ENGINEERING REPORT

FOR

CFA - GREEN INNOVATIVE GRANT

ENERGY EFFICIENCY PROPOSAL

FOR THE

TOWN OF WAPPINGERS FALLS, NY POTW

FOR

A CIRCULAR ECONOMY THROUGH ANAEROBIC DIGESTION AND PYROLYSIS

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1) Executive Summary

This project is a circular economy solution that improves energy efficiency, offsets carbon dioxide emission, sequesters carbon, and revitalizes local water resources. There are two primary infrastructure investments; 1) an anaerobic digester inputs invasive aquatic water chestnut & excess food waste, and 2) a wood pyrolysis unit inputs branches & brush. Outputs are renewable electricity (applied to our Wildwood POTW), renewable heat (applied to the highway department), and marketable agriculture products. These existing manufactured technologies will be configured in an innovative way to produce an environmentally and economically sustainable operation that will make our public works more energy efficient. The installation will create 2 to 3 long-term jobs and transition our local biomass waste to beneficial products of value while saving taxpayer money. Related environmental justice and education programs are incorporated into this proposal to build capacity within the community and regional stakeholders. By investing in this project, NY will establish a resilient solution that would serve as a model to be replicated throughout the Hudson Valley and across the state.

2) Project Background and History

a. Site Information

Three locations are being considered for this installation with the final decision made in conjunction with the town and village of Wappingers Falls. The preferred location is the Wappingers Highway Department located at 10 Highway Drive shown in Figure A. This provides easy truck access from Route 9 both northbound and southbound.

Locations in other municipalities including Beacon and Kingston are also under consideration, although these are presently envisioned as future expansion locations for this overall project.

The Environmental Justice Areas of Wappingers Falls and New Hamburgh are included in the impacted areas for this project as shown in Figure B.

b. Ownership and Service Area

The land on which this is located will remain the property of the municipality. The equipment will be owned by the municipality or possibly by Hudson Valley Biogas. This will be negotiated with the municipality.

We intend that this facility will provide a destination for food and yard waste, harvested invasive water chestnuts, and woody waste for an area up to 25 miles in radius from its location.

"The Cultivator" and Hudson valley Biogas intend to be an active participants in the construction and operation of this facility.

The output will be

1. Electrical power supplied to the Wildwood WWTP located at 99 New Hackensack Rd. in Wappingers Falls, shown in Figure C.
2. Heat from composting, pyrolysis, and the biogas engine which can be used for digestor temperature control, general room heating, compost heating, and other anticipated agricultural uses.
3. Agricultural products such as solid or liquid fertilizer and compost for soil improvement.

c. Existing Facilities and Present Condition

There are no similar, existing facilities in this area.

Composting facilities exist in Newburgh, Beacon, Wappingers Falls, Poughkeepsie, Milton, New Paltz, and Kingston, NY among others, according to www.compost.css.cornell.edu/maps.html. Some of these facilities generate significant public opposition due to foul odors generated by inadequate operation of the facility.

This facility is designed to handle up to 900 tons/year (17 tons/week) of food and plant waste to the digestor and up to 750 cu. yards/year (15 cu. yds/week) of woody waste.

Other than initial start-up, this will be a net energy generator. Electrical power design output is approximately 250 MW or almost 300 average homes. This power will be dedicated to one of the local POTW facilities through the existing power grid.

d. Definition of the Problem

Currently, in the United States, approximately 1 lb. of food waste is generated per person daily. Looking at it another way, between 30 and 40% of all food ends up as waste rather than consumed for a variety of reasons. Most of this waste occurs at the production and food preparation stages. The vast majority of this waste is currently landfilled or incinerated while a small portion is composted.

Beginning on January 1, 2022, New York state food processors and handlers generating over 2 tons of food waste per week are required to donate or recycle this waste if a facility exists within 25 miles of its location. This project will demonstrate the feasibility of locating and operating a food waste recycling/processing facility which turns this waste into useful products and community benefit using the triple bottom line of people, planet, and prosperity.

