Turning Trash Into Cash with Landfill Gas-to-Energy Projects

Speakers:

**Cerro Colorado Landfill, City of Albuquerque:**
Mark Dear: Environmental Compliance Coordinator/Facility Engineer, City of Albuquerque Solid Waste Management Department; and
Marcia Pincus: Mountain Region Manager, SCS Engineers

**Prairie View Landfill, Will County:**
Dean Olson: Director, Will County Land Use Department, Resource Recovery & Energy Division
Landfill Gas to Energy Utilization at the Cerro Colorado Landfill

Transfer of Landfill Gas to the Metropolitan Detention Center (MDC) for use in a pre-heat domestic boiler
Grant Application Award

- In 2010 the City of Albuquerque Solid Waste Management Department (SWMD) was selected by the EPA Climate Communities Grant Program as a finalist for a $500,000 grant for to utilize landfill gas from the Cerro Colorado Landfill to help an on-site contractor recycle glass, and to help provide energy to the Metropolitan Detention Center (MDC) adjacent to the landfill in western Bernalillo County.
- SCS Engineers was retained by the SWMD to develop a Focused Feasibility Study to develop options and provide recommendations for landfill gas usage at the MDC.
The Cerro Colorado Landfill is located about 9 miles southwest of the City of Albuquerque.

The landfill was built in 1989 and has been accepting municipal solid waste and certain special wastes since that time.

Total acreage at the landfill is 980, with 395 acres permitted for waste disposal. The total capacity is 81 million cubic yards.

The landfill is subject to NSPS 40 CFR Part 60 WWW.

In 2004 a gas collection and control system was installed, which included 40 vertical wells, an open flare with a maximum capacity of 2130 SCFM, and two blowers to provide vacuum on the collection system. There are currently 46 vertical wells, and wellheads on 7 leachate risers and one horizontal gas line.

The Cerro Colorado Landfill is the largest landfill in the State of New Mexico, and primarily services the City of Albuquerque, Bernalillo County, and other surrounding towns and counties.
Focused Feasibility Study

- The EPA grant provided a 3 year window for design and completion of the project.
- The feasibility study was to explore the possibility for direct gas usage in the MDC boilers, or possibly utilize landfill gas for electrical generation at the MDC.
The standard model for landfill gas production is the EPA’s LandGEM model.

SCS Engineers has developed their own first order decay model, based on LandGEM, which has variable Ultimate Methane Recovery Potential (Lo) and Decay Rate Constant (k) that are more representative of the low precipitation and overall climatic conditions encountered in southwest United States landfills. The SCS model also estimates recovery directly, which requires an estimated of the current and future coverage and effectiveness of the proposed ongoing gas collection system.

The SCS model was used in this Feasibility Study.
The Three Options for Direct Use of the Landfill Gas at the Metropolitan Detention Center

The hot water usage at the MDC varies, but was estimated for design purposes as 50 gallons per day per inmate, which equates to about 135,000 gallons per year. Since landfill gas production is too limited to effectively produce electricity, the following were proposed as viable uses at the MDC:

1) Modify a **single hot water heater** or boiler with new burners in order to accommodate LFG usage.

2) Add a **dedicated pre-heat LFG boiler with by-pass option** and recovery capacity to match 50% of the hot water load.

3) Add a **dedicated LFG** boiler with recovery capacity to match at minimum 50% of the connected hot water load requirement.
The first option was to replace one of the Raypak natural gas burners on one of the existing boilers for domestic hot water. The conversion from natural gas to LFG would have required 1.825 MMBTU per hour, and would have produced 25 GPM of 180 F hot water at full capacity. Specialized burner tips would have been required, and it appeared that such modification would be difficult to find for a Raypak boiler.

This option would have only used about 18.5% of the LFG currently available from the LFG collection system, and the boiler would be restricted to only operating on LFG, and although bypass would be possible, it would limit the facility to only two boilers instead of three.
Option 2 was recommended by SCS and was chosen as the most viable option for the MDC, allowing flexibility in their day to day operations. As part of their recommendations, SCS also looked at the possible use of the LFG for electrical generation. They recommended a Cat 3520 gen-set, capable of producing 1.6 MW of power. The estimated cost for the gen-set was $4.3 million, with annual O & M costs of $250,000 to $450,000, which was outside the funding scope for this project.

A Sellers S-125-W 3049 MMBTUH boiler was installed at the MDC, and operates as a pre-heat boiler in conjunction with both the facility domestic and laundry hot water heaters. The boiler pressure needed to match that of the typical house pressure of 60 psi. This initially proved somewhat difficult.
For transport of the gas from the landfill to the MDC, SCS specified a Perennial Energy GCS-450-343 450 SCFM gas compression station. Since prior LFG lab analysis did not indicate any elevated levels of particulate, aerosols, or other contaminants, then filtration of the gas was not required. Exposed portions of the transmission line at the landfill and the MDC were done in stainless steel with cathodic protection, including the pig launching station at the MDC, and the receiving station at the landfill.

In order to accommodate possible future use of the LFG for electrical generation at the MDC, a 12 inch HDPE transmission line was installed, although only a much smaller line was needed for supplying gas to the pre-heat boiler at the MDC. Because of the volume in the line, only 7 psi of operating pressure is required to maintain ongoing operation of the Sellers S-125-W 3049 MMBTUH boiler.
It was decided that the logical location for the compressor station was adjacent to the existing flare station, located on the west side of the landfill property. The gas could be diverted prior to entering the flare station, and the controls between the two could be easily integrated if they were adjacent. The transmission line is approximately 2 miles in length, and is routed around the waste disposal cells along a landfill access road, then up a steep hill, and then across the MDC property through a restricted area and up to the physical plant.

The SWMD did the trenching, backfilling and pipe installation on the City property side, while Bernalillo County handled excavation, installation, and backfill on their side. SCS handled all fabrication, welding, and above ground installation, including installation of the boiler and support systems at the MDC. Construction over-site was handled by SCS, and the coordination between the public entities and the engineers was accomplished fairly seamlessly.
# Emission Reductions and Environmental and Energy Benefits for Landfill Gas Energy Projects

For electricity generation projects, enter megawatt (MW) capacity: 

- OR -

For direct-use projects, enter landfill gas utilized by project:

<table>
<thead>
<tr>
<th>Direct Equivalent Emissions Reduced</th>
<th>Avoided Equivalent Emissions Reduced</th>
<th>Total Equivalent Emissions Reduced</th>
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<tr>
<td>MMTCO₂E/yr</td>
<td>MMTCO₂E/yr</td>
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<tr>
<td>million metric tons of carbon</td>
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<tr>
<td>dioxide equivalents per year</td>
<td>dioxide equivalents per year</td>
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<tr>
<td>tons CH₄/yr</td>
<td>tons CO₂/yr</td>
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<tr>
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Equivalent to any one of the following annual benefits:
- Annual greenhouse gas emissions from __ passenger vehicles: 1,939
- Carbon sequestered annually by __ acres of pine or fir forests: 2,407
- CO₂ emissions from __ barrels of oil consumed: 24,626
- CO₂ emissions from __ gallons of gasoline consumed: 1,201,938

Equivalent to any one of the following annual benefits:
- Annual greenhouse gas emissions from __ passenger vehicles: 228
- Carbon sequestered annually by __ acres of pine or fir forests: 283
- CO₂ emissions from __ barrels of oil consumed: 2,900
- CO₂ emissions from __ gallons of gasoline consumed: 141,536

Equivalent to any one of the following annual benefits:
- Annual greenhouse gas emissions from __ passenger vehicles: 2,168
- Carbon sequestered annually by __ acres of pine or fir forests: 2,690
- CO₂ emissions from __ barrels of oil consumed: 27,526
- CO₂ emissions from __ gallons of gasoline consumed: 1,343,474

**Energy Benefits** (based on project size entered):
- Heating __ homes: 340

For additional environmental benefit options, view the [Greenhouse Gas Equivalencies Calculator](http://www.epa.gov/energy/ggcalc.htm) on the EPA Clean Energy Web site.

