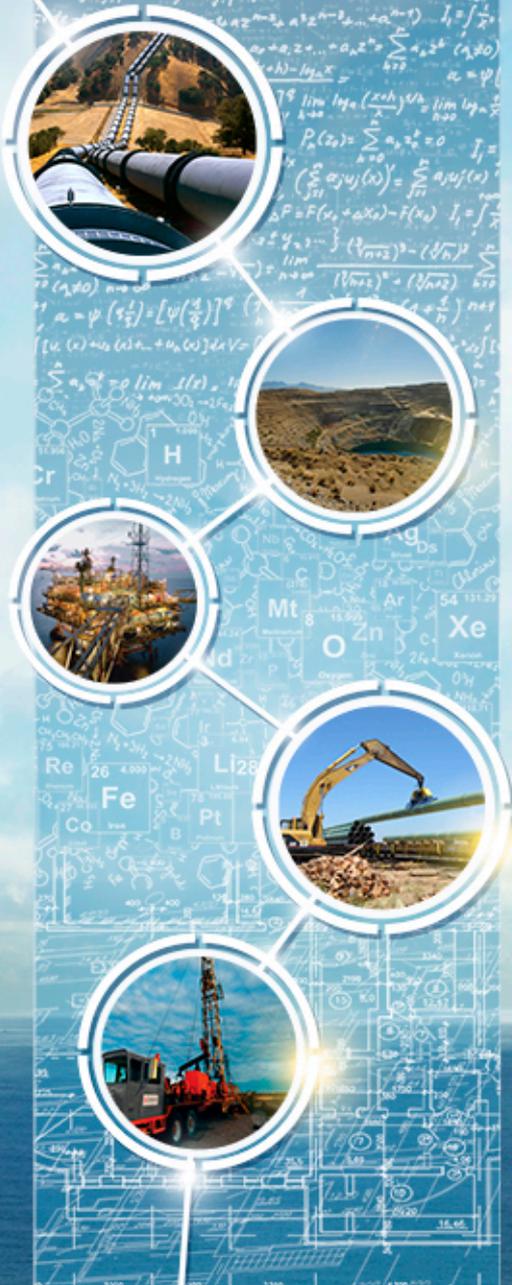




Organics Diversion

Relative Impacts on LFG Generation and Operations

Daryl O'Dell, P.E., P. Eng.



- Current Status of Organics Diversion
- 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



Typical Waste Stream

- MSW
 - Organic Materials
 - Food Waste 9%
 - Garden Waste 19%
 - Paper Waste 33%
 - Other Organics 7%
- Organic Subtotal 68%**
- Inorganic Materials 32%**

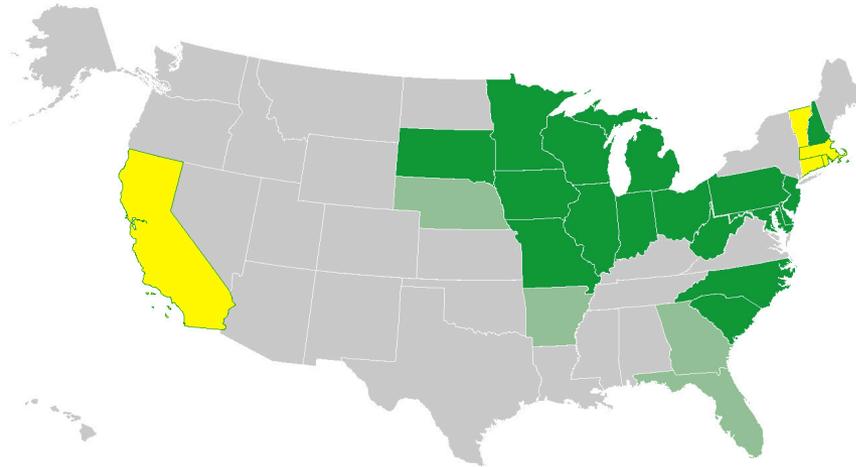


Framework of Bans – Various States

| | CT | VT | MA | CA | RI |
|-----------------|---------------------------|---|--------------------------|--|---------------------------|
| Effective Date | January 2014 | 2014 | October 2014 | April 2016 | January 2016 |
| Materials | SSOM | Food scraps | | | SSOM |
| Who is affected | Commercial & Industrial | Universal | Commercial & Industrial | Commercial & Industrial | Commercial & Industrial |
| Tonnage | 104 tons/yr (2 ton/wk) | 104 tons/yr (2 ton/wk) | 52 tons/yr (1 ton/wk) | 8 CY/wk | 104 tons/yr (2 ton/wk) |
| Tonnage Goal | 52 tpy (2020) | Phase to full ban in 2020 – no distance limit | -- | 4 CY/wk-2020 (2 if not near diversion goal in 2020) | -- |
| Reach/Radius | 20 miles | 20 miles | No limit | Not stated | 15 miles |
| Key Exemption | Schools & hospitals | | | | Schools |

Status of Legislation/Regulation

States that Ban Organics or Mandate Organics Recycling - October, 2014



Ban/mandate some yard debris: Arkansas*, Delaware, Florida*, Georgia*, Illinois, Indiana, Iowa, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska*, New Hampshire, New Jersey, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, South Dakota, Vermont, West Virginia, Wisconsin

