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Micro Hydroelectricity Research and Demonstration in Madison County

With the RF STEM funding, the following program outcomes were addressed:

1. Students will conduct site assessments for residential micro hydroelectricity systems to estimate power and energy output
2. Students will be able to design and install residential, grid-interactive micro hydroelectricity systems
3. State and local decision-makers will have the opportunity to explore functional, grid-interactive micro hydro systems to decide upon grant funding opportunities
4. Students will address grid-interactive micro hydroelectricity system economics

The funding awarded for this project was used to complete the installation of two residential micro hydroelectricity systems in Madison County. Students conducted full site assessments for both sites to create full system designs (including penstock materials and components, turbine sizing, electrical balance-of-system components, and wire sizes). The funding provided was used as an incentive for two systems to offset cost of materials.

One system (New Woodstock) is on Town property and will be used extensively as a showcase for Town, County, and State officials to see the technology. The hope is to demonstrate the technology to lobby for New York State Energy Research and Development Authority (NYSERDA) grant funds to offset systems costs (much like those provided for solar PV, solar thermal, and small wind systems). Currently, no incentives are available for these highly sustainable systems.

The second system in Oneida, NY was initially surveyed by a class at Morrisville State College in Fall 2012. Funds were used to defray a portion of the system costs for the landowner to move forward with an installation.

Students have worked extensively on both sites. Each week a 3-hour lab was dedicated to one of these sites, for a total of 42 hours (168 student-hours). Additionally, these sites were used as the basis for system design exercises used in class, which totaled an additional 44 student-hours.

The New Woodstock micro hydro system has been operating at a constant 745 Watts, which corresponds to approximately 6,500 kWh/year of electricity. The total installed cost was just under $20,000, giving an energy cost of $0.15/kWh over a 20 year lifespan. However, this system was intentionally overbuilt to allow for a second turbine to be paired for future demonstrations on this County property.

The site in Oneida has one week left for completion, but it is expected to produce approximately 1400 Watts (12,250 kWh/year) with a total installation cost of approximately $13,000. Over an expected 20 year lifespan, this corresponds to a cost of electricity of $0.05/kWh.
Though the economics of micro hydro systems are appealing, with an incentive from NYSERDA, more individuals who have the resource would be able to install systems due to the lower up-front costs. Also,

in the above examples, labor cost is fairly minimal since student labor in lab exercises was predominately used for the installations. A NYSERDA incentive would be used to offset installation and labor costs. To this end, a “grand opening” of the New Woodstock system is in the works to showcase the system to town supervisors, local assemblymen and state senators.

As additional results of these efforts, I was invited to present our findings at a graduate student seminar at Rochester Institute of Technology’s Golisano Institute for Sustainability. This cross-institutional collaboration is important to provide students with a stronger knowledge of the field. Additionally, these systems were the basis of several presentations I have given at Madison County Energy Committee meetings. Dissemination of the technology economics has been a strong effort to showcase students’ efforts.

Since the initial drive to install demonstration micro hydroelectricity projects came from a Syracuse University E-nitiative grant (Kauffman Foundation), the RF STEM funding provided opportunities to our students that dovetailed nicely with previously obtained funds. My hope is to expand this teaching, research, and demonstration project to surrounding counties by seeking additional future funds.

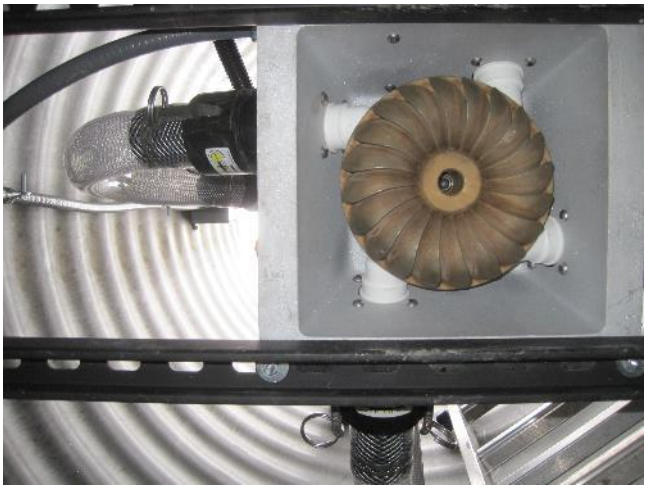
New Woodstock Site

Installing the ES&D Stream Engine turbine

Installing the 8” PVC penstock

Disconnect, controller, inverter, and energy meter

ES&D Stream Engine 1 kW hydro turbine



ES$D Stream Engine Turgo runner, 4 nozzles

System operating at 350 GPR an 750 Watts (6500 kWh/yr)

Oneida Site

Ball valve and vacuum relief valve at intake

Heat fusion of 4” HDPE penstock

Making a gentle bend with the flexible penstock

High line transport of concrete on a steep site

Completed manifold and power house

Building the distribution manifold