Overview

Biomass from mixtures of native perennial grassland plants can be harvested annually as a source for bioenergy production—**a new source of potential income for rural Minnesota**. Native perennial grasses, forbs, and legumes grown together in grasslands can be produced on underutilized farmland, land that is not suitable or economical to grow commodity crops. **Biomass harvested from these plants can serve as a source of revenue for farmers** on land that has been considered marginal. Reestablished native grasslands provide a number of environmental services besides biomass for renewable energy. Grasslands **stabilize soil** and **prevent wind and water erosion**, **protect natural waters** by intercepting nutrients from runoff, **provide habitat** for wildlife, provide resources for pollinators and enemies of crop pests, and **sequester carbon** deep beneath the soil surface.

Grassland biomass systems can serve the functions of land in the Conservation Reserve Program (CRP), plus provide additional benefits to producers and the environment. With uncertainty about the continuation of the CRP, **now is a good time to plan for a market-based approach** to fund state and federal goals of protecting soil, water, and providing habitat with perennial cover. **A self-sustained grassland bioenergy system can lead to growth and prosperity for rural Minnesota.**

Many states have renewable energy production goals, including **Minnesota's goal of 25 percent** electricity generation from renewables by 2025. **As the deadlines for these statewide goals approach, demand for biomass could increase.** Many technologies are ready to convert biomass into renewable energy, including enzymes for converting cellulose to ethanol, systems for anaerobically digesting mixtures of manure and biomass to produce natural gas, and methods for mixing shredded biomass for burning with fossil fuels to generate electricity with reduced net carbon emissions. As these technologies improve, the cost of bioenergy should decrease and improve the economic potential for farmers to grow biomass crops on marginal lands.

Forever Green Initiative:
NATIVE PERENNIAL GRASSLAND

Managing for biomass and environmental services on underutilized farmland

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Research Status and Goals

Investments made in faculty, post-doctoral researchers, graduate students, technicians, and undergraduate employees support the research and development of grassland biomass research on underutilized farmland.

Activities: The Forever Green Initiative (FGI) has led numerous research projects relating to the agronomics and ecosystem services of grassland biomass. Future studies will focus on how grassland biomass can address specific environmental needs of Minnesota. For example, we plan to test the effectiveness of managing grassland biomass on wellhead protection areas to provide and economically viable method for reducing nitrate leaching to groundwater. A comprehensive study is needed to measure hydrology and nitrogen dynamics beneath grassland biomass production systems. A second major objective is to measure profitability and water quality benefits of growing grassland biomass crops in buffer regions. The continuous living cover provided by grassland biomass crops is expected to reduce subsurface nitrate transport, surface runoff of nutrients, and soil loss to ground and surface waters. We propose a long-term project that would quantify the water quality improvements by replacing annual crops with perennial grassland bioenergy crops along waterways requiring a buffer.

Outcomes: Studies will be continued to determine appropriate fertilizer rates for switchgrass and grassland mixtures, harvest timing for conserving valuable nutrients, and methods to improve establishment success of native grassland species. We will continue to measure bioenergy yields across various grassland types and regions of Minnesota. Outcomes of future projects will focus on providing detailed information and guidelines on the impact of native grasslands on water quality and carbon sequestration of native grasslands when planted over well head protection areas and buffer strips along waterways.

Pilot Studies

We have monitored long-term field experimental sites with monocultures and polycultures of native plants throughout Minnesota. We have baseline information on biomass production and changes in plant persistence with time. Additional large scale grassland studies have shown the efficacy of biomass harvest and their use for wildlife. The University of Minnesota Morris campus has a biomass gasification facility to convert biomass into renewable energy. This could be the site of a farm-to-fuel demonstration. The Morris campus has a substantial existing research facility for processing biomass, converting it to bioenergy, and measuring biological and economic implications of the conversion.

COMMERCIALIZATION PLAN

Some of the prior pilot projects harvested native grassland biomass on approximately 1,000 acres of Minnesota, typically on land that was marginal for other agricultural crops. Those projects showed that such harvesting was sustainable and provided healthy habitat for Minnesota wildlife that would not be available with other uses of the land. Economic evaluations in those projects suggested that scaling up by a factor merely of ten would make this kind of renewable bioenergy economically viable, providing an increment in income to local rural landowners and a profitable return to power companies. Therefore, a proposed next step is to establish a collection of land at this enlarged scale, work with property owners to arrange care and harvesting of biomass on the land, and work with select power generation companies to profitably convert the biomass into renewable energy. The Morris research site can contribute methods and measurements to this effort.

The ultimate potential is substantial. Previous estimates from the pilot projects showed that the idle and degraded land in Minnesota, converted to grassland biomass, could provide enough renewable energy to obviate the need for several large new fossil fuel or nuclear power plants.

TIMELINE

2017 through 2022 and beyond

- **Research and development of native grassland biomass systems for underutilized agricultural land.**
- **Long-term experiments to determine how these perennial systems change through time and how changes affect the ecosystem services they provide.**