THE GROWING IMPORTANCE OF BIOMASS

Harpreet kaur Channi*

Harwinder Singh Sohal**

ABSTRACT

Energy is the key input to derive and improve the life cycle. Primarily it is the gift of nature to the mankind in various forms. The consumption of the energy is directly proportional to the progress of the mankind. The advancement in technology has to lead to the introduction of newer electricity production techniques. Although biomass/bio-energy is being used by man for centuries, but more research is being done to introduce methods to cut down the energy/plants costs and make it as eco-friendly as possible. This renewable power is being made the alternate source of energy. The bio energy is generated from living organism as well as other sources which together constitute the biomass. The most important fuel worldwide after coal, oil and natural gas is biomass. It is expected to become one of the key energy resources for global sustainable development and helps to meet the increasing energy demands. This paper gives a brief comparison of conventional and modern biomass conversion technologies. The objective of this paper is to introduce the basics of algal-bio fuel production and the current status of this emerging biodiesel source. Finally it will be recommended which technologies to be used for bio diesel production.

Keywords: *Energy, Biomass, Sustainable, Consumption, Eco –Friendly.*

* Guru Nanak Dev Engineering College, Ludhiana.

**Assistant Professor, Information Technology Department, L.L.R.I.E.T. MOGA.

I. INTRODUCTION

Biomass can be referred to any biological living or dead thing. It could be the wood or any other organic waste that can be renewable or recyclable or any living organism. This bio energy is generated from living organism as well as other sources which together constitute the biomass. This can be used for the generation of fuel. There are many examples of bio energy that are very common and can be a source of energy. The energy source is provided via the burning of wood and other organic waste so that less energy is consumed. The microorganisms are also involved in green generation. It includes the utilization of bacteria and to genetically alter the function of the micro organism so that it produces cellulose ethanol. Alcohol duel is very common and can be used for the energy purposes and green energy can be created in this way. According to the International Energy Agency (IEA, 2002a), approximately 50% of the population in developing countries relies on biomass energy. Bio energy, bio ethanol and bio diesel are used extensively nowadays to conserve fuel and save energy as much as it is possible. Now many car producers are also accepting this technology and supporting it for the generation of energy. Sugar cane, beet and maize are also utilized for the energy generation purposes. Biomass resources consist of primary, secondary and tertiary sources. Primary resources are produced by photosynthesis and directly taken from the land. They include short rotation woody crops and residues resulting from harvesting of agricultural crops (e.g.wheet, straw etc) and forest trees.

Secondary biomass resources are obtained from the processing of primary resources either physically, chemically or biologically. Tertiary resources are post consumer residue streams including animal fats and greases, packaging wastes and construction and demolition debris. There are mainly two conversion technologies included thermo chemical conversion and biological conversion that can convert biomass resources into power, heat and fuels for potential use in developing as shown in the Fig.1. [1].

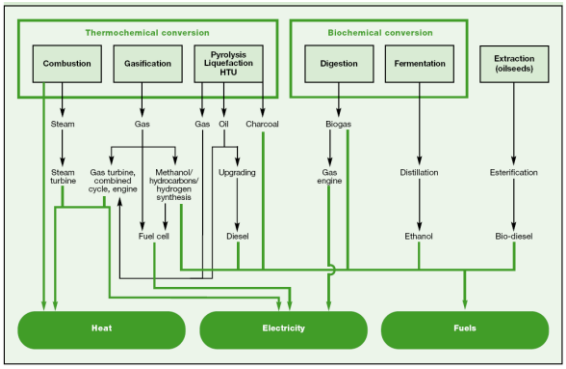

Fig.1 Main Biomass energy conversion processes

II. RELATED WORK

Joseph Dipardo[2] describes that the production of ethanol from corn is a mature technology that is not likely to see significant reductions in production costs. However, if cellulose-based feedstocks are used instead of corn, substantial cost reductions may be possible. Producers are experimenting with units equipped to convert cellulose-based feedstocks, using sulphuric acid to break down cellulose and hemicelluloses into fermentable sugar. Although the process is expensive at present, advances in biotechnology could decrease conversion costs substantially. If Department of Energy goals are met, the cost of producing ethanol could be reduced by as much as 60 cents per gallon by 2015.He also presents a brief overview of cellulose conversion technology and various feedstock options, followed by an examination of projected ethanol costs and gasoline prices under various technological scenarios for cellulose ethanol conversion, as well as the uncertainty of oil prices.

