Biomass Gasification for Wastewater Treatment
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
- Wastewater Treatment Plant Sludge
- Mixtures improve performance
Using The Producer 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**
- 80+% Wood
- Tire
- Pelletized Crop
- Chicken Litter (Dried Biosolids)
- Unprocessed MSW
- ASR

**Application**
- Gas to Liquids
- Combustion Turbine
- Recip. Engine
- Steam Turbine
- ORC Generator
- Steam
- Drying
- Process Heat

Increasing Difficulty
System Configurations
Biosolids Disposal

Waste Water Treatment Plant → Dewatered Biosolids → Storage Hopper → Thermal Dryer → Fluidized Bed Gasifier

- Thermal Fluid Loop
- Heat Exchange
- Closed Loop System
- Air Emission Control Equipment
- Biochar
Class A BioSolids

Municipal Wood Waste (~2 tpd)

Gasifier

Fuel Gas

Producer Gas Burner

Thermal Oil Heater

Flue Gas

Biochar

~5% of Feedstock Mass

Dried Biosolids

90% Solids EPA Class A

Condensed Steam Back to Plant

Sludge Dryer

Wet Sludge From Plant (~36 tpd)

15% Solids

Fertilizer Substitute
Wood Waste to Power

- **Wood Waste**
- **Gasifier**
  - Fuel Gas
    - **Thermal Oxidizer**
      - Hot Oil
      - Cool Oil
    - **Thermal Oil Heater**
      - Flue Gas
- **Biochar** (~5% of Feedstock Mass)
- **Organic Rankine Cycle (ORC) Generator or Steam Turbine**
- **Power Out**
Waste To Energy Project Development
A Municipal Vision Taking Shape Now

Municipal Garbage

Pellets Out of Sorter & Into Gasifier

Other Waste Streams

Garbage Pellets

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

Municipal Waste Sorter

Sorter Removes Recyclables

Plastics
Glass
Metals

Heat and/or electricity for the process

Output Options
- Electricity
- Class A biosolids

Wood Waste

Pellets

TIRES SLUDGE CROPS

Heat Energy

PHG Energy
Phase Approach: Use Existing Waste Streams

**Application Options:**
- Power Generation
- Sewer Plant Sludge Drying
- Combined Heat and Power
- Heat and/or electricity for the process

Output Options:
- Electricity
- Class A biosolids

**PHASE 1:** Start with what can be easily handled today

- Garbage
- Municipal Garbage
- Pellets Out of Sorter & Into Gasifier
- Pellets
- Wood Waste
- TIRES
- SLUDGE
- Other Waste Streams
- Municipal Waste Sorter
- Sorter Removes Recyclables
- Plastics
- Glass
- Metals

Heat Energy
WWTP Waste to Energy Projects

City of Covington
Covington, TN

City of Lebanon
Lebanon, TN

Sevier Solid Waste
Pigeon Forge, TN
City of Covington, TN

- Serve the Community
- Reduce Landfilled Material
- Help Our Environment
- SAVE THE CITY MONEY

Covington, TN USA
Population: 9,063
Area: 10.3 sq. miles
Covington Waste-To-Energy Plant
Covington WWTP (1.5 MGD)
Covington WWTP Facts

- Max Flow – 1.5 MGD
- Avg. Daily Flow – 1.0 MGD
- Peak electrical load 150Kw
- Avg. electrical load 100Kw
Covington Waste to Energy System: Site Layout

Process Steps:
1. Prepare and feed wood
2. Mix the sludge/wood together
3. Run the mixture through a dryer
4. Gasify the material
5. Combust the Producer Gas
6. Heat the thermal oil
7. GE ORC
Waste Material Is Feedstock

City Wood Waste:
Collected and used as fuel

Sludge From Sewer Plant:
utilized rather than trucking to landfill
Waste Combines

Feedstock is combined, dried and sent to the top of the Gasifier by conveyor equipment.
Clean Conversion To Fuel Gas

Thermo-chemical Gasification process converts feedstock to fuel gas **without** incineration
Fuel Gas is Combusted in a thermal oxidizer to cleanly produce heat

Heat Drives an Organic Rankine Cycle Generator to make electricity through a hot oil loop

→ Deferred Disposal Costs
→ Deferred Electricity Costs
→ Reduced Carbon Footprint
City of Lebanon, TN

Lebanon, TN USA
Population: 28,408
Area: 38.63 sq. miles
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

Yields $100k/year free cashflow
Lebanon, TN WWTP

City of Lebanon WWTP

Future Biomass Gasification Facility
Lebanon, TN
Waste-To-Electricity System

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

- Max Flow – 5 MGD
- Avg. Daily Flow – 3.0 MGD
- Peak electrical load 800Kw
- Avg. electrical load 600Kw
- Gasification system to generate 420 kW
A Positive Economic Impact Is Essential For Every Project

Always a Foundation or Cornerstone of Problem Solving

- **REVENUE STREAMS**
  - Tipping fees
  - Outlet for the energy: heat or electricity or both
  - Deferred capital expenditures
  - Biochar market

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