LFGE Benefits Calculator
http://www.epa.gov/lmop/res/calc.htm

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Last updated 2/20/09
Installation of the gas line proved to be challenging in some locations, especially adjacent to the MDC, where there were already extensive underground utilities, including electric lines, sanitary lines, storm drains, natural gas, and water lines. Since the new transmission line was routed through secure areas with multiple line high security fencing, it was very important that installation be accomplished quickly and with restrictions on open trenching. Under the paved portions at the MDC, Bernalillo County elected to use an on call contractor for excavating and paving.

At left is the pig launching assembly being welded together above ground in order to minimize welding in the trench. Tight conditions and generally working without trench boxes necessitates above ground construction of components, which can then be lowered into the trench and welded into place. By assembling this station above ground first, SCS eliminated at least five welds that otherwise would have to be done “in-trench”. Other sections of pipe at road crossings were also assembled “out of trench”.
While you can use a trenching machine for gas line installation, there are advantages to using an excavator, which can not only do trenching work, but, when equipped with straps, can move the assembled pipe and place it in the trench. Successful lift installment when backfilling for compaction is also more easily accomplished when using an excavator.

Always use PVC or HDPE story pipes temporarily installed for surveying top of pipe elevations, in order to have accurate as-builts of the pipeline. When employing story pipes, it is best to utilize an excavator for completion of backfilling.

SCS Engineers recommended using an excavator for backfilling, but the City staff tried using a small dozer and a motor grader to roll the soil in, and it didn’t work very well. The story pipes were tipped over and inadvertently knocked off the top of pipe.
At some point in the future the MDC would like to be able to use the LFG from the Cerro Colorado Landfill to fire a generator (or series of generators) to either cover all the electrical requirements at the facility, or at least offset a significant percentage of their current requirements. Electricity is by far their current highest utility cost. Thus the decision to oversize the gas supply line to 12 inch HDPE.

The original overhead power to the landfill open flare was disconnected in 2012 when the underground feed from the new distribution panel was installed. Since the distribution panel was designed with only existing electrical needs in mind at the time, there was not room to accommodate the new compressor skid. Therefore it was necessary to reactivate the overhead 3 phase power in order to operate the compressor skid.
In 2011 the City of Albuquerque installed a 250 kW PV ground mounted solar photovoltaic system. The system was connected through a utility meter and disconnect to a new distribution panel that supplies partial power to the landfill shop, offices, truck wash, and utility flare. Unfortunately there was not enough capacity built in to the system to also supply partial power to the compression system, which required overhead connection.

The original proposal to the EPA included plans for installing a supplementary 2 inch HDPE line to supply LFG to Growstone, an on-site contractor that processes recycle glass collected and delivered by the City. The glass is initially crushed by the SWMD and then further processed by Growstone. Unfortunately the budget proved insufficient to complete the smaller gas line at this time.
Recommendations for LFG Projects at Landfills

1) Contract ASAP with a qualified engineering firm like SCS Engineers, who has extensive experience in LFG collection and control systems, and the design and installation of alternative use systems. This is a very specialized field, which most local mechanical and electrical engineering design firms are not qualified for. Most local construction companies, including plumbing and electrical specialists, are not qualified for specialized LFG system installation.

2) If you are applying for a State or Federal grant to either supplement or pay entirely for a proposed LFG alternative use project, make sure that the resources (both financial and physical) are available to fulfill your part of the project, since there are typically deadlines attached to funding.

3) When in doubt, oversize. You never know what other opportunities might arise in the future as your landfills’ gas production increases with time.

4) Where possible, try to maximize gas production in your landfill. The acceptance of certain wastes, including organics and sludge, will improve the potential for gas production. If your facility permit allows, try to recycle water or leachate through the landfill to improve gas production.

