LMOP Workshop: LFG Energy Project Development Discussion

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LFG Project Components

- Estimation of LFG generation and recovery potential
- LFG collection system implementation
- Evaluation of project options
- Evaluation of project revenue and financing sources
- Project development structures and partnerships
- Conduct financial analyses and sensitivity studies

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LFG Recovery Projections

- Recovered methane in the LFG is the overall asset
  - Energy (Btu’s, MWh)
  - Renewable energy credits
  - Carbon credits (small)
- LFG recovery estimates are basis for project economic analyses
  - Use of LFG modeling - U.S. EPA LandGEM
  - Models estimate LFG generation – need to apply collection efficiency to get recovery
  - Estimating LFG generation, collection efficiency, and LFG recovery is not an exact science

LFG Model Development Considerations

- Use reliable input data
  - Waste characterization
  - Waste disposal history
  - Projected future waste receipts
- Garbage in = garbage out!

LFG Model Development Considerations (cont.)

- Selection of model and inputs based on climate and landfill characteristics
  - LandGEM
    - NSPS k and Lo values
    - AP-42 k and Lo values
  - Collection efficiency estimates
    - AP-42 (75%)

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LFG Model Development Considerations (cont.)

- Many site-specific conditions will impact recovery:
  - Geometry
  - Leachate
  - Cover
  - Operations
- Other considerations:
  - LFG collection system expansions
  - Leachate levels in landfill can reduce recovery potential of extraction wells
- Development of multi-year LFG generation and recovery estimates
  - Should be conservative
  - Account for declining recovery and subsequent collection system expansions

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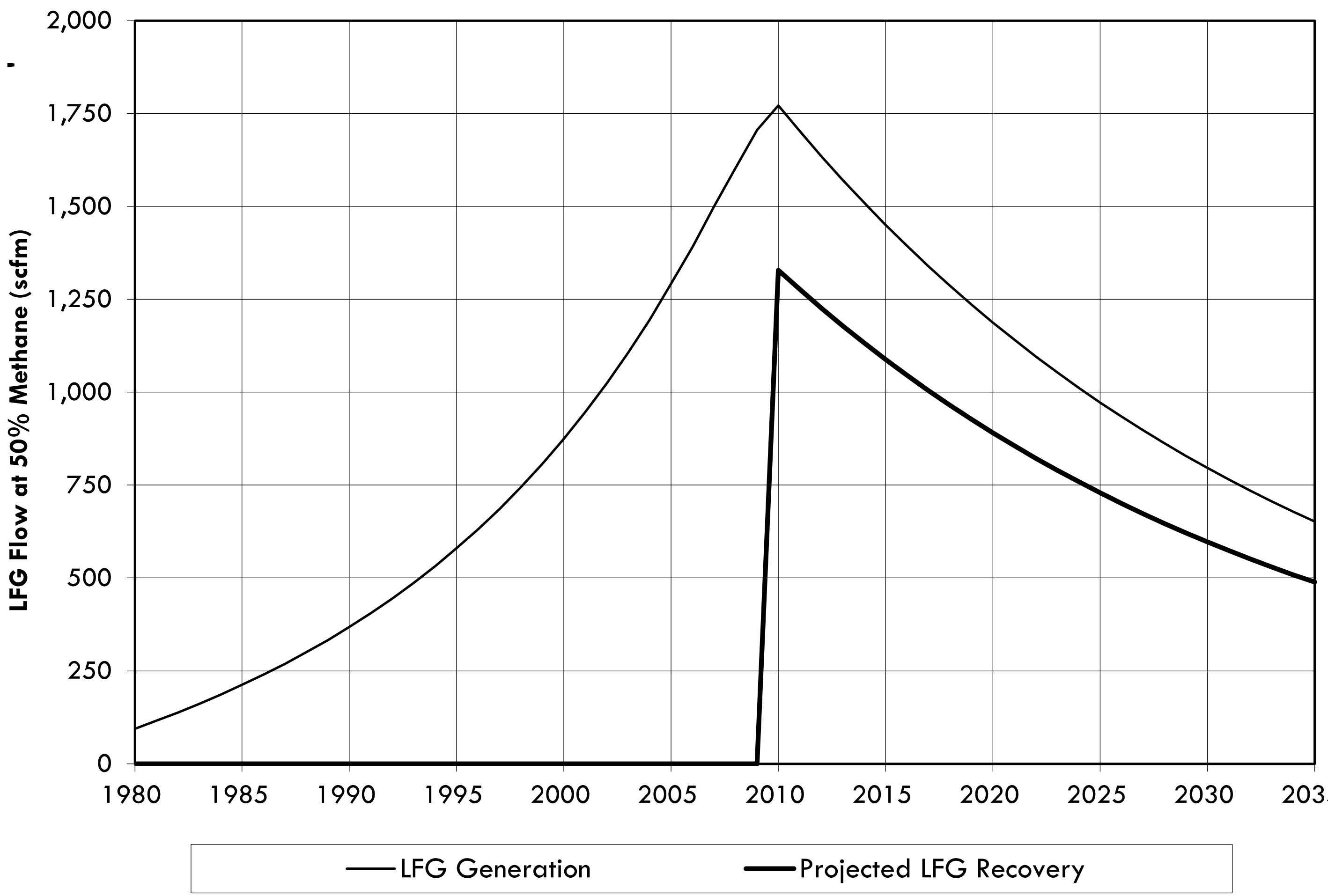
Analyze Energy Potential from Landfills

