Organics Diversion – Relative Impacts on GCCS Design and Operations

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Topics

- LFG Basics
- Modeling Basics
- Example Facility
  - Possible Energy Concerns
  - Effect on Waste Stream
  - Organics Effects on LFG Production
  - Organics Effects on LFG Design and Planning
  - Facility Economics
- Potential Project Goals
- Planning
- Conclusions

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Typical Waste Stream

MSW

Organic Materials	
Food Waste	*9.0%*
Garden Waste	*19.0%*
Paper Waste	*33.0%*
Other Organics	*7.0%*
Organic Subtotal	***68.0%***
Inorganic Materials	***32.0%***

Typical Composition – various studies

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LFG Basics

- How is LFG Formed?
  - Natural byproduct of decomposition
  - Occurs in an anaerobic environment
  - Anaerobic bacteria feed on and decompose cellulose in the waste
    - Cellulose is a complex carbohydrate consisting of many glucose units in a linear chain structure

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LFG Basics

- What Comprises LFG?
  - Approximately 55% methane and 45% carbon dioxide (methane can be as high as 60%)
  - Small percentage of nitrogen and oxygen
  - Trace VOC's and NMOC's

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LFG Basics

- Phases of LFG Production
  - Phase I: Oxygen Consumption
  - Phase II: Decomposition
  - Phase III: Methane Producing Bacteria Well-Established
  - Phase IV: Sustained LFG Production
  - Phase V: End of Life (Decreasing LFG Production)

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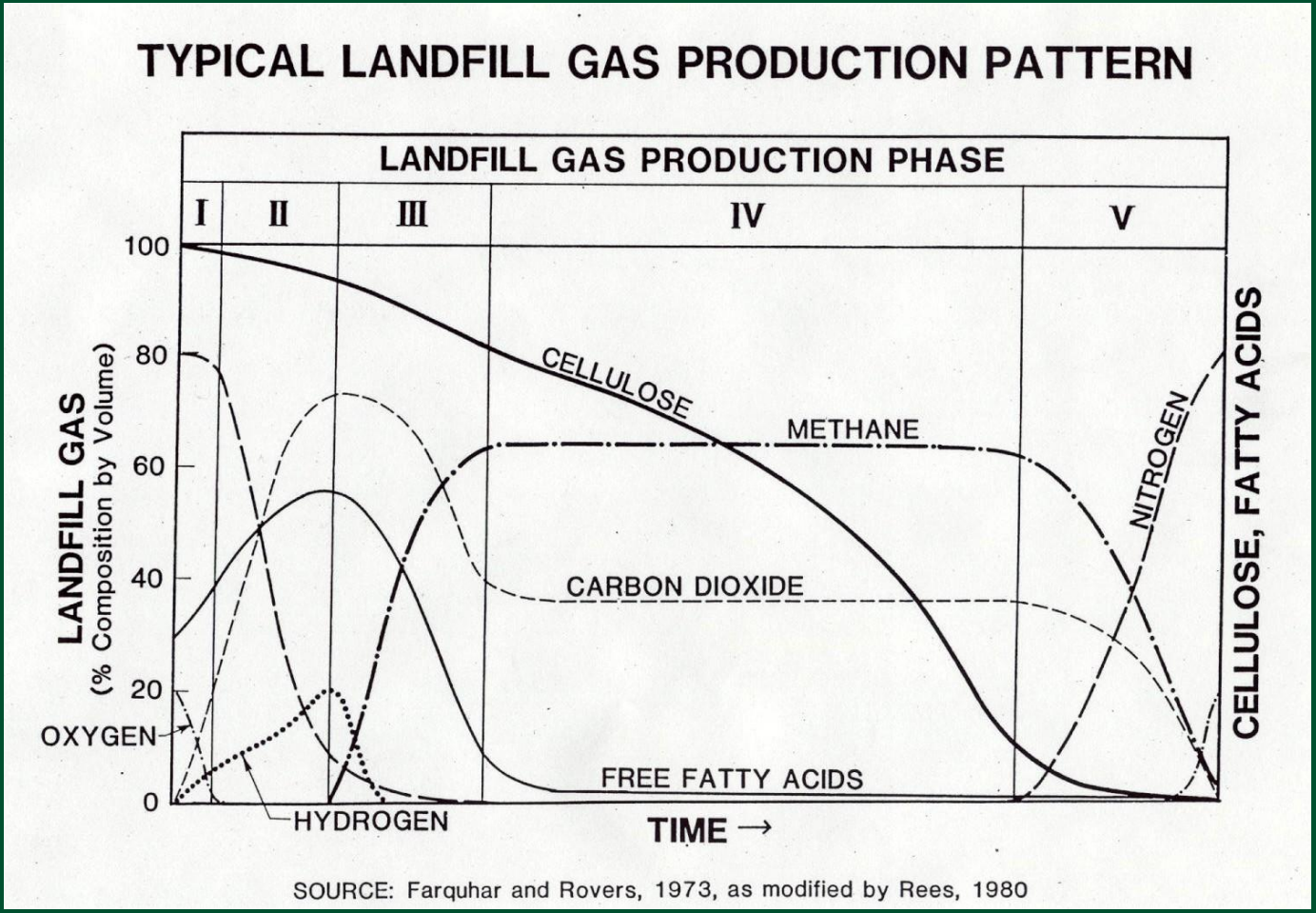
LFG Basics



