Methane Utilization at Coquitlam Landfill: Opportunities and challenges at an old, closed landfill

Harvey Choy (presenter)
Solid Waste Department, Metro Vancouver

Other contributors: Genevieve Tokgoz, Conor Reynolds

Global Methane Initiative
Vancouver, BC
March 14, 2013
Methane Utilization at Coquitlam Landfill: Overview

Objectives of Presentation
1. Cohesive story on historic methane collection/utilization, LFG System upgrade, LFG utilization and carbon accreditation
2. Challenges of LFG utilization for an old landfill
What do a 30-year old closed landfill and 25,000 beef cows have in common?
Both generate the same amount of methane!

Trivia: One beef cow “emits” approx. 0.5 tonnes GHGs per year
Outline

- Landfill History
- BC Regulations
- Drivers: Sustainability Framework
- Carbon accreditation
- Methane generation and capture
- Options for beneficial use (2009 and 2012 study)
- What’s next?
Coquitlam Landfill - History

- Urban setting (near Vancouver)
- 2 Million tonnes of MSW from 1975 to 1983
- Landfill Gas (LFG) Collection System constructed in 1993
- LFG beneficially used as fuel by paper recycling facility from 1993 to 2011
- Avoided fugitive methane emissions 135,000 tonnes CO2 E since 1993
Flaring of gas started in 2011
Current flow: 110m$^3$/h
LFG Collection System upgrade to increase gas capture
Looking for new beneficial user
Landfill Gas Regulations

- BC Landfill Gas Management Regulation in Effect January 1, 2009
- Applies to active landfills that receive waste – Coquitlam Landfill Exempt
- LFG capture and destruction qualifies for carbon credits and not limited to 2016
Drivers: Metro Vancouver Sustainability Framework

Greenhouse Gases Targets
- Regional: Reduce 15% by 2015 and 33% by 2020
- Corporate: Carbon Neutrality (signatory to BC Climate Action Charter)

Energy Targets
- Increase energy recovery from existing solid waste operations by 10% by 2015
- Seek alternate forms of energy
Carbon Credits - Methane Destruction

- Expanding LFG collection means environmental benefits

Carbon credits:
- Project Plan validated for 10yr
- B.C. Climate Action Charter
- Could offset up to one third of MV’s carbon footprint

- Future beneficial use = more GHG reduction & credits
Methane Generation Timeline

1983: Landfill Closure
1993: First LFG collection system
2008: Study recommends major upgrades
2011: New system construction begins
Methane Generation Timeline: LFG Utilization Project – Why?

Compare 20 year project periods – much less LFG available now
Landfill Gas Generation and Collection
Collection System Upgrade – required for utilization project

- 2009 Utilization Assessment: should upgrade LFG system to increase potential for a utilization project

  - Phase 2 Upgrade proposed for 2014
  - Phase 1 (70%) complete
Landfill Gas Utilization Challenges for an Old Closed Landfill

1. Low quantities of gas
2. Declining generation rates of gas
3. Landfill Gas Quality characterized as poor
4.Completing feasibility studies is difficult
Utilization Options for 2009 Study

- **Scenario A: 110 m³/h in 2010**
  - Direct use – hypothetical user 1 km from the landfill
  - 2 x 65 kW microturbines for electricity generation
  - 1 x 100 kW cogeneration engine

- **Scenario B: 220 m³/h in 2010**
  - Direct use – hypothetical user 1 km from the landfill
  - 4 x 65 kW microturbines for electricity generation
  - 2 x 100 kW cogeneration engine
  - Upgrading to pipeline – Assumes N2 level is <2%.
## Results of 2009 Utilization Assessment

