From Waste to Energy
From Problem to Opportunity...

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Agenda

- Bio Gas
- Anaerobic Digestion (AD)
- Sources of Municipal Bio Gas
- Bio Gas to Electricity
- Case Studies
Anaerobic Digestion

- A natural biological process
- Anaerobic digestion that produces biogas can occur naturally as in landfills or in controlled environments such as biogas plants.
- These gases contain methane which is burned as fuel.
- Low BTU generator sets required to burn the methane mix gases recovered.
- Utilized gases are damaging to the environment if allowed to escape.
- Use of these gases help to reduce global warming.
Renewable – Biogas / Biodigesters

Cummins gensets can turn methane into electricity and heat for the anaerobic digester, eliminating its release into the air and providing a revenue stream from net metering and GHG credits.
Cogeneration (CHP)

CHP is an efficient choice. Up to 85% of the fuel consumed can be turned into usable energy, in properly sized and operated systems.
Biogas plants

- Biogas plants use airtight steel tanks or covered lagoons as anaerobic digesters.
- The digesters are fed with food, agricultural or other biodegradable wastes.
- These act as feed for various types of bacteria, resulting in high methane biogas.
- The gas is cleaned and then fed into a Generator.
- Waste exhaust and engine heat can be efficiently used.
Landfill

- Traditional landfills contain 50% organic waste, which produces gas naturally through anaerobic digestion.
- Landfill gas consists of approx. 50% methane (CH4) plus CO2, N, ammonia and non-methane organic compounds.
- The biogas is retrieved by drilling wells into the landfill and collecting gas.
- Converts methane to CO2 reducing the greenhouse effect.
Preparation of Landfill site
Landfill – Gas Equipment
Waste Water

- Untreated wastewater in municipal and industrial treatment plants can produce biogas through anaerobic digestion.
  - The biogas is produced by digesters used in the treatment process and then captured as a fuel source.
- The gas recovered can have a high methane content of 65-75%.
- Sludge disposal is a significant issue for municipalities.
- Cost of disposing of sludge and solids.
- Waste heat can be used to dry the sludge and then feed into a Gasifier to produce more electricity.
Energy Crops

- Cactus
- Moringo
- Sorgum Stalks
- Sugar stalks
A Social Business Opportunity
Energy Crop Farming

- Community grown biomass
- Low skills set required
- These crops require no fertilizer and are hardy
- Job creation
- Farmers sell to the Power Plant
- Renewable energy
Plug and Flow BioGas Digester

- Horizontal Biogas Digester - Plug and flow system
- Use of Greenhouse and Engine waste heat to warm digester
- Cost effective material to lower capital cost
Phases to a Bio Gas from Waste Project

Identify Bio Gas Sources
- Feedstock
- Location
- Consistency of Supply
- Tons Vs Power generated

Use of Power and Heat
- Municipal Use of Power
- Surplus?
- Nearby Industrial Parks
- Heat for drying Sewerage Sludge

Commercial Project
- Gas Off-taker - Investor
- Gas Power Plant
- Power Purchase Agreement
- Operation and Maintenance
Cherry Island Landfill

- Owned by Delaware Solid Waste Authority
- Approximately 1,800 tons per day of MSW
  - Currently holds 8M tons of MSW
  - 25 years remaining capacity
- Cummins Power Generation was the successful bidder for gas rights on the RFP
  - Existing contract with Calpine ending, RFP issued in early 2010
- Gas volume currently at 5,000 scfm @ 50% methane content
  - All available for purchase except 1,100 scfm
  - Approximately 110mmBTU/hour of energy to sell
Biogas Pipeline Route
Landfill Biogas – Case Study

The Project
• Methane recovery to generate power for sale to nearby cement plant
• Ten year operation and maintenance agreement

Viridor Landfill, Scotland UK

The Outcome
• Power that can be profitably sold

The Solution
• 3.5 MW turnkey waste-to-energy power plant
Municipal Organic Waste – Case Study

Canary Islands, Spain

The Project

- Reduce volume of waste products entering local landfills
- Economical power and heat from low-Btu methane production process

The Outcome

- Profitable operations
- Sale of excess power to local utility at premium price for biogas-derived power
- Environmentally-sound waste reduction

The Solution: 2,7 Mwe Power Plant
Municipal Utility

CHP Biogas - Le Sueur, MN

**Customer’s Background and Needs**

- Hometown BioEnergy, Le Sueur County, MN
- Utilize renewable biogas to meet state renewable energy requirements

**The Solution**

- Combined Heat and Power Application
- Provided 4 grid paralleled QSV91 Phase II engine generator sets

**Commercial Overview/Benefits**

- Generating electricity for customers from municipal waste biomass feedstock
- Selling fertilizer to end users for additional revenue
Project Experience: Dunbar Landfill

**Project Area:** Europe

**ESB Customer:** Viridor

**Site Name:** Dunbar, UK

- Full turnkey design modular solution on new landfill developed
- Power house construction
- Dewatering particular removal
- Runs on untreated landfill gas
- High siloxane experience

**Application:** Utility Base Load-power Low BTU

**Generator Sets:** Four 1750 GQNB
Project Experience: Columbus Waste Water Works

**Project Area:** USA

**ESB Customer:** Columbus Water Works

**Site Name:** Georgia, USA

**Application:** Converting waste gas generated as a byproduct of waste water treatment into electrical and useful thermal energy.

**Current Run Hours:** up to 75000 in total

**Genset Model Number:** Two 1.75 MW C1750 N6C lean-burn generator sets
Project Experience: Riverside Sewage

**Project Area:** UK

**Application:** Biogas Combined Heat and Power project

**ESB Customer:** Riverside Sewage Treatment Works

**Current Run Hours:** 2000 (2014)

**Site Name:** London, UK

**Genset Model Number:** C2000N5C LOW BTU
Thank You

Cummins Power Generation