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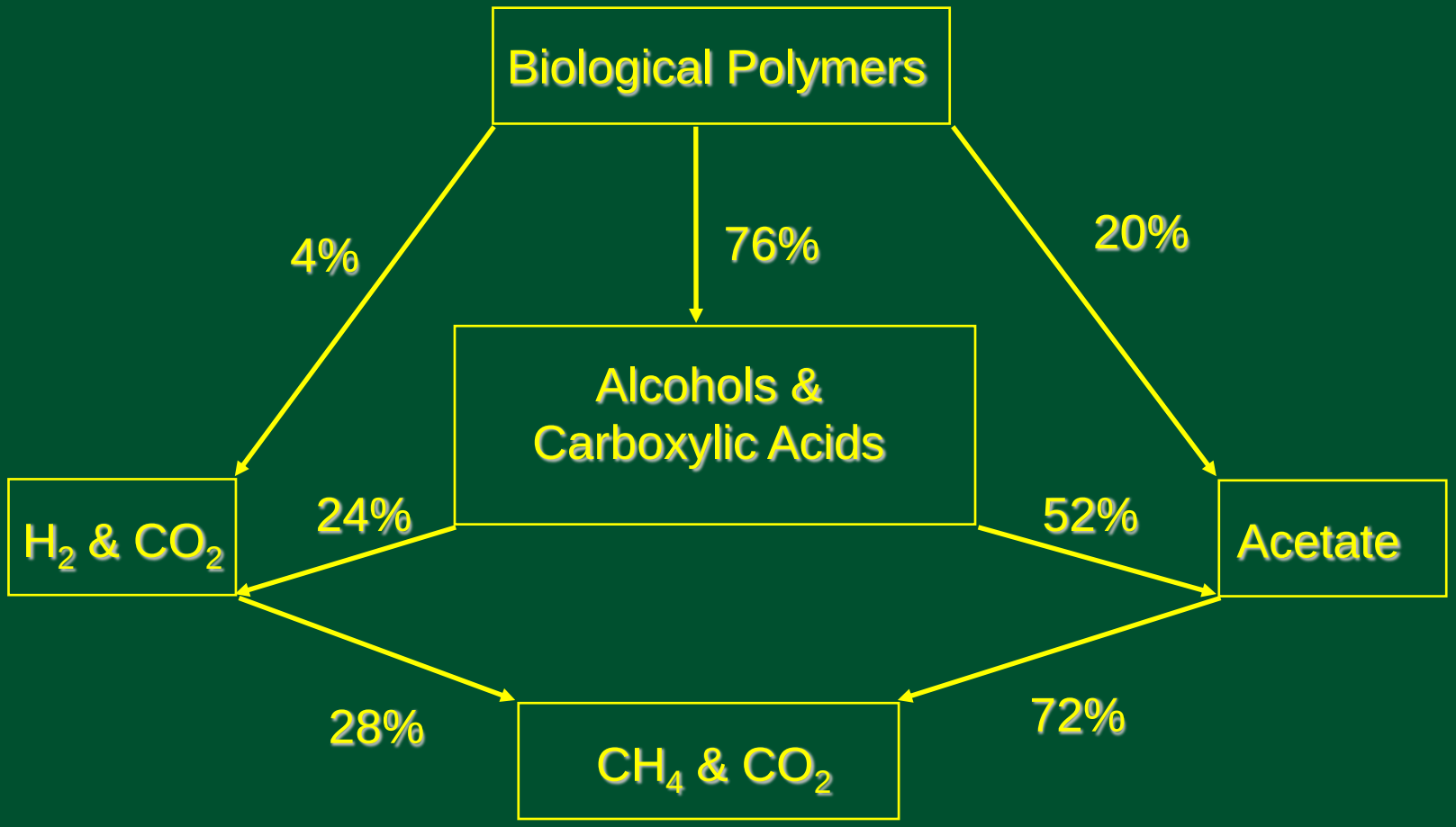
Methanogenic Substrate Flow



(Landfills, EMCON Associates, 1982 (modified))

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LFG Potential

- Rule of Thumb

A cubic yard of waste will produce the same amount of LFG as another cubic yard of waste with the same composition; the question is when that gas production will occur.

Remember Not to Mix Apples and Oranges

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Landfill Gas Emissions Model (LandGEM)

- Developed by the USEPA – www.epa.gov
- Basis in Scholl Canyon Studies (1970s)
- Used for Regulatory Assessment – (NSPS/Emissions Guidelines)
- Fairly Simplistic
- Easy to Use
- Few Modifier Inputs – Limit Flexibility

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LandGEM Inputs for Gas Generation Estimates

- k – Rate of methane generation for the mass of waste
- L_o – Potential Methane Generation Capacity, depends on the type and composition of waste, the higher the cellulose content the higher the L_o
- Annual Waste Rate (Tons)
- Closure Year (Input or Calculated by Model)

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LandGEM

"LandGEM is considered a screening tool – the better the input data, the better the estimates."

-LandGEM User's Guide

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Factors in LFG Modeling

- Accurate Disposal History
- Waste Characteristics
- Volume of Cover Soils Placed
- Useful in Correct Applications and Detrimental When Improperly Applied
- Things Change and Models Will Need to be Updated
- Actual LFG Recovery Data
- Relative Moisture of the Waste Mass
  - Known Leachate Mounding
  - Leachate Recirculation

