

BIOENERGY AS AN EXCELLENT CHOICE OF RENEWABLE ENERGY

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Abstract: Environmental pollution and global warming associated with the use of fossil fuels has forced the search for alternative fuels, the Biomass is considered the renewable energy source with the highest potential to contribute to the energy needs of modern society for both the industrialized and developing countries worldwide. The most important biomass energy sources are wood and wood wastes, agricultural crops and their waste byproducts, municipal solid waste, animal wastes, waste from food processing, and aquatic plants and algae. Currently, much research has been focused on sustainable and environmental friendly energy from biomass to replace conventional fossil fuels. Biomass yield and its potential differs between countries, however, many technologies have been studied in recent years for their possible use with biomass, such as combustion, pyrolysis, gasification and liquefaction. The objective of this research is determinate the potential and the uses of biomass energy and their contribution to the sustainable energetic development throughout the world.

Keywords: Bioenergy • Renewable energy • Sustainability.

Introduction: The environmental pollution and global warming associated with the use of fossil fuels, has forced a search for alternative fuels. Renewable energy is energy generated from natural resources such as water, sunlight, wind, rain, tides, geothermal and biomass sources. Renewable energy sources are continually and naturally replenished in a short period of time. Solar cells, wind turbines, biofuels and emerging technologies are poised to become major energy sources throughout the world. Renewable energy has an important role in the industry, business and, households as providing modern energy access to the billions of people in developing countries that continue to depend on more traditional sources of energy. Worldwide there is a growing interest in the use of solid, liquid and gaseous biofuels for energy purposes. There are various reasons for this, such as: i) political benefits (for instance, the reduction of the dependency on imported oil); ii) employment creation (biomass fuel create up to 20 times more employment than coal, gas and oil; and iii) environmental benefits such as mitigation of greenhouse gas emissions, reduction of acid rain and soil improvements (van Loo and Koppejan, 2008).

Biomass is a term for all organic material that stems from plants (including algae, trees and crops). Biomass is produced by green plants converting sunlight into plant material through photosynthesis and includes all land- and water-based vegetation, as well as all organic wastes. The biomass resource can be considered as organic matter, in which the energy of sunlight is stored in chemical bonds. When the bonds between adjacent carbon, hydrogen and oxygen molecules are broken by digestion, combustion, or decomposition, these substances release their stored chemical energy. Biomass has always been a major source of energy for mankind and is presently estimated to contribute of the order 10–14% of the world's energy supply (McKendry 2002).The objective of this research is determinate the potential and the uses of

biomass energy and their contribution to the sustainable energetic development throughout the world.

Materials and Methods: Some papers were studied to determinate the trade-offs between different source of bioenergy and its environmental impacts. Energy source, technology, water footprint and gas emissions were considered. All the reported data about biomass generation or about greenhouse gas emissions were obtained from greenhouse experiments. The details of the experimental design and the methods used to characterize the soil and biomass can be found in the next papers: Fernández-Luqueno et al. (2009), Fernández-Luqueno et al. (2010), Mendez-Bautista et al., (2010), and Juarez-Rodriguez et al., (2012). The amounts of wastewater or sludge added to soil varied although they were according to traditional fertilization rates.

Results and Discussions: Anaerobic digestion, also called methane fermentation, offers practical solutions for the treatment of high-strength organic wastes such as sewage sludge (Appels et al., 2008), municipal solid waste (Ismail and Abderrezaq, 2007) livestock wastewater (Cantrell et al., 2008), food waste (Kim et al., 2007) and dedicated energy crops (Amon et al., 2007). It is well known that carbohydrates, lipids and proteins are among the main components of biodegradable matter. Of these, carbohydrates are known to be easily and rapidly converted via hydrolysis to simple sugars, and subsequently fermented to volatile fatty acids (VFAs) (Miron et al., 2000).

Additionally, second generation microalgal systems have the advantage that they can produce a wide range of feedstocks for the production of biodiesel, bioethanol, biomethane and biohydrogen. Algae are an extremely diverse group of organisms, and it is not surprising that different species of algae produce different compounds that could be used as alternative fuel feedstock. Five commonly studied algal components or products useful for alternative fuels are: lipids for petroleum fuel substitutes, carbohydrates for ethanol, hydrogen, methane via biomass gasification, and biomass for direct combustion, anaerobic digestion, or thermochemical conversion.

