

# Bio-Fuel: An Approach towards Energy Security in India

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**Abstract**—India is one of the fastest growing economies in the world. The Development Objectives focus on economic growth, equity and human well being. Energy is a critical input for socio-economic development. India is the world's fifth largest consumer of energy, and by 2030 it is expected to become the third largest, overtaking Japan and Russia. India has only 0.4 percent of the world's proven oil reserves. It is also projected to run out of coal, its primary source of energy, in forty years. Its domestic natural gas reserves are limited as well. Fossil fuels will continue to play a dominant role in the energy scenario in our country in the next few decades. India's energy security would remain vulnerable until alternative fuels to substitute or supplement petro-based fuels are developed, based on indigenously produced renewable feed stocks, i.e. bio fuel. In bio fuels, the country has a ray of hope in providing energy security. It is based solely on feed stocks to be raised on wastelands that are not suited for agriculture, thus avoiding a possible conflict of fuel vs. food security. An indicative target of 20% blending of bio-fuels, both for bio-diesel and bio-ethanol, by 2017 is proposed under National Bio-fuel Policy.

**Keywords:** Bio-fuel, Energy, Policy, Biodiesel, Ethanol.

## 1. INTRODUCTION

In the context of shrinking crude oil reserves, rising demand and the resultant rise in prices of petroleum, as well as the concerns about global climate change and energy security, bio energy is becoming increasingly relevant as a possible and potential alternative to fossil fuels. With rapid industrialization, urbanization and population growth, the gap between demand and supply in the Indian energy scenario will continue to be wide in the coming decades of 21<sup>st</sup> century. Increased use of Renewable Energy Sources and Energy Conservation are the twin ideas of sustainable energy supply. Bio-fuels are liquid or gaseous fuels produced from biomass resources and used in place of, or in addition to, diesel, petrol or other fossil fuels for transport, stationary, portable and other application. Bio-fuels are derived from renewable bio-mass resources and, therefore, provide a strategic advantage towards sustainable development and to complement conventional energy sources in meeting the rapidly increasing requirements for transportation fuels associated with high economic growth, as well as in meeting the energy need of

India's vast rural population. Considering the scenario, the objective of this paper is to analyse the current trend and possibilities of bio-fuels in India focusing on bio-diesel and ethanol and also to recommend some means towards successful implementation.

## 2. DEFINITION AND BROAD CLASSIFICATION OF BIO-FUELS

1. 'Bio-fuels' are liquid or gaseous fuels produced from biomass resources and can be used in place of, or in addition to, diesel, petrol or other fossil fuels for transport, stationary, portable and other applications;
2. 'Biomass' resources are the biodegradable fraction of products, wastes and residues from agriculture and forestry as well as the biodegradable fraction of industrial and municipal wastes.

## 3. SOURCES OF BIO-FUELS

(i) **First generation bio fuels:** First generation bio fuels are made from biomass consisting of sugars, starch, vegetable oils, animal starch or biodegradable output wastes from agriculture, industry, forestry and households using and meet only 30% of national requirement, while the balance is met through imports of nearly 146 million metric conventional technologies.

(ii) **Second generation bio fuels:** Second generation bio fuel technologies are gaining importance because first generation bio fuels manufacture has got major limitations. The primary one is that, they cannot be produced beyond a threshold level without threatening food security.

**Second generation bio fuels,** also known as advanced bio fuels, are fuels that can be manufactured from various types of biomass. Biomass is a wide-ranging term meaning any source of organic carbon that is renewed rapidly as part of the carbon cycle. Biomass is derived from plant materials but can also include animal materials.

First generation bio fuels are made from the sugars and vegetable oils found in arable crops, which can be easily

extracted using conventional technology. In comparison, second generation biofuels are made from lignocellulosic biomass or woody crops, agricultural residues or waste, which makes it harder to extract the required fuel.