Figure 1. Landfill Gas Generation and Recovery Rates



Collection and Flaring

- If not required to collect, consider economics of collection system design
  - Location of wells
  - Maximize LFG recovery per well
- Early installation of a wellfield to a cell can be an economic benefit

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Utilization

- Evaluation of project options
- Options may be limited by location
- LFG treatment needed
  - Moisture
  - Siloxanes
  - Reduced sulfur compounds
  - Compression
- Consider phased project approach
  - Phase 1 – Collection and flaring
  - Phase 2 – Utilization

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Monitoring

- Flaring-only projects
  - LFG flow meter (ft^3/min)
  - Methane analyzer
  - LFG temperature and pressure
  - Control device operation (temperature, exhaust gas analyzer, etc.)
  - Electrical use by system
- Energy projects
  - LFG flow
  - Methane analyzer
- Pay attention to calibration and maintenance requirements

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Project Costs

- Capital/Infrastructure
- Operations and Maintenance (O&M)
- Administrative

Capital/Infrastructure Costs

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

O&M Costs

- Scheduled maintenance
  - LFG analysis at each well
  - Balancing of collection system
  - Leachate management
  - Blower/flare lubrication and maintenance
  - Utilization system maintenance
  - Monitoring system maintenance
- Unscheduled maintenance
  - Component failure
  - Impacts of nature
  - Conflicts with landfill operations

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Administrative Costs

- Permitting and local zoning
- Political issues
- Legal/ownership issues
- Utilization projects
  - Contracts
  - Power purchase agreements
  - Buying rights-of-way
  - Interconnection fees


Typical Electric Project Components & Costs

3 MW, engine, 15-yr project:

- Total capital cost = ~$5.15 million
  - Gas compression & treatment, engine, & generator = ~$4.89 million
  - Interconnect equipment = ~$255,000*
- Annual operation & maintenance cost = ~$526,000/year

*interconnect costs can vary widely

$2010 capital costs; O&M is the cost in the initial year of project operation (2011).

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Typical Direct-Use Project Components & Costs

800 scfm, 5-mi pipeline, 15-yr project:

- Total capital cost = ~$2.7 million
  - Gas compression & treatment = ~$1,000,000
  - Pipeline = ~$337,000/mile
  - (Plus end-of-pipe combustion equipment retrofits, if needed)
- Annual operation & maintenance cost = ~$112,000/year

$2010 capital costs; O&M is the cost in the initial year of project operation (2011).

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Project Revenues

- Energy sales
  - Electricity
  - Gas
- Environmental attributes
  - RECs
  - Carbon credits

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Financial Analyses

- Establish cost and revenue projections
- Create a cash flow model
- Consider project options
- Develop a business plan

Cost and Revenue Projections

- Based on estimated LFG recovery
- Project revenue
  - Energy sales (Btu's, MWh's)
  - Environmental attributes (RECs, GHG credits, etc.)
- Project costs
  - Capital/Infrastructure
  - O & M
  - 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 should include:
  - Revenue based on LFG recovery over time
  - Initial and additional capital investments (wellfield expansions, additional engines, etc.)
  - Escalation of project expenses and energy prices
  - Financing costs
  - Taxes

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Consideration of Project Options

- Develop cash flow model for all reasonable project options
- Compare results to determine the best project option:
  - Annual cash flows
  - Net present value
  - Debt coverage
  - Rate of return

Financial Considerations

- Size of LFG wellfield
  - How much of the landfill is producing sufficient gas for recovery?
- Will LFG project include collection and flaring costs?
  - Collection system installation costs are substantial
  - If collection system is already installed a significant cost is avoided

Financial Considerations (cont.)

- Distance to end-user
  - Significant cost for direct-use projects is the pipeline to an end-user
- Electricity/fuel rates
  - Local electricity and natural gas prices impact the viability of a project

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Risk Considerations

- LFG availability
- Construction
- Equipment performance
- Community acceptance
- Power sales agreement
- Energy sales agreement

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Project Development Structures

- Primary structures:
  - Self-develop
  - Project Developer

- Factors to consider in determining the structure to select:
  - Economics
  - Expertise
  - Risk level

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Project Development Structures (cont.)

Self-Development

- Pros:
  - Retain control of the project
  - Receive all revenue
  - Rewarding challenge for landfill staff
  - Fosters relationships with end-users and community
- Cons:
  - Significant upfront costs and financing required
  - Time consuming
  - More risky

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Project Development Structures (cont.)

Project Developer

- Pros:
  - Reduces risks
  - Expertise may bring a project online faster
  - Possible economies of scale
  - Additional landfill staff not necessary
- Cons:
  - Ownership and control of project remains with developer
  - Less revenue
  - Possible conflicts of interest

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Development Considerations

- LFG rights
  - Clarify ownership!
- Manage expectations of project economics
- Understand procurement procedures
- Development of an RFP

Summary

- Systematic approach to project development
- LFG recovery estimates are key
- Develop cost and revenue stream assumptions
- Run financial analyses over range of project conditions
- Selection of project option
- Procurement of financing, infrastructure, sales agreements, engineering support and project development team