*Allow yard debris disposal in landfills that generate energy

Ban/mandate food scraps: California, Connecticut, Massachusetts, Rhode Island, Vermont.
Also of note: New York City, Seattle

Source: Haaren, Themelis and Goldstein, State of Garbage in America, BioCycle Magazine, Oct 2010, updated 5-2011, 3-2012, 4-2013, 6-2014, 10-2014

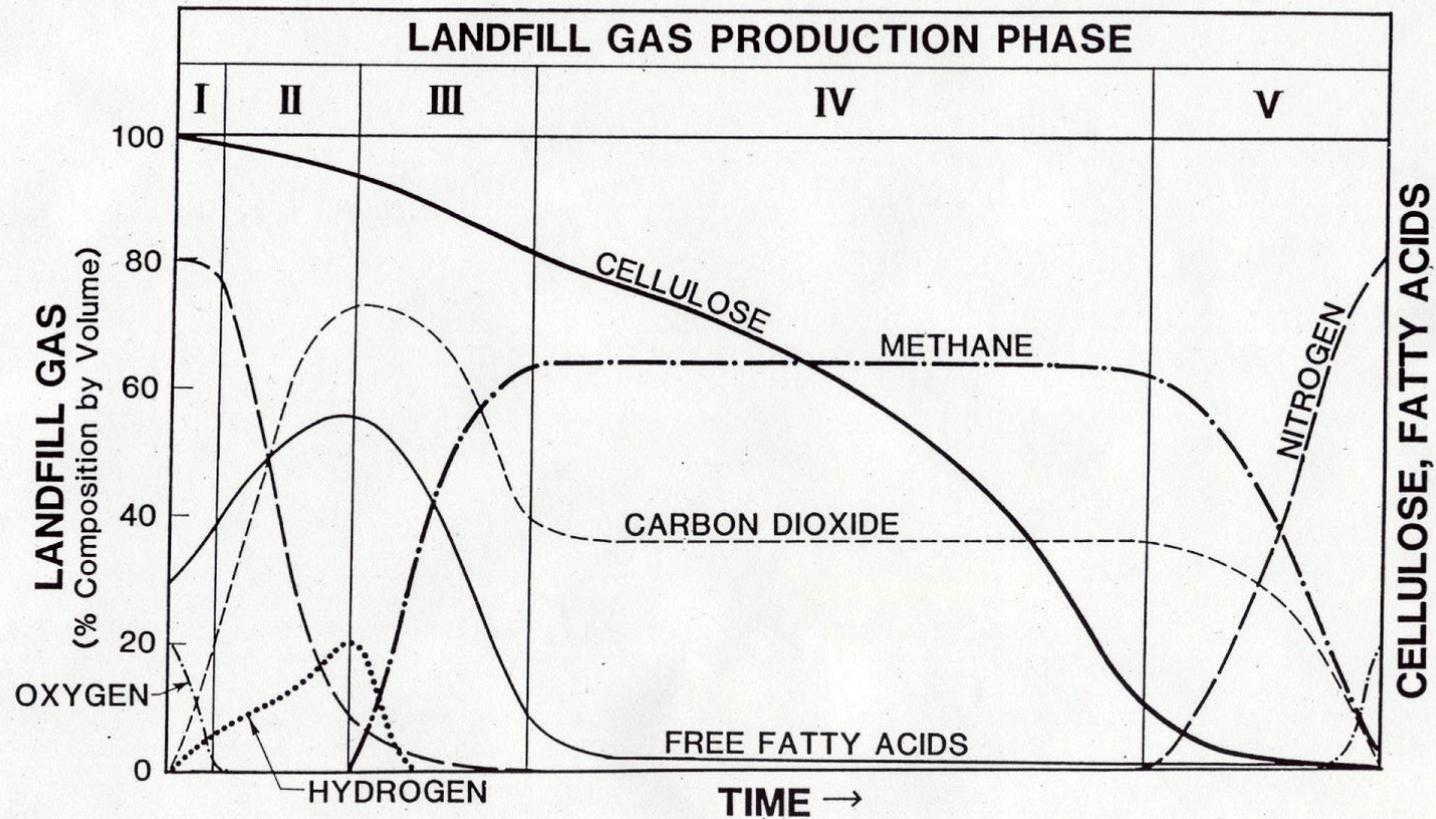
LFG Potential

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.

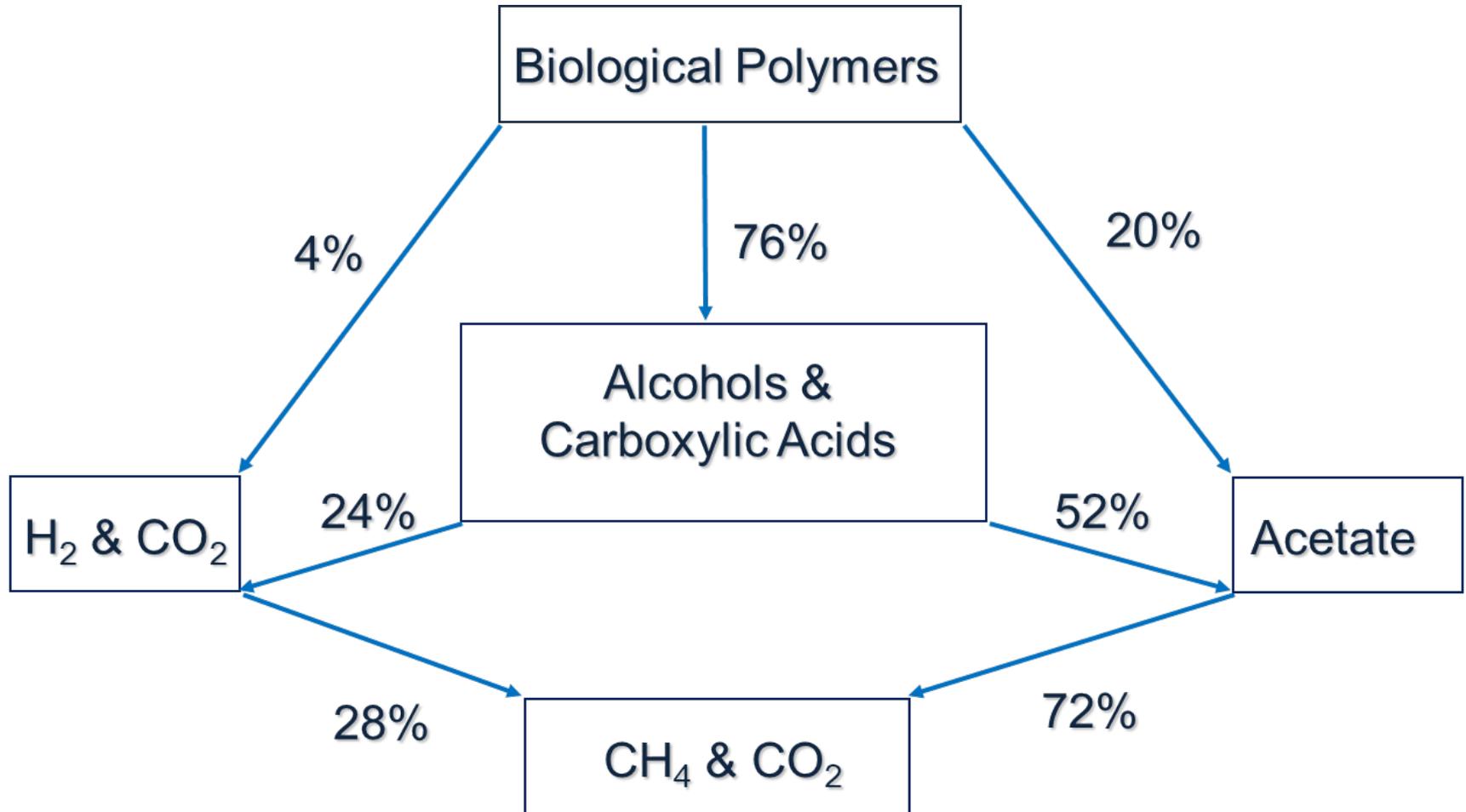
Remember not to mix apples and oranges!

TYPICAL LANDFILL GAS PRODUCTION PATTERN



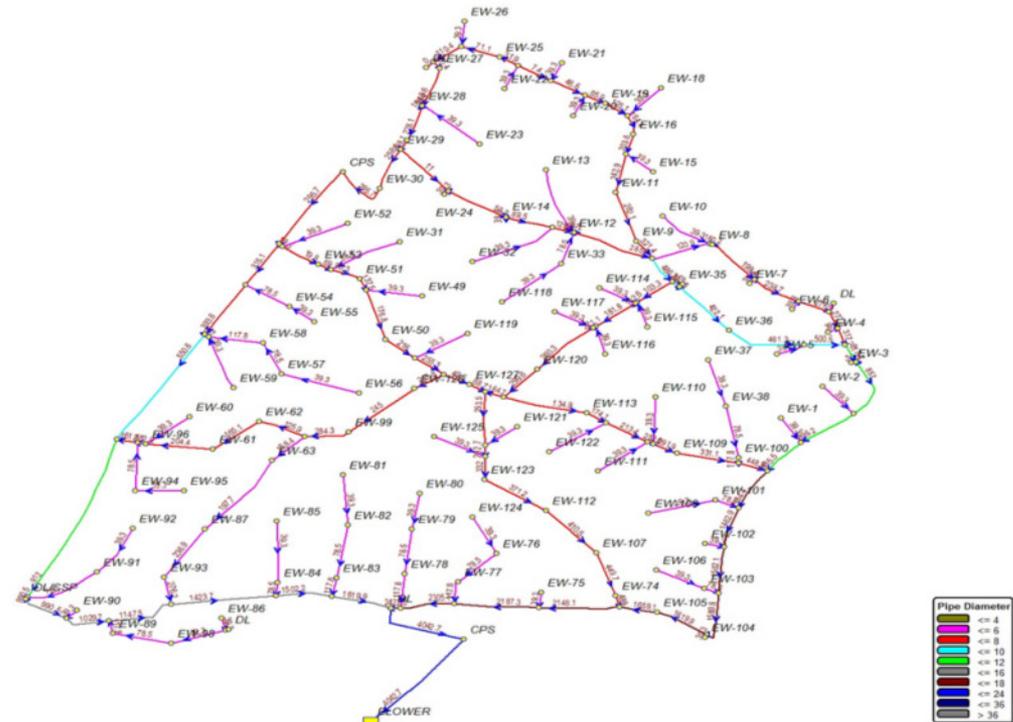
SOURCE: Farquhar and Rovers, 1973, as modified by Rees, 1980

