electricity and compost to support agriculture.

5.12.2 World over, technologies available for converting wastes into Biofuels such as drop-in fuels, bio-CNG, bio-Hydrogen etc. are in nascent stage and need to be proven on commercial scale. Conversion of such wastes into bio-CNG is a model which will be promoted for meeting the energy demand in rural areas and address the environmental issues. Technologies providing higher yield of bio-CNG per unit of waste processed will be promoted in line with the policy. Setting up of such plants for production of advanced fuels will also be promoted through various incentives and offtake assurance. Similarly, Hydrogen, one of the costliest fuel, has found its use in many industries including Refineries. bio-hydrogen, produced from biomass and wastes, will be interesting proposition to explore.

5.12.3 World over, methanol has found its use as transport fuel in blended form with motor spirit. The same can be produced from various sources including agriculture residues, natural gas, high ash coal etc. Presently, India is a net importer of methanol. Surplus biomass availability offers potential for production of bio-methanol & bio-butanol and their application in Indian transport system will be explored.

5.12.4 Di-Methyl Ether (DME) is obtained by removing 1 molecule of water from 2 molecules of methanol, which is a chemical process, usually aided by catalyst. Use of (DME) in domestic LPG as a substitute of Propane is being explored by the R& D institutions. DME can also be a substitute for diesel in slow RPM diesel engines and hence promotion of industrial production of methanol is pertinent for widespread usage, industrial application & acceptance of DME as potential fuel.

5.12.5 Production of biofuels from Algae (3G) has promising potential in terms of high oil content, limited waste streams and minimal land requirements (compared to biomass), depending on the production pathway. Presently, the production of such fuels is at its nascent stage and need further examination with respect to commercial viability. Algae based biofuels & requisite R&D on the subject will also be promoted to attain techno-commercial viability.

C. Financing

5.13 Government will consider declaring oil expelling/extraction and processing units for production of biodiesel and storage and distribution infrastructure for biofuels as a priority sector for the purpose of lending by financial institutions.

5.14 Sourcing of multi-lateral and bi-lateral funding would be encouraged for biofuel development including carbon financing opportunities.

5.15 Joint ventures and investments in the biofuel sector would be encouraged. 100% Foreign Direct Investment (FDI) in biofuel technologies would be encouraged through automatic approval route provided biofuel so produced is for domestic use only.

D. Financial and Fiscal Incentives

5.16 Government will consider extending financial incentives including viability gap funding, subsidies and grant for biofuels. Government will classify Second Generation (2G) Ethanol, drop-in fuels, bio-CNG, algae based 3G biofuels, bio-methanol, DME, bio-hydrogen etc." as "Advanced Biofuels". A National Biofuel Fund may be considered for providing financial incentives.

5.17 The policy envisages incentivizing the nascent "Advanced Biofuel" industry with fiscal incentives in the form of tax credits, advance depreciation on plant expenditure, differential pricing vis-à-vis 1G Ethanol, Viability Gap Funding (VGF) etc. for encouraging stakeholders to set up 2G Ethanol Bio refineries. Schemes will be launched to take the "Advanced Biofuel" programme forward.

5.18 Opportunities of generating carbon credits for the savings on CO_2 emissions on the account of biofuel feedstock generation and use of biofuels, in pure or blended form, will be explored.

5.19 NABARD and other Public Sector Banks will be encouraged to provide funding, financial assistance through soft loans etc.

E. Research & Development and Demonstration

5.20 Strong technology focus is imperative for the development of second generation and advanced biofuels utilizing domestic feedstock. The Policy would encourage Innovation and provide thrust to Research & Development (R&D) and Demonstration in the field of biofuels by utilizing developed / emerging technologies while undertaking R&D activities. The R&D activities will be in the areas of developing new raw material for biofuel production, plantations, processing and conversion technologies. Efficiency Improvement and Innovation for maximizing efficiencies of different end-use applications and utilization of by-products will be encouraged. High priority will be accorded to indigenous R&D and technology development based on local feedstocks. Patents would be registered wherever possible. Research programme in the field of biofuels involving multiple institutions with clearly defined goals and milestones would be supported.

5.21 Identified areas of intensive R&D work include

(a): Biofuel feedstock production

(b): Advanced conversion technologies from identified feedstock

(c): Technologies for end use applications including modifications for biofuels

(d): Utilization of bi-products of biofuels

5.22 Pilot/ Demonstration projects will be set up for biofuel production. Grants would be provided to Research Organizations, Institutions for undertaking R&D and setting up demonstration projects, specialized centers in high technology areas. Existing R&D centres would be strengthened and linkages would be established between the research organization, institutions and industry for wider usage/application. Government will encourage participation of the Industry in R&D and technology development including transfer of know-how would be facilitated to the Industry.

