

# Overview

January 12, 2010



**Terra Green Energy, LLC**

Biomass Pre-treatment Technology

GreenCoal™ torrefied biomass

*“The ultimate solution enabling the full utilization  
of all types of biomass”*



# Biomass is a difficult energy source

Production – Harvesting & Collection – Handling  
– Transportation – Storage – Pre-treatment –  
Feeding – Conversion

- Every aspect is expensive!

**Torrefaction dramatically reduces these costs!**



# Terra Green Energy, LLC

- Terra Green Energy, LLC is a torrefaction technology licensing company
- Terra Green Industries, LLC will build, own, and operate the commercial sized torrefaction demonstration facility



**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.



# Terra Green Energy, LLC

## Significant Events

- \$1M Grant from the Pennsylvania Energy Development Agency
- \$130,000 Loan from the Ben Franklin Technology Partnership
- Letter from FirstEnergy
- Option on Wyssmont Turbodryer



# Design Team Partners

**Pegasus TSI**

**Advanced Recycling Equipment (ARE)**

**Aeroglide /Onix**

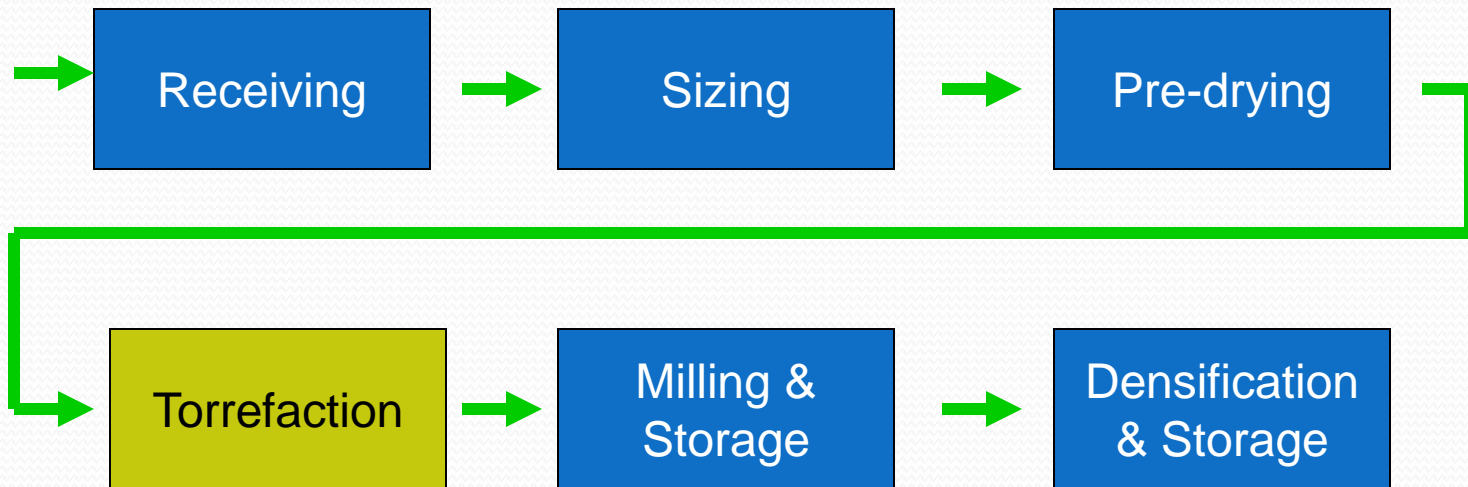
**American Refining Group (ARG)**

**MACTEC**

**Terra Green Energy**

- ***“Bringing together the experts to make the project happen and happen smartly”***

# Torrefaction Process Steps



# Advantages of Torrefaction

**Renewable, sustainable,  
carbon neutral**

Allows coal burning facilities to meet RPS requirements

**Cleaner burning**

lower  $\text{NO}_x$  &  $\text{SO}_x$  which are primary targets of EPA

**Lower ash content than coal**

1% vs. 15% in coal

**Co-fire with coal without  
CAPEX**

No need for special storage, handling or pulverizing equipment, use existing assets

**Resists water uptake**

Untreated biomass turns to mush with moisture

# Advantages of Torrefaction

**Lower operating costs**

As much as 30% lower than wood pelletization

**Higher heat content**

10,000 Btu/lb. vs. 7,800 for wood pellets  
Avoid de-rating boiler system capacity