Dr V Sivasubramanian[3] states that India is the sixth largest and one of the fastest growing energy consumers in the world due to raising population and power consumption. Vehicular pollution contributes to about 70% to the total air pollution and is estimated to have increased 8 times in the last 2 decades. Due to limited crude oil reserves, India meets about 72% of its crude oil and petroleum products requirements through imports, which are expected to expand further in coming years. Bio-fuels promise to be an appropriate option to be fixed as a solution to these problems. Bio-fuels have been developing in stages and have come up a long way. Bio-fuels were produced initially using waste oil as raw material and then as the demand rose up various generations of technologies using different raw materials mushroomed up as options for bio-fuels production. Various companies and research setups for algal fuels are coming up and are backed by big investors in India.

Jinxing Peng ,Zhihua Fan, Guanyi Chen[4] describes that Biomass thermo chemical conversion for liquid fuel rapidly growing attention as it is perceived to offer significant security energy system in recent years. The liquid from biomass pyrolysis is known as bio-oil, pyrolysis oil, or bio crude for short. Bio-oils will play an important role as fuels used in combustors, engines or gas turbines for power generation or transport fuel. But some problems baffling its industrialization processes, in particular, the complexity of bio-oil became the key difficulty. Their main objective is to review processes of bio oil in order to successfully implement the technologies, which are more relevant to our analysis in that it attempts to find best conversion technology that reduces pollution problem. They also reviewed recent research on bio-oil from several hotspots, such as biomass pyrolysis reactor,

co-pyrolysis, separation and analysis, upgrading of bio-oil, biomass pyrolysis CFD molding and mechanism and main regularities.

S. Laux, J. Grusha[5] describes that co firing has been shown to be an effective means for greenhouse gas mitigation. Carbon dioxide (CO2) generated from the combustion of fossil fuels such as coal is often considered to be one of the critical greenhouse gases. Methane (CH4), which can be generated in landfills from the decomposition of organic matter such as wood waste, is also considered to be a greenhouse gas. It is an effective means to displace fossil fuel and, simultaneously, removing such bio fuels as wood waste, agricultural materials, and non-recyclable paper from the waste stream being interred in landfills. Apart from mitigating greenhouse gases, he also suggests that biomass co firing also provides a low cost approach to increasing generation capacity for "green power" without major changes to existing equipment.

Ansu Abraham [6], describes that biopower is a sustainable green technology to tackle the continuous growing energy demand problem. Though there is huge potential for biomass, the industry faces some challenges. Higher generation cost; competition, biomass invasion etc. are some of the problems associated with bio power technology. Financial incentives, policy regimes, CDM assistance, entrepreneurial trainings are some of the strategies that may be adopted to spread the technology. He also suggests that the integration of biomass-fuelled gasifiers in coal-fired power stations would be advantageous in terms of improved flexibility in response to fluctuations in biomass availability and lower investment costs.

Vish. Kallimani, Anurag. Guduri, Mahesh. Reddy, Jyoti.Kallimani [7], describes that urbanization all over the world has created serious problems of solid waste disposal. Increased population causes increased food consumption which directly leads to increase in the solid waste resulting from the processing of food and post consumption. The waste food from various sources such as houses, public places etc, include various costs in transporting plus they add up a disastrous green house gas in long term, from the dump sites. If these resources are used properly, it can produce many useful things such as energy, compost and monetary benefits. They proposed an integrated system: Micro Power House (MPH) based on natural non-conventional energy resources such as kitchen waste, solar and water, clean energy concepts.