5.23 Life Cycle Analysis (LCA) of emerging Technologies in biofuel sector is crucial keeping in view our commitments at international forums for reduced GHG emissions. Technologies at pilot stage with encouraging performance, promising LCA reports and in accordance to our commitments on Climate change, will be promoted as Clean Technology for subsequent deployment at demonstration / commercial scale.

5.24 A focused group may be constituted to promote Research and Development in the areas of biofuels having representatives of academic and industry besides relevant Ministries to provide knowledge connect through national, bilateral and multilateral research programmes.

F. Quality Standards

5.25 Development of test methods, procedures and protocols would be taken up on priority along with introduction of standards and certification for different biofuels and end use applications. The Bureau of Indian Standards (BIS) has already evolved standards for bioethanol, biodiesel for standalone and blended form applications. Development of specifications for higher blending levels are underway.

5.26 The Bureau of Indian Standards (BIS) would review and update the existing standards, as well as develop new standards for devices and systems for various end-use applications. Guidelines for product performance and reliability would also be developed and institutionalized in consultation with all relevant stakeholders.

5.27 The policy will encourage development of required skill sets so that trained and skilled manpower is available for adapting to the new demands of the biofuel industry.

G. Distribution & Marketing of Biofuels

5.28 Oil Marketing Companies will continue to store, distribute and market biofuels. They will be primarily responsible for maintaining and improving the storage, distribution and marketing infrastructure to meet the requirements of biofuels. Government may also consider to allow other players to distribute and market biofuels depending upon factors like ensuring quality standards, consumer awareness about blending percentages, warranty requirements etc.

H. Pricing of Biofuels

5.29 At present, the price of first generation molasses based ethanol for EBP Programme is being determined by the Government based on the recommendation of a Committee constituted for this purpose. For procurement of biodiesel for blending in diesel, the price is being determined by OMCs. The Government will continue to incentivise first generation biofuels by administered prices or market determined prices depending upon various factors including market conditions, availability of biofuels in domestic market, import substitution requirement, etc. The advanced biofuels will be given a differential pricing to further incentivise them. The mechanism for differential pricing for advanced biofuels will be decided by the National Biofuel Coordination Committee.

6.0 IMPORT & EXPORT OF BIOFUELS

6.1 Indigenous production of biofuels would be encouraged by a set of practical and judicious incentives. The Policy emphasizes development of domestic Biofuel Industry and Feedstock. Allowing import will adversely affect domestic biofuels and hence import of biofuels will not be allowed.

6.2 The policy encourages augmenting indigenous feedstock supplies for biofuel production utilizing the wastelands for feedstock generation. However, depending upon availability of domestic feedstock and blending requirement, import of feedstock for production of bio diesel would be permitted to the extent necessary. Feedstock import requirements will be decided by the National Biofuel Coordination Committee proposed under this Policy.

6.3 As the domestic biofuels availability is much lower than the Country's requirement, export of biofuels will not be allowed.

7.0 ROLE OF STAKE HOLDERS

7.1 Active participation of all stakeholders viz. Ministries/Departments, the State Governments Farmers, Business & Industry and Professionals will be ensured in following areas:

(i) Generation of feedstock in sustainable manner on wastelands.

(ii) Encourage farmers to grow varieties of feed stock on their marginal lands

(iii) Establishment of suitable supply chain for feedstock.

(iv) Feedstock storage infrastructure.

(v) Single window clearances & expeditious approvals.

(vi) Incentives such as tax incentives, subsidized power, water supply, access roads etc. to biofuel Plants

A Role of States

7.2 The successful implementation of biofuel programme largely depends on the active participation of the States. The learning experiences of the States who have set up Biofuel Development Boards will be utilized for setting up Biofuel Boards in other States and the State Governments would be encouraged to suitably empower these agencies/boards for development and promotion of biofuels in their respective States. Other Stake holders will also be enrolled for the programme.

7.3 State Governments would also be required to decide on land use for plantation of non-edible oilseed bearing plants or other feedstocks of biofuels and on allotment of Government wasteland, degraded land for raising such plantations. Creation of necessary infrastructure would also have to be facilitated to support biofuel projects across the entire value chain.

7.4 States will also be encouraged for granting single window clearances in setting up biofuel plants. State Governments will also be pursued for supporting initial few Biofuel plants with fiscal incentives, tax rebates, supply of subsidized power, land allocation on priority at subsidized rates.

