Who is PHG Energy?

Since 2007, providing our customers waste-to-energy systems that produce renewable/sustainable power or fuel gas, and cleanly dispose of material that likely otherwise would be landfilled.

Owned by a Tennessee family that for over 71 years has provided equipment solutions to the construction, power generation, forestry and agricultural industries. Now a multi-state regional company with 11 offices.
Delivering Affordable Renewable Technology

Clean Energy Conversion

Through Gasification

- Carbon Emissions
- Crop Residues
- New Landfills
- Tipping Fees
- Clean Energy
- Transportation Costs
- Sludge Disposal
- Crop Residues

Clean Energy Conversion
Waste to Energy Projects

Sevier Solid Waste Inc.
Pigeon Forge, TN

City of Covington
Covington, TN

City of Lebanon
Lebanon, TN
What is Gasification?

The clean, efficient **conversion** of biomass into a combustible fuel gas in an **oxygen-starved** environment

- A thermo-chemical process to produce a clean fuel gas. **This is NOT Incineration.**
- Feedstock flexible of the life of the equipment
- Can retain and retrofit current equipment to use the gas (boilers, kilns, etc.)
- On demand energy generation
- About 95% of what goes in comes out as fuel gas. The other 5% is a charcoal biochar with many uses.
- Can be adapted for future applications
Downdraft Gasification

- Evaporate moisture from the feedstock
- Feedstock breaks down to gas and tars
- 3000 degree F oxidation layer cracks tars
- Carbon reforms with steam to create CO and H\(_2\)
- Rotating Grate shaves biochar layer
- Residue box for biochar removal
Simple Solutions to Complex Problems
The Flow of Material to Gas

- Feed Hopper
- Feed Auger
- Gasifier
- Gas Exit Pipes
- Biochar Collected

→ Quick shutdown and restart up to 24 hours later
→ Few moving parts = simplified maintenance
Flexibility / Expandability

PHG-LF

PHG-12

(6) X PHG-8

PHG-12

PHG-LF
What Can You “Gasify?”

- Woodchips
  - Utility trimmings
  - Scrap pallets/Construction
  - Bark or waste wood
  - Commercial waste
- Agricultural and animal waste
- Scrap tires and rubber products
- Food processing and other manufacturing waste
- Switchgrass, miscanthus and other purpose-grown energy crops
- Mixtures improve performance
Feedstock Specifications

- Consistent feedstock = consistent gas
- Moisture content is key (< 30%)
- Feedstock size: ¼” to 4”
- Ash content < 10%
- Minimum bulk density: 14lbs/ft³
- Low cost waste streams from other processes can greatly improve economics
- Feedstock “Blends” offer further flexibility
Using The Fuel Gas:

Currently Being Utilized Here and Worldwide

• Electricity: Gas or steam turbines and ORC generators
• Steam: Boiler and community heating systems
• Direct Thermal: Kiln Operations & Sludge Dryers
• Combustion: Industrial thermal oxidizers
Project = Feedstock + Application

DRIVING vs. DRIVEN Variables

Feedstock

Application

Chicken Litter
(Dried Biosolids)

Process Heat

Drying

Steam

ORC Generator

Steam Turbine

Recip. Engine

Combustion Turbine

Gas to Liquids

Increasing Difficulty

80+% Wood

Tire

50+% Wood

Pelletized Crop

Processed MSW

Unprocessed MSW

Chicken Litter (Dried Biosolids)

MSW

Boral Brick

Lebanon/Covington

Sevier Solid Waste Inc.

ASR

Boral

Brick

Lebanon/Covington

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Sevier Solid Waste Inc.
A Municipal Vision Taking Shape Now

Garbage → Municipal Garbage → Pellets Out of Sorter & Into Gasifier → Municipal Waste Sorter → Plastics, Glass, Metals → Sorrter Removes Recyclables → Pellets → Wood Waste → Tires, Sludge, Crops?

Output Options:
- Electricity
- Class A biosolids

Application options:
- Power Generation
- Sewer Plant Sludge Drying
- Combined Heat and Power
- ??

Heat and/or electricity for the process

→ Provide key infrastructure to reduce disposal cost risk and volatility
Phase Approach: Use Existing Waste Streams

- **Garbage**
  - Municipal Garbage
  - Pellets Out of Sorter & Into Gasifier
  - Pellets
  - Wood Waste

- **Other Waste Streams**
  - Tires
  - Sludge
  - Crops

- **Municipal Waste Sorter**
  - Sorter Removes Recyclables
  - Heat and/or electricity for the process
  - Output Options:
    - Electricity
    - Class A biosolids

- **Application options:**
  - Power Generation
  - Sewer Plant Sludge Drying
  - Combined Heat and Power
  - ??

- **Heat Energy**

**PHASE 1: Start with what can be easily handled today**
Feedstock logistics are **KEY**

Material Collection, Preparation, and Transport

*Start with a wood base and mix other feedstock in*

Tipping Fees  Biochar Sale

Green Energy

Biochar
Covington and Lebanon Waste-To-Electricity Systems

- Feedstock Flexible System
- Energy savings at the WWTP
- Revenue streams for tipping fees and biochar
- Deferred waste disposal costs
Lebanon Waste to Energy

Known Operating Elements:
• 32 TPD material processed (Expandable to 64TPD)
• 3 tons sludge, 3 tons tires, 26 tons wood waste
• Operating 24/5/52 or 6240/year

Variable Income Elements and Cash Flow Drivers:
• Tipping fee income to City from Industry and/or Wilson County
• Material hauling and pre-processing costs
• Taking existing ATAD offline and processing sludge in gasifier
System for Sevier Solid Waste

- Reduces Compost Disposal Cost
- Reduces Odor Control Cost
- Generates Revenue from the sale of biochar
Gaining understanding of the waste and energy infrastructure needs and support for a new approach to both

- FEEDSTOCK VS. APPLICATION
  - Tipping fees and hauling costs
  - Outlet for the energy: heat or electricity or both
  - Deferred capital expenditures
  - Biochar market

- KEY CONSIDERATIONS
  - Understanding feedstock preparation and logistics
  - Managing project complexity
  - Change management
  - Work WITH regulators to resolve new issues
Questions?

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