Methanogenic Substrate Flow



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

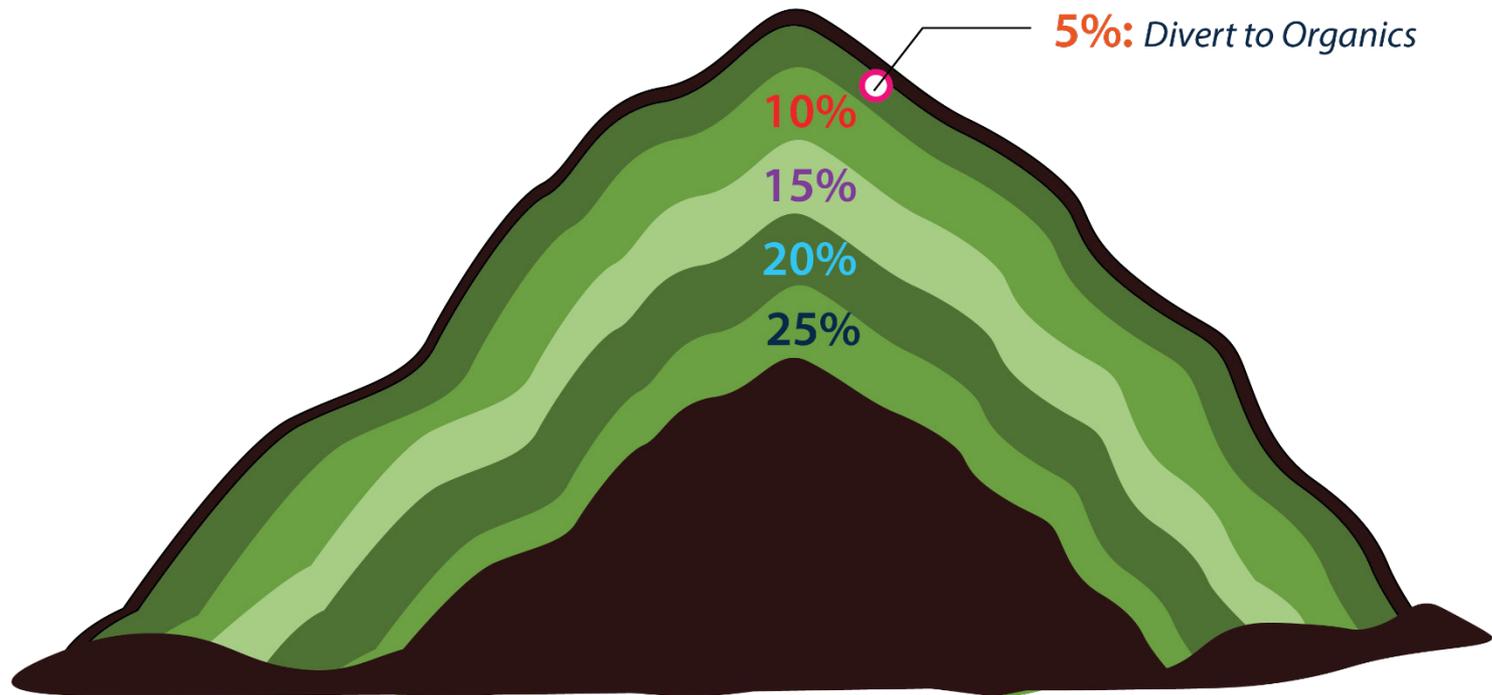


Factors in LFG Modeling

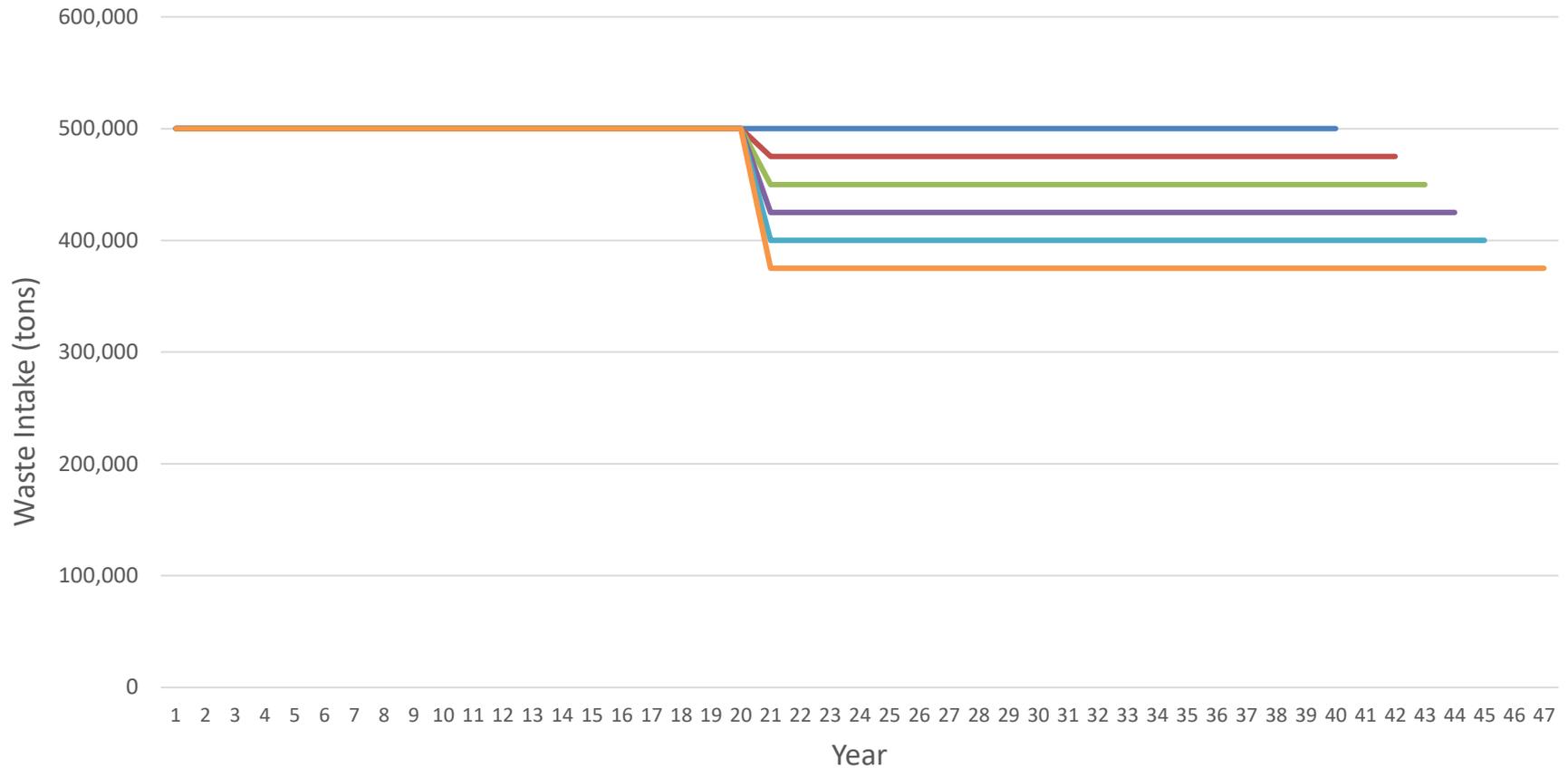
- Accurate Disposal History
- Waste Characteristics
- Volume of Cover Soils Placed
- Actual LFG Recovery Data
- Relative Moisture of the Waste Mass
 - Known Leachate Mounding
 - Leachate Recirculation