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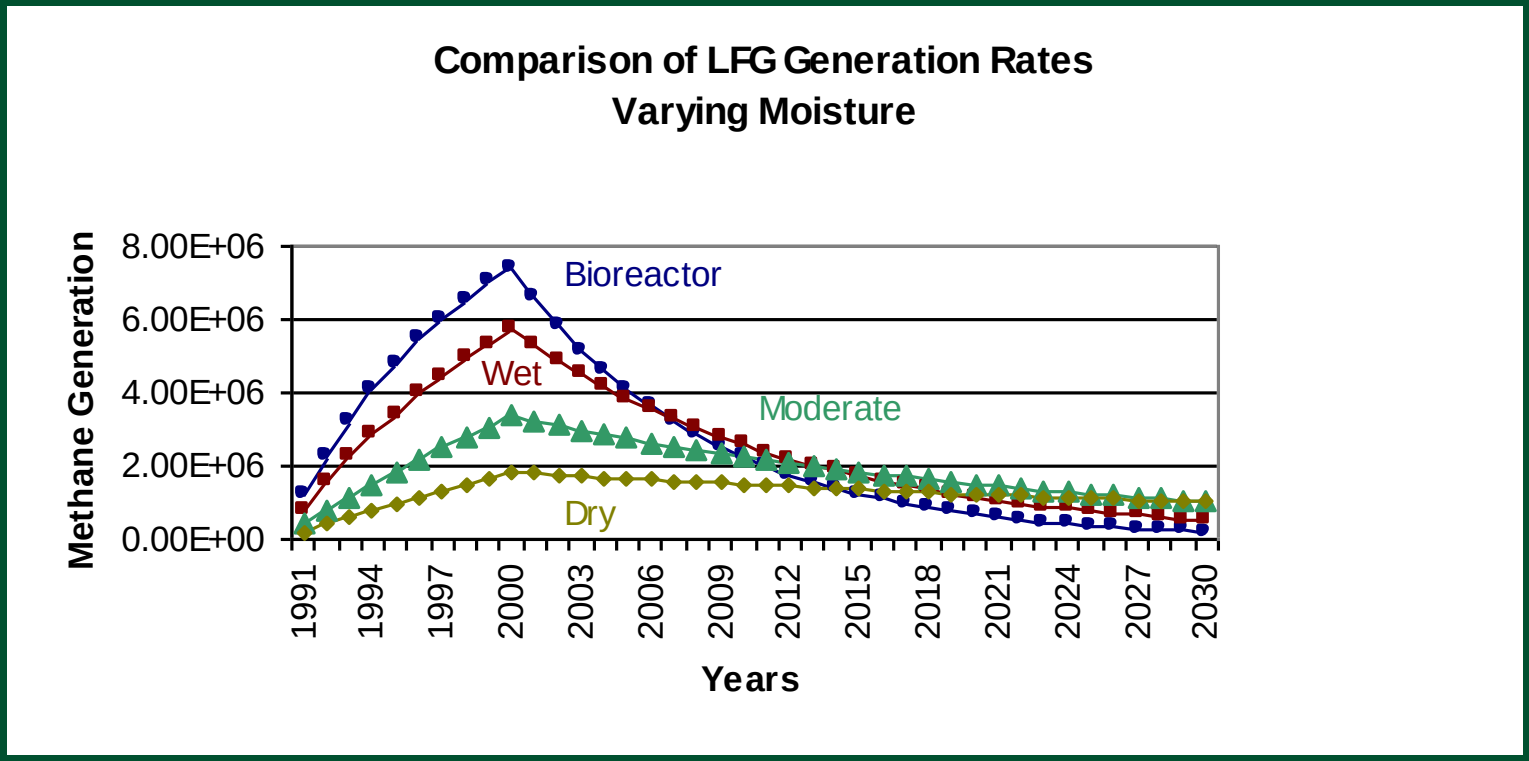
Moisture Comparison



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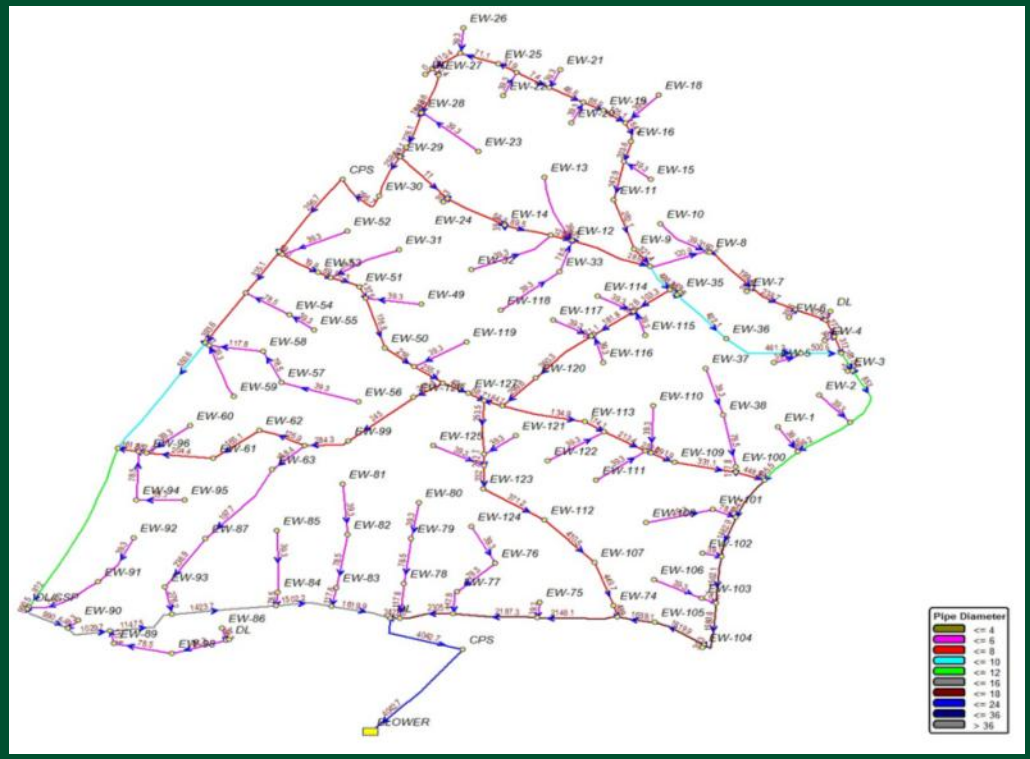
Example Facility

- MSW Landfill
- Waste Acceptance of 500,000 tons per Year
- Organic Fraction Only – Exclude Non-Putrescible Waste
- 40 Year Life for Base Case
- Looped GCCS Design with Perimeter Header
- One Flare/Energy Plant Location
- No Leachate Recirculation
- Active GCCS



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Possible Energy Concerns Prior to Organics Diversion

1. Current LFGTE Facility and Flaring Operations
2. Minimal Flaring, Engines Near Full Load
3. Engines Have Excess Capacity

