



A Successful South Carolina Landfill Gas Project

Enoree Phase II Landfill
Greenville, SC

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Clean Energy Web cast

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Quick Project Overview:

- **Owner:** Greenville Gas Producers, LLC (GGP) & County of Greenville
- **Location:** Enoree Landfill - 1311 Anderson Ridge Rd – Greer, SC 29651
- **Developer:** William P. Brinker (Jr) & the GGP development Team
- **LMOP Industry Partners Involved:** Greenville Gas Producers, Enerdyne Power Systems, Advance One Development, GC Environmental, Golder Associates, Caterpillar, Caterpillar Financial Services, County of Greenville, & Duke Energy Carolinas.
- **Output:** 3.2 MW
- **Fuel:** Landfill Gas
- **Engines:** Two Caterpillar G3520's

Overview Continued:

- ***Expected Life:*** 15+ years
- ***Operational As Of:*** July of 2008
- ***Power Purchase Agreement:*** Duke Energy Carolinas, LLC – Contract
- ***Renewable Energy Credits (REC):*** Sold to Duke Energy Carolinas, LLC
- ***Carbon Credits:*** Validated, Verified, & Sold Under VCS (Voluntary Carbon Standard)
- ***Section 45 Tax Credit:*** Qualified – 10 yrs



Background

Landfill and Siting Considerations

- **Enoree Landfill** — Closing, Needed to be capped, <2.5 MM MG of Waste in Place.
- Needed a flexible wellfield with lots of valves to allow for the capping contractor to work while we kept the flare operating and any end-use operating, so the system was segmented into 6 sections so that any 4 or 5 could be on line at all times to support a speedier capping and a healthy landfill gas end use.
- The GCCS was originally constructed on top of the ground so that segments could be lifted away by the capping contractor, the contractor could install boots around the wells and the system placed back on top of the synthetic liner and covered with soil.

Background Landfill and Siting Considerations

- System above ground



- Significant Valve / segmenting system



- Placed on the Cap later



- Lots of Rock



Landfill Gas 101

Electricity Projects



Diversity of Project Types Electricity Generation



**Internal
Combustion Engine**
(range from 100 kW to 3 MW)



Gas Turbine
(range from 800 kW to 10.5 MW)



Microturbine
(range from 30 kW to 250 kW)

Landfill Gas 101

Costs of the Technologies

- Reciprocating Engines 40% Efficient
\$1,400/kw to install
Need 5-7 cents/kwh to retire debt
- Micro-Turbines 28% Efficient
\$2,200/kw to install
Need 7-9 cents/ kwh to retire debt
- Gas Turbines 28% Efficient
\$1,300/kw to install
Need 4-7 cents/kwh (CHP) &LG. LF.

Greenville Gas Producers, LLC & the County of Greenville South Carolina





Enoree Phase II MSW Landfill

- Completely Voluntary GCCS
 - 76 Collection Points
 - 2000 scfm flare
- Greenville County wanted to be a good neighbor!
- 'Beneficial-use' project desired
- GCCS design by Golder Associates
- Built by Advance One Development, LLC & Enerdyne Power Systems, Inc



Major Accomplishments:

- First known US landfill VCS Project
- First successful **non-utility** owned LFG power generation project in SC.
- Very Successful new Siloxane & Gas Treatment System.



Carbon Credits – Getting Started

- Good Thing...
- Helped a small project like this one become a viable option!
- Provides a significant incentive to maximize collection efficiency.
- They Truly Promote a 'Green' Image for the community.

Carbon Credits

- First known US landfill gas project to be:
 - Approved,
 - Validated,
 - Certified to earn VER (Verified Emission Reduction) credits, and
 - Traded under VCS (the Voluntary Carbon Standard).
- VCS is one of the most stringent and recognized quality carbon standards in the world.
- This project has already generated and sold 90,000 tonnes of Verified Emission Reductions (VERs).
- Expected to generate over 120,000 tonnes in 2009





Carbon Credits... What's involved?

