

## Biofuels Production Process and the Net Effect of Biomass Energy Production on the Environment

M.R. Heydari azad<sup>1,\*</sup>, R. Khatibi nasab<sup>2</sup>, S. Givtaj<sup>2</sup>, S.J. Amadi Chatabi<sup>2</sup>

<sup>1</sup> No.7 east Shirzad Street, Valiasr crossroads, Tehran, Iran

<sup>2</sup> Department of Mechanical & Aerospace Engineering, Science and Research Branch, Islamic Azad University, Tehran, Iran

\* Corresponding author. Tel: +98 21 66720338, Fax: +98 21 66720519, E-mail: azad138887@yahoo.com

---

**Abstract:** Biomass is based on carbon. It is also the admixture of organic molecules that include hydrogen, oxygen, often nitrogen and small amounts of other atoms like alkali metals, alkaline earth metals and heavy metals. Better method of producing biomass for more energy production has the potential to replace fossil fuels. Converting biomass to liquid, gaseous or solid fuel depends on four main characteristics:

1) Platforms 2) processes 3) feedstock 4) products

Platforms are the most important feature in this classification; they are the key intermediate between raw materials and final products.

There are two main methods to convert biomass to liquid, gaseous or solid fuel: Biochemical and thermo chemical. Biochemical method is known as the sugar platform that is based on enzymatic hydrolysis and fermentation. Thermo chemical method depends on thermo chemical process. Methods that are in this category contain Direct Combustion Gasification and Pyrolysis.

Utilizing biofuels instead of fossil fuels due to a lot of reasons are preferred. They produce less CO<sub>2</sub> than fossils, they produce a little bit of brimstone and they do not produce pure C. Moreover, they can help to reduce greenhouse gasses and can save the environment from destruction. On the other hand, using such fuels help not only the nature to be more stable, but also to gain stable increment in future.

This article is seriously focused bio fuels production process and the net effect of biomass energy production on the environment, tools and combining methods to produce components that cover the mechanism of biomass energy production process and the unique performance of these parts. In this paper the development of biorefinery technologies and using renewable resources in national and international level is studied.

Of course it would be considered that producing more biomass for energy has the potential to pollute water resources and decrease food security.

**Keywords:** Biomass energy production process, Bio fuels production process, Renewable energy resources.

---

### 1. Introduction

Changes in utilization of the Earth and combustion of fossil fuels are the worst mankind's effects on the Earth which have changed the cycle of carbon in the planet.

Combustion of fossil fuels enters huge amounts of carbon dioxide (CO<sub>2</sub>) into the atmosphere. Biofuel is a kind of energy which is very important according to the following reasons:

1. Environmental concerns
2. for security reasons
3. Currency saving (frugality in foreign currency savings), social and economical issues related to rural sector and so on.

Biomass is a renewable energy resource which is produced from bio materials. Bio materials contain herbaceous reliquiae which are used for producing electricity and heat. Biomass is one of the most important factors in the economy of the world. If we use biofuels, cost of production will be reduced because of dramatic improvement in efficiency, paying attention to the environmental systems and development of rural places.

Biofuels are vegetable oil, Biodiesel, Bioethanol, bio methanol, Biogas, etc. Most of the biofuels, like ethanol are produced from corn, wheat or sugar beets. Biodiesels are usually

produced from oil seeds. For example the amount of energy that can be gained from each m<sup>3</sup> of wood with moisture content of 60% is 7GJ or the amount of energy that can be gained from each m<sup>3</sup> of new harvested herbaceous is 3GJ. Bio-ethanol is a suitable replacement for gasoline or it can also be used as its supplement. By using bio-syngas, Bio ethanol can be gained from the steam of biomass which is obtained from the reformed biomass process. Bio-methanol recovers easier from biomass than bio-ethanol. Biodiesel is an environmental friendly fuel and is a good replace for liquid fuels in diesel engines that can be used without change. Using herbaceous oils to make biodiesels has been significantly developed due to these reasons:

1. They produce fewer amounts of CO<sub>2</sub> and pollutant in comparison of fossil fuels in the time of combustion.
2. Ability of being renewable for bio diesel in comparison of conventional diesel fuel oil.

