Distributed Generation:

The Use of Biomass to Create Electricity

Jim Neumeier,
Vice President, Business Development

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Tulane University School of Science and Engineering 2011 ENGINEERING FORUM

Agenda

- Company Introduction
- Commercial Strategy/Market Penetration
  -Operational Partner Roles
- IEI's Validated WTE Solution
- Brief Cost/Benefit Comparison
- Questions

IEI Overview

- Founded in 2001
- Headquartered in Fenton, Mo (suburb of St. Louis)
- Privately funded
- 27 worldwide patents

- Technology based upon proven pressurized updraft Gasification and Genset technology that includes field-based retrofit of existing diesel & natural gas fleets
- Mission: develop and commercialize megawatt-scale, distributed power generation using carbon-based, renewable fuels

Waste-to-Energy (WTE) Solution

- 2 MW building blocks
- Megawatt class, distributed generation
- Scalable, deployable, modular system
- Fully automated
- No dependence upon transmission lines
- Months to installation
- Solves large waste management issues

Operational Partners

Extended Enterprise Model

- Expertise
- Technology Partners
- Credibility
- Operational Partners
- Reduce Risk/Capital
- Commercial Partners

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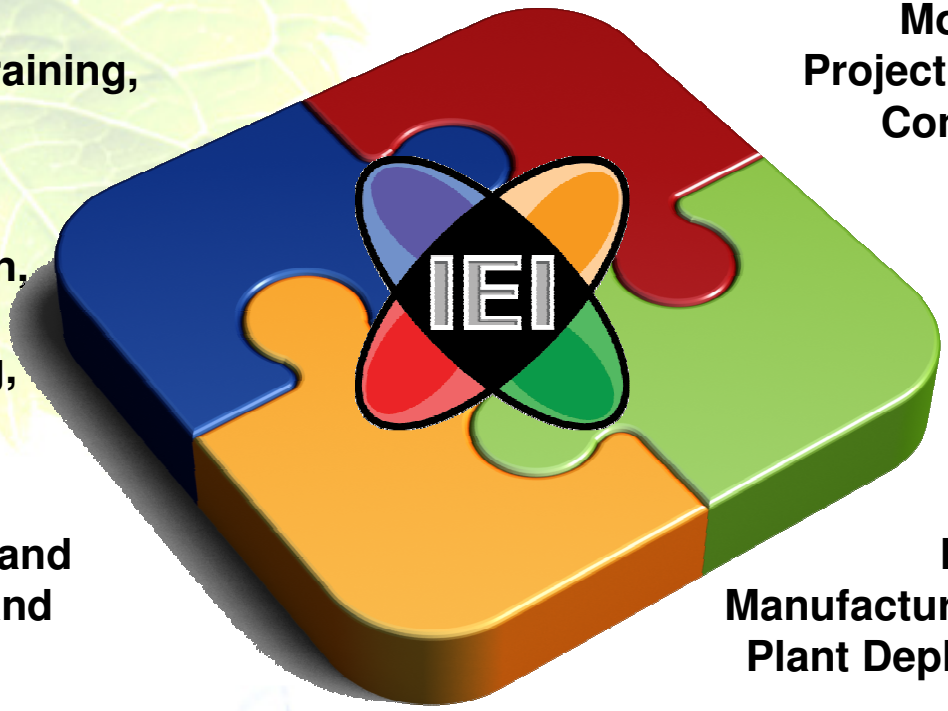
Operational Partner "Drill Down"

Operation and maintenance, training, spare parts

Modular Design, Project Management, Control Systems, Purchasing

EPC site construction, site management, ASME manufacturing, bonding



Process, Chemical, Mechanical, Refinery Engineering

Genset modification and Internet monitoring and control

Modular Manufacturing and Plant Deployment

Corporate finance (clean tech companies)
Renewable energy development and project finance
Environmental policy/law