(iii) **Third and Fourth generation bio-fuels:** The third generation biofuels include Algal biodiesel, Algal hydrogen and conversion of biomass to hydrogen whereas the fourth generation biofuels include biofuels from high solar efficiency cultivations.

#### 4. SCENARIO OF BIOFUELS IN INDIA

The domestic production of crude oil from fossil fuels remains more or less stagnant over the years, tonnes of crude petroleum products have been imported that cost the country close to \$90 billion in 2008-09.

In 2010, India registered the highest change in bio-fuel production from the previous year. With the addition of 0.151 million tonnes of oil equivalent, India registered an 85% increase in production over its 2009 production. India holds only 0.3% share of the global production in 2010. However, this is likely to increase as India prepares for a change in its bio-fuel mandate from its current E5 (5% ethanol content in the fuel supply) to E10 (10% ethanol content in the fuel supply) and ultimately E20 by 2017. Present estimates indicate India's bio-fuel demand at 0.5 billion gallons in 2012 which will grow to 6.8 billion gallons by 2022.

#### 5. BIODIESEL AND BIOETHANOL

India's biofuel production accounts for only 1% of the global production. This includes 380 million litres of fuel ethanol and 45 million litres of biodiesel. It is worth noticing that India is the second largest producer of sugarcane in the world but accounts for only about 1% of global ethanol production. This can be attributed to the fact that 70-80% of the cane produced in the country is utilized for production of sugar and the remaining 20-30% for alternate sweeteners like jaggery and khandsari.

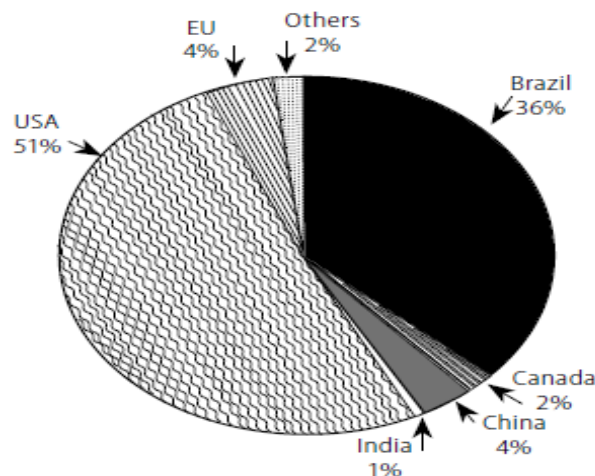
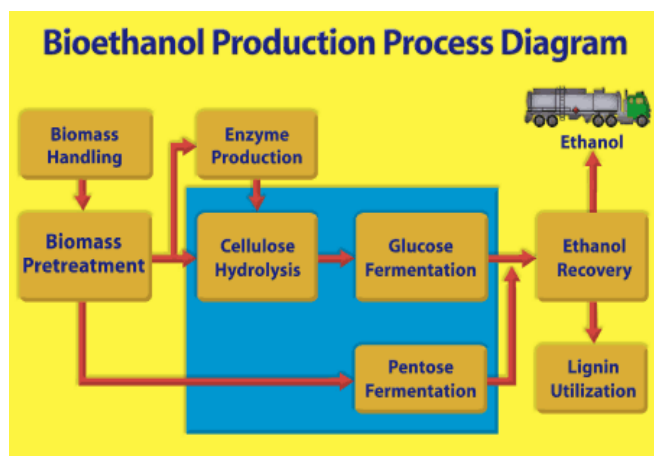


Fig. 1: Country Wise Analysis of Production of Ethanol, 2008

Ethanol is produced from fermentation of molasses which is a by-product in the manufacture of sugar from sugarcane. It is estimated that, out of one tonne of sugarcane, 85-100 kg of sugar and 40 kg of molasses can be recovered.