Example Facility - Organics Effect on Waste Stream

500,000 TONS OF WASTE

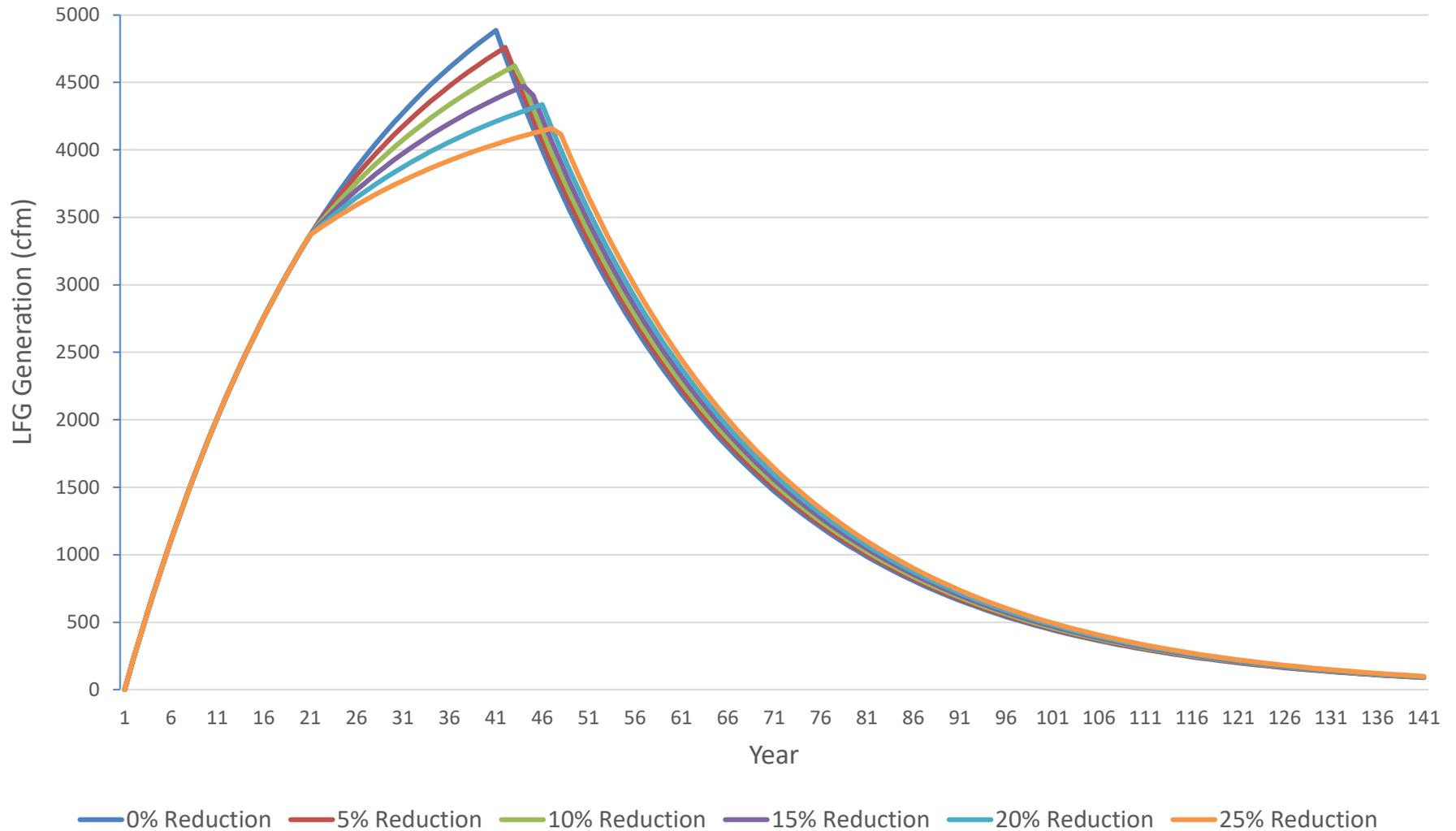


Example Facility – Option #1, Extending Life



— 0% Reduction — 5% Reduction — 10% Reduction — 15% Reduction — 20% Reduction — 25% Reduction