The IEI Difference

- Engaged subject matter experts
- Well-funded system upgrades
- Practice trials, validation & commissioning

Fully Integrated WTE System

Fuel Sourcing → Gasification (Syngas) → Electrical Power Generation

- Electricity
- Heat for HVAC
- Waste Stream Reduction

Scalable, Modular, Deployable Power Plant composed of 2MW building blocks

System Overview

INNOVATIVE ENERGY INCORPORATED

IEI Waste-to-Energy Sustainable Clean Energy System with 2 MW Pads Scalable to Your Requirements

Innovative Energy Incorporated is a privately held, emerging-growth company focused on developing technologies that generate clean renewable energy as an economically viable alternative to fossil fuels.

The demand for renewable, clean energy has been driven around the world by a global effort to limit greenhouse gases. States, municipalities and utilities only have a few options, such as solar and wind, which are much more expensive than their fossil-fuel counterparts and have limited their use.

Innovative Energy® technology is designed to use low-cost sustainable waste materials, such as trash, wood chips, and grasses to generate clean energy within the local community. Co-locating power generation, fuel, and electrical load is the most cost-effective energy model while also ensuring local energy independence.

Today, Innovative Energy's select team of dedicated professionals—from technicians and engineers to top management and investment partners—is focused on commercializing these sustainable energy solutions and transforming the global energy markets.

