Creating Energy from Waste

The Biogas Segment

David McCallum, Business Development
GE Power & Water, Gas Engines
GE’s Gas Engines Business

Global Employees: ~ 2,800 | Operating in 100+ countries*

**Power Generation**
- Jenbacher, Waukesha

  - Electrical output: 335 – 8,850 kW
  - Electrical efficiency up to 48.7%, overall efficiency over 90%
  - 19,500+ engines delivered, 18,200 MW power globally
  - Natural gas and CHP, a leader in special gas applications (biogas, LFG, CMG, BFG), oilfield power

**Gas Compression**
- Waukesha

  - Output: 160 bhp – 4,835 bhp (119 kW – 3,605 kW)
  - 12,000+ compression engines delivered, over 13.2 million bhp power globally (9,850 MW)
  - Wellhead, gathering, storage/transmission

**Heat Recovery**
- Clean Cycle™

  - 125 kW_e generator for waste heat-to-electricity
  - For engines, biomass boilers, other heat-wasting applications as low as 121°C (250°F)
  - No additional emissions in operation

* figures as of 31 Dec 2010
Fuel Flexibility and Tailor-Made Solutions

- Landfill gas
- Sewage gas
- Oilfield applications (AP gas)
- Special gases
- Biogas
- Island mode
- Cogeneration (Natural gas)
- Industrial power plants (IPPs)
- Greenhouse applications
- Coal mine gas

GE Power & Water, Gas Engines
Biocycle – November 2011
GE’s Waste-to-Energy Product Portfolio

**Waukesha APG®1000**
- Electrical output: 1,100 kW (60 Hz)
- V16 cylinder
- 1,800 rpm (60 Hz)
- Since 2006 in the product program

**Jenbacher Type 2**
- Electrical output: 335 kW (60 Hz)
- V8 cylinder
- 1,800 rpm (60Hz)
- Since 1976 in the product program

**Jenbacher Type 3**
- Electrical output: 633 - 1,059 kW (60 Hz)
- V12, V16 and V20 cylinder
- 1,800 rpm (60 Hz)
- Since 1988 in the product program

**Jenbacher Type 4**
- Electrical output: 900 - 1,421 kW (60 Hz)
- V12, V16 and V20 cylinder
- 1,800 rpm (60 Hz)
- Since 2002 in the product program

**Jenbacher Type 6**
- Electrical output: 1,622 – 3,013 kW (60 Hz)
- V12, V16, V20 and V24 cylinder
- 1,500 rpm (60 Hz with gear-box)
- Since 1989 in the product program
Energy Balance of a Gas Engine

~1:1 Ratio (electric:thermal)
Applies
• Important consideration when picking the right prime mover
The Waste-to-Energy Product Line

Average electrical output [kW]
Average thermal output (70°C/90°C) [kW]
Uses of waste heat

Most efficient/effective

• Direct use of exhaust (ie: drying)
• Hot water for reuse
• Steam generation
• Steam absorption chilling
• Direct fired absorption chilling

Least efficient/effective

• Hot water absorption chilling
Thermal energy “value” by source

**Exhaust:**
- Direct to process
- Hot Water
- Steam
- To Absorption Chiller

**Jacket water:**
- Direct to process (cooling)
- Preheat Condensate/feedwater
- To Absorption Chiller
GE’s Jenbacher gas engine business offers customized biogas solutions
GE’s Jenbacher gas engines dual fuel biogas solution produces 1,060 kW of electricity and 1,240 kW of thermal energy for a total system efficiency of 85.7%.
Trigeneration with gas engines

- Operated with heat, utilizing inexpensive “excess energy”
- No moving parts in absorption chillers, **no wear** and therefore **low maintenance expenses**
- **Noiseless** operation of the absorption system
- **Low** operating costs and **life-cycle costs**
- **Water** as refrigerant, **no use of harmful substances** for the atmosphere
Four of GE’s Jenbacher gas engines surpassed 200,000 operating hours, and generated about 46,000 MWh of electricity annually displacing the equivalent of 360,000* tons of CO2 since 1999.

* According to the airports annual report 2007
The other “Trigen”: Greenhouse Fertilization
The GE’s Jenbacher gas engines Greenhouse Solution produces 12 MW of electricity while directing the thermal energy and CO₂ from the engine exhaust to the greenhouse, achieving a total system efficiency of 93%
GE’s CHP ROI web tool

https://www2.gepower.com/chp_calculator/pages/CHPTool.jsp
Promoting the use of Biogas and Anaerobic Digestion

- 162 Members from the U.S., Germany, Italy, Canada and the UK
- All Industry Sectors Represented

**Key Industry Goals:**

- Promote biogas markets, technologies and infrastructure
- Achieve policy parity
- Promote as a best practice for environmental stewardship and greenhouse gas reduction

www.americanbiogascouncil.org
Changing the Biogas Industry through:

- Legislative and Regulatory Affairs:
  - Federal: Biogas Tax Credit; Clean Energy Standard; NAT GAS Act; Farm Bill
    - Introduction of Biogas ITC Bill (Rep. Kind)
  - States: California, Iowa, Massachusetts, Indiana, more

- Sharing Expertise:
  - 5 Specialized Working Groups

- Education and Outreach:
  - Briefings, presentations, and webinars for customers, policy makers, and the general public
  - Large Industry Network – 150+ company members
    - Entire supply chain of production, processing and use

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**ABC Webinar Series: Maximize your Biogas Production**

More details here: [http://www.americanbiogascouncil.org/about_webinars.asp](http://www.americanbiogascouncil.org/about_webinars.asp)

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