Cedar Falls Utilities is a municipal utility providing four separate utility services to the City of Cedar Falls, Iowa. Included in these services is The Municipal Electric Utility of the City of Cedar Falls, Iowa. The electric utility generates electricity in several locations, owns fractional shares of strategic transmission lines, and distributes energy within the City of Cedar Falls and in the rural area north and west of the city limits. One of the electric generation locations is Streeter Generation Station in Cedar Falls, where two small electric generating units are located. Streeter Station was the primary electric generation site for electricity for the City of Cedar Falls until 1978, when the electric utility bought into fractional shares of large remote generation facilities and transported the electricity to Cedar Falls via the transmission system. At that time, Streeter Station became a peak generation facility instead of a baseload generation facility. In the last five years, economics have been favorable for 3000 to 5000 hours of operation per year at Streeter Station. Both units have been active in electric generation in those years.

There are two electric generation units at Streeter Station. Unit #7, built in 1973, is rated at 35 megawatts and burns pulverized coal. Unit #6, built in 1963, is a stoker fed coal fired steam electric generation unit with an output rating of 16 megawatts. Stoker units scatter solid fuel onto a grate, where the fuel is burned and the released heat is transformed into steam to drive the turbine. Stokers are designed for stoker grade coal, but have the capability to handle any solid fuel. With this in mind, the electric utility began investigations into the possibility of combusting densified bio-based fuels instead of coal in Unit #6. The investigations were based on the assumption that the unit had the potential to combust exclusively biofuel as the primary fuel instead of coal.

On the Electric Utilities initiative and at the Utilities cost, a series of test burns were performed in 2004, 2005 and 2006. Eight short term test burns were conducted in that time period. The first two test burns used corn cobs, ground and reformed into pellets. A 10 ton test burn demonstrated compatibility of the pellets with the fuel handling system, and the 50 ton test burn demonstrated the heat potential of these pellets to produce steam. The third test burn was fired with 10 tons of commercially available wood pellets, made from ground hardwood reformed into pellets. For the fourth test burn, the utility contracted the custom manufacture of larger diameter pellets made from ground corn stalks. After several manufacturing challenges, 12 tons of corn stalk pellets were produced, and these were the fuel for the fourth test burn. The search for a more economical densification process lead to the agricultural process of cubing, originally designed to densify hay for consumption by livestock. Using rented equipment, the cubing process was used to densify corn stalks and switchgrass. An attempt was made to densify oat hulls into a cube, but this was unsuccessful. Commercially available oat hull pellets were purchased as an alternative. The final three test burns were of longer duration, and the fuels were corn stalk cubes, switchgrass cubes and oat hull pellets. The corn stalk cubes deteriorated between production and combustion, and this burn was unsustainable. A small portion of the deteriorated material was redensified, and a short duration test burn of recubed corn stalks was sustainable but could not achieve full capacity. The test burn of the switchgrass cubes was sustainable but also could not achieve full capacity. The oat hull pellets burned very well, with minimal handling problems and full capacity electric generation.

Retrospective analysis of the first series of test burns pointed to several significant challenges. All of the economic modeling showed biofuel based electric generation to be more costly than coal fired generation, and in the competitive wholesale electric market, the cost was excessive. A municipal utility is responsible to the community it serves to provide the best value at the lowest cost, and generation with biofuels could not be justified because of the cost. Existing policies and proposed policies have potentials to equalize the costs, just as federal policy has encouraged the development of wind energy. These policies include tradable tax credits (municipals do not benefit from standard tax credits), Renewable Energy Production Incentive, Department of Agriculture policies, Department of Energy grants, green credits and carbon taxes. Cedar Falls Utilities has investigated the impact of these policies on the cost of

