



## Overview

### Terra Green Energy, LLC

**Electric generation companies** are facing requirements that create and/or increase the percentages of power required to be created through the use of renewable fuels as well as more stringent emission requirements. This is a result of both state and national regulatory and legislative actions to reduce Green House Gas (GHG) emissions, forestall climate change, and become less reliant on imported fuels. The use of traditional biomass requires major capital expenditures for retrofitting of feedstock handling systems and the boilers' burner combustion systems.

For the purposes of the Energy from Biomass and Waste Conference, Terra Green Energy, LLC proposes to discuss its unique biomass pretreatment technology known as torrefaction. Use of the torrefaction technology to treat biomass converts it into a coal-like solid fuel. Any electrical generation facility currently utilizing coal which elects to co-fire with torrefied biomass will reduce its emissions of mercury and greenhouse gases including lower SO<sub>x</sub>, NO<sub>x</sub>, and carbon dioxide.

The torrefied biomass ("GreenCoal™") is capable of being used in coal fired boiler applications in direct replacement of coal. Use of GreenCoal™ torrefied biomass will allow an electrical generation customer to meet its RPS, air emissions and regulatory requirements without the need for capital expense.

**Terra Green Energy, LLC (TGE)** has developed proprietary commercial torrefaction technology, is the holder of the intellectual property, and will license the technology to third parties. A typical torrefaction facility will contain two parallel reactor

processing trains and produce 90,000 tons of GreenCoal™ torrefied biomass annually.

**Torrefaction** is a mild pyrolysis (roasting) process carried out in the absence of oxygen which renders the biomass (including feedstocks such as forestry residues, waste wood and switchgrass) dry, energy dense, easily grind-able, hydrophobic, and cleaner burning. During the torrefaction process most moisture and volatile compounds are removed leaving a final product which is like coal yet much cleaner burning.

### **TGE Torrefaction Technology**

Terra Green Energy, LLC in conjunction with an affiliated company , Terra Green Industries, LLC, is proposing to construct and operate a demonstration torrefaction facility on a site located in McKean County. The demonstration facility will be constructed in two phases each with a capacity to produce 45,000 tons per year of torrefied biomass. The torrefaction system will utilize existing commercially available equipment from key suppliers specifically modified for the torrefaction reaction.

The two key components include a specifically modified specialty dryer/torrefaction reactor and a unique combustion unit in a proprietary configuration with exceptional advantages. These advantages include:

- The ability to accelerate the initial torrefaction step thereby decreasing torrefaction time and increasing the overall capacity of the system, and
- The ability to re-circulate and combust the torrefaction gases generated to provide all or almost all of the energy required to power both drying and torrefaction.

These advantages combined with the principals' experience operating complex process equipment systems in the petroleum industry provide a unique competitive advantage.

Finally, as an 'engineered fuel', pelletized GreenCoal™ torrefied biomass has a significant operating cost advantage over its closest rival – conventional wood pellets. According to a published report by ECN from the Netherlands, the operating costs of torrefaction are approximately 30% lower than for conventional wood pellets even though capital costs are somewhat higher (22%).

The GreenCoal™ torrefied biomass product will be densified into briquettes or pellets. Briquettes are the form of fuel that electrical generation companies are equipped to handle as it is most similar to the coal they currently handle and are currently feeding into their boilers. The densification (briquetting) improves handling during shipping, reduces dust, and increases the bulk density of the fuel. Pellets will be made available in the home heating market.

There are more than 80 coal-fired electrical generation facilities in Ohio, New York and Pennsylvania alone. Plants in Ohio face renewable fuel requirements under the Ohio Alternative Energy Portfolio (see [www.PUCO.ohio.gov/PUCO/rules](http://www.PUCO.ohio.gov/PUCO/rules)). The Ohio regulations require at least one half of the renewable energy be generated in Ohio, so the requirement cannot be met by purchasing power from a renewable generation source located outside the state.

Pennsylvania's Alternative Energy Portfolio Standards require electrical utilities to source at least eight percent of the electric power they sell to Pennsylvania consumers from alternative resources including biomass, and another 10 percent from a second tier of alternative resources.

Co-firing even a small portion of coal with non-torrefied biomass requires a multi-million dollar investment at each site. The use of torrefied biomass permits an electrical generation facility to co-fire biomass without the need for infrastructure modification or cost.

Power plants will benefit from the use of GreenCoal™ torrefied biomass due to its much higher Btu value; 10,000 Btu/lb for GreenCoal™ torrefied biomass compared to 7,800 Btu/lb. dried non-torrefied biomass, or 4,000 Btu/lb. or less for green biomass.

The higher heat content of the torrefied biomass allows a plant to meet peak usage demands and to avoid “de-rating” their boilers. In discussions with FirstEnergy, they referred to GreenCoal™ torrefied biomass as rocket fuel for this very reason. The combustion of GreenCoal™ torrefied biomass to make electrical energy simply releases the same carbon into the atmosphere that would be released naturally when the organic matter decomposed – thus making the process “carbon-neutral.”

According to the Biomass Power Association:

- (1) Biomass is twice as effective at reducing GHG as other forms of renewable energy;
- (2) When organic matter is burned in the open, dumped in landfills or decomposes in the wild, it returns carbon to the atmosphere as either carbon dioxide (CO<sub>2</sub>) or methane gas (CH<sub>4</sub>) – with methane being 25 times more potent as a GHG on an instantaneous basis;
- (3) When burned in a boiler, biomass completely combusts methane during its energy-making process, releasing only CO<sub>2</sub> into the air;
- (4) By efficiently combusting organic matter, biomass use reduces the amount of CO<sub>2</sub> that would be released if this organic matter simply decomposed.

We would welcome the opportunity to present our company and its exciting technology at the Energy & Environment Week Conference in April.

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