**Higher Bulk Density**

800 kg/m<sup>3</sup> vs. 650 kg/m<sup>3</sup>

**Auto thermal operation**

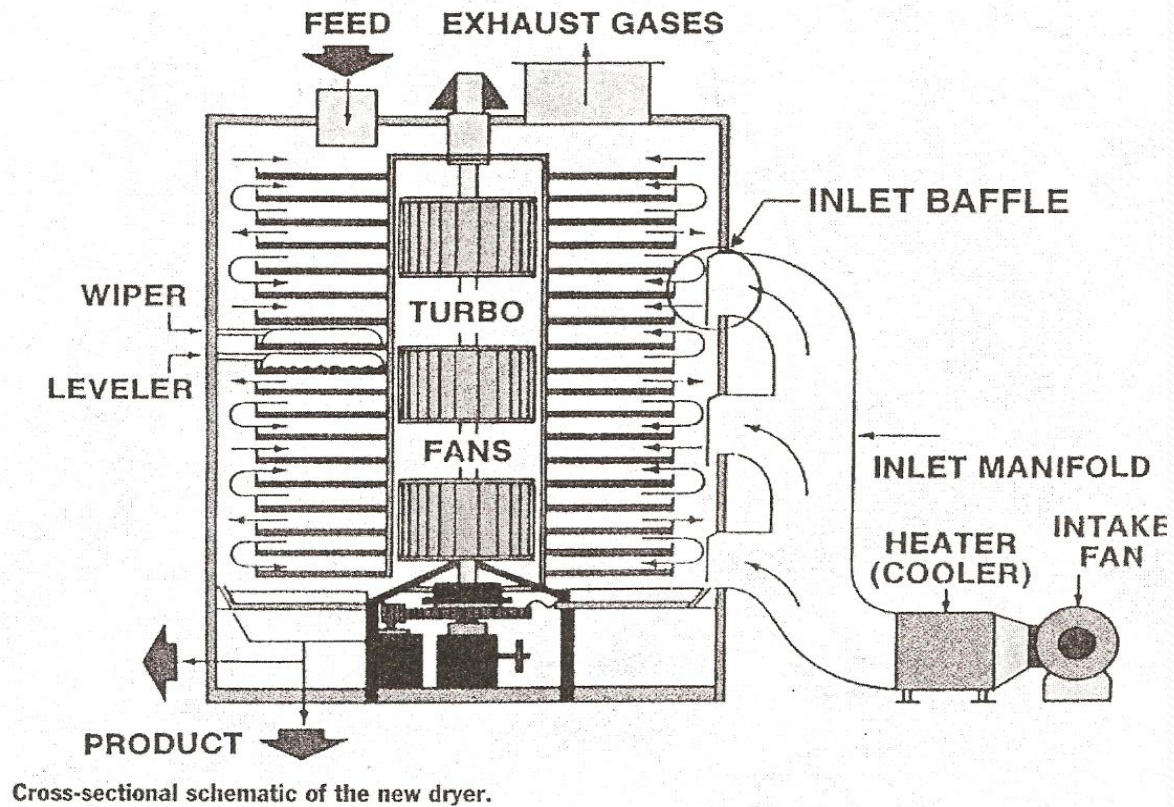
Little if any supplemental fuel required

**Wider range of potential feedstocks**

Forestry residue, switchgrass, other grown-on-purpose crops



# Wyssmont Turbodryer





## GreenCoal™ Torrefied Biomass

### Important Product Characteristics

- Heat Content 9,500 – 10,500 btu/#
- Ash Content <2%
- Moisture <2%
- Carbon, total 55% typical
- Carbon, fixed 29% typical
- Oxygen 38% typical
- Volatiles 68% typical
- Chlorine 29 mg/kg
- Sulfur 0.01 weight % typical

Initial testing indicates that torrefaction reduces the chlorine content



# Terra Green Energy, LLC

## Current Activities

- 1) Completing the 2<sup>nd</sup> phase of engineering
- 2) Equipment design specification underway
- 3) Completed option on used V37 system
- 4) Site selection complete – option in negotiation
- 5) Air permitting underway

# Wyssmont V37 Turbodryer



# Wyssmont V37 Turbodryer





# Terra Green Energy, LLC

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