biofuels, and advocated policy changes that would equalize the cost. Until these costs could be equalized, no significant advances could be made in the biofuel project.
Another significant challenge is development of a supply chain for the fuel. Electric production is an energy intensive process. Rough calculations indicate the need for 200 tons of biofuel daily to operate Unit #6 at half of the rated capacity. Quantities needed for short duration test burns can be obtained, but the production capacities for any longer duration test burns are not available. Until these capacities are increased, there is not sufficient supply to perform extended test burns. Included in this supply chain are the producers of the raw material, a transportation infrastructure to move the material from production sites to a processing facility, storage of the raw material, a processing facility to densify the material to the specifications needed for generation, and a transportation system to move the densified material from the production site to Streeter Station for in time delivery. Development of the supply chain is in its infancy, biofuel suppliers are emerging, but a sustainable capacity does not exist for continuous production at Streeter Station.

A third significant unknown is the affect of biofuel combustion on the boiler. Before any long term contracts or commitments can be made, a thorough study of the performance of the boiler during biofuel combustion is needed. Impacts of mineral deposition and mechanical abrasion on the boiler tubes from biofuel combustion must be determined. The appropriate procedure to determine these affects is to perform extended test burns and determine the impacts with monitoring during the burn and an inspection of the boiler after the burn. This requires a fuel supply sufficient to perform the extended burn, which has been unavailable.

In the time following the initial test burns, the utility has been active in presenting the requirements of the project to potential suppliers, updating the economic analysis of the project, presenting the project to interested parties locally, regionally and nationally, and advocating the project politically at the local, state and federal levels. No additional test burns have been performed since then. Recent developments in the biofuel sector of the economy have brought new biofuel suppliers into the market with capacity to manufacture larger quantities of fuel, several other potential fuel feedstocks have been identified, and one promising new densification configuration has become available.

In March of 2009, the Utility again presented the project in Washington, D.C.. A Congressional Appropriation was designated to this project, to be administered through the Department of Energy. With this funding and a cost share from the utility, another step is planned for the project. The Utility intends to test three new biofuel options in three densification configurations, mixed prairie grasses in cubes, mixed agriculture residues in pellets and sugar cane bagasse in bripells. These three test burns will be short duration test burns. Following completion of the short test burns, one potential fuel and densification configuration will be selected for a ten day test burn. The selection will be influenced by the quantity of the potential fuel available, the most suitable densification process for mechanical handling and combustion, and the production capacity of the densification configuration. Production of the biofuel will be contracted with a biofuel manufacturer; the product will be shipped to Streeter Generating Station, and burned in Unit #6 for electric generation. The unit will be monitored during the test burn, and following the completion of the ten day burn, the boiler will be entered and inspected to determine the effect of the combustion process on the internal components of the boiler.

The findings at the end of this step are critical to the future of the project. If the selected biofuel appear to be compatible with the combustion process in the boiler, a longer test burn of thirty days duration is planned. The results of the thirty day burn will provide sufficient information for the utility to begin contract discussions with biofuel providers for long range, large quantity supplies of biofuels. The utility will determine specifications and provide a steady demand to encourage expansion of the biofuel supply chain. Transportation costs will heavily favor regional or local suppliers, adding local economic development and increasing the local demand for raw materials. The anticipated raw material would

consist of primarily low value agricultural by products or underutilized crops which could function as energy crops.
However, if the mineral content in the biofuel causes excessive fouling or slagging in the boiler, the project will require re-evaluation. The mineral content of the biofuel feedstocks varies significantly. With the assistance of mineral analysis, the tendency of the biofuel feedstocks to foul or slag could be predicted, and the densification feedstocks can be selected to minimize the impact on the boiler. If this is an unavoidable consequence of the combustion of all biofuels, the entire project will need to be reassessed and possibly terminated.

Test burns are helpful to determine compatibility of the biofuels with the mechanical handling system and the combustion process in the boiler. However, the economic modeling is still the most important factor to be considered, and if the cost of the fuel is more than the value of the end product, electricity, the project will not proceed. Economic modeling by the utility using the most reliable information at the present time and the best economy of scale achieved in the best biofuel scenario shows biofuels to be still more costly than coal. Again, changes in policy have the potential to change the model in the future.