SUSTAINABLE LANDFILL BIOCELL

AN INNOVATIVE TECHNOLOGY TO BIOSTABILIZE ORGANIC FRACTION OF MUNICIPAL SOLID WASTE

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OUTLINE

- Organic Fraction of Municipal Solid Waste (MSW) Stream.
- Waste Biostabilization in a Conventional Landfill.
- Conventional vs. Biocell Landfills.
- Biocell Landfills – Introduction.
- Case Study – City of Calgary Sustainable Landfill Biocell.
- Operation / Monitoring.
- Future.

This project received a 2006 Consulting Engineers of Alberta Showcase Award of Excellence.

ORGANIC FRACTION OF MUNICIPAL SOLID WASTE STREAM

- Approximately 70% of waste currently landfilled is organic.
  - Yard waste (25%), Food waste (20%), Paper (25%).
- Up to 75% of MSW generated in the region is disposed to landfills.
- Decomposition of organic fraction of MSW in a landfill generates landfill gas (mