A comparison of renewable energy options for Florida

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The environmental benefits of renewable energy have always been mentioned as a major advantage, however, the deciding factor will be the unit cost of producing renewable energy. The unit cost of renewable energy must compete with the cost of energy from other sources before renewable energy can be developed further. Renewable energy should be practical to produce and economical to use. Solar, wind, water (in form of hydro energy), biomass crops, and municipal solid wastes are the main options for renewable energy. Geographical, and climatic conditions are important factors in determining the type of renewable energy for each area. In Florida, biomass crops are a potential source of renewable energy that can be economically developed. Because of climate and topography solar energy is the only other source of renewable energy that is available in Florida. However, domestic low temperature solar water heaters, a simple type of solar energy usage, is not widely used due to its limitations. A solar water heating pilot program in central Florida compared its costs only to the electric water heater. However, comparing the cost to a gas water heater would yield more questionable results[1]. Data on annual average daily direct normal solar radiation for the United States shows Florida with 14 MJ/m^2 compared with up to 28 MJ/m^2 for other areas [2]. The cost of photovoltic system that converts solar energy to electricity is still high and ranges $6 to $8 per watt [3].

There are three major factors contributing towards development of a biomass energy system: land availability, suitable crops, and favorable climatic conditions. Availability of low opportunity cost land that can produce high yield biomass crops is a necessity for establishing an economically competitive biomass energy system. A viable renewable energy system depends on the consistency of feedstocks delivery to conversion facilities throughout the year. Energy conversion facilities using biomass cannot rely only on one single crop that can be harvested and made available only within a narrow harvesting season. A number of suitable biomass crops, that can be grown and harvested throughout the year and provide a consistent flow of feedstocks for most of the year are the major elements in a successful biomass-to-energy system. Favorable climatic conditions such as a long growing season and high rainfall during the growing season can produce higher yielding biomass crops. Results of various studies have shown that in Florida biomass crops have the advantage in all three major factors required for establishing a successful bioenergy system [3].

Land availability and favorable climatic conditions

Suitable land, with low opportunity cost, is one of the most important factor for developing biomass crops. Results of numerous studies in Florida have shown that there are considerable suitable sites that can be used to grow biomass crops. A Geographic Information System was used to study land availability for biomass production in Florida. Results show that there are more than 70 thousand parcels of forest, agricultural, reclaimed, or industrial land with a total area of 2.5 million ha (6.17 million acres) in peninsular Florida. Land-use and land cover classification show these parcels as being used as crop and pasture land, natural or developed forest, reclaimed land, power plants, waste treatment facilities, food processing, other processing facilities, and transportation terminals. The crop and pasture land-use type with an area of 877 thousand hectares has the highest potential biomass production, over five million Mg per year. Potential biomass production for all types of land-use in peninsular Florida exceeds 13 million Mg per year [3]. Florida's favorable climatic conditions which include yearly rainfall of 45 to

80 inches (various parts) and 280 to 365 frost free days per year serve toward higher yields and longer growing season.

Suitable Crops

Florida's weather conditions are favorable for many types of crops for biomass feedstocks. However, there are certain crops that have higher yields and no environmental problems. Results of numerous studies over the past 20 years have shown that elephantgrass, sugarcane, *Leucaena*, various *Eucalyptus* species, and slash pine have higher yields than other biomass crops in the area. Elephantgrass has been considered for production of ethanol as well as electricity. Yield estimates for biomass crops are based on results of growing these crops in test plots in Florida. Sugarcane is the highest yielding biomass crop in the State with yields ranging from 30 to 49 dry Mg/ha/year (14-22 ton/A/yr) on different soil types. Elephantgrass, *Leucaena*, various *Eucalyptus* species, and slash pine are estimated to yield from 20 to 40 dry Mg/ha/yr (9-18 ton/A/yr) on various soil types. Based on a four year crop rotation period *Eucalyptus* yield is estimated at 29 to 40 dry Mg/ha/yr (13-18 ton/A). Pine yield, based on an eight year crop rotation period, was estimated at an average of 21 dry Mg/ha/year (9 ton/A)[4]. An important operational advantage of biomass crops in Florida is the wider harvesting window, extending up to 11 months in some cases. This helps to reduce the need for storage, allows efficient use of processing capital, and reduces total cost of biomass feedstock.

Energy producing capacity of biomass crops

Ethanol and electric power are the final products of a biomass energy system. Based on analysis performed one dry Mg of sugarcane can produce up to 486 L (117 gal/ton) of ethanol. Elephantgrass, *Leucaena*, and *Eucalyptus* can produce 421 L (101 gal), 417 L (100 gal/ton), and 442 L (106 gal/ton) of ethanol, respectively, per dry Mg [5]. For the production of electricity, laboratory analysis of sugarcane presscake, elephantgrass, *Leucaena*, and *Eucalyptus* indicated the energy value ranged from 17.8 to 19.3 MJ per dry Mg (7660 to 8300 Btu/dry lb). Cost of producing fuel grade ethanol, including sugarcane production, harvesting, transportation, and processing, are estimated at $0.25 per liter ($0.93/gal), and the cost of producing electricity from various biomass crops in central Florida range from $0.068 to $0.08 per kWh[6].

Conclusion

Options for renewable energy in Florida include biomass and solar energy. At the preset time there are limitations to using solar energy. Low temperature solar water heating systems may be cost competitive only under certain circumstances. Solar hot water is not suitable and economical for every house, thus it is not widely used. Initial capital cost of a solar electric system (photovoltic system) is still high ($30,000 to $40,000 for a 5 kilowatt sytem[3]). Considering climatic advantages in Florida, biomass production and conversion to fuel grade ethanol and electricity would be a more economical option.

References

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