PROJECT UPDATE

NYSERDA Grass Combustion Research Program

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PRINCIPAL RESEARCHERS

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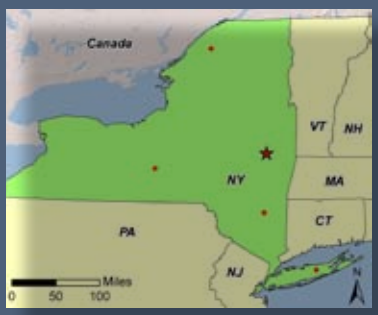
PROJECT LOCATION



Ithaca, NY (Cornell); Canton, NY (SUNY Canton); Highland, NY (LH-LI RC&DC); and Upton, NY (BNL)

CONTACT INFORMATION

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http://www.nyserda.org/Programs/Research_Development/biomass.asp

KEYWORDS

- Biomass
- Emissions
- PM 2.5
- Grass
- Boiler
- Efficiency

PROJECT FOCUS

Researchers at the State University of New York at Canton and Cornell University will investigate energy, emissions, and operational performance of grass combustion in various wood and biomass heating equipment, including residential and small commercial-scale stoves and boilers. Single- and two-stage (gasification) equipment using various types and blends of grasses will be analyzed. Emissions that will be measured are CO (carbon monoxide), unburned hydrocarbons, SOx (sulfur oxides), NOx (nitrogen oxides), and PM2.5 (particulate matter less than 2.5 microns). The projects will involve both laboratory testing and field demonstrations and the best performing equipment will be sent to BNL (Brookhaven National Laboratory) for extended testing.

Researchers at the LH-LI RC&DC (Lower Hudson Long Island Resource Conservation and Development Council) have developed a mobile grass pelletizer intended to go from farm-to-farm to pelletize grasses that have been grown. Under their current project they will seek to optimize the performance of the pelletizer.

CONTEXT

With the recent increase in oil prices and greater attention being paid to green practices, more and more people are turning to alternative energy sources such as grasses for heating. Grasses carry several advantages over other biomass feedstocks:

- Several types such as reed canarygrass, switchgrass, golden rod, foxtail and timothy can be grown in New York State (NYS)
- Can be grown on marginal farmland that would otherwise not be used and there are about 1.5 million acres of unused or underutilized agricultural land in NYS
- Perennial grasses minimize soil erosion and help solve nutrient management problems on livestock farms
- Estimated yield of 3 tons/acre (can be as high as 6 tons or as low as 0.5 tons)
- Energy content similar to wood pellets
- Minimal maintenance required to grow
- Necessary equipment is currently available on most farms
- Rapidly renewable with the potential of multiple harvests per year
- Local resource that supports a local economic model

Moblie Grass Pellitizer
Photo Credit: Joe Heller (LH-LI RC&DC)

Pellets made by the Mobile Grass Pellitizer
Photo Credit: Joe Heller (LH-LI RC&DC)

Bailing of Reed Canary Grass
Photo Credit: Jerry Cherney, Cornell

Mowing Mixed Grass Hay
Photo Credit: Jerry Cherney, Cornell

Bailing Mixed Grass Hay
Photo Credit: Jerry Cherney, Cornell

Since 1975, the New York State Energy Research and Development Authority (NYSERDA) has developed and implemented innovative products and processes to enhance the State's energy efficiency, economic growth, and environmental protection.

However, there are still some research issues that have to be resolved before widespread combustion of grasses is adopted:

- High ash content: Grasses can have an ash content as high as 10+%, whereas premium wood pellets have less than 1%. The ash found in grasses has a lower melting point than that in wood and combusting such pellets in typical wood burning appliances can lead to the formation of large clinkers (melted chunk of ash) and severe ash buildup on the combustion chamber walls leading to a significant decrease in performance. Also, ash can be a significant component of PM2.5 emissions which carry serious cardiopulmonary risks.
- Chlorine content: Grasses tend to have a relatively high chlorine content. During combustion involving chlorine there is the potential for the formation of hydrochloric acid and other chlorinated compounds. The hydrochloric acid leads to corrosion issues, while other compounds may increase toxic emissions.

These issues may be addressed through soil management techniques as well as eliminating or minimizing the use of fertilizers, particularly those containing chlorine. The ash content can be reduced by over wintering the crops or letting them sit in the field for some time after cutting but before harvesting to allow a significant fraction of the ash and chlorine to leech out. However, there is concern that extended leeching will lead to serious deterioration of quality or complete loss of the crop. It has also been noticed that different parts of the plant tend to have a higher ash content, so it may be possible to discard those parts before processing into a fuel. Another approach from the heating equipment side is to use corrosion-resistant materials, an ash management system which continuously breaks up clinkers and removes the ash, and an advanced 2-stage combustion design which promotes the bonding of any chlorine with the ash, thereby reducing both chlorinated and PM2.5 emissions. Several countries in Europe are successfully utilizing grass and straw residues for bioheat, although it is often combusted in very large systems which are robust enough to handle industrial grade fuels.

Clinker formation from grass combustion
Photo Credit: BIOENERGY 2020+

Corrosion due to combustion involving chlorine
Photo Credit: BIOENERGY 2020+

PROJECT IMPLICATIONS

These projects will evaluate grass combustion in biomass burning equipment and analyze any emissions, energy, and operational performance issues which will help to identify primary research and development (R&D) goals. This is an early step in the process of bringing a fuel with so much potential into the marketplace. However, to adequately address the environmental aspects, it is imperative that the grasses are burned in a highly efficient, low emissions manner. This will require a multiple-prong approach involving further R&D in all aspects from farming, to pelletizing, to the heating equipment.