B. Role of Ministries/Departments

7.5 The role of different Ministries and Departments for effective implementation of biofuels programme in the Country is tabulated below:

Ministry/Department	**Role**
Ministry of Petroleum & Natural Gas	• Overall Coordinating Ministry for development of biofuels • National Biofuel policy & its implementation • Research, Development & Demonstration on applications of biofuels • Marketing and Distribution of biofuels • Blending levels of biofuels • Development & Implementation of Pricing & Procurement Policy • Dispute redressal • Foster international collaboration for advance Biofuel research and Capacity Building • MSW to transportation fuels
Ministry of Rural Development	• Plantation, Supply Chain activities along with Rural livelihood programmes, MGNREGA etc.
Department of Agriculture & Cooperation (Ministry of Agriculture & FW)	• Production of plant materials through Nurseries and plantations for biofuels in coordination with other Ministries
Ministry of Environment, forest and Climate Change (MoEF&CC)	• Biofuel plantations in forest lands and environmental issues concerning biofuels • Involvement of communities in maintenance of plantations and supply chain
Ministry of Science and Technology (Department of Biotechnology and Department of Science & Technology)	• R&D&D on various feedstocks and improvement of technologies for Biofuel development. • Promote innovation and cutting edge research in Biofuel area. • Development of technologies for bio-refinery and value added products.
Ministry of Road Transport and Highways	• Encourage consumption/usage of Biofuels in transport sector
Ministry of Railways	• Encourage consumption/usage of Biofuels
Department of Consumer Affairs (Ministry of CA, F&PD)	• Laying down specifications, standards and codes for ensuring quality control of biofuels for end uses
Ministry of Heavy Industries and Public Enterprises	• To advise Manufacturers of Equipment for making them compatible with biofuels available in the market
Ministry of New & Renewable	• To generate/produce energy through biogas including enriched biogas,

Energy	bio-CNG and bio-power etc. from biomass/urban, industrial and agricultural waste.
Ministry of Housing & Urban Poverty Alleviation	• To coordinate with States and ULBs for the availability of MSW as an important feed stock for biofuels including municipal solid waste in urban areas for which the policies are being enunciated by this Ministry
Ministry of Consumer Affairs, Food & Public Distribution, Department of Food & Public Distribution	• DFPD to provide suitable financial incentives to the sugar sector for setting up of ethanol distilleries

8.0 INTERNATIONAL COOPERATION

8.1 Owing to renewed focus in the field of biofuels, scientific and technical cooperation will be established internationally in accordance with national priorities. This will include cooperation in joint research and technology development, field studies, pilot scale plants and demonstration projects involving R&D institutes and industry. Appropriate bilateral and multi-lateral cooperation programmes for sharing of technologies and funding would be developed.

9.0 INSTITUTIONAL MECHANISMS

A. Biofuel Policy Institutional Mechanism at the Centre

9.1 Under the Allocation of Business Rules, responsibilities have also been allocated to various Ministries to deal with different aspects of biofuel development and promotion in the country. Synergy is required between various departments and agencies due to the broader outlook/scope of work involved. This calls for an empowered Committee for policy guidance and early review on different aspects of biofuel development, promotion and utilization.

9.2 It is envisaged to set up a National Biofuel Coordination Committee (NBCC) headed by the Minister, Petroleum and Natural Gas and representatives of concerned Ministries would be the Members of this Committee. The Committee would meet periodically to provide overall coordination, effective end-to-end implementation and monitoring of biofuel programmes. The National Biofuel Coordination Committee will have the following composition:

Chairman: Minister of Petroleum & Natural Gas

Members:

i. Secretary, Ministry of Petroleum & Natural Gas

ii. Secretary, Department of Rural Development, Ministry of Rural Development

iii. Secretary, Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture & Farmers Welfare

iv. Secretary, Ministry of Environment, Forest & Climate Change

v. Secretary, Department of Science & Technology, Ministry of Science & Technology

vi. Secretary, Department of Expenditure, Ministry of Finance

vii. Secretary, Ministry of Road Transport and Highways

viii. Chairman Railway Board

ix. Secretary, Department of Food & Public Distribution, Ministry of Consumer Affairs, Food & Public Distribution

x. Secretary, Department of Heavy Industry, Ministry of Heavy Industries and Public Enterprises

xi. Secretary, Department of Bio-Technology, Ministry of Science & Technology

xii. Secretary, Ministry of New & Renewable Energy

xiii. Secretary, Ministry of Housing & Urban Poverty Alleviation

xiv. CEO, NITI Aayog

xv. Joint Secretary (Refinery), Ministry of Petroleum & Natural Gas – Member Secretary

9.3 Working Group on Biofuels - In order to monitor the implementation of biofuel programme, a Working Group will be setup. This Working Group will have the following composition:—

Chairman: Joint Secretary (Refinery), Ministry of Petroleum & Natural Gas

Members:

(i) Eminent experts in the field of biofuels nominated by MoP&NG

(ii) Technical experts from research and academic institutions in the field of biofuels

(iii) Representatives from relevant Ministries/Departments as mentioned in 9.2 above

(iv) Representatives of OMCs

(v) Representative of PCRA

(vi) Representatives/ Experts from the Industry, CSIR Lab, National Sugar Institute & Biofuel Associations