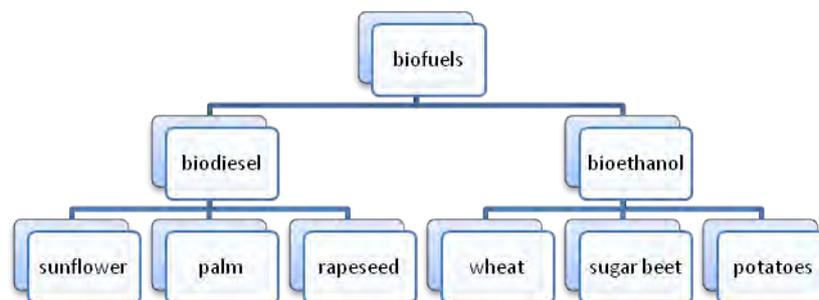


Fig.1. Resources of bioethanol and biodiesel

Technology of producing biomass energy in use of waste or plant matter to produce energy with lower level should be in a way that prevents production of greenhouse gases. [1]

In developed countries there are some modern and efficient technologies for converting bio-energy or at least such kinds of technologies are growing. Hence biofuels in industrialized countries compete with fossil fuels. [2]

Using of bio energy as a fuel of vehicles is getting more and more popular and it can get some portions of fuel market in future decades. In below, some advantages of using it are listed:

1. It helps to the structure of nature and stability of environment which is at risk.
2. Biofuel resources are accessible easily.
3. An economic frugality for consumers. [3]

### 1.1. How to get energy from biomass

So as to get energy from crude oil it must be refined in order to gain energy, processes must be done on biomass so that energy can be gained from it. Generally, the methods, processes and equipments that can be used to produce energy from Biomass are called Biorefinery. In fact Biorefinery is placed in front of refinery in oil and gas industry.

### 1.2. Biorefinery energy production methods

1. Sugar platform: This method is based on biochemical reactions and processes
2. Thermo chemical Platform: This method is based on thermo chemical processes

### 1.3. Sugar platform

In general in this method biomass converts into sugar or other fermented food. In the next steps the result of the material will be fermented by bacteria, yeasts and other microorganisms. Finally, because of processes which occur on the material, products like alcohol or other products that energy can be obtained from them is produced.

### 1.4. Thermochemical Platform

Methods that are in this category are:

1. Direct Combustion
2. Gasification
3. Pyrolysis

### 1.5. Direct Combustion

In fact the first people who produced biomass energy through the burning were early humans. This method is not very useful in terms of efficiency and productivity. In other ways through the biomass heating in the absence of oxygen or gas into liquid fuels, you can have high energy efficiency. Besides in comparison of Direct Combustion they have less pollution and higher economic efficiency.

### 1.6. Gasification

In this method biomass is heated in the absence of oxygen. The product is mixed with carbon monoxide and hydrogen, which is called Syngas. The outcome product will be synthesized with oxygen easily and can be used in turbines, boilers, etc. as a fuel.

As it was mentioned, using such kinds of fuels make not only high efficiency but also lower pollution.

### 1.7. Pyrolysis

Solid biomasses can be turned into liquid using chemical and catalysis methods. In method Pyrolysis like the method Direct Combustion, biomasses are heated in the absence of oxygen. These products, which are normally liquid, can be used as a fuel.

Now, this method is under research and study for a better environment.