Effects of Organics Reduction on LFG Production – Landfill Life Extended



Example Facility – Organics Effect on Waste Stream

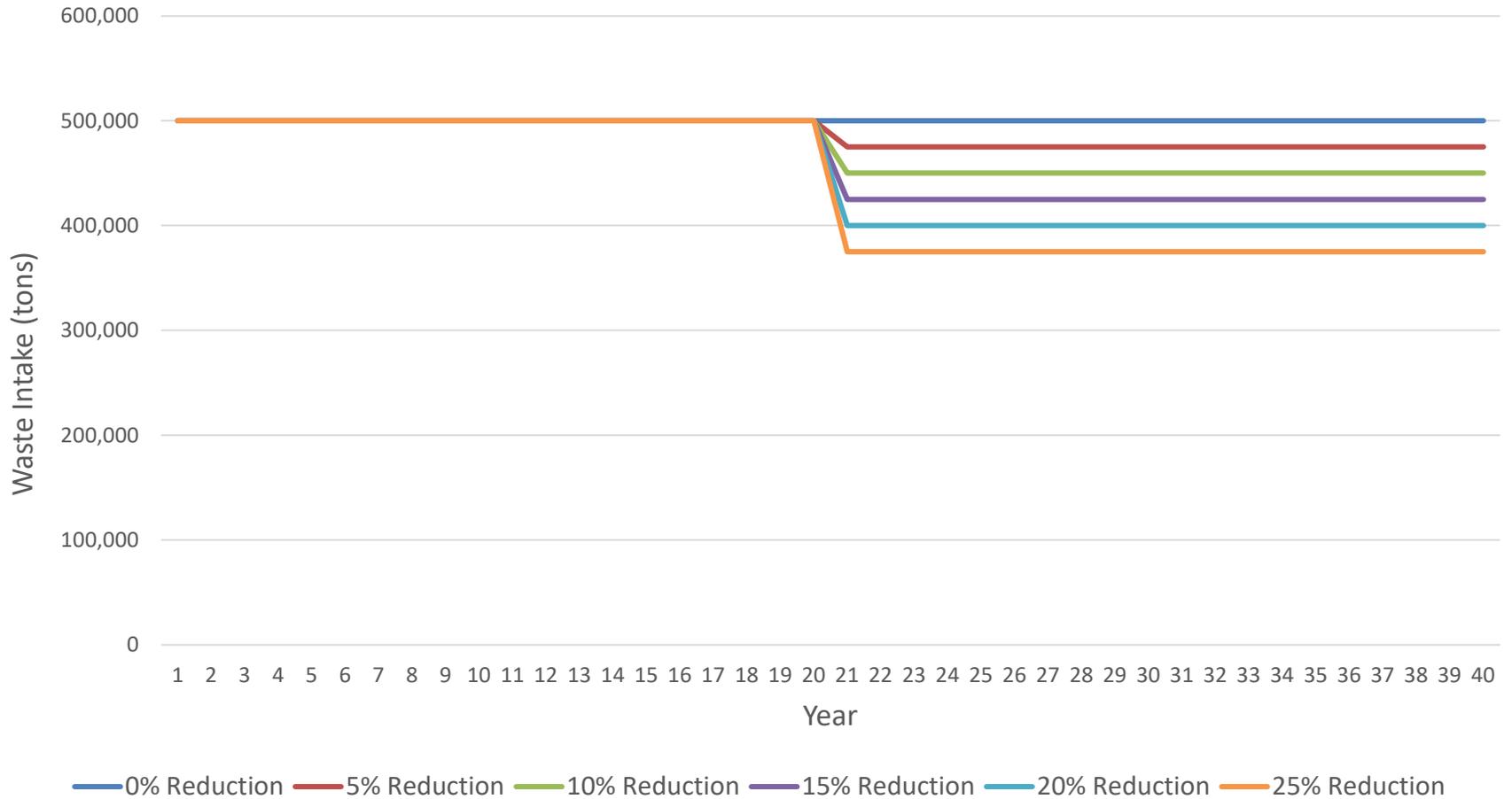
500,000 TONS OF WASTE

Replacing
5, 10, 15, 20, 25%
with
Inorganics

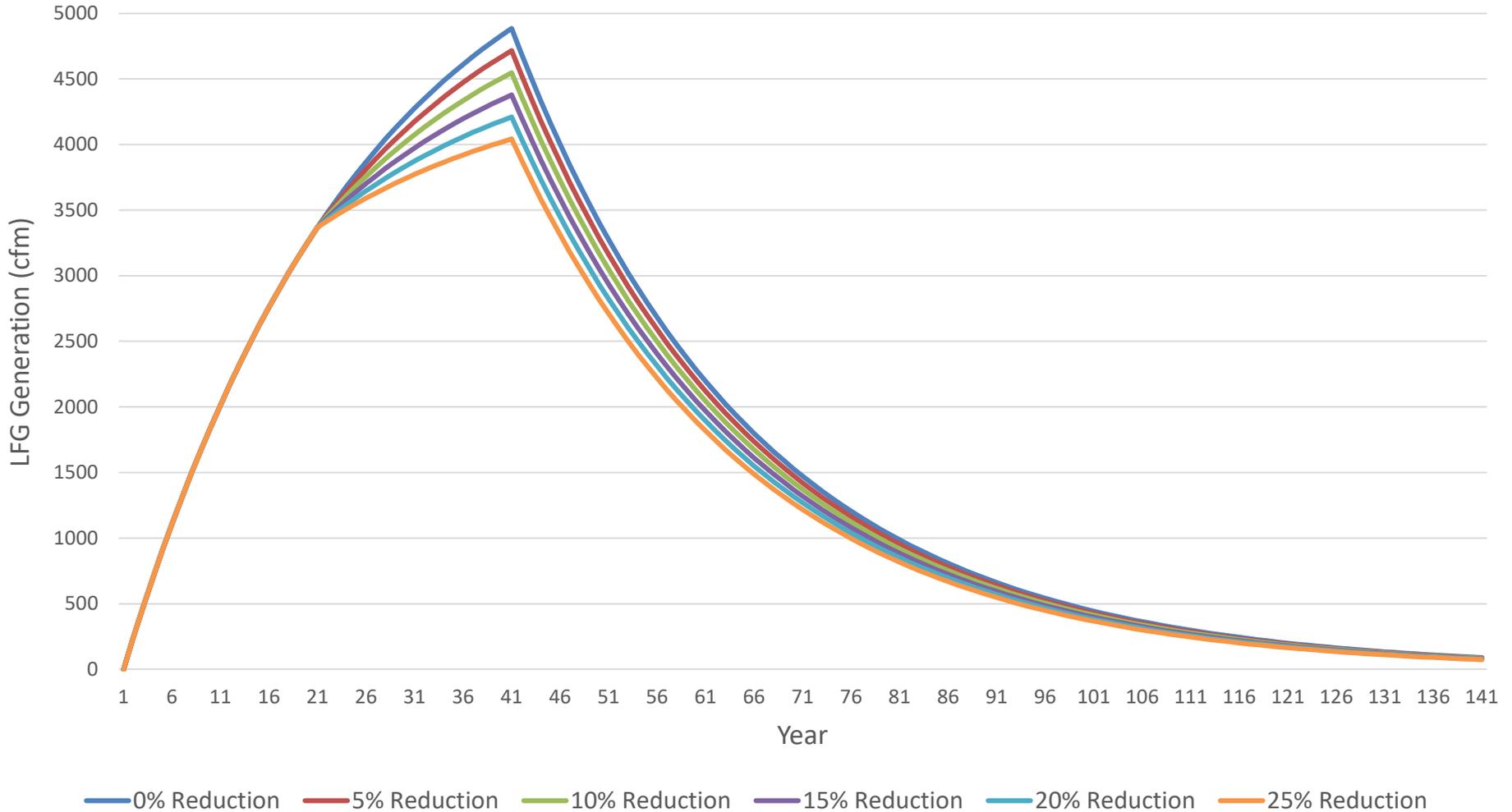
Remove
5, 10, 15, 20, 25%
Organics



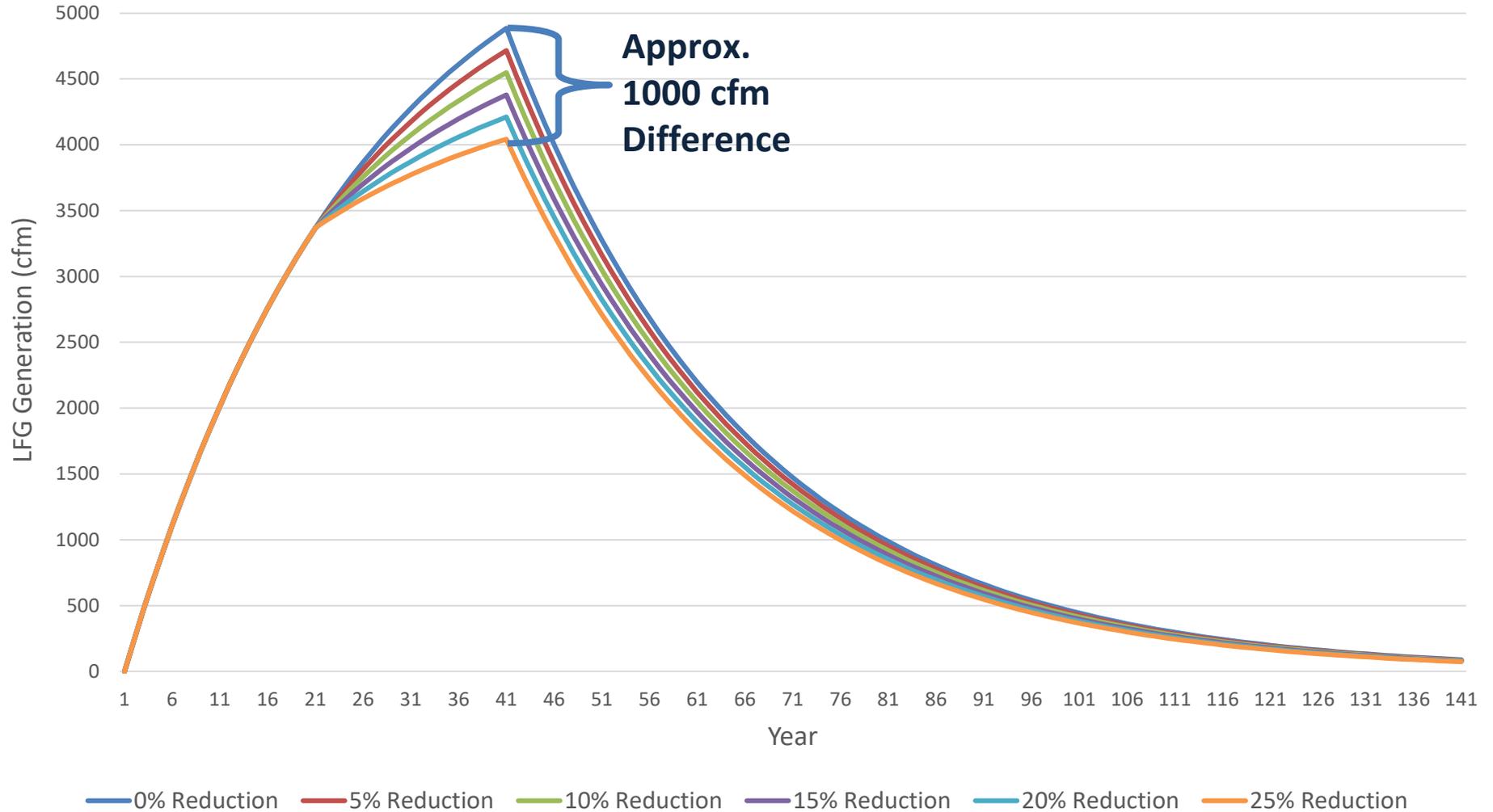
Example Facility – Option #2, Waste Replaced



Effects of Organics Reduction on LFG Production – Optimize Waste Acceptance



Effects of Organics Reduction on LFG Production – Optimize Waste Acceptance



What are our Goals?

- Immediate Profits from LFGTE
- Long-term Profits from LFGTE utilizing less equipment
- Decrease Costs Related to Landfill Operations
- Increase Landfill Life
- Regulatory Compliance

For Sites with Landfill Gas to Energy

- 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)

Potential Benefits

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

Considerations for an Existing LFGTE 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 Operator

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

Get Ready for Change!!!

- Planning is Crucial for Project Success. Plan in Advance
- Be Realistic with Gas Modeling
- Turn Lemons into Lemonade; Find Ways to Save and Profit
- Consider Alternatives (Leachate Evaporation, BioCNG, etc.)



A Decrease in Organics will Decrease LFG Flow



Thank you!

Questions?

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