Methane to Markets

Landfill Biogas Project Financing and Development
Outline

- Review of Landfill Biogas Project Components
- Revenue Sources
- Project Costs
- Financial Analyses
- Project Development Challenges
- Recommendations
Landfill Biogas Project Components

- Estimation of biogas potential
- Utilization options
  - Electrical generation
  - Industrial use
  - Treatment of biogas
- Financing
- Construction
- Collection and/or flaring
- Monitoring
  - Emission reductions
  - Energy sales
Estimation of Biogas Potential

- Observation and analysis of landfill operations
- Collection of accurate data
- Use of landfill biogas modeling
  - Selection of appropriate model and inputs based on landfill characteristics
  - Close scrutiny of model results via comparison with results from other landfills (if possible)
- Development of multi-year biogas generation and recovery estimates.
  - Conservative but realistic?
  - Be aware of over-estimation
Multi-year Biogas Projections

- Biogas methane is the overall asset
- Recovery estimates are basis of project economic analyses
- Account for declining recovery and subsequent collection system expansions
Example Biogas Projection

Figure A-1. Landfill Gas Generation and Recovery Projection
Collection and Flaring

- Required for both emission reduction and utilization projects
- If not required to collect, consider economics of collection system design
  - Location of wells in deeper areas
  - May not install wells in shallow or old areas
  - Maximize biogas recovery per well
Utilization

- Evaluation of project options
- Options may be limited by location
- Biogas treatment needed?
  - Water
  - Siloxanes
  - Reduced sulfur compounds
  - Compression for high-pressure end use?
- Consider phased project approach
  - Phase 1. Collection and flaring for emission reductions
  - Phase 2. Utilization after establishing biogas collection
Monitoring

- Emission reduction projects
  - Biogas flow meter (m³/h)
  - Gas analyzer (% methane, % nitrogen, etc.)
  - Biogas temperature and pressure
  - Control device operation (temperature, exhaust gas analyzer, etc.)
  - Electrical use by system

- Energy projects
  - Biogas flow
  - Electrical generation

- Pay attention to calibration and maintenance requirements for greenhouse gas market programs
Revenue Sources

- Emission reductions
- Energy sales
  - MWh electric
  - MWh thermal
- Incentives
  - Grants
  - Low interest loans
  - Economic development programs
Revenue - Emission Reductions

- Review UNFCC ACM00001 for Guidance
- Determine project baseline
- Estimate annual methane recovery
  - Total cubic meters of biogas recovered * % methane * density of methane
- Selection of control device and associated destruction efficiency
  - Open flares 50%
  - Enclosed flares 90%
- Account for project energy use (electricity to operate blower)
Revenue – Emission Reductions (Continued)

- Calculate Annual Emission Reductions
- \[ ER = (MD_p - MD_b) \times GWP - (EL \times CEF) \]
  - \( ER \) = Emission reductions
  - \( MD_p \) = Methane destroyed by project
  - \( MD_b \) = Methane that would have been destroyed in absence of project
  - \( GWP \) = Global Warming Potential for Methane
  - \( EL \) = Electricity use by project
  - \( CEF \) = \( CO_2 \) emissions per kWh of electricity generation
Revenue – Energy Sales

- Calculate annual biogas recovery and associated energy value based on project type
  - MWh (thermal)
  - MWh (electrical)
- Evaluate expected unit price (zloty/MWh)
- Estimate annual revenue from energy sales
Revenue - Incentives

- Methane to Markets Grants
- Low interest loans for energy or environmental projects?
- Renewable energy tax credits/pREFERRED pricing for renewable energy generation?
- Economic development incentives if utilization project
  - Creates employment
  - Supports local industry by providing low-cost source of energy
Project Costs

- Infrastructure
- Operations
- Administrative
Infrastructure Costs

- Gas collection system
  - Account for future expansions if landfill is still in operation
- Blower/flare
- Utilization equipment
  - Engine, turbine
  - Pipeline
  - Treatment
- Monitoring equipment
Operational Costs

- **Scheduled Maintenance**
  - Biogas analyses at each well
  - Balancing of collection system
  - Leachate removal?
  - Blower/flare lubrication and maintenance
  - Utilization system maintenance
  - Monitoring system maintenance

- **Unscheduled Maintenance**
  - Component failures
  - Impacts of nature
  - Conflict with landfill operations (e.g., truck runs over wellhead)
Administrative Costs

