

Markets for Short Rotation Crops: the American experience

Jake Eaton

Plant Materials Manager
Potlatch Corporation Hybrid Poplar Program, Boardman, OR USA

1. ABSTRACT

The United States has been slow to promote the use of short rotation crops for bioenergy. While the corn derived ethanol market has been subsidized to promote its production and the soybean derived biodiesel market is showing signs of acceptance, short rotation crops have not gained a foothold in the US energy market.

The benefits of bioenergy fuels over fossil fuels are well documented. Bioenergy fuels can diversify the energy portfolio of the US, provide greater energy security, and at the same time benefit the environment.

Funding to research production systems and conversion technologies needs to be at a higher level. Tax credits and other forms of subsidies to promote a bioenergy industry are needed. Further, a federal mandate to increase the renewable energy portfolio of the US is lacking. Research on switchgrass, willow, and poplar energy crop technology continues and a few pilot projects have been initiated. However, until these technologies become more competitive with fossil fuel energy generation, their future is uncertain.

2. INTRODUCTION

After the energy crisis of the 1970's it seemed that the United States was poised to create a bio-based energy industry. However, once the high energy costs subsided and long-term petroleum supplies were secured interest in bioenergy waned and little movement occurred during the 1980's.

The benefits of bioenergy are the same now as they were in the 1970's. Bioenergy would spur economic development in agriculture, at a time when farm commodity prices are low and many farmers are going out of business. It would provide energy supply options and enhance the energy security of the US. Ultimately, bioenergy would benefit the environment by decreasing the release of greenhouse gasses and other toxic pollutants to the atmosphere.

3. RECENT HISTORY

Since 1992 several federal legislative initiatives have helped revive the bioenergy industry in the US. The change to a democratic administration in 1992 helped foster this revival. The Energy Policy Act of 1992 supported research in bio-based fuels and power systems. The Biomass Research and Development Act of 2000 contained a funding mandate for bio-based fuels research. In 2002 the US Department of Energy (DOE) created the Office of the Biomass Program (OBP) to develop technologies needed to drive the growth of a new bio-industry. The primary focus of the OBP is to address barriers to the creation of a bio-based industry in the US.

The barriers are numerous and range from the basics of biomass production to technologies of how to convert it efficiently. Currently, there are information gaps in how to logistically supply biomass feedstock. The issues of biomass supply, storage, transportation, and physical and chemical composition have to be analyzed. Major technological advances need to occur in the areas of biomass conversion efficiency. Ultimately, a new biomass industry will have to be created. The implementation of this technology will depend on how well technological and financial risks are evaluated. Such issues as high capital costs and new and unproven technologies raise the risks of bio-based energy development.

In spite of these barriers the OBP has set three biomass delivery goals for the year 2020:

1. 10% of all transportation fuels.
2. 5% of all industrial and utility power.
3. 18% of all chemicals.

President George Bush also has recently come forth with a goal calling for an 18% reduction in greenhouse gas (GHG) intensity by 2012. GHG intensity is defined as the ratio of GHG emissions to dollars of gross national product (GNP). This voluntary program will slow the increase of GHG emissions in the US, but not reduce them from current levels.

4. BIOENERGY CROPS IN THE UNITED STATES

Bioenergy crops in the US include corn derived ethanol, soybean and canola derived biodiesel, switchgrass that is being considered for co-firing technologies, and woody crops like poplar and willow that can be burned to produce energy. Ethanol is by far the largest bioenergy product in the USA.

The most recent characterization of the biomass industry in the USA was done in 1999. At that time the US had half of the worlds installed capacity, generating 7800 mega-watts (MW) of electricity in 350 plants. This amounted to just 1% of the total USA energy generation in 1999.

The benefits of bioenergy crops over petroleum-based fuels are primarily a reduction in sulfur, carbon monoxide, and carbon dioxide emissions. Table One illustrates the comparison of emissions from wood, switchgrass, and coal feedstock.

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Table 1. Feedstock Emission Comparison

	Sawdust	Switchgrass	Subbituminous coal	Bituminous Coal
% Carbon	32	40	51	66
% Sulfur	.01	.16	.35	2.79
BTU/Pound	5400	6600	8900	11700
% Nitrogen	.26	.65	.68	1.4

Table 1 shows that bio-based feedstock compares favorably with traditional energy feedstock. Even though coal produces more BTU's per unit of feedstock, the amount of sulfur and nitrogen compounds produced per BTU are less with the non-fossil fuel feedstock. The majority of the coal burned in the USA is bituminous.