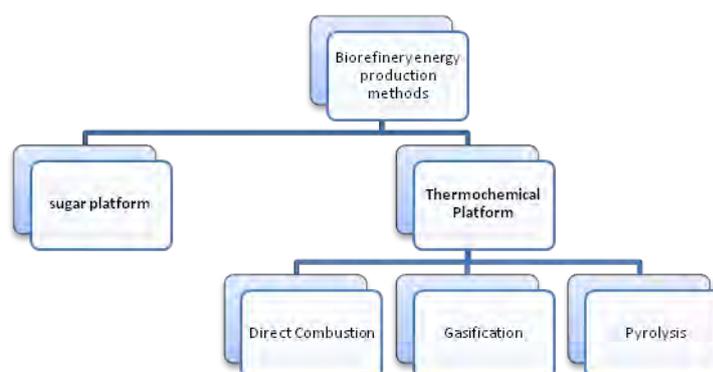


Fig.2. Flow Chart of Biorefinery energy production methods

## 2. Biofuels

### 2.1. Bioalcohols

Biofuels which are in forms of gas and liquid are mostly used in a 100% pure as a fuel for vehicles. They are also used, in some cases, with mixture of other fuels, For example, ethanol can be mixed with gasoline as 15-20% alcohol by volume without any problem. [4]

Alcohol can be used as vehicles fuel according to the following:

1. Methanol ( $\text{CH}_3\text{OH}$ )
2. Propanol ( $\text{C}_3\text{H}_7\text{OH}$ )
3. Butanol ( $\text{C}_4\text{H}_9\text{OH}$ )
4. Ethanol ( $\text{C}_2\text{H}_5\text{OH}$ )

They are known as BIOALCOHOLS when they are obtained from land resources. Bio-ethanol contains about 5% water. This compound can be purified by simple distillation and becomes as azeotropic mixture. Mixture of gasoline and ethanol is known as gasohol. Gasohol can even be as follow: 97% gasoline, 3% ethanol

However, this gasohol has higher percent octane compared with the previous. In general, this mixture can cause to reduce emissions of greenhouse gasses and some other pollutants. Of course, it should not be forgotten that ethanol evaporates easily and we know that its evaporation in hot weather causes pollution and produces greenhouse gas. Ethanol can be combined with gasoline easily without water. Hydrated ethanol includes not entire 2% of water volume. Mixture of gasoline- hydrated ethanol cannot be combined with diesel.

But we can use emulsion, to form diesohol. Bio ethanol is a petrol additive/substitute. It is possible that wood, straw and even household wastes may be economically converted to bioethanol. fig. 3. Shows ethanol production in different continents.