Zheng Zong-ming, Kang Peng, Liu Zhong-ming, Sun Yan, Liu De-hua[8] describes that biodiesel is a renewable alternative to fossil energy, which has shown great prospects for global proliferation in the past decade. The by-product glycerol accounts for about 10% w/w of biodiesel during the process of biodiesel production. In this process glycerol can be

fermented into 1,3-propanediol (1,3-PD), a high value added chemical with a promising future in the polymers, for example, polytrimethylene terephthalate. They proposed an integrated production of 1,3-PD with crude glycerol from biodiesel process could be a promising way to improve the profit of the whole process during biodiesel production.

Yusuf Chisti[9] describes that renewable biofuels are needed to displace petroleum derived transport fuels, which contribute to global warming and are of limited availability. Biodiesel and bio ethanol are the two potential renewable fuels that have attracted the most attention. As biodiesel and bio ethanol produced from agricultural crops using existing methods cannot sustainably replace fossil-based transport fuels, but there is an alternative. Biodiesel from microalgae seems to be the only renewable biofuels that has the potential to completely displace petroleum-derived transport fuels without adversely affecting supply of food and other crop products. Most productive oil crops, such as oil palm, do not come close to microalgae in being able to sustainably provide the necessary amounts of biodiesel.

III. PROBLEM FORMULATION

Biomass use is growing globally. Despite the advancements in biomass energy technologies, most bio energy consumption in India still remains confined to traditional uses. The modern technologies offer possibilities to convert biomass into synthetic gaseous or liquid fuels (like ethanol and methanol) and electricity. Lack of biomass energy market has been the primary barrier to the penetration of modern biomass technologies. Growing experience with modern biomass technologies in India suggests that technology push policies need to be substituted or augmented by market pull policies.

The problem with the traditional use of biomass is described as follows:

1. The traditional uses of biomass(ie burning wood, agricultural residues and dung) is inefficient and give rise to harmful indoor air pollutant and the energy delivered is often less convenient to use as compared to electricity, gas and kerosene.
2. Some of the bio power technologies do generate air emissions like SO2, NO and CO2. Another air quality concern associated with biomass plants is particulates. Till date, no biomass facilities have installed advanced particulate emission controls.
3. This is the problem which needs further research to improve the technologies.

A. Objectives of the proposed Work

The objective is to give a brief comparison between conventional and improved technologies for the production of bio diesel. The disadvantage of bio-oils presents many obstacles to the substitution of fossil, such as acidic, viscous, reactive, thermal instability and corrosiveness.

So, an upgrading process by improving these properties is required before its application. Upgrading of bio-oil include hydride oxygenation; catalytic cracking, steam reforming for hydrogen, emulsification, etherification. So the main objectives are

- To move from traditional biomass energy to modern biomass energy.
- To realize a stable energy alternative that will meet world demand while mitigating climate change and to develop renewable clean fuels.
- To create a cost competitive, environmentally friendly, and renewable source of liquid fuel.
- To address barriers in order to promote and upgrading of biomass power.