<table>
<thead>
<tr>
<th></th>
<th>Direct Use</th>
<th>Microturbines 2 x 65 kW 4 x 65 kW</th>
<th>Micro-cogeneration 100 kW engine 200 kW engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario A</td>
<td>$200k</td>
<td>-$700k</td>
<td>-$800k</td>
</tr>
<tr>
<td>Net Present Value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scenario B</td>
<td>$700k</td>
<td>-$900k</td>
<td>-$200k</td>
</tr>
<tr>
<td>Net Present Value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scenario B</td>
<td>-14,900</td>
<td>-1,400</td>
<td>-6,700</td>
</tr>
<tr>
<td>GHG emissions reductions over 20 years (tonnes CO$_2$E)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Options for beneficial use (2012 study)

- Heating, Greenhouses
- Upgrade and inject into natural gas pipeline
- Direct use in modified boiler
- CNG for use in vehicles
- Electricity Generation

Flare
Summary of Preliminary Feasibility Study - Utilization Options

Range of NPVs for each Beneficial Use Option

NPV $ millions

-2.5
0.0
2.5
5.0

Direct Use
Upgrade to Pipeline
Quality
CNG
Electricity
Next Steps

- Phase 2 collection system upgrade
- Update analysis with new LFG capture to assess feasibility and options
- Procurement process to find beneficial user
Contact Information

Harvey Choy, P.Eng.
Senior Project Engineer
Solid Waste Department, Metro Vancouver
Harvey.Choy@Metrovancouver.org
604-451-6604
Upgrade & Inject into Natural Gas Grid

<table>
<thead>
<tr>
<th>Description</th>
<th>Metro produces pipeline quality natural gas and injects into the natural gas grid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Requirements</td>
<td>Stringent pipeline quality specs need to be met and pressure to 3,600 psi</td>
</tr>
<tr>
<td>Key Considerations</td>
<td>High capital cost (due to purification &amp; treatment) Price of natural gas Relatively high power use for compression (operating)</td>
</tr>
<tr>
<td>Cost</td>
<td>$1,000,000 - $1,500,000</td>
</tr>
<tr>
<td>GHG benefits</td>
<td>11,000 t CO2 annually</td>
</tr>
</tbody>
</table>
## Option – Direct Use

<table>
<thead>
<tr>
<th>Description</th>
<th>Metro sells raw LFG to a nearby industrial business for use in their boiler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Requirements</td>
<td>Condensate management system &amp; boiler modifications</td>
</tr>
<tr>
<td>Key Considerations</td>
<td>Price of natural gas - revenues</td>
</tr>
<tr>
<td></td>
<td>Pipeline distance - capital</td>
</tr>
<tr>
<td>Cost</td>
<td>$500,000 - $1,500,000</td>
</tr>
<tr>
<td>GHG benefits</td>
<td>25,000 t CO2 annually</td>
</tr>
</tbody>
</table>
## Compressed Natural Gas for Vehicles

<table>
<thead>
<tr>
<th>Description</th>
<th>Produce CNG for use in vehicles.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Requirements</td>
<td>Purify gas to min 88% methane and compress to over 3,000 psi</td>
</tr>
<tr>
<td>Key Considerations</td>
<td>Nitrogen removal</td>
</tr>
<tr>
<td></td>
<td>Delivery infrastructure and fueling stations</td>
</tr>
<tr>
<td></td>
<td>Type and number of CNG vehicles</td>
</tr>
<tr>
<td>Cost</td>
<td>$1,500,000 - $2,000,000</td>
</tr>
<tr>
<td></td>
<td>High operating costs</td>
</tr>
<tr>
<td>GHG benefits</td>
<td>24,000 t CO2 annually</td>
</tr>
</tbody>
</table>
## Electricity

<table>
<thead>
<tr>
<th>Description</th>
<th>Metro produces electricity and sells to BC Hydro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Requirements</td>
<td>Similar to reciprocating engines, LFG treatment required (typically siloxanes)</td>
</tr>
<tr>
<td>Key Considerations</td>
<td>Microturbine units can handle low volumes of LFG Ability to obtain BC Hydro contract for low electricity output</td>
</tr>
<tr>
<td>Cost</td>
<td>$500,000 - $1,000,000</td>
</tr>
<tr>
<td>GHG benefits</td>
<td>0 (in BC electricity is hydro generated)</td>
</tr>
</tbody>
</table>