Research to Advance Grass Bioenergy

Purpose: The purpose of this publication is to briefly describe research progress to-date and assess future research needs to advance the grass bioenergy industry.

Current Status

Grass pellet bioenergy has the potential to be an economically and environmentally acceptable option for generating some local energy in rural America. A grass pellet system is particularly appropriate in the Northeastern USA. This system lacks a political lobby for start up support.

From a crop management standpoint, high yields of grass are possible, but combustion quality will never be able to match that of wood products. Overwintered switchgrass has produced a feedstock below 3% ash content. In-field leaching of cut reed canarygrass produced grass pellets at 2.8% ash content. Most clean wood products will have an ash content below 1%.

This reed canarygrass field produced feedstock at 2.8% ash content in 2005.

The primary difficultly in jump-starting this new industry is that both a pellet supply and a pellet demand need to be developed simultaneously. Without government support it will be difficult get a grass pellet industry established.

Future Research Needs

Although a grass bioenergy pellet system is technically feasible, there are a number of potential enhancements to the system that should be investigated.

1. Modifications to appliances to facilitate utilization of high ash feedstocks.
Europe has boilers capable of burning grass biomass, few are available in North America. There is practically no interest from companies in modifying pellet stoves to deal with grasses. A few pellet stoves are capable of burning grass. The proliferation of stoves designed to burn corn grain coincidentally resulted in a few stoves that can also burn grass pellets. The high price of corn grain has severely impacted the availability of corn grain for combustion.

Research is needed to minimize the corrosion potential of grasses relatively high in K, Cl and S content. Pellet stoves could be designed specifically to deal with grass. Some pellet boilers in Europe are capable of burning grass, providing central hot water heat. Such boilers can not only have an automated pellet feed from a storage bin, but can also have automated ash removal. Boilers that use chopped hay bales are available, as well as whole bale burners.

On a light industrial scale, boilers and combined heat-power (CHP) units could also use grass, although they would almost certainly require modifications. There has been limited testing of grass in CHP units, such as Community Power Corporation's BioMax gasifier. One of the advantages of these larger scale units is that they provide a significant market for pellets. Modification of larger scale units to effectively deal with grass would have a major impact on the acceptance and expansion of a grass pellet industry.

2. Optimize crop management.
The most significant and rapid advances can be made through management research. The primary drawback of grass biomass is the composition relative to combustion.

Management of grass can potentially result in an ash content from less than 3% (for overwintered switchgrass) to over 20% (for hay with soil contaminaton). We know that delayed harvest, either overwintering standing grass or delayed baling of cut grass, can significantly reduce both ash and the primary elements that interfere with the combustion process (K and Cl). Research to understand grass species-soil type-water uptake interactions will optimize grass management (minimize ash and maximize yield).

A small scale gasifier.

3. Identify optimum size and placement strategies for grass pelleting facilities.
Grass pelleting operations could be relatively small (4-6,000 tons/year), medium (8-12,000 tons/year), to large (100,000 tons+/year). Assuming 3 ton/acre grass yields, these facilities would require grass from approximately 1,500, 3,000, or 30,000+ acres. A circle with a 2 mile radius from the processing plant would hold approximately 8,000 acres or roughly 4,000 crop acres. The size of a pelleting plant in relation to the avalable feedstock is a critical relationship. Mobile pelleting units are also available that have the potential to dramatically impact this relationship.

4. Economic evaluation of the grass pellet bioenergy system.
Initial grass pellet bioenergy economic analyses from Ontario suggest that grass could be competitive with most commonly used fuels for heating. This is assuming no government subsidies and no value for the environmentally beneficial effects of this system. The European wood pellet industry expanded very rapidly, but was assisted by government support and support from conventional energy companies. A thorough economic analysis of the system is needed, as well as a method for valuing the environmental benefits of the system.

5. Grass breeding and biotechnology.
A minimum of grass breeding for biomass has been carried out to-date. The greatest impact from breeding would be increased yield. Breeding for improved combustion quality should be attempted, however, benefits would happen over a long time span and major benefits would be unlikely. Genomics work also could be attempted, but massive acreage might be required for return on investment. Improvements could come at the expense of species diversity. Movement to a grass monoculture on a large scale, as is the case with several row crops, has distinct disadvantages, with pesticide use likely.

6. Development of an economical celluose-to-ethanol conversion process.
Processes for conversion of cellulose to ethanol have been in the developmental stages for several decades. The very significant resources dedicated to this conversion process should continue to be allocated, as an economical process will eventually provide an alternative energy use for grasses.

Conclusions

At this point in time, the single most limiting factor to the development of a grass bioenergy industry is the lack of incentives for industry to develop combustion units appropriate for grass. Additional crop management research and economic evaluations would also positively impact the adoption and expansion of a grass pellet bioenergy system.

For more information

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