

Brown, Vence & Associates, Inc.

Landfill Gas Utilization Project County of Santa Cruz

Presented to
Institute of Electrical and Electronics Engineers, Inc.
SF Chapter

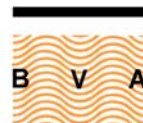
March 20, 2003
Presented by Thomas D. Vence, Vice President



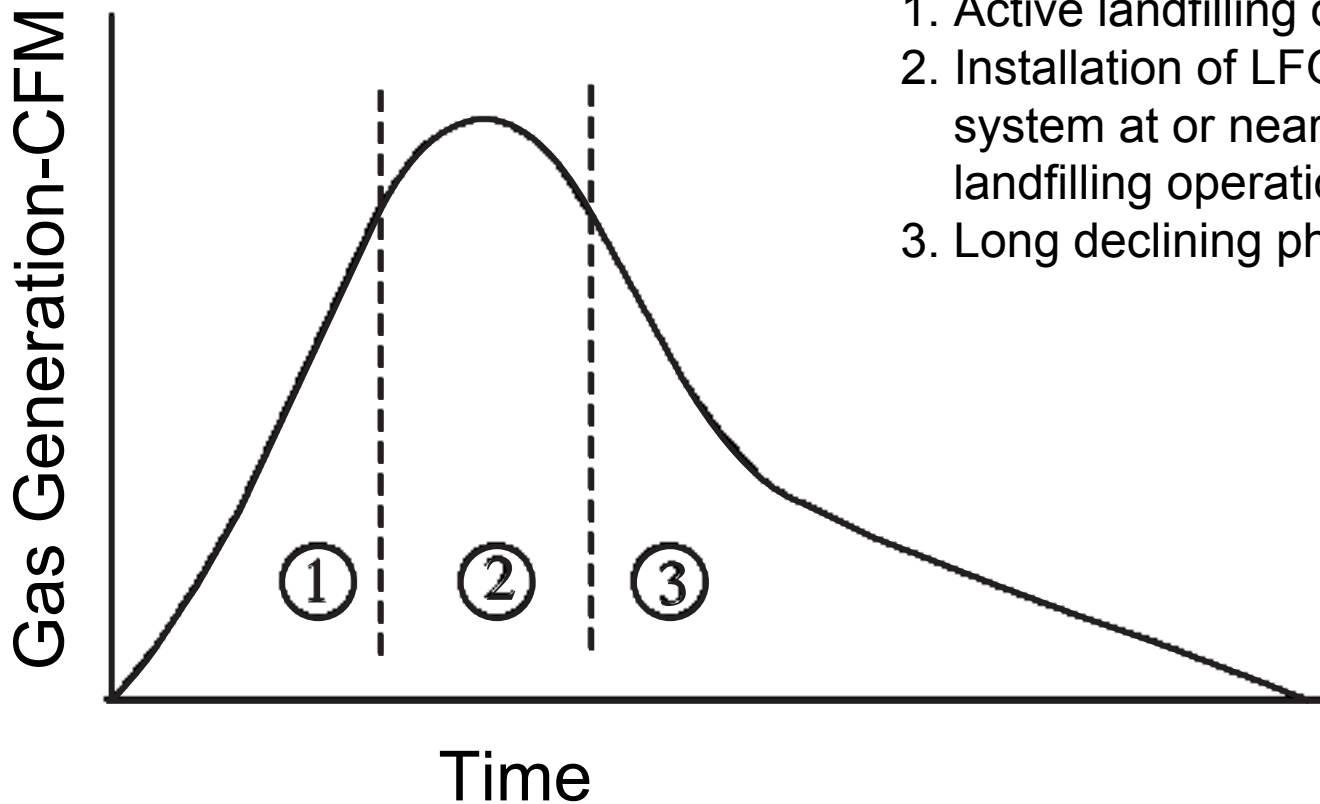
The Problem and the Opportunity



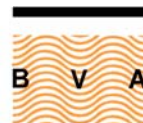
| | Volume |
|------------------|--------------|
| Methane | 45-58% |
| Carbon Dioxide | 32-45% |
| Nitrogen | 0-3% |
| Oxygen | less than 1% |
| Hydrogen Sulfide | 10-200ppm |
| NMOCs | less than 1% |