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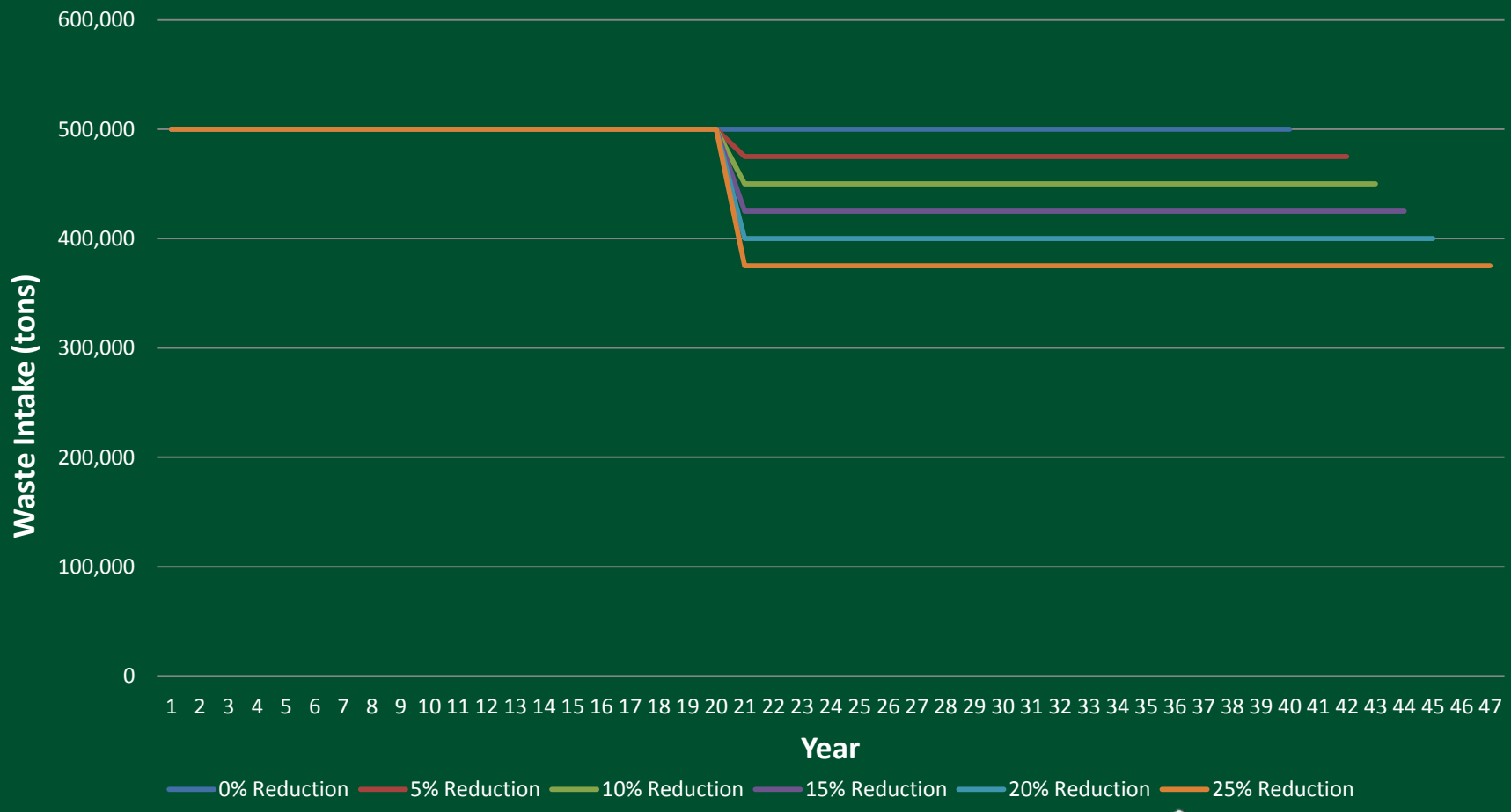
Example Facility - Organics Effect on Waste Stream



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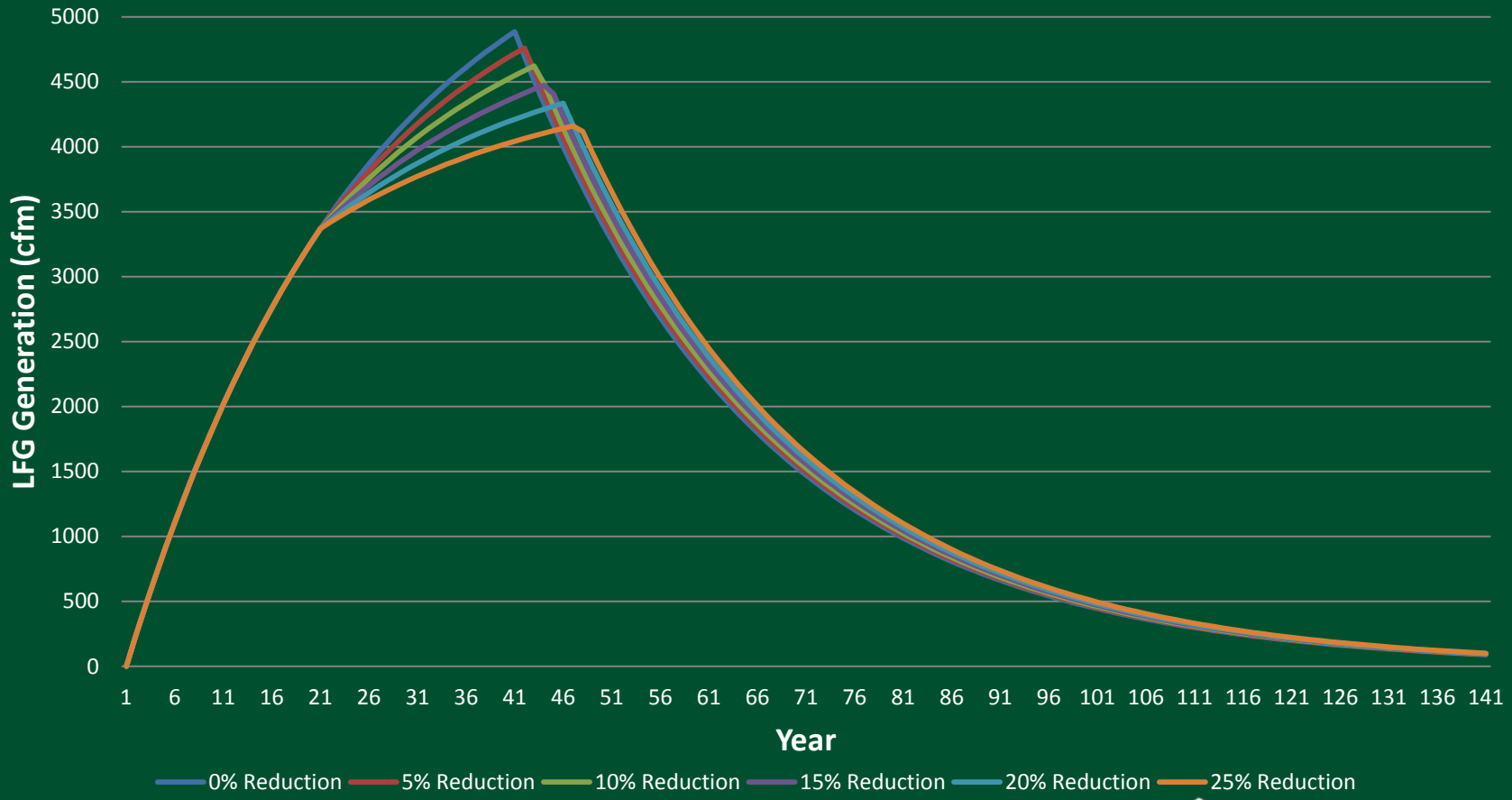
Effects of Organics Reduction on LFG Production – Landfill Life Extended