- Detailed Reporting
 - Daily, Weekly, Monthly Reports
- Continuous recording
- Having the right equipment!
- Redundancy
 - 3 flow meters
- Ex. 4 daily readings
 - Site Operator – GEM 2000
 - Yokogawa Chart Recorder
 - SCADA System
 - Office Dial-in
- Semi-Annual Verifications



Carbon Credit Challenges

- Only CDM methodologies were accepted by VCS when initiating this project
- Few DOE's (Designated Operational Entity) were available
- CDM methodologies are complex & use very conservative calculation values.
- CDM – 'Additionality' – difficult to argue and project specific
- Validation is extremely time consuming

Power Project Barriers:

- **The local utility cooperative could not purchase the power...**
- **... and it was not economically feasible to 'wheel' the power to another utility.**
- **GGP had to build a power line directly to a utility that would buy the renewable power (Duke Energy Carolinas, LLC)**
- **This was no small feat. 1 mile of new line & 2.5 of upgrades**
- **Some of the permits and approvals included:**
 - the US Army Corps of Engineers,
 - (two) Wetlands Boards,
 - SC DHEC Bureau of Water – to cross a 'navigable waterway'
 - Crossing under a 230KV main Transmission Line,
 - Crossing over an 800 PSI Gas Transmission Line,
 - Approvals in Greenville & Spartanburg Counties
 - DOT & County road crossing permits, and
 - Private right-of-way acquisitions.

Power Generation Equipment:

- Two Caterpillar G3520 LFG engines.
- 20-cylinder
- 2233HP
- 1.6MW Each
- 30 year Industrial Grade
- Fully enclosed 'package' unit
- ISO Switch Gear
- Modular – 'easy' to move
- These are among the cleanest and most efficient engines available on the market today.
- *Supplied by:* Blanchard Caterpillar (SC dealer)





SILICA BUILD UP INSIDE THE FLARE HOUSING

Gas Treatment System:

- GC Environmental, Inc. Designed & built the state of the art gas treatment skid.
- This patent pending process removes water, siloxanes, and many non-methane hydrocarbons.
- The process has been effective in removing siloxane with some lab results coming back as 'non-detectable.'



Gas Treatment System:

- Siloxane content is being reduced from the 15-20 PPM range to the PPB range.
- The skid employs a proprietary Pressure Swing Adsorption & Temperature Swing Adsorption Technology
- Able to remove light and heavy siloxanes
- We expect to see a substantial increase in the life expectancy of the engine.
- Saving oil changes means more on-line time, and reduced O&M costs.



Benefits to the County

The County will receive several benefits over the life of this project...

The County benefits by about \$300,000 per Year with about 60% in cash and 40% in avoided costs of power and personnel.

A few include:

Cash

- Revenue from gas payments
- Revenues from associated credits (Carbon / Tax/ etc).

Avoided Costs

- GGP will also operate and manage the project at **no** cost to the County.
 - Including capital improvements to the well-field and equipment,
 - general well-field O&M, power, insurance, calibrations, technicians, permits,
 - and all associated responsibilities to the end-use project.
- A '**tonne**' of positive **PR**. Just Google it...



Environmental Benefits

Produces enough power for about
2000 homes!

The **Annual Reduction** of GHG
attributable to this project is
approximately the same as the
annual GHG emissions of:

- More than **25,000** passenger cars
- Carbon Dioxide emissions from **319,000** barrels of oil consumed
- Carbon sequestered by **31,000** acres of pine forest!



Project Costs

- \$3.5 Million Financed by Caterpillar Financial Services for:
 - Engines
 - Gas Treatment Skid
 - Power Lines
 - Transformers
 - Installation & miscellaneous items
- Approx. \$1 Million more By Greenville Gas Producers, LLC.
- Approx. \$1 Million was spent by Greenville County.

Plant Operation:

- 24/7 Operation
- 95% + online time @ full capacity
- 3.2 MW
- 1 full time technician
- Scheduled maintenance is on off-peak hours
- 1- runs Synthetic oil
- 1- runs CAT NEGO EL350 oil
- Sound Attenuation – Very Important!





Moving Forward...

- If you have a landfill, public or private...
- Use this project and others that have been done as an example...
- LFG projects from medium BTU to high BTU, power, or simply flaring are **POSTIVE** and beneficial in a number of ways.
- Act ahead of the curve...
- **TAKE ACTION!**
- **ACT NOW!**
- Everyday without a project is a day of lost revenue and it causes undo harm to our environment!

Night time



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