Biodiesel is a renewable energy produced from algae, seeds or legumes. Assessments of the uptake of biofuels range between 20% and 25% of global transport road fuels by 2050 (Francisco et al., 2009). Biodiesel is currently produced from oil synthesized by conventional fuel crops that harvest the sun's energy and store it as chemical energy. This presents a route for renewable and carbon-neutral fuel production. However, current supplies from oil crops and animal fats account for only approximately 0.3% of the current demand for transport fuels. Increasing biofuel production on arable land could have severe consequences for global food supply. In contrast, producing biodiesel from algae is widely regarded as one of the most efficient ways of generating biofuels and also appears to represent the only current renewable source of oil that could meet the global demand for transport fuels. The main advantages of second generation microalgal systems are that they: (1) have a higher photon conversion efficiency (as evidenced by increased biomass yields per hectare); (2) can be harvested batch-wise nearly all-year-round, providing a reliable and continuous supply of oil; (3) are able to utilize salt and waste water streams, thereby greatly reducing freshwater use; (4) can couple CO₂-neutral fuel production with CO₂ sequestration; (5) Produce non-toxic and highly biodegradable biofuels. However, current limitations exist mainly in the harvesting process and in the supply of CO₂ for high efficiency production (Schenk et al., 2008). Recent awareness of CO₂ emissions has resulted in a shift from less environmental friendly fossil fuels to renewable and sustainable energy alternatives (Gil et al., 2010). Among these, biomass is considered to be one of the few viable replacement options (Munir et al., 2009). Biomass can be grown in a sustainable way through a cyclical process of fixation and release of CO₂, there by mitigating global warming problems (McKendry, 2002). Biomass fixes CO₂ in the form of lignocellulosics during

photosynthesis and the CO₂ emitted from the combustion of these materials makes no net contribution to the accumulation of CO₂ in the atmosphere or to the greenhouse effect.

World production of biomass is estimated at 146 billion metric tons a year, mostly wild plant growth. Some farm crops and trees can produce up to 20 metric tons per acre of biomass a year. Types of algae and grasses may produce 50 metric tons per year (Demirbas, 2001). The conversion of biomass into energy can be achieved in a number of ways. To provide a fuel suitable for direct use in spark ignition gas engines, the fuel must be provided in either a gaseous, or a liquid form. Production of a gaseous fuel from biomass can be achieved by the application of a number of technologies, each with its specific requirements, advantages and disadvantages.

In general, the characteristics of the ideal energy crop are: a) high yield (maximum production of dry matter per hectare), b) low energy input to produce, c) low cost, d) composition with the least contaminants, e) low nutrient requirements. Desired characteristics will also depend on local climate and soil conditions. Water consumption can be a major constraint in many areas of the world and makes the drought resistance of the crop an important factor. Other important characteristics are pest resistance and fertilizer requirements.

Some 1.5 billion people worldwide still lack access to electricity, and approximately 2.6 billion are reliant on wood, straw, charcoal, or dung for cooking their daily meals (REN21, 2010), which shows that a cheap, friendly environmental source energy is necessary. Social and economic development production of renewable energy, particularly biomass, can provide economic development and employment opportunities, especially in rural areas, that otherwise have limited opportunities for economic growth. At this time there are many renewable energy technologies which supplies energy from sun, wind, water, waves, subsoil, microorganisms, plants, manure, sludge, domestic organic wastes, etc., biofuels is a wide area which produces energy such as power, biogas, biodiesel and, bioethanol. However, biofuels will be a viable alternative only if they provide a net energy gain, have environmental benefits, be economically competitive, and be producible in large quantities without reducing food supplies (Hill et al., 2006).

Fossil fuels provide 85% of the US energy requirements, a figure that is similar in most countries. Energy demands are increasing with population growth and economic development. This situation is not sustainable for several reasons; oil reserves are limited, and the increasing use of oil and coal leads to ever increasing CO₂ emissions, which carry the risk of climate change (Schelleret al., 2010). The use of fossil fuels is now widely accepted as unsustainable due to depleting resources and the accumulation of greenhouse gases in the environment that have already exceeded the “dangerously high” threshold of 450 ppm CO₂-e. To achieve environmental and economic sustainability, fuel production processes are required that are not only renewable, but also capable of sequestering atmospheric CO₂ so that biofuels are rapidly being developed.

Biomass encompasses among others, vegetation, energy crops, as well as biosolids, animal, forestry and agricultural residues, the organic fraction of municipal waste and certain types of industrial wastes. Its appeal is due to its potential worldwide availability, its conversion efficiency and its ability to be produced and consumed on a CO₂-neutral basis (Cebucean et al., 2010). Such as waste-to-energy plants offer both generation of clean electric power and environmentally safe waste management and disposal (Iakovou et al., 2010).

Many research efforts document the current and potential role of biomass in the future global energy supply (e.g. Parikka, 2004; Yamamoto et al., 2001). Theoretically, the total bio-energy contribution (combined in descending order of theoretical potential by agricultural, forest, animal residues and organic wastes) could be as high as 1100 EJ, exceeding the current global energy use of 410 EJ (Hoogwijk et al., 2003). (Berndes et al. 2003) further reinforce this potential of biomass in the future global energy supply by analyzing and synthesizing earlier studies on the subject. However, a careful analysis of all the related literature reveals that there

is no consensus regarding the biomass potential among the researchers, but rather their assessments differ strongly. One of the most critical bottlenecks in increased biomass utilization for energy production is the cost of its logistics operations.

Conclusions: It is evident from the study that biomass can only replace conventional energy to some extent due to economic, social and other constraints, this is true for developed countries due to their huge energy demand compared with what biofuel options are able to supply as well as for developing countries due to the low yield of their agriculture and competition for land and water for food production. However, biomass may contribute to optimizing the energy and resource balance of agricultural, livestock, or industrial production systems at an appropriate scale. The beneficial effect of regenerating energies not only regarding the environment protection, but also in economical and social domain, thus biomass could be recommended as a good renewable-energy source throughout the world.

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