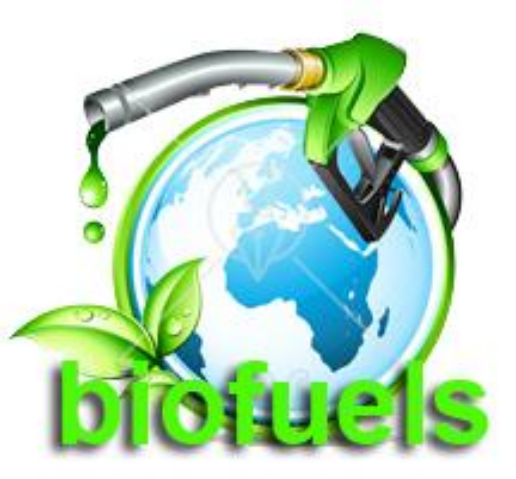
B. Biofuel Institutional Mechanism at the States Level

9.4 The policy encourages setting up of State Level Biofuel Development Boards in line with the broad contours and provisions of this National Policy on Biofuels. Five such Boards are functional in the States of Chattisgarh, Uttar Pradesh, Karnataka, Rajasthan and Uttarakhand. The State Governments aid these Boards and are entirely responsible for their functioning. Other States will be encouraged to set up similar boards to promote biofuels in their respective States in line with the broader objectives of this National Policy on Biofuels. The existing boards will be encouraged to undertake handholding activities so that more and more States participate in the biofuel programme.

SANDEEP POUNDRIK, Jt. Secy.

Uploaded by Dte. of Printing at Government of India Press, Ring Road, Mayapuri, New Delhi-110064
and Published by the Controller of Publications, Delhi-110054.

NATIONAL POLICY ON BIOFUELS, 2018



The Union Cabinet headed by the Prime Minister Shri Narendra Modi approved National Policy on Biofuels, 2018 ("Policy") on Wednesday, 16th May 2018.

Biofuels allow the use of surplus food grains, sugar beet and starch for production of ethanol to blend with petrol to cut oil imports by □4,000 crore in 2018. Therefore, the Policy 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 production of ethanol.

Salient Features of the Policy:

1. The Policy categorizes 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.

2. The Policy 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.

3. Farmers are at a risk of not getting appropriate price for their produce during the surplus production phase. Taking this into account, the Policy allows use of surplus food grains for production of ethanol for blending with petrol with the approval of National Biofuel Coordination Committee.

4. 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.

5. The Policy encourages setting up of supply chain mechanisms for biodiesel production from non-edible oilseeds, used cooking oil, short gestation crops.

6. Roles and responsibilities of all the concerned Ministries/Departments with respect to biofuels has been captured in the Policy document to synergize efforts.

Following are the benefits expected:

1. Reduce Import Dependency: One crore litre of bio-ethanol saves Rs. 28 crore of foreign exchange (forex) on oil imports at current rates. The ethanol supply year 2017-18 is likely to see a supply of around 150 Crore litre of ethanol which will result in savings of over Rs.4000 crore of forex.

2. Cleaner Environment: One crore litre of E-10 saves around 20,000 ton of CO_2 emissions. For the ethanol supply year 2017-18, there will be lesser emissions of CO_2 to the tune of 30 Lakh ton. By reducing crop burning and conversion of agricultural residues/wastes to biofuels there will be further reduction in Green House Gas emissions.

3. Health benefits: Prolonged reuse of Cooking Oil for preparing food, particularly in deep-frying is a potential health hazard and can lead to many diseases. Used Cooking Oil is a potential feedstock for biodiesel and its use for making biodiesel will prevent diversion of used cooking oil in the food industry.

4. MSW Management: It is estimated that, annually 62 MMT of Municipal Solid Waste gets generated in India. There are technologies available which can convert waste/plastic, MSW to drop in fuels. One ton of such waste has the potential to provide around 20% of drop in fuels.

5. Infrastructural Investment in Rural Areas: It is estimated that, one 100klpd bio refinery will require around Rs.800 crore capital investment. At present Oil Marketing Companies are in the process of setting up twelve 2G bio refineries with an investment of around Rs.10,000 crore. Further addition of 2G bio refineries across the Country will spur infrastructural investment in the rural areas.

6. Employment Generation: One 100klpd 2G bio refinery can contribute 1200 jobs in Plant Operations, Village Level Entrepreneurs and Supply Chain Management.

7. Additional Income to Farmers: By adopting 2G technologies, agricultural residues/waste which otherwise are burnt by the farmers can be converted to ethanol and can fetch a price for this waste if a market is developed for the same.

Moreover, farmers are at a risk of not getting appropriate price for their produce during the surplus production phase. Thus, conversion of surplus grains and agricultural biomass can help in price stabilization.