IV. PRESENT WORK

A. Bio Diesel Production

The world is entering a period of declining non-renewable energy resources, popularly known as 'Peak Oil', while energy demand is increasing. As supply dwindles and costs rise, nations will be forced to utilize alternative energy sources. In order to achieve a secure and stable energy supply that does not cause environmental damage, renewable energy sources must be explored and promising technologies should be developed. In recent years, use of microalgae as an alternative biodiesel feedstock has gained renewed interest from researchers, entrepreneurs, and the general public. Biodiesel derived from green algae biomass has the potential for high volume, cost effective production. It can be carbon neutral and produced intensively on relatively small areas of marginal land. The quality of the fuel product is comparable to petroleum diesel and can be incorporated with minimal change into the existing fuel infrastructure. Innovative techniques, including the use of industrial and domestic waste as fertilizer, could be applied to further increase biodiesel productivity. Currently, biodiesel is made from a variety of feed stocks, including pure vegetable oils, waste cooking oils, and animal fat and recycled greases. Global resources of vegetable oils and fats amount to some 62 million tons per year, which is small compared to the annual global diesel consumption of 3,300 million metric. These materials contain triglycerides, free fatty acids, and other contaminants depending on the degree of pre-treatment they have received prior to delivery. However, the limited supply of these feed stocks impedes the further expansion of biodiesel production. Fig. 2 gives annual biodiesel yield from different sources.

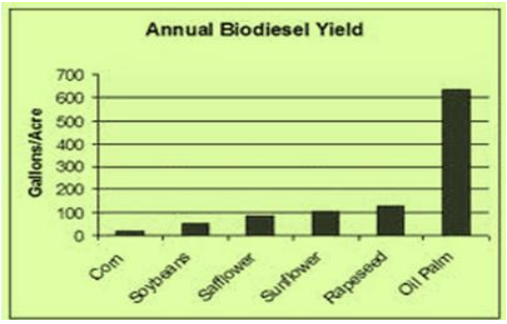

Fig. 2 Annual Biodiesel yield from different sources

Basically biodiesel as defined by the World Customs Organization (WCO) is "a mixture of mono-alkyl esters that are derived from organic oils, plant or animal, through the process of tranesterification as shown in Fig.3. The biodiesel transesterification reaction is very simple. There are several methods to extract oil from algae that includes mechanical systems, chemical, thermal, plasma and microwave techniques.

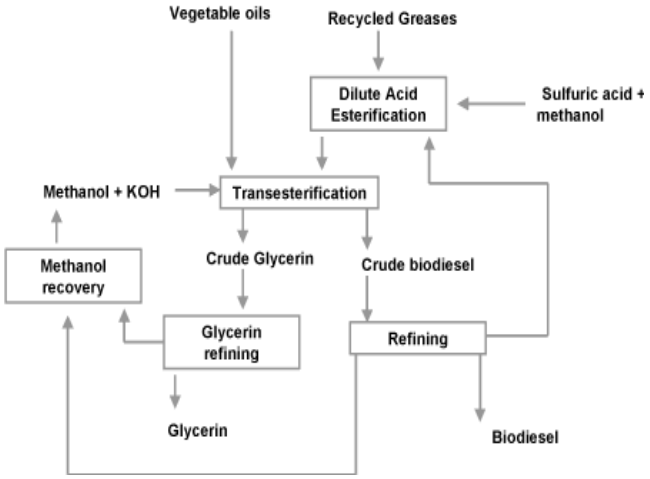

Fig. 3 Basic technology for bio diesel production.

Algal biomass is an interesting sustainable feedstock for biodiesel production. It can produce up to 30 times more oil per acre than other oil producing crops. Various methods are available for the extraction of algal oil, such as enzymatic extraction, chemical extraction through different organic solvents, mechanical extraction using hydraulic or screw, Ultrasonic extraction, and supercritical extraction using carbon dioxide above its standard temperature and pressure. The production of microalgal biodiesel requires large quantities of algal biomass. To minimize expense, the biomass must be produced using freely available sunlight and is thereby affected by fluctuations such as daily and seasonal variations in light levels. Microalgae can be grown on a large scale in photo bioreactors. Many different designs

of photo bioreactors have been developed, but a tubular photo bioreactor seems to be most satisfactory for producing algal biomass on the scale needed for biofuels production

V. RESULTS

A. Algae as a Bio energy Source

Algae are aquatic organisms that grow using light and carbon dioxide (CO2) to create biomass. There are two classifications of algae: microalgae and microalgae. Microalgae are the large multi-cellular algae often seen growing in ponds. On the other hand, Microalgae are tiny unicellular algae that normally grow in suspension within a body of water. In biodiesel production usually aquatic unicellular green algae are used. This type of algae is a photosynthetic eukaryote characterized by high growth rates and high population densities. Table 1 gives oil content of microalgae.