Landfill Gas Production

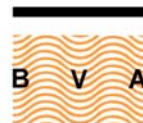
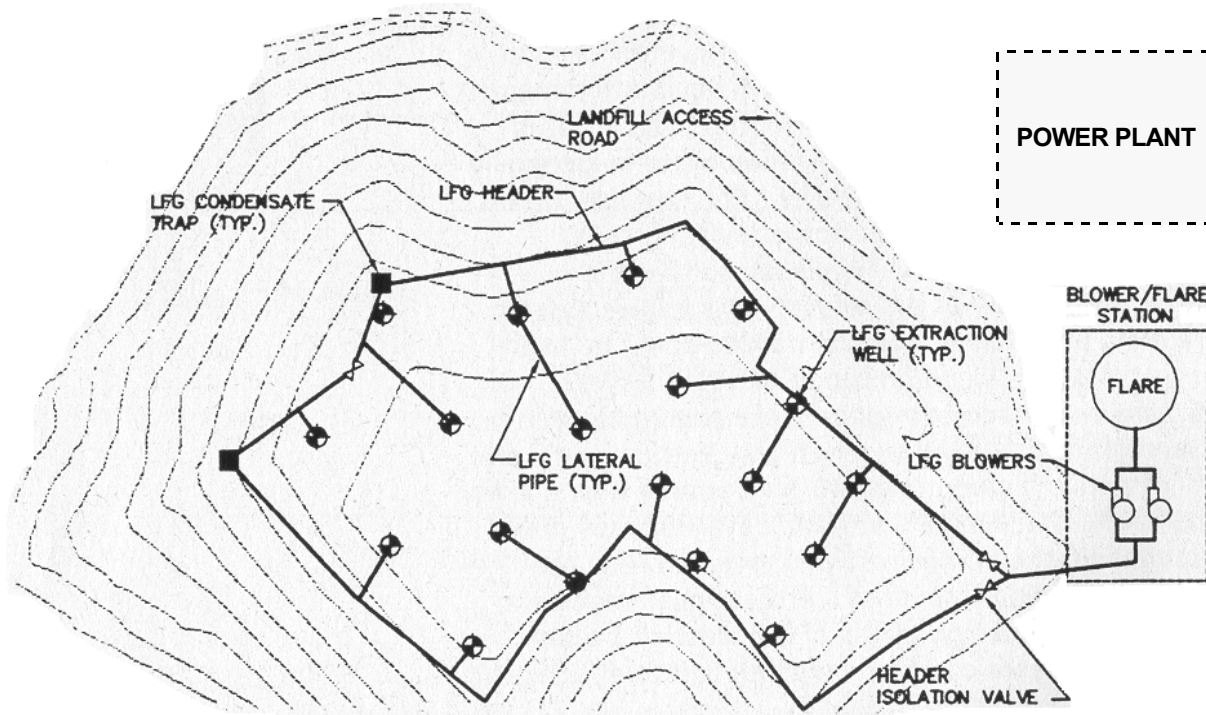


1. Active landfilling operation
2. Installation of LFG extraction system at or near end of landfilling operation
3. Long declining phase



Options for Managing Landfill Gas

SCHEMATIC OF A TYPICAL LFG COLLECTION SYSTEM



Landfill Gas Flare



LFG Energy Utilization

- 450 – 500 BTU/SCFM
- Approximately 10,500 BTU/KWH
Gross HHV
- 1050 – 1167SCFM LFG for 3 MW
Gross



Landfill Gas-to-Electricity Technology

- Established
- Types
 - Reciprocating Engine
 - Microturbines
 - Gas Turbines
- Most 1 MW to 5 MW
- Steady-state operation



History

- 1975 First commercial gas energy recovery project
- 1978 PURPA enacted
- 1982 First electricity generating project
- 1985 End of long-term Standard Offer contracts
- 1986 IRS Section 29
- 1992 Energy Policy Act - REPIs
- 1994-1995 New regulations under RCRA, CAA and CWA
- 1996 New Source Performance Standards and Emission Guidelines of 1996
- 1996 AB 1890



2003

- 50 LFG power plants in California, 333 in the United States
- AB 1890
- Federal subsidies
- Federal tax credits
- Green power market



