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 appears to be an economically and environmentally appropriate system for generating some local energy in rural America. A grass pellet system should work particularly well in the Northeastern USA. This system lacks a political lobby for start up support and will likely be slow in developing.

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 in 2005 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.](image)

At this time there are almost no pelleting facilities in the country set up to deal with grasses. The primary difficulty in jump-starting this new industry is that both a pellet supply and a pellet demand need to be developed simultaneously.

**Future Research Needs**

Although a grass bioenergy pellet system is technically prepared to go on-line immediately, 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, none are available in North America. There is practically no interest from companies in modifying pellet stoves to deal with grasses. One notable exception is the Harman Stove Company, which is evaluating some modifications to facilitate handling of high ash feedstocks. A few pellet stoves are capable of burning grass, thanks to corn grain. The proliferation of stoves designed to burn corn grain has coincidentally resulted in a few stoves that can also burn grass pellets.

   There are a variety of devices that could burn grass biomass with minor modifications. 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. A boiler that uses chopped hay bales is available.

   On a light industrial scale, boilers and combined heat-power (CHP) units could also use grass, with minor 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 contamination). 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).

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 available feedstock is a critical relationship. Mobile pelleting units are also available that would dramatically impact this relationship.

4. Economic evaluation of the grass pellet bioenergy system.
Initial grass pellet bioenergy economic analyses from Ontario suggest that grass is 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 would 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.