Microalgae	**Oil content (% dry weight)**
Crypthecodinium cohnii	20
Phaeodactylum tricornutum	20-30
Cylindrotheca sp.	16-37
Botryococcus braunii	25-75
Chlorella sp.	28-32
Nitzschia sp.	45-47
Tetraselmis suecia	15-23
Nannochloropsis sp.	31-68
Schizochytrium sp.	50-77

Table.1 Oil content of microalgae

B. Advantages of Biodiesel from Algae oil

Producing biodiesel from algae has been labelled as the most efficient method. The main advantages of deriving biodiesel from algae oil include: rapid growth rates, a high per-acre yield (7 to 31 times greater than the next best crop – palm oil). Certain species of algae can be harvested daily. Algae bio fuel contains no sulphur; it is non-toxic and highly bio-degradable.

Algae consume carbon dioxide as they grow, so they could be used to capture CO2 from power stations and other industrial plant that would otherwise go into the atmosphere. Due to the above advantages, it is called as the fuel for the future.

Algae can be used to generate energy in several ways. One of the most efficient ways is through utilization of the algal oils to produce biodiesel. It can also be explored for a variety of other uses, such as fertilizer, pollution control, and human nutrition. The production of biodiesel from microalgae is shown in Fig. 4.

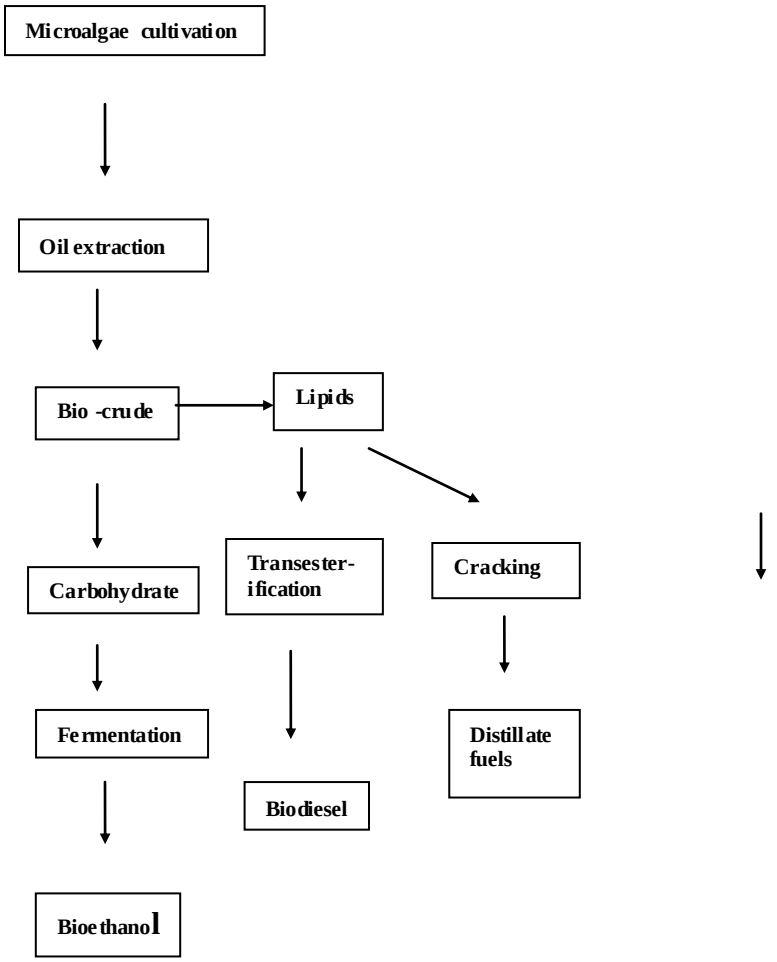

Fig. 4 Algal biodiesel production

Smoke (particulate material) and soot (unburned fuel and carbon residues) emitted by diesel engines are of increasing concern to urban air quality problems and are causing a wide range of adverse health effects for their citizens, especially in terms of respiratory impairment and related illnesses. The lack of heavy petroleum oil residues in the Biodiesel will have less smoke, and less soot produced from unburned fuel. Further, since the Biodiesel contains oxygen, there is an increased efficiency of combustion even for the petroleum fraction of the blend. The improved combustion efficiency lowers particulate material and unburned fuel emissions especially in older engines with direct fuel injection systems. State and federal

laws evolve over the next few years to accommodate the biodiesel as an approved alternative diesel fuel. More plants will be constructed for biodiesel processing in coastal areas of the country. Lower production costs will help lower the price of biodiesel and increase its use in vehicles.

- It is biodegradable and renewable in nature.
- It can be used alone or mixed with conventional diesel in a preferred ratio of mixtures ranges from 5% to 20%.
- It is cheaper than conventional diesel and has potential for rural employment generation. There has been greater awareness on biodiesel in India in the recent years and significant activities have picked up for its production to boost the rural economy.