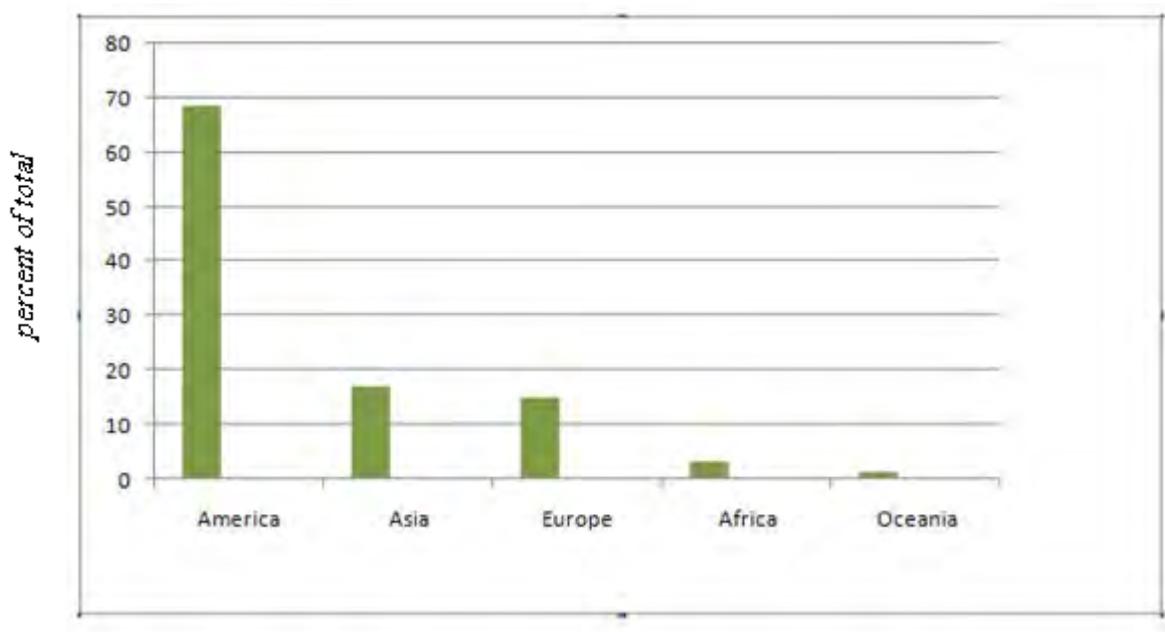


Fig.3. Ethanol in different continents

## 2.2. Biodiesel and Vegetable oils

Triglyceride chemical molecules with three molecules of fatty acid esters are joint to a glycerol molecule of herbaceous oils.

Herbaceous oils can be used as fuels for diesel engines; but they are more viscose than normal diesel fuels so they need to be reformed before they enter an engine.

There are different ways to reduce the viscosity of the herbaceous oils:

- 1-pyrolysis
- 2-Dilution
- 3-microemul-sifications
- 4-catalytic cracking
- 5-transesterifications

Process Pyrolysis has more benefits than Transesterifications. The components of the liquid fuels which produced in process Pyrolysis are resembled to the chemical components of the normal diesel petroleum fuel. Herbaceous oils can be turned into the maximum liquid and gas hydrocarbons using the processes pyrolysis, catalytic cracking, decarboxylation and deoxygenating. [5, 6]

Using herbaceous oils for making biodiesels, which is a renewable energy, introduces a new profitable way of using herbaceous oils. It means that this fuel produces lower pollutant in comparison of usual diesel which causes potential exhaustion. [7]

## 3. Conclusion

Biofuel, a pure fuel and a renewable energy, is obtained from biomaterials like herbal residue (corn, wheat, sugar beet and wood, straw, oilseeds, etc.). Biofuel is a good replacement for fossil fuels (non renewable) and with mentioning economical, safety and environmental reasons it is so crucial. Besides, it has more advantages than fossil fuels due to these reasons:

- 1- Frugality for users; Utilizing herbal residue and other agricultural products which have not been able to use by now.
- 2- Biofuels are renewable in comparison of normal diesel petroleum fuels.
- 3- They produce less amount of CO<sub>2</sub> in comparison of fossil fuels in the time of combustion.
- 4- They produce less pollutant which is a good help to the structure of nature and stability of environment which is at risk.
- 5- The resources of biofuels are available and their raw materials are varied for producing biofuels.

A biofuel is produced in this way:

- 1- Thermochemical Platform (1.Direct Combustion 2.Gasification 3. Pyrolysis)
- 2 - Sugar platform

Biofuels which are in forms of gas and liquid are mostly used in a 100% pure as a fuel for vehicles. It is also used, in some cases, with mixture of other fuels.

## **References**

- [1] Sheehan J, Cambreco V, Duffield J, Garboski M, Shapouri H. An overview of biodiesel and petroleum diesel life cycles. A report by US Department of Agriculture and Energy; 1998. p.1 –35.
- [2] Puhan S, Vedaraman N, Rambrahaman BV, Nagarajan G. Mahua (*Madhuca indica*) seed oil: a source of renewable energy in India. *J Sci Ind Res* 2005;64:890 –6.
- [3] Puppan D. Environmental evaluation of biofuels. *Periodica Polytechnica Ser Soc Man Sci* 2002;10:95 –116.
- [4] IEA (International Energy Agency). Renewables in global energy supply. An IEA FactSheet. Paris, November 2002.
- [5] Cadenas A, Cabezudo S. Biofuels as sustainable technologies: Perspectives for less developed countries. *Technol Forecasting Soc Change* 1998;58:83 –103.
- [6] Di Giulio C. Using advanced technologies to reduce motor vehicle greenhouse gas emissions. *Energy Policy* 1997;25:1173 –8.
- [7] Reijnders L. Conditions for the sustainability of biomass based fuel use. *Energy Policy* 2006;34:863 –76.