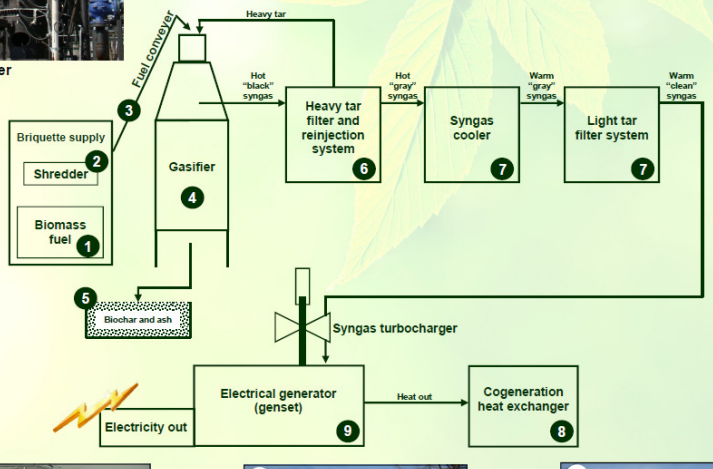
Fuel conveyer

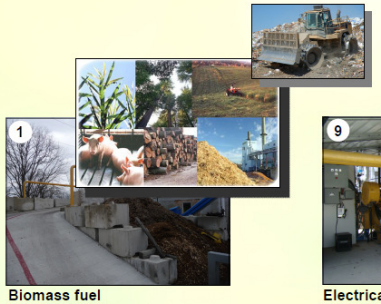
Gasifier

Biochar and ash hoppers

Tar collection tank

Raw fuel shredder





Biomass fuel

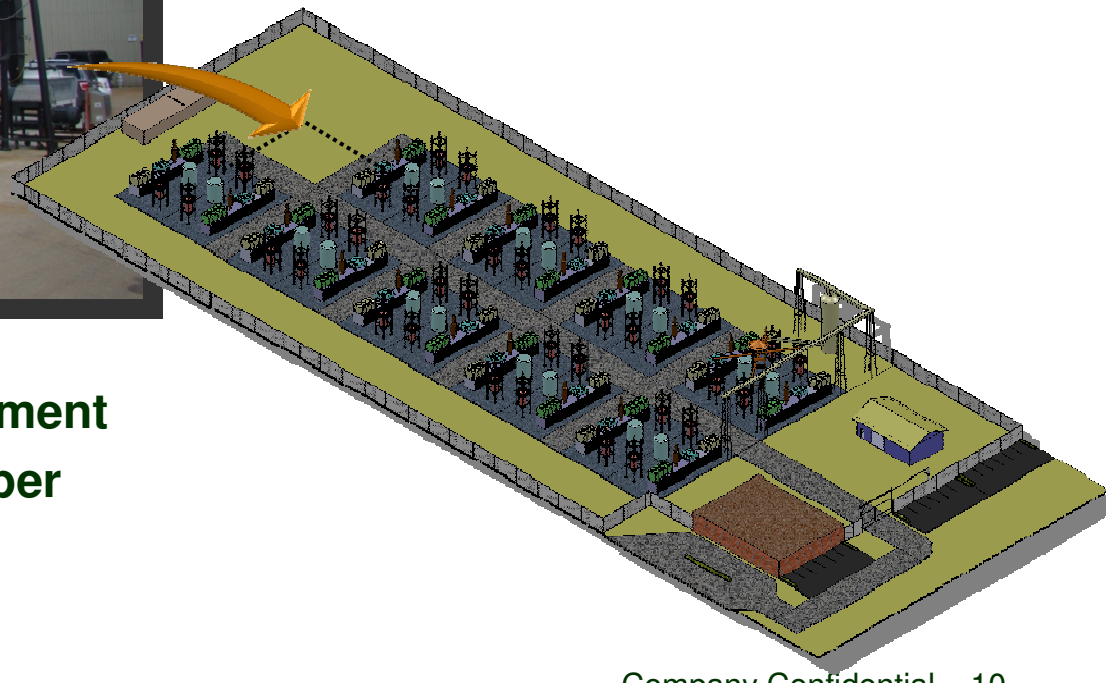
Electrical generator (genset)

Cogeneration heat exchanger

Syngas cooler and filter

Modular-Scalable-Deployable System

- 20 MW modular plant composed of 2 MW building blocks
- Scalable to meet any base load requirement



- Standard, pre-engineered site layout facilitates rapid deployment
- Compact footprint ~ 3,000 ft^2 per MW