5) When installing gas lines, you should ideally try to use two excavators. The first excavator digs the trenches, while the second can lift the assembled pipe into the trench and then backfill in well controlled lifts that allow for compaction as specified by the engineer. Also, an excavator can easily dig under fences and around obstacles, whereas a trencher cannot.
PRAIRIE VIEW RDF
Prairie View RDF

- Located at JAAP (approx. 40 miles Southwest of Chicago), 223 acres on 455 Acre Parcel
- Will County Owner, Waste Management, Operator
- Maximum 23 Year Life
WM/Will County Methane to Energy Plant

- Landfill Contract Signed w/WM in 1997 w/Gas to Energy Plant Clause
  - County Retains Gas Rights & WM Installs Gas Collection System
  - WM owns Methane to Energy Plant & Tax Credits
CONTRACT PHASE

- DOE Grant Applied 6/09
- County Board Approves DOE EE CBG Strategy 11/09
- $1 Million DOE Funds to Methane to Energy Plant
- Schiff Harden Hired to Negotiate Gas to Energy Contract
- February 2010 County Board Authorizes Contract Execution
METHANE TO ENERGY PLANT DETAILS

- Waste Management Required To Meet Milestone Timeframes
- Initially (3) 1.6 MW CAT 3520 Engines, 12.8 MW When Fully Built
- Construction Begins Fall 2010; Waste Management Completed Construction Summer 2011, ComEd(Utility) December 2011
- Easement Negotiation Winter 2011
WM/Will County Methane to Energy Plant

- Commissioning December 2011
- Operational Winter 2011/2012
- Electricity Powering 3,000 Homes Initially, 8,000 When Fully Built; Capture GHG, Revenue for County 20+ years
- Revenue Estimated @ $450,000 Annually (Per year initially– Based Upon Gas Generated)
WM/Will County Methane to Energy Plant

- County is paid for gas, WM Sells Electricity, Excess Gas Flared Until New Engine(s) Are Permitted
- Gas Payments, Revenue Sharing; Guarantees of Performance
- Public/Private Partnership: WM Builds/Operates; County Project Management
WM/Will County Methane to Energy Plant

- Leachate Recirculation Allowed by County (previously prohibited)
- Creates 30% more gas quicker, Decomposition of Waste, Potential Benefits in Post-Closure Care,
- Additional Airspace = Revenue
- Cost of Plant: Approx $9 Million
WM/Will County Methane to Energy Plant

Lessons Learned & Positive Reflections:

- Select an Experienced Contractor (i.e. Waste Management): WM Installs/Manages Gas System & Plant
- Look at Both Sides When Negotiating Contract
- Allow for Flexibility in Contract if Markets Fluctuate (i.e. After 4th Engine is Placed)
What Made It Happen?

- Why Did WM & County Board Become Partners Again?
- What Factors Made the Contract Happen?
- County Board Sees Big Picture (Energy & $)
- County & WM Work Together to Implement Project
- Included Critical Deadlines to Keep Project Moving
WM/Will County Methane to Energy Plant

- WM Paid Utility a Premium to Be More Responsive to the Project
- WM Built in Time for Additional Permits (Air, Land); Approvals
- WM’s Experience w/ 50+ GTE Projects, Financially Solvent
- WM Pushes Utility w/ County’s Help
- WM Meets Critical Milestones
WM/Will County Methane to Energy Plant

- Result: Positive Long Term Project for Will County & Waste Management: Produce Green Power, Make Revenue (and no cost to County)
- Dept of Energy Funds Spurred Plant to Be Built Faster; Helped Sell Project; County Did Not Need to Use Its Funds
BENEFITS

- PR: National Recognition for WM & Will County

- $8+ Million Leveraged, $1 million investment from DOE Grant = $20 - $30 million of revenue

- County now has another revenue source to consider funding green projects for 20 - 30 years.

- Landfill revenue in 2013 is continuing Environmental Education, Grant Related Projects, which started under the EECBG
BENEFITS (cont)

- Landfill Revenue May Also Provide:
  - Seed $$ For Grants for Additional Renewable Energy Projects (i.e. Solar)
  - Energy Efficiency Projects for County, local entities
  - 2012 - 2025 Energy & Conservation Plan Being Implemented This Year; Plan Recommends Utilizing Landfill Funds For Future Energy Efforts
WM/Will County Methane to Energy Plant

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