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Economics

Assumptions

-1000 scfm of LFG yields approximately 2.7 MWh of electricity

-Obtain $0.05/kw-hr

CAT 3520 Landfill Gas Generator

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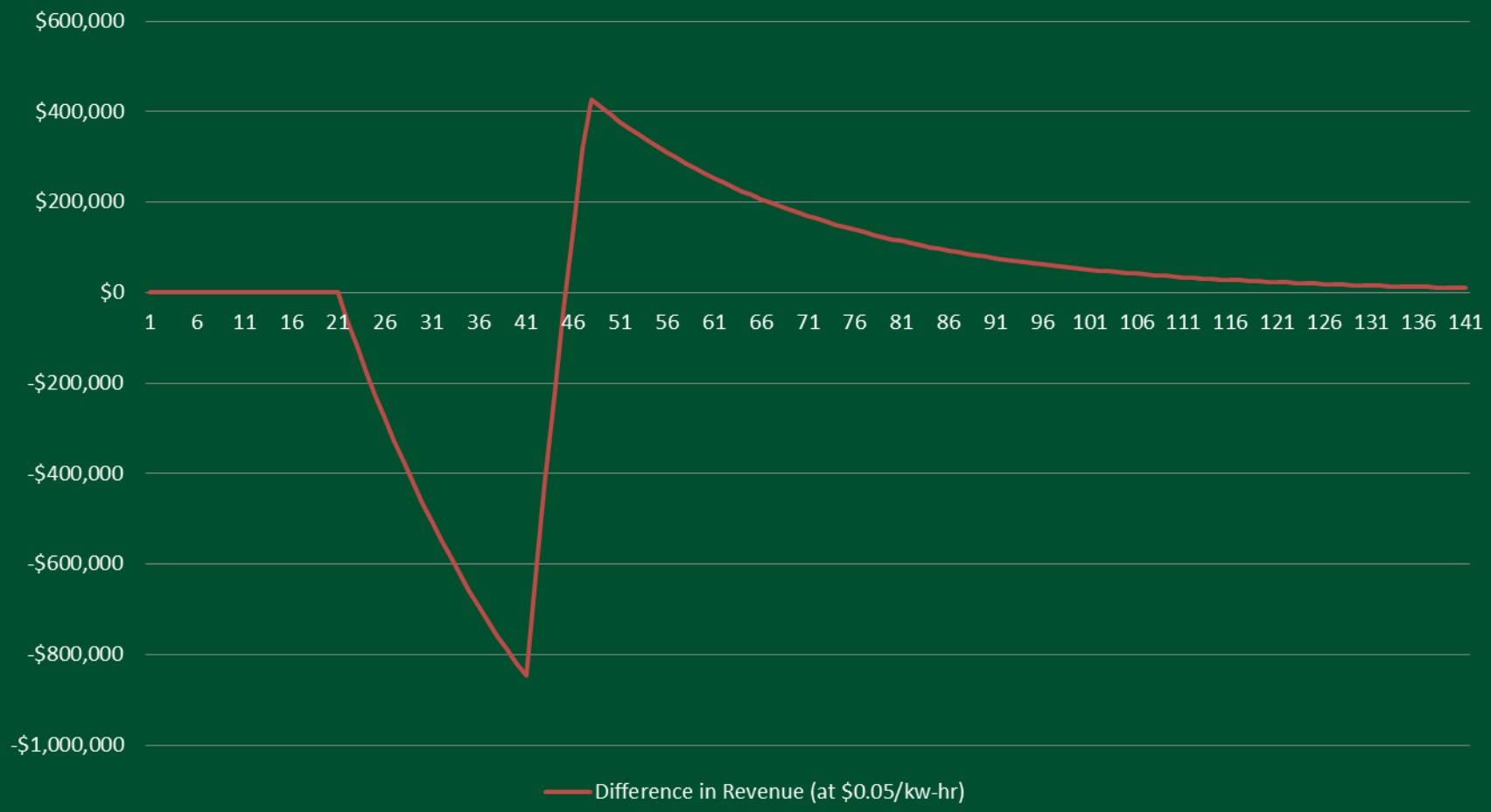
Case 1 Revenue Comparison

(Difference Between Base Case & 25% Organics Reduction Flow)