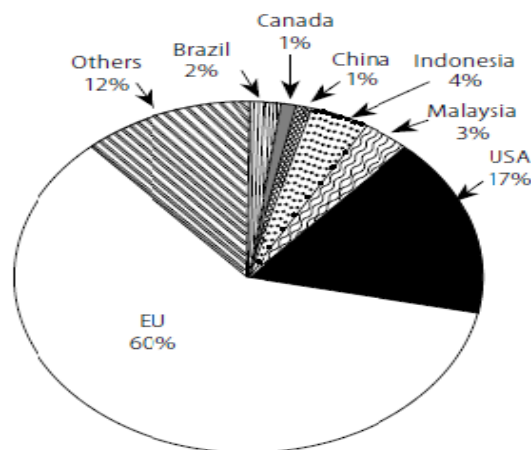


Fig. 2: Country Wise Analysis Of Production Of Bio-Diesel, 2008

India is not self-sufficient in edible oil production and depends upon large quantities of import of palm oil and other vegetable oils to meet the domestic demand. So India does not use vegetable oils derived from rapeseed, mustard or palm oil for production of biodiesel. Biodiesel in India is mostly produced from oils extracted from non-edible seeds of shrubs like jatropha and pongamia.

#### 6. DEVELOPMENTS UNDER THE BIOFUEL POLICY

In 1948, The Power Alcohol Act heralded India's recognition of blending petrol with Ethanol. The main objective was to use ethanol from molasses to blend with petrol, to bring down the price of sugar, trim wastage of molasses and reduce dependence on petrol imports, subsequently the act was repealed in 2000, and in January 2003, the Government of

India launched the Ethanol Blended Petrol Programme promoting the use of Ethanol for blending with Gasoline and the use of Bio-Diesel derived from non-edible oils for blending with diesel(5% blending).The Government of India approved the “National Policy of Biofuels” on December 24, 2009. Since then, considerable advancements have taken place in the direction of cultivation, production and use of biofuels.

The Indian Railways has started to use the oil (blended with diesel fuel in various ratios) from the Jatropha plant to power its diesel engines with great success. Currently the diesel locomotives that run from Thanjavur to Nagore section and Tiruchirapalli to Lalgudi, Dindigul and Karur sections run on a blend of Jatropha and diesel oil. In one of the biggest initiatives for bio-fuel production in the country, Indian Railways is poised to set up four bio-diesel plants costing about Rs. 120 crore. While two bio-diesel esterification plants are going to be commissioned at Raipur and Chennai during the next two years, the other two units will be set up subsequently. Each plant, estimated to cost around Rs 30 crore, will produce 30 tons bio-diesel per day, which means more than 9, 000 tons a year.

## 7. NATIONAL POLICY FOR BIO-FUELS:

India is one of the fastest growing economies in the world. The Development Objectives focus on economic growth, equity and human well being. Energy is a critical input for socio-economic development. The energy strategy of a country aims at efficiency and security and to provide access which being environment friendly and achievement of an optimum mix of primary resources for energy generation. Fossil fuels will continue to play a dominant role in the energy scenario in our country in the next few decades.

The crude oil price has been fluctuating in the world market and has increased significantly in the recent past, reaching a level of more than \$ 140 per barrel. Such unforeseen escalation of crude oil prices is severely straining various economies the world over, particularly those of the developing countries. Petro-based oil meets about 95% of the requirement for transportation fuels, and the demand has been steadily rising. Provisional estimates have indicated crude oil consumption in 2007-08 at about 156 million tonnes. The domestic crude oil is able to meet only about 23% of the demand, while the rest is met from imported crude.

India’s energy security would remain vulnerable until alternative fuels to substitute/supplement petro-based fuels are developed based on indigenously produced renewable feedstocks. In biofuels, the country has a ray of hope in providing energy security. Biofuels are environment friendly fuels and their utilization would address global concerns about containment of carbon emissions. The transportation sector has been identified as a major polluting sector. Use of biofuels have, therefore, become compelling in view of the tightening automotive vehicle emission standards to curb air pollution.