Gasifier - Controls

- Electrical control system

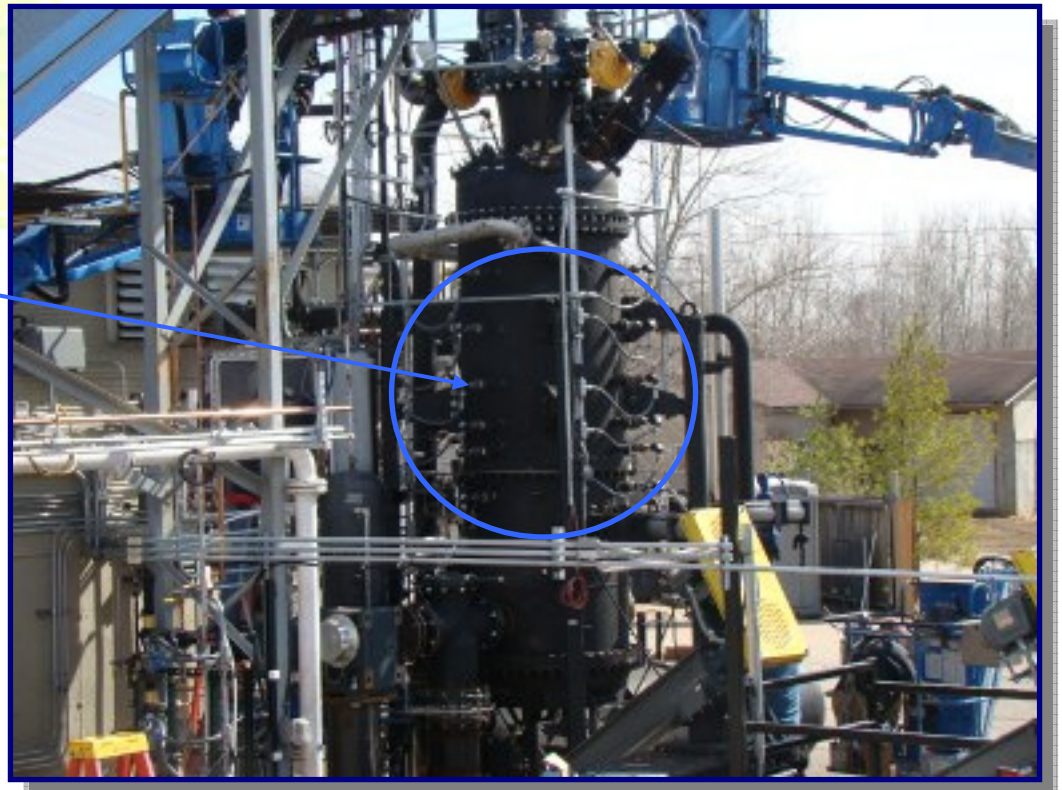

Main PLC control panel


VFD control panel

- 480 VAC control with VFD motor controllers

Gasifier – Controls

- Temperature and pressure sensors
- Proprietary temperature control system



Rear view of gasifier body

Injection/Reinjection

- Inline filters in condensate water reinjection system to prevent nozzle plugging
- Water injection nozzle material can handle high chlorides