- Permitting and local zoning
- Political issues
- Legal/ownership issues
- Emission reduction projects
  - Project Design Documents
  - Validation and verification
- Utilization projects
  - Contracts
Typical Electric Project Components & Costs

- 3 MW engine project for 15 years:
  - Installed engine and gas treatment skids
    - Installed capital cost = ~$5,100,000
  - Interconnect
    - ~$250,000 (approximate – many variables at play)
  - Annual operation & maintenance
    - Cost = ~$570,000/year

- Total capital cost = ~$5.35 million
- Total annual cost = ~$570,000
Typical Direct Use Components & Costs

- 800 scfm project for 15 years:
  - Gas compression & treatment
    - Installed capital cost = ~$1,040,000
  - Pipeline
    - Installed capital cost = ~$330,000/mile
  - Annual operation & maintenance
    - Cost = ~$50,000/year
  - End-of-pipe combustion equipment retrofits, if needed

- Total capital cost (5-mile) = ~$2.69 million
- Total O&M cost = ~$750,000
Financial Analyses

- Establish Cost and Revenue Projections
- Create Cash Flow Model
- Consideration of Project Options
- Develop Business Plan
Cost and Revenue Projections

- Estimated biogas recovery
- Projected revenue
  - Emission reductions
  - Energy
- Projected costs
  - Infrastructure
  - Operations
  - Administrative
- Applicable project incentives
  - Tax credits
  - Grants
Cash Flow Model

- Costs and revenues should be calculated and compared on a year by year basis over the expected life of the project.

- Calculations to include:
  - project performance over time
  - escalation of project expenses and energy prices
  - financing costs
  - tax considerations
Consideration of Project Options

- Develop cash flow model for all reasonable project options
- Compare results to determine best project option
  - Annual cash flows
  - Net present value
  - Debt coverage
  - Rate of Return
Consideration of Non-Price Factors

- Accuracy of project option assumptions
- Environmental performance
- Reliability of project option components
Project Financing

- Typically, biogas projects require financing to develop project infrastructure
- Investors and banks do not like to lose money when financing projects
- You need to demonstrate project financial performance and risk
- Detailed project cash flow analyses and supporting assumptions are critical
Challenges to Implementing Landfill Biogas Projects

- **Getting the Rights to the Biogas**
  - Unclear ownership
  - Unduly high expectations by landfill owners
  - Arduous or unclear procurement procedures
Challenges to Implementing Landfill Biogas Projects

- Estimating Recoverable Landfill Biogas
  - Finding reliable input data
    - Waste characterization
    - Waste disposal history
    - Projected future waste receipts

Garbage in = Garbage out!
Challenges to Implementing Landfill Biogas Projects

- Over Estimating Recoverable Landfill Gas
  - The US EPA LANDGEM model estimates gas generation - not recovery
  - Many site-specific conditions will impact recovery
    - Site geometry
    - Leachate
    - Cover
    - Operations
    - Vandalism
Challenges to Implementing Landfill Biogas Projects

- Poor System Design
  - “Watering-in” of wells and collection system
  - Corrosion and siloxane build-up on system components
  - Increased vandalism
  - Increased costs
Challenges to Implementing Landfill Biogas Projects

- Other Technical
  - Incomplete system installation
  - Poor system operations & maintenance
  - Scavengers
Challenges to Implementing Landfill Biogas Projects

- Technical Issues
  - If you over-estimate the recoverable gas you will not meet your investment expectations
  - If you have poor system design and operations, you will collect even less of the recoverable gas that already is constrained by site-specific factors
Recommendations

- **For Landfill Owners**
  - Be realistic – there is a lot of risk in these projects for the investor - they are not gold mines!
  - Simplify and speed up procurement processes
  - Help your investor implement the project in any way you can – don’t be an impediment
  - The sooner the investor makes money – the sooner you will!
Recommendations

- **For Investors**
  - Pay attention to details and assumptions
  - Be realistic about project costs, revenues, and schedules
  - Run financial sensitivity scenarios to determine project boundaries
  - Avoid deals that are overly complex
Recommendations

- Scrutinize biogas generation projections
- Work with reputable construction and engineering firms
- Obtain written quotes for costs
- Include price and schedule contingencies
- Compare multiple sources of financing