## 8. THE VISION AND GOALS

The Policy aims at mainstreaming of biofuels and, therefore, envisions a central role for it in the energy and transportation sectors of the country in coming decades. The Policy will bring about accelerated development and promotion of the cultivation, production and use of biofuels to increasingly substitute petrol and diesel for transport and be used in stationary and other applications, while contributing to energy security, climate change mitigation, apart from creating new employment opportunities and leading to environmentally sustainable development.

The Goal of the Policy is to ensure that a minimum level of biofuels become readily available in the market to meet the demand at any given time. An indicative target of 20% blending of biofuels, both for bio-diesel and bio-ethanol, by 2017 is proposed. Blending levels prescribed in regard to bio-diesel are intended to be recommendatory in the near term. The blending level of bio-ethanol has already been made mandatory, effective from October, 2008, and will continue to be mandatory leading up to the indicative target.

## 9. RECOMMENDATIONS

### Plantations

Plantations of trees bearing non-edible oilseeds will be taken up on Government/community wasteland, degraded or fallow land in forest and non- forest areas. Contract farming on private wasteland could also be taken up through the Minimum Support Price mechanism proposed in the Policy. Plantations on agricultural lands will be discouraged. There are over 400 species of trees bearing non-edible oilseeds in the country. The potential of all these species will be exploited, depending on their techno-economic viability for production of biofuels. Quality seedlings would be raised in the nurseries of certified institutions / organizations identified by the States for distribution to the growers and cultivators.

In all cases pertaining to land use for the plantations, consultations would be undertaken with the local communities through Gram Panchayats/ Gram Sabhas, and with Intermediate Panchayats and District Panchayat where plantations of non-edible oil seed bearing trees and shrubs are spread over more than one village or more than one block/ taluk. Further, the provisions of PESA (Panchayats Extension To Scheduled Areas) would be respected in the Fifth Schedule Areas.



## 10. RESEARCH & DEVELOPMENT

Intensive R&D work would be undertaken in the following areas:

(a) Bio-fuel feed-stock production based on sustainable biomass with active involvement of local communities through non-edible oilseed bearing plantations on wastelands to include inter-alia production and development of quality planting materials and high sugar containing varieties of sugarcane, sweet sorghum, sugar beet, cassava, etc.

(b) Advanced conversion technologies for first generation biofuels and emerging technologies for second generation biofuels including conversion of ligno-cellulosic materials to ethanol such as crop residues, forest wastes and algae, biomass-to-liquid (BTL) fuels, bio-refineries, etc.

(c) Technologies for end-use applications, including modification and development of engines for the transportation sector based on a large scale centralized approach, and for stationary applications for motive power and electricity production based on a decentralized approach.

(d) Utilisation of by-products of bio-diesel and bio-ethanol production processes such as oil cake, glycerin, bagasse, etc.



## 11. CONCLUSIONS AND FUTURE PROSPECTIVES

Currently, India's position in global biofuel map is not very prominent. However, the country has ambitious plans to expand the biofuel sector. After analyzing the National Policy on Biofuel's of the Government of India (Ministry of New &

Renewable Energy), we would like to make the following recommendations:

1. The Government should take steps in the direction of setting up regulating nurseries for certification of seeds and planting materials and to regulate the mechanism of cultivation.
2. An up-to-date technology policy is central to bring in efficiency in production which is also cost effective so that the industry would survive on its own without any subsidies or support.
3. The focus on research has to be sustained to explore the feasibility of environment-friendly and economically sustainable feed stocks. 4. Offer opportunities for promoting local level entrepreneurship and enhancement of women's participation.
4. Ambiguity in land rights is also considered as an issue in development of wastelands for biofuel.
5. Modification in the engines of the vehicles so that it can run on hybrid fuels.
6. The Government should adopt some of the measures from the success of biofuels in countries like Brazil.

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