Other waste including plastics, paper goods, metals, and glass, etc. accounts for an additional approximately 4 lbs. per day per person from all sources. No more than 20% of this is recycled.

The invasive water chestnut is currently clogging vast areas of our waterways, dramatically reducing public enjoyment of them (Figure D). Some municipalities, including the Village of Wappingers Falls, regularly seek to harvest a portion of this growth. The harvested plants are often composted or landfilled. Only a small portion

of the total area infested by the water chestnuts can be harvested due to time constraints and access by the harvesting machines.

Storms coming through the region which knock down trees, tree trimming, seasonal cleanup, and other activities generate woody waste that decomposes very slowly and is not suitable for composting. Recently, significant amounts of woody waste have been ground up and used for mulch. A portion of the mulch is used for agricultural purposes; however large mounds of mulch are accumulating across our region.

This proposal provides for a sustainable, reliable, expandable means to deal with each of these aspects of the problem.

The food waste will be fed to an anaerobic digestion (AD) system that will convert this waste into compostable material, liquid digestate, and biogas. The compost can be sold and used to improve the quality of soil for growing plants. The digestate may be suitable for application as a liquid fertilizer, although this remains to be confirmed. If not, a suitable disposal method will be built into the system, such as at a POTW.

The biogas will need to be treated and fed to a combined heat & power (CHP) engine to generate electrical power and recoverable heat. The power will be fed into the local electrical grid and dedicated to supply one of the local POTW's noted above.

The heat from this engine can be used for heating buildings part of or adjoining the facility, to improve the digestion efficiency, create hot water for local use, or for new agricultural uses envisioned as part of a future expansion of this facility to truly create a model circular economy. It can also be used in a heat pump to provide refrigeration during the summer.

The pyrolysis system will also create multiple usable products. These include biochar, a form of activated carbon. This has multiple uses including as a soil improvement, absorbent with many uses, and can be added to a composting facility. The heat can be used in similar ways as noted above for the CHP engine excess heat.

e. Financial Status

We propose to fund this project through a "Green Innovative Program Opportunity" grant and community support. The total currently estimated cost is $1.41 million. A summary breakdown of this cost is shown in Figure E. 75% of this total is requested through the GIPO grant after initially being covered through a private investor. The remaining 25% of the project cost will be covered through community investments.

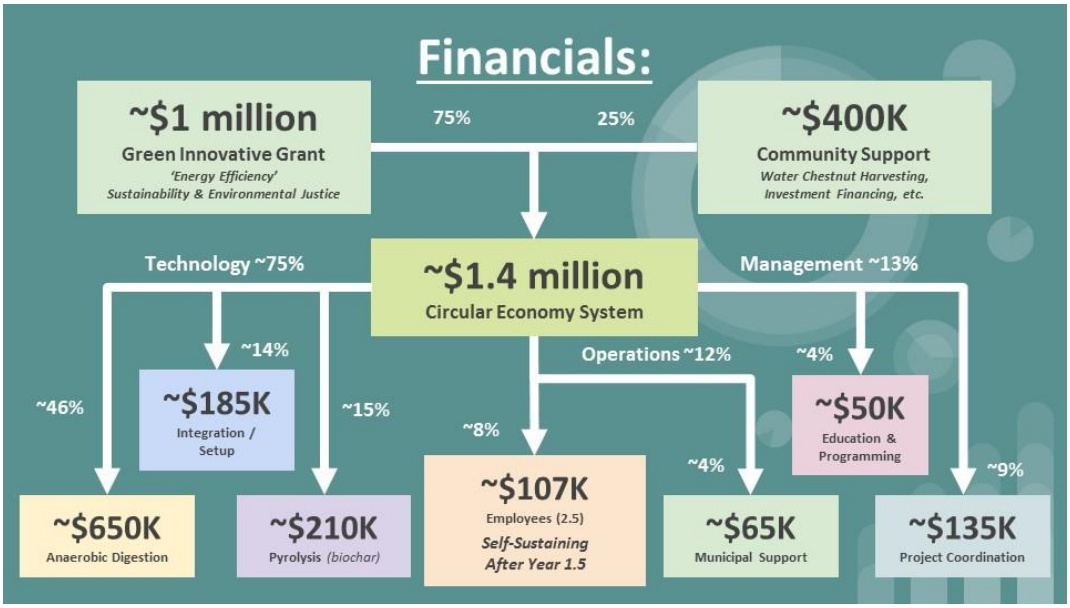
Once the system is operating, we anticipate that it will be self-supporting and payback the full loan amount in less than 10 years based on the value of electricity generation, agricultural products sold, usage of the heat.