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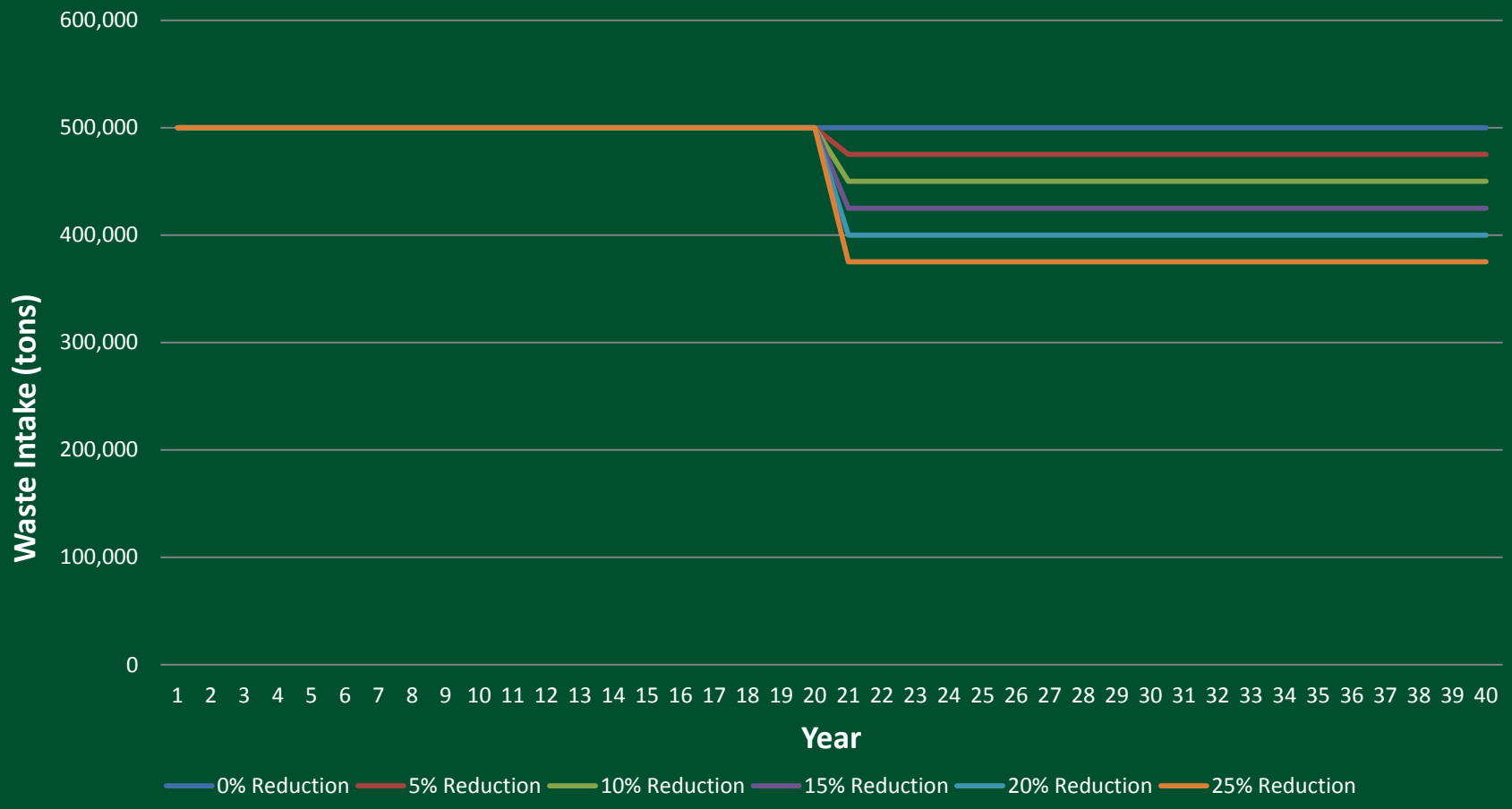
Example Facility - Organics Effect on Waste Stream



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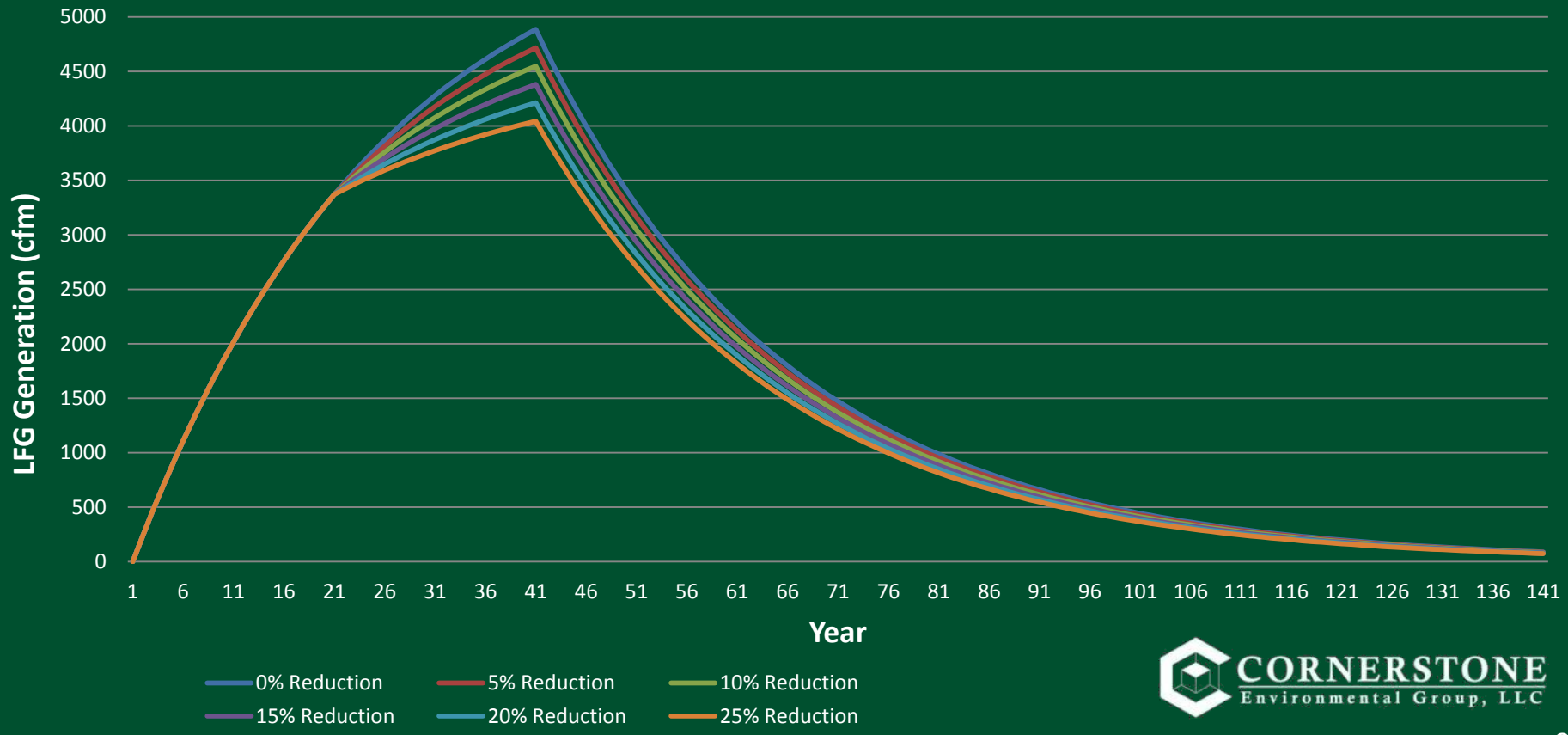
Effects of Organics Reduction on LFG Production – Optimize Waste Acceptance