2003 Continued

- On site generation
- CEC Subsidies for renewable energy



Other Renewable Energy Subsidies

- REPIs
 - For publicly-owned power plants
 - Up to 1.6 cents/kWh
 - Depends on annual appropriations by Congress
 - SWANA lobbying for more funding
- Production Tax Credits
 - Public project can benefit
 - Based on \$/MM BTU (Approx 1-2 cents/Kwh)
 - Eligible through 2002 or 2007



Example of Economics

| <u>Item</u> | <u>Per kWh</u> |
|----------------------------|------------------|
| Costs | |
| Debt service..... | 2.5 cents |
| Recurring..... | 3.5 cents |
| Total..... | 6.0 cents |
| Revenues | |
| Electricity sales..... | 4.5 cents |
| Subsidies/tax credits..... | 2.5 cents |
| Total..... | 7.0 cents |



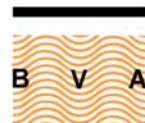
Project Development Process

- Pre-development
 - Feasibility assessment
 - Project definition
- Development

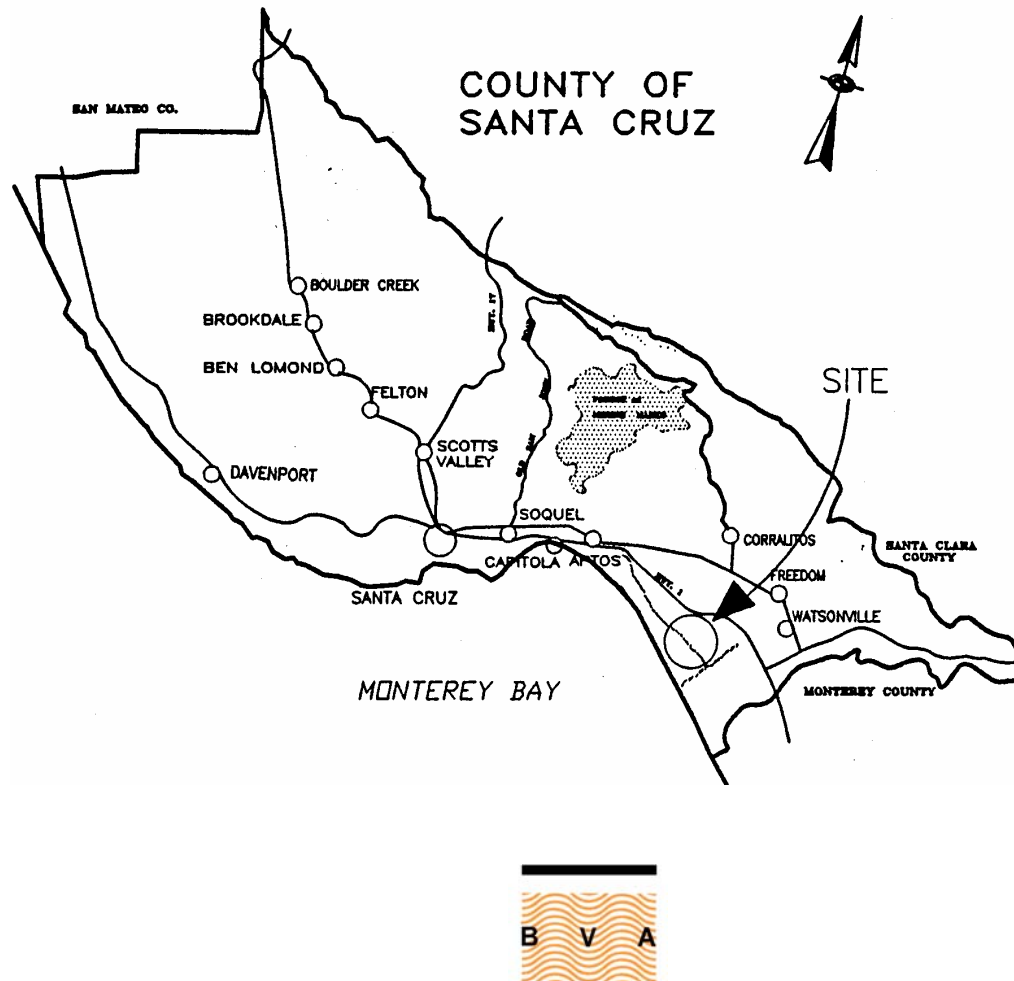


Project Development Process Continued

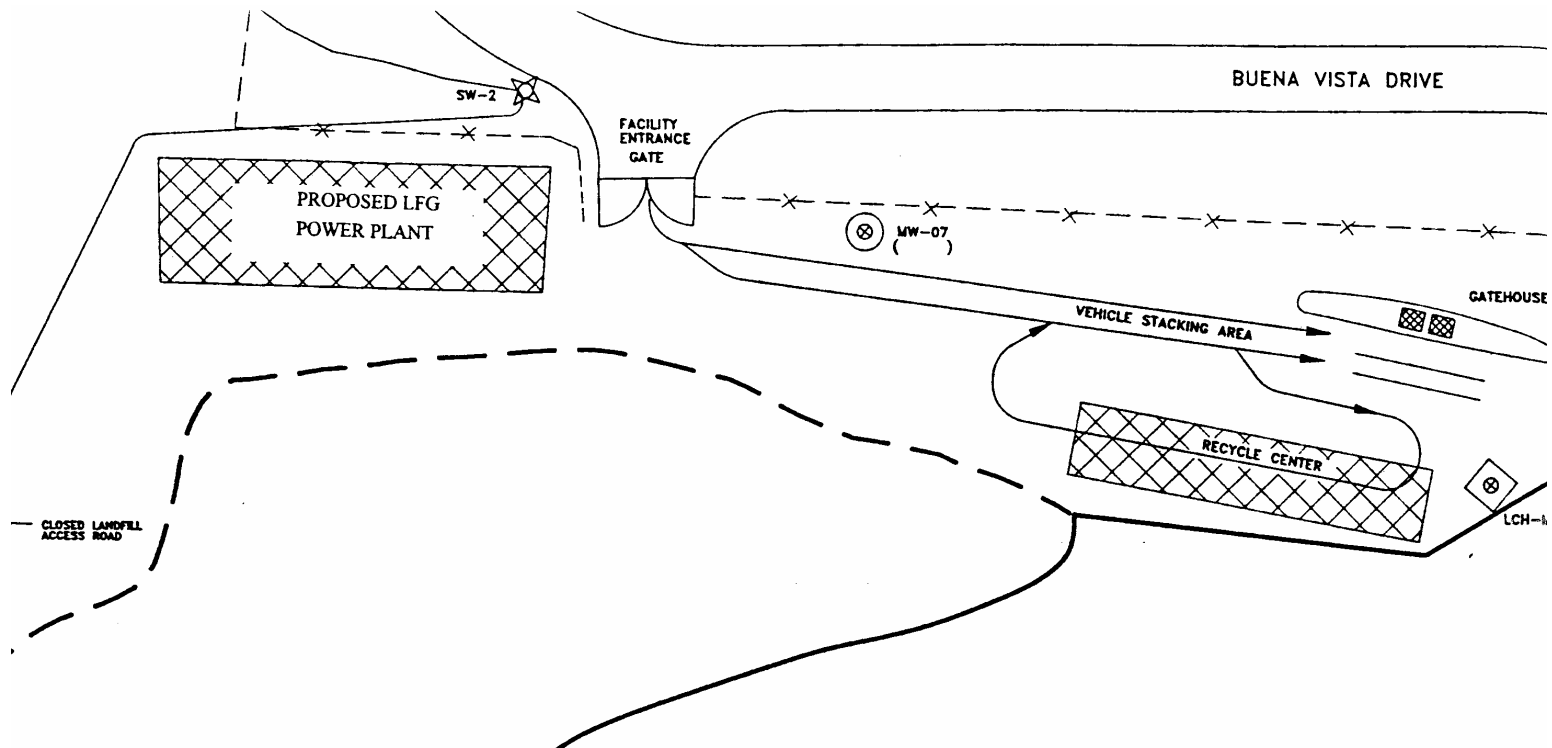
| Project Component | Feasibility Assessment | Project Definition | Project Development |
|----------------------------|--|---|---|
| Gas Production | Preliminary Estimate | Sustainable yield study | Ongoing gas testing |
| Engineering and Permitting | Approximate plant size and type | Preliminary design (number, size, type of engines, site location, utility interconnections) | Submit permit applications and obtain permits |
| Ownership structure | Identify options | Select ownership structure | Develop and sign contracts |
| Economic Analysis | Preliminary cost estimates, cash flows | Finalize cost estimates, finalize cash flow | Potential changes to cash flow analysis |
| Power Sales Agreements | Estimate electricity pricing | Prepare RFPs and select buyer | Sign power sales contracts |
| Tax Credits | Estimate PTC value | Prepare RFPs and select buyer | Sign PTC agreements |
| Other Subsidies | Estimate value | Apply for subsidies | Awarded subsidies |
| Project Financing | Identify options, estimate rate | Define length of financing, identify source of financing, percent equity, cost of financing | Close financing |