3) Alternatives Analysis

a. No-action: New York State law requires improved handling of food scraps and waste beginning Jan. 1, 2022 with significant penalties if no action is taken. Therefore, doing nothing is not an economical option. Doing nothing or making no changes regarding the invasive water chestnuts will only further clog our waterways and significantly reduce or eliminate recreational use of much of our lakes and streams. Continued harvesting and composting the water chestnuts provides little benefit and can contribute to foul odors at composting facilities.
b. Repair or replacement vs. new construction: There are no similar facilities existing to handle these very significant challenges. The only existing options are continued composting (with the issues noted above) and finding new and more expensive areas for landfills.
c. Regional consolidation opportunities: The NYS law covering handling food scraps requires that facilities be located within 25 miles of the generators. This program envisions creating additional, future facilities to meet this 25-mile requirement.
d. Centralized vs. decentralized: By decentralizing these facilities, we provide a much greater economic benefit to the communities with many new business and employment opportunities.
e. Environmental impacts and mitigation measures: All of the impacts for this facility will be positive ones on the environment and surrounding communities. Not providing this facility and its operations will provide continued negative impacts listed above.
f. Seasonal limits, challenges, and requirements: The generation of food waste is pretty constant throughout the year. Harvesting water chestnuts is strictly a warm weather activity as the plants die back during cold weather. Generation of woody materials can occur throughout the year based on different sources including storm damage to trees.
g. Permit requirements: permits for the digester, pyrolysis, and biogas functions are necessary and included in the program.
h. Water and energy efficiency measures: Cooling water is required for the pyrolysis stack gases. A recirculating cooling tower system is planned to meet this need. Fresh water will be needed if hot water for washing, etc. becomes part of the overall system. Energy efficiency is built into the biogas CHP engine and pyrolysis units including excess heat recovery and converting the biogas into electrical power.
i. Constructability and schedule: The digester, CHP engine, and pyrolysis units are each skid mounted, for delivery to the site ready for installation. Construction of

foundations, buildings to house the units, etc. are included. Construction is anticipated to be complete by the end of second quarter, 2022. See Figure F.

j. Cost Estimate: Total project cost is presently estimated at $1.41 million as shown below.



Of this total, the $50,000 education and $115,000 first-year operations cost are non-construction costs. All other costs are construction costs. Contingency costs at 10% are included in each section, for a total of $135,000.

k. Non-monetary Factors: increasing the harvesting of water chestnuts from local waterways will improve the recreational opportunities for these areas. Moving from landfill and composting of food and similar waste will significantly improve the carbon footprint as the carbon is sequestered in activated carbon and compostable materials. Increased local employment will be achieved as additional facilities like this are built as anticipated and through the creation of additional, new businesses related to creation of a circular economy.

4) Summary and Comparison of Alternatives

a. There are no feasible alternatives to this program that meet its objectives as noted above.

5) Recommended Alternative

This project is recommended as presented as no feasible alternatives have been identified.