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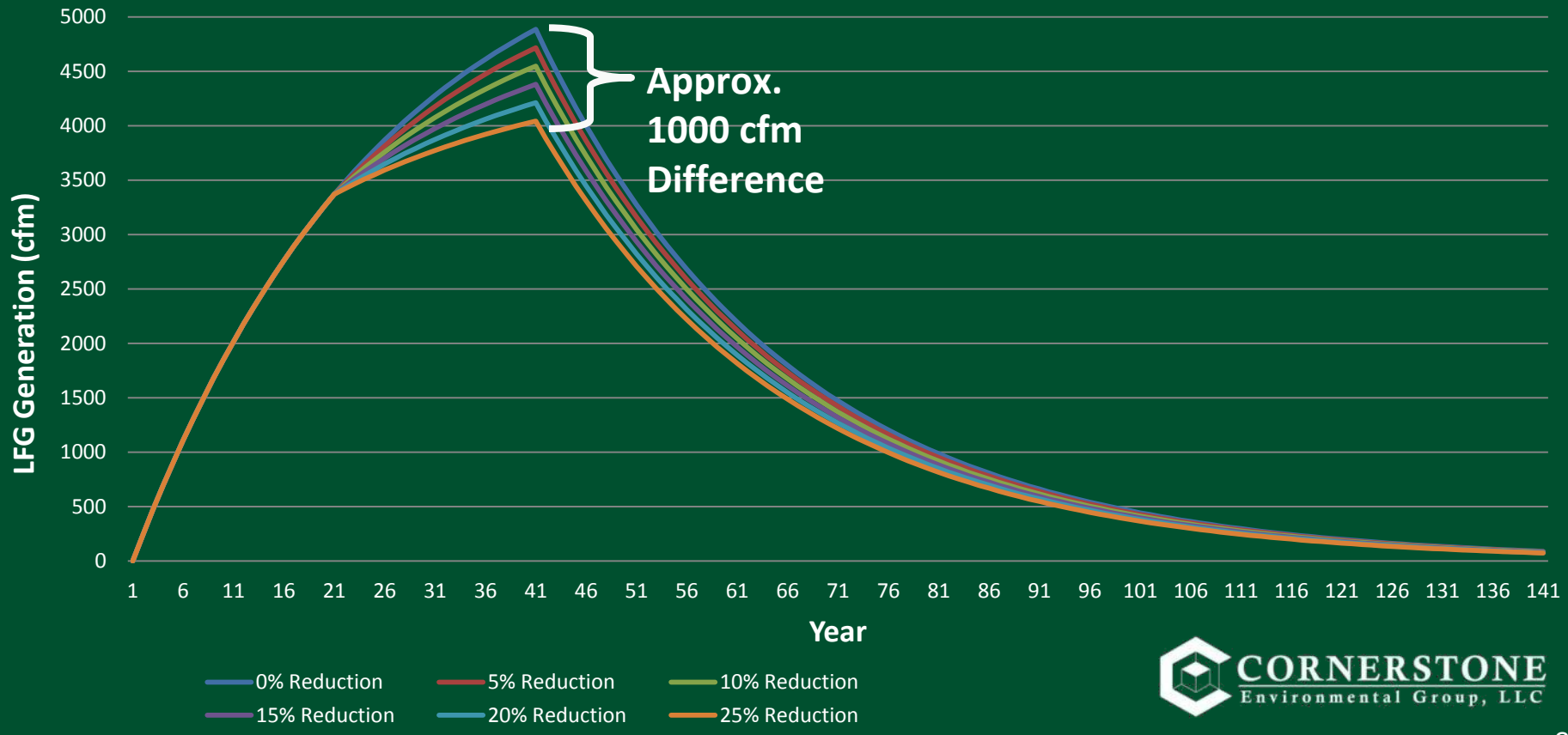
Effects of Organics Reduction on LFG Production – Optimize Waste Acceptance