Water control circuit

Gasifier - Controls

- Proprietary dynamic syngas filteration system

Gasifier - Safety

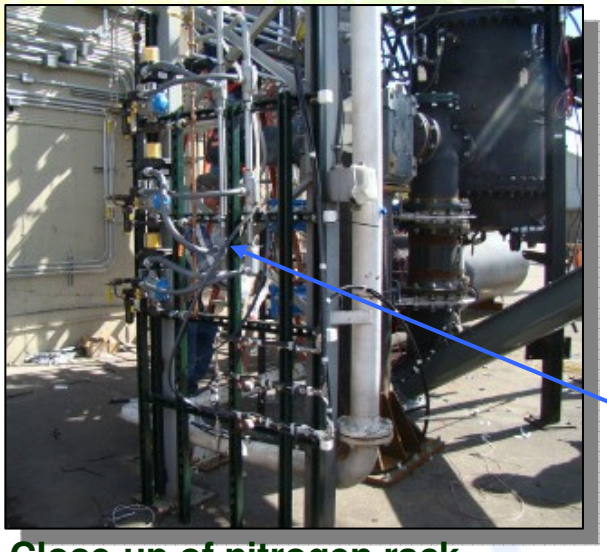
- Pressure-relief valves

Front view of gasifier

Gasifier - Safety

- Class-1/Division-2 electrical system

Rear view of gasifier

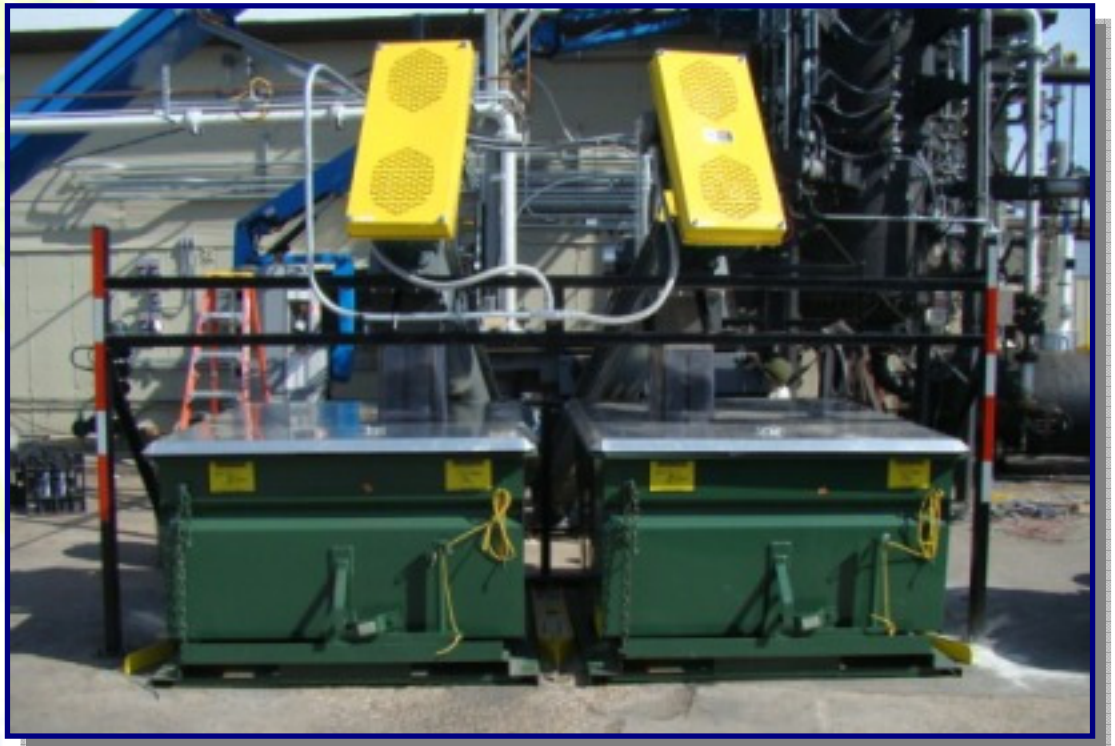


Close-up of nitrogen rack

- Nitrogen solenoid purge rack system for ash exit system

Gasifier - Ash/Slag Separation System

- System separates biochar and ash/slag automatically
- Biochar may be recycled with new fuel



Biochar and ash/slag conveyors with exit hoppers

Gasifier - Controls

- Heat-traced and insulated primary 80-gallon tar collection tank
- Proprietary tar reinjection pump with controls

Tar collection and reinjection system

Syngas Cooler & Filtration

- Light tar vapor removal system

Syngas Cooler & Filtration

- Syngas cooler
- Primary filter and secondary filters
- Heat-traced and insulated for process temperature control

Syngas Cooler

- Syngas cooler duct work
- Heat-traced electrical control panels

Rear view of syngas cooler

Proprietary Generator - Genset

- Caterpillar 3516TA 1.3/2.0 MW engine genset
- Control system for syngas/dual fuel operation
- Specialized ignition, instrument, and fuel control

Genset

Generator - Controls

- HMI touch screen annunciation
- Easygen engine system control
- Live syngas monitor controller
- CH4, CO and H2 with BTU monitor
- Air fuel mix controller
- Timing controller
- Knock controller