6) Maps and Figures

FIGURE A – PLANNED LOCATION
Wappinger Highway Dept. – 10 Highway Dr., Wappingers Falls, NY

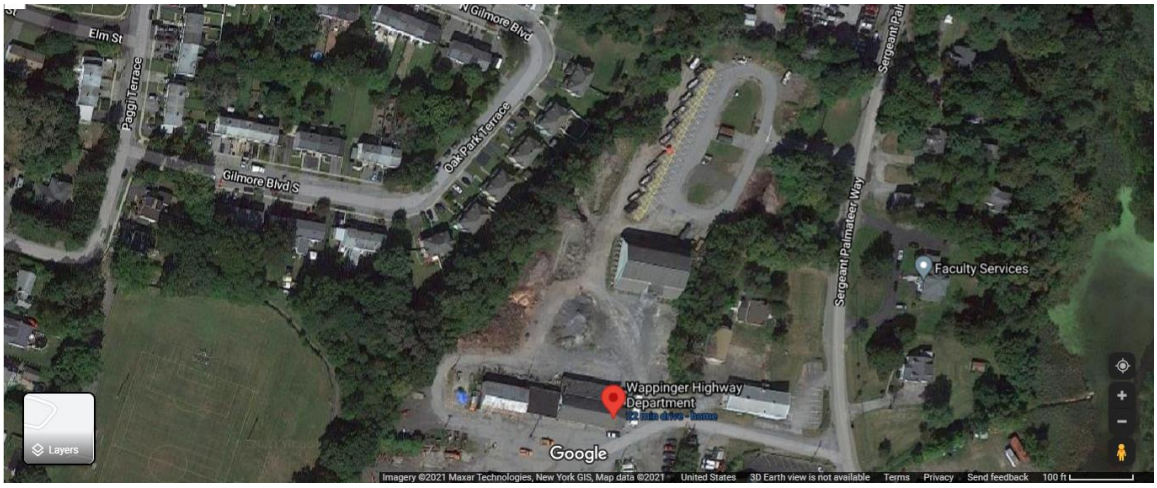


FIGURE B – ENVIRONMENTAL JUSTICE AREAS

FIGURE C – WILDWOOD POTW FOR CONNECTION
99 Hackensack Rd., Wappingers Falls, NY

FIGURE D – WATER CHESTNUT INFESTATION

FIGURE E – COST SUMMARY

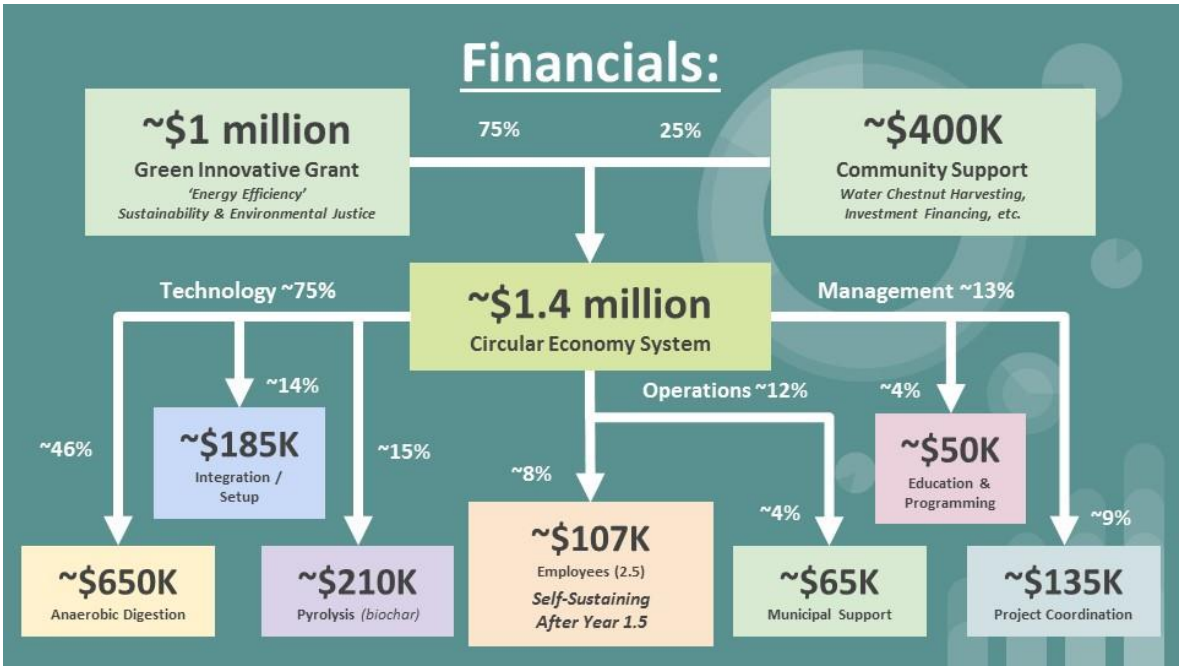
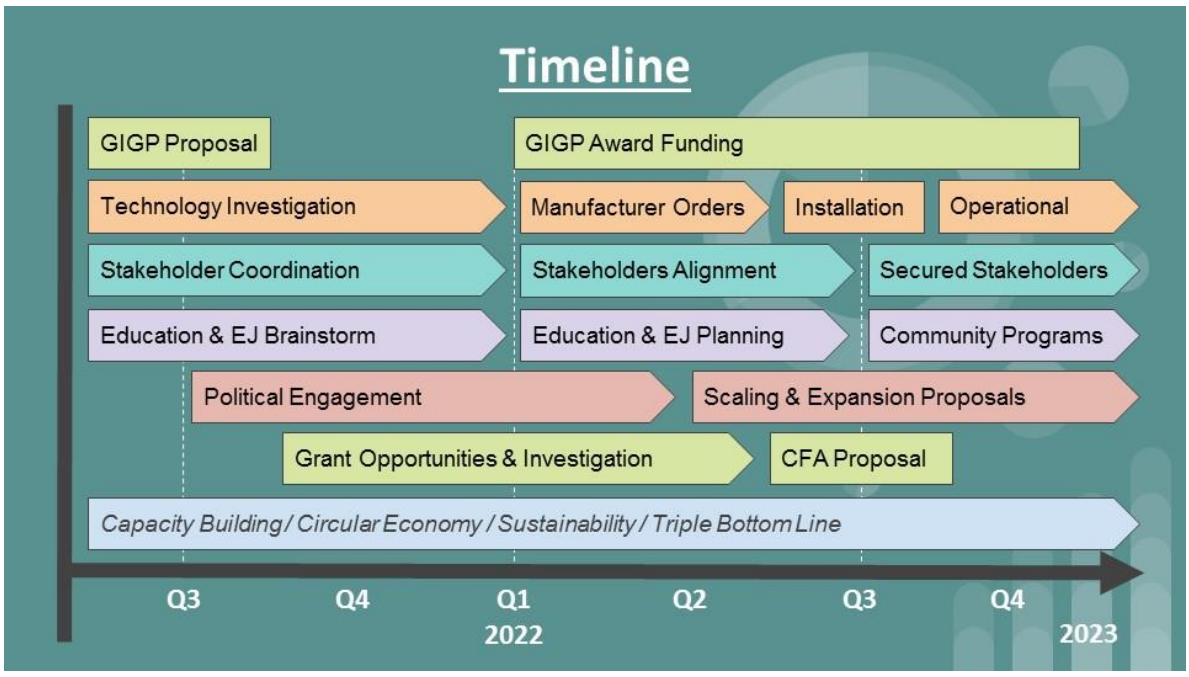


FIGURE F – PROJECT SCHEDULE



7) Engineering Report Certification

During the preparation of this Engineering Report, I have studied and evaluated the cost and effectiveness of the processes, materials, techniques, and technologies for carrying out the proposed project or activity for which assistance is being sought from the New York State Green Innovative Grant Program. In my professional opinion, I have recommended for selection, to the maximum extent practicable, a project or activity that maximizes the potential for meeting the NYS Food Donation and Food Scraps Recycling Law, reducing the area covered by invasive water chestnuts, reducing land fill volumes, creating a true circular economy with a focus on the triple bottom line, and energy conservation, taking into account the cost of constructing the project or activity, the cost of operating and maintaining the project or activity over the life of the project or activity, and the cost of replacing the project and activity.

Title of Engineering Report: CFA - Green Innovative Grant - Energy Efficiency Proposal for the Town of Wappingers Falls, NY POTW

Date of Report: July 30, 2021

Signature: Ross S Topliff

Date: July 30, 2021

Effective 07/12/2007

Stamp