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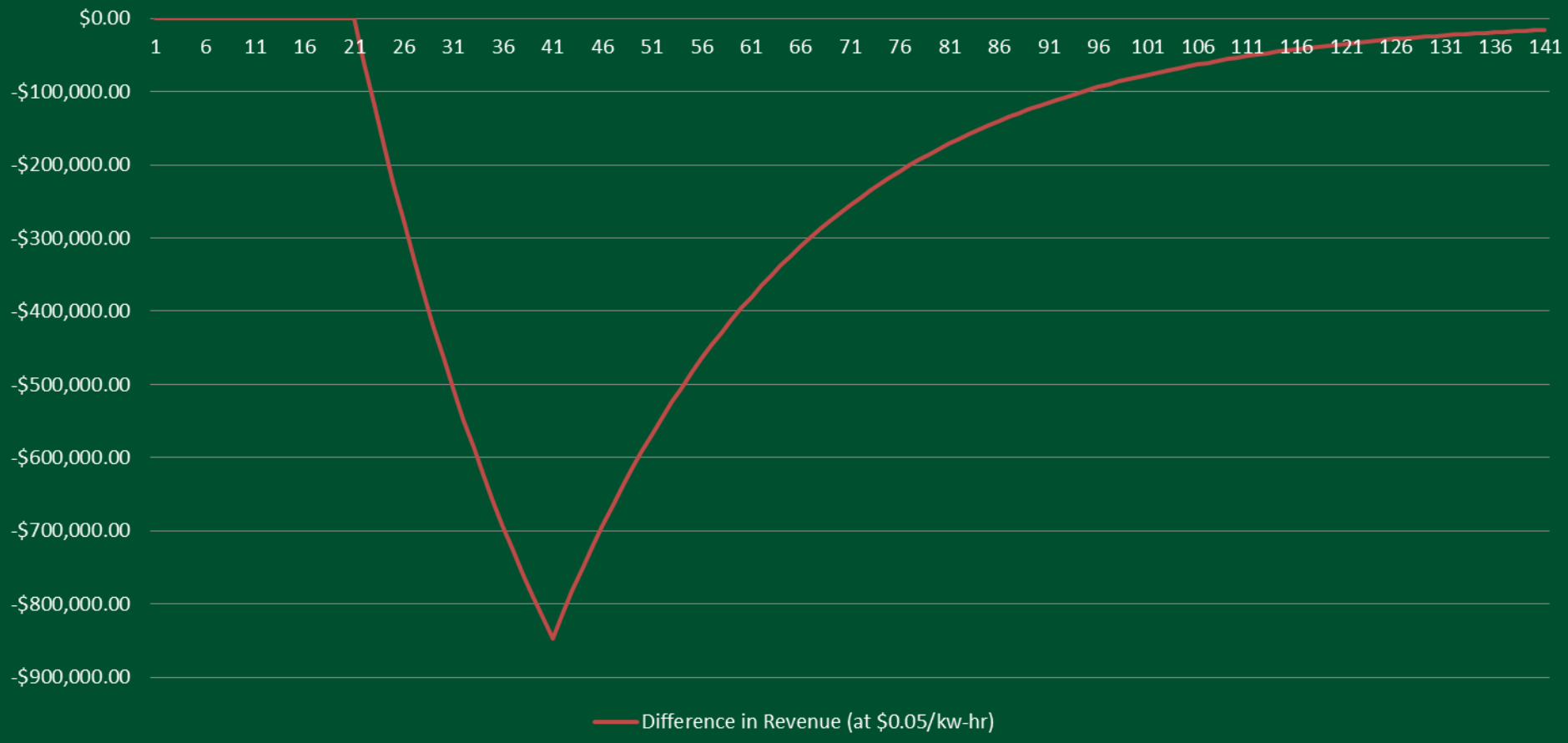
Case 2 Revenue Comparison

(Difference Between Base Case & 25% Organics Reduction Flow)



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Now What Happens to the Design

Pipe Nominal Diameter	Countercurrent Scenario Max. Recommended Velocity = 20 ft/sec (scfm)	Concurrent Scenario Max. Recommended Velocity = 40 ft/sec (scfm)
	SDR 17	SDR 17
4"	102	204
6"	221	466
8"	375	750
10"	583	1165
12"	820	1639
16"	1291	2581
18"	1634	3267
24"	2904	5808

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GCCS Savings

Pipe Size	Difference Between Base Cost and 25% Reduction
6"	$ 46,650.00
8"	$ 198,722.00
10"	$ (253,917.00)
12"	$ (31,464.00)
16"	$ 250,096.00
18"	$ (466,683.00)
24"	$ -
Total:	$ (256,596.00)

	25% Reduction Savings
Piping	$ (256,596)
Flare	$ (220,000)
Engines	$ (2,700,000)
Total:	$ (3,176,596)

- Potential savings of over $3 million dollars

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What are our Goals?

- Immediate Profits from LFGTE
- Long-term Profits from LFGTE Utilizing less equipment
- Decrease Costs Related to Landfill Operations
- Avoid Odor
- Increase Landfill Life
- Regulatory Compliance
- Neighbors

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Potential Costs

- Lower Revenue from LFGTE
- May Not Be Able to Meet Contract Requirements
- Unable to Operate Existing Equipment
- LFGTE Facility may Increase Vacuum if LFG Flow Decreases (Potential to Negatively Affect the GCCS)
- Reduce LFG Flow not Recouped if Organic Portion is Replaced by Inorganics

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Potential Benefits

- Lower GHG Emissions
- Potential Savings from Smaller GCCS and Fewer Engines
- Potentially Lower Operating and Maintanence Costs
- May be able to Extend the LFG flow

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Considerations for Existing Facility

- Revise LandGEM Model if Decreased Organics are Anticipated
- Be Aware of Contract Obligations
- Confirm Minimum Requirements to Run Engines / Beneficial Use Equipment
- Communicate with LFGTE

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Considerations for New Facility

- Don’t Over-Estimate LFG Modeling
- May Want to Decrease the Size of Piping System, However Don’t Under-Size Your GCCS
- Don’t Get Into a Contract That Can’t Be Met

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Be Ready For Change

- Waste Rates
- Population
- Economy
- Regulations

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Losing the Gas! What am I Going to Do!

- Plan in Advance
- Be Realistic with Gas Modeling
- Turn Lemons into Lemonade; Find Ways to Save and Profit
- Think of the Community and Regulators
- Consider Alternatives (Leachate Evaporation, BioCNG, etc.)

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Conclusion

- Needs are Facility-Specific
- Decreases in LFG Flow May Benefit Some Facilities/May Cost Others
- Benefits Related to Community and Regulators
- Planning is Crucial for Project Success
- A Decrease in Organics will Decrease LFG Flow

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Questions?

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