4.1 Ethanol

Ethanol is primarily used in blending with gasoline. One bushel of corn can produce 2.5 US gallons of ethanol (7 liters/27 kg). The US has 60 ethanol production plants in operation or under construction with a capacity of 2 billion US gallons per year. A 50% increase in capacity is planned, from which one-third will come from non-grain feedstock. These will utilize agricultural and forest residues and switchgrass.

4.2 Biodiesel

Biodiesel production in the US is currently 50 million US gallons per year and growing. Biodiesel is also blended with commercial fuels or burned in modified engines. The primary agricultural crop for converting to biodiesel is soybean. One bushel of soybean produces 1.5 US gallons of biodiesel (5.7 liters/27 kg). Some states are proposing mandates to use biodiesel. It is hoped that the market in the US could grow to 2 billion US gallons per year.

4.3 Switchgrass

Crops like switchgrass, willow, and poplar can be co-fired with coal or natural gas. Switch grass is a tall perennial grass that can yield as much as 5-9 tons/acre annually and only requires replanting every 10 years. One ton of switchgrass can produce the same amount of energy as 100 US gallons of ethanol. Promotion of switchgrass as an energy crop has increased over the last 5 years, with the US DOE taking the lead in research and development. It has several benefits when compared to annual energy crops. Switchgrass is better at protecting the soil, stores more carbon dioxide in the roots and soil, and requires much less energy to produce.

The potential of switchgrass in the US can be illustrated by three projects that intend to use it in co-firing. Southern Company is researching the use of switchgrass at facilities in Gladsden, AL and Albany, GA. The projects are designed to produce 10% of the energy from burning switchgrass. The grass is pressed into cubes before going into the burner. A third project is underway in Iowa where Alliant Energy is projecting to use 200,000 US tons of switchgrass per year, producing 35MW of electricity from the crop.

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Switchgrass production technologies and its conversion efficiency in co-firing systems are being refined. The number one question regarding the future of this crop for use in bioenergy remains its economic viability.

4.4 Willow and Poplar

The current markets for the use of woody biomass are still being explored and created. Aside from the wood products industry in the US that has used woody residues for several years to generate electricity, woody energy crops have not seen a large market demand. Technologies for growing willow and poplar are well advanced and the potential of bioenergy from woody biomass is great, but the economics of production and conversion are not competitive with fossil fuels.

One example of a willow bioenergy project is based in New York. A willow research program supported by the US DOE has been going on for several years at State University of New York (SUNY). The current status of the project is to initially use willow to produce 10 MW of electricity by co-firing with coal. This output could be doubled once the willow feedstock is available.

The use of poplar as a designated energy crop is nonexistent at this time, however one project in Minnesota has been proposed. Large hybrid poplar growers in the western US routinely send some of their residual material to generating facilities to be burned in boilers for electricity production. This is not a profitable market, but it avoids disposal costs.

NGPP Minnesota Biomass has proposed the project in Minnesota. It calls for using 40,000 tons of wood and agricultural biomass per month to produce 38.5 MW of electricity. Approximately half of the feedstock will come from a designated hybrid poplar energy crop. The impetus for this project is a MN state mandate for using and promoting bioenergy. The mandate provides subsidies for the use of biofuels. MN currently has 466 MW of electricity that is biofueled and is one of the largest ethanol producing states in the USA.

5. CONCLUSION

Several issues need to be resolved to promote the use of bioenergy in the USA. Research and technology development on energy crop production systems and conversion efficiency must continue and be supported at a higher level. This will lead to demonstration projects and future adoption of this technology. Tax credits to promote the production of bioenergy crops need to be enacted at the federal level. The renewable fuels standard needs to be increased and a mandate to produce energy from biomass crops needs to be enacted. In addition, biomass energy projects could receive accelerated depreciation and investment tax credits to make the financial returns more favorable.

Movement on these issues in the near future is not promising. The current administration is not supportive of non-petroleum based energy. This mindset was recently expressed in the current version of the Energy Bill moving through the USA congress. A proposal to mandate

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electric utilities to make at least 10% of their power from renewable sources was left out of the draft 2003 Energy Bill.

6. REFERENCES

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