VI. CONCLUSION AND FUTURE WORK

The proposed method of biodiesel production is gaining importance for its ability to replace fossil fuels and its environmental benefits makes biodiesel a renewable source of energy. Biodiesel has great potential; however, the high cost and limited supply of organic oils prevent it from becoming a competitor for petroleum fuels. As supplies grow and petroleum fuel costs rises, alternative fuels will become more attractive to both investors and consumers. For biodiesel to become the alternative fuel of choice, it requires an enormous quantity of cheap biomass. Using new and innovative techniques for cultivation, algae may allow biodiesel production to achieve the price and scale of production needed to compete with, or even replace, petroleum. The goal of biomass program is also to enable the production of biofuels nationwide and reduce dependence on oil through the creation of a new domestic bioenergy industry supporting the Energy Independence and Security Act (EISA) goal of 36 bgy of renewable transportation fuels by 2022.Many technical challenges remain and these include improvements in current

technology for producing high quality biodiesel, use of solvents that are no fossil-based, conversion of the by-products such as glycerol to useful products such as methanol and ethanol, and development of low cost photo bioreactors. Extensive efforts are underway to achieve commercial-scale production of microalgae biodiesel which is likely to be possible in near future.

REFRENCES

1. [Hanne Østergård, Risø National Laboratory, " Bioenergy and emerging biomass conversion technologies"
2. Joseph DiPardo, "Outlook for Biomass Ethanol Production and Demand".

3. Dr V Sivasubramanian, "Current status of Research on algal bio-fuels in India" *J. Algal Biomass Utln*. 2009, **1** (1): 1-8 © PHYCO SPECTRUM INC
4. Jinxing Peng ,Zhihua Fan, Guanyi Chen,"Thermochemical conversion technology on lignocellulosic biomass to liquid fuel : a critical review"
5. S. Laux, J. Grusha, "Co-firing of Biomass and Opportunity Fuels in Low NOx Burners".
6. Ansu Abraham, **"**Biopower: The Green Technology for Sustainable Development", 2009 International Conference on Computer Technology and Development.
7. Vish. Kallimani, Anurag. Guduri, Mahesh. Reddy, Jyoti.Kallimani, "Design and development of a compact high rate digester for rapid bio-methanation from a kitchen waste for Energy generation" IEEE ICSET 2010.
8. Zheng Zong-ming, Kang Peng, Liu Zhong-ming, Sun Yan, Liu De-hua, **"**Bioflocculant Synthesized by Klebsiella pneumoniae during 1,3-Propanediol and Bio-diesel Integration Process."
9. Yusuf Chisti, "Biodiesel from microalgae beats bioethanol"