Buena Vista Location Map

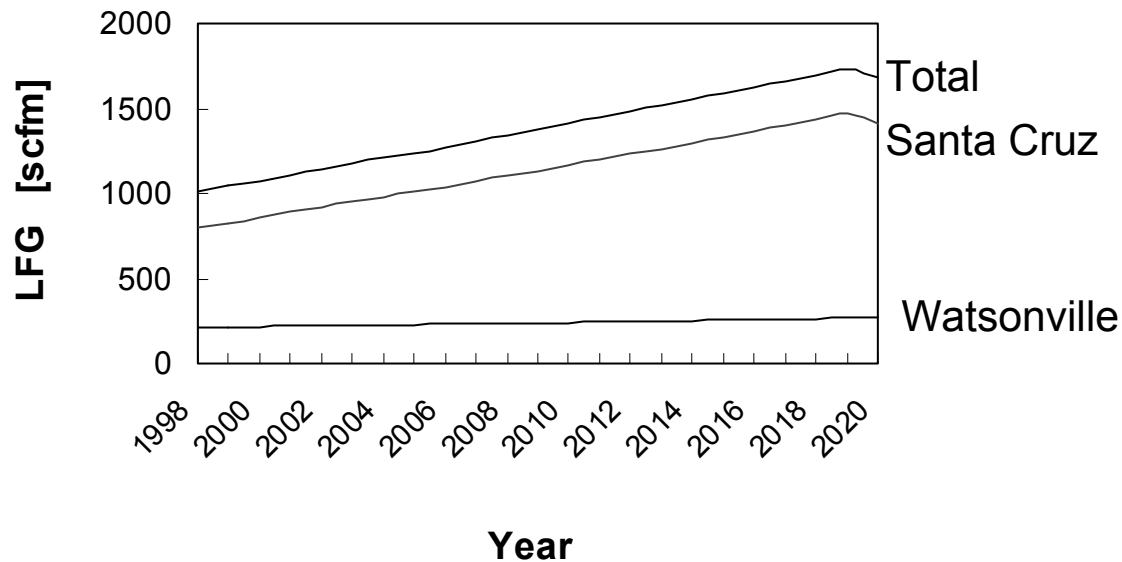


Buena Vista Site Plan



Buena Vista Landfill Gas Production

GAS PRODUCTION CURVES



Permit Requirements

- Modification to solid waste facility
- Minor amendment to land use permit
- CEQA
- Authority to construct
- Permit to operate



Ownership Structure

- Public
- Public/Private
- Private



Power Sales Agreement

- 5 year term
- Fixed pricing up to 3 MW for first 5 years
- For remaining years, commodity energy purchase at power exchange rate
- Pursue opportunity for green premium



Sensitivity Analysis

| Case | Relative Risk | Sensitivity Assumptions | Possible Migration Measures |
|---|---------------|-----------------------------------|---|
| Base case | | No Change | |
| Gas Production Decreases | Low | Gas production reduced 10% | Proper management of gas field |
| Technical Performance Decreases | Low | Plant availability reduced to 85% | Extended warrantee from engine manufacturer; good operation and maintenance program |
| Operations and Maintenance Cost (O&M) Increases | Medium | O&M costs increase by 10% | Good operation and maintenance program |
| Capital Costs Increase | Low | Capital costs increase by 10% | Request equipment and construction bids prior to financing |
| Environmental Requirements Increase | Low | Capital costs increase by 10% | Early discussions with Air Board |
| PTCs Decrease | Low-Medium | PTCs reduced by 20% | Comprehensive due diligence |



Financing

- Equity
- Debt
 - Project Financing
 - Municipal Financing



Issues to Consider

- Sufficient landfill gas
- Potential to capture tax credits
- Large on-site electricity usage (optional)
- Monitor REPIs
- Potential for another renewables auction