Genset main control cabinet

Generator – Turbo Cooler

- Turbocharger after cooler system
- Fan noise limited to 55 dba

Turbocharger after cooler

Generator - Radiator

- Fan noise limited to 55 dba
- Optional co-generation heat source

Genset radiator

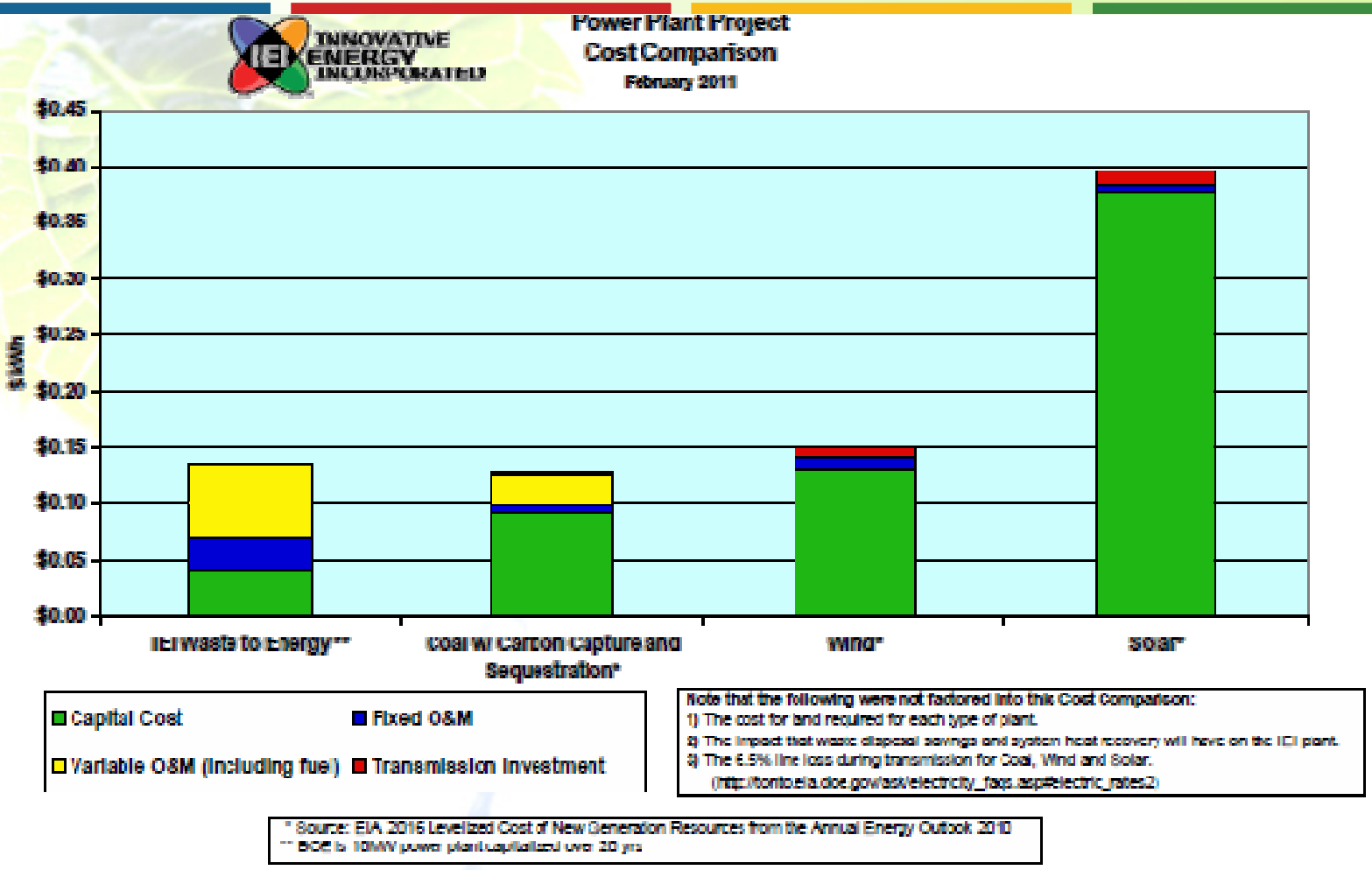
Flexible Energy Platform Mitigates Biomass Risk

- Reduces technical/economic risk with system flexibility
- Reduces economic risk with scalability
- Reduces economic/political risk with small footprint, distributed, design

All communities should weigh risk factors

- Community support
- Project economics
- Site / infrastructure
- Fuel specifications
- Appropriate technology

Cost/Benefit Analysis
Comparative Renewable Technologies



IEI WTE Advantages

System Features

- Continuous "Baseload" power
- Waste to Energy
- Modular, Scalable, Deployable

Direct Benefits

- Reduced dependence on the grid
- Fueled by existing waste streams / biomass
- Recycles current waste streams into energy
- Fueled by existing waste streams / biomass
- Advanced technology provides very small footprint/MW
- Provides substantial levels of electrical energy and heat while reducing waste
- Technology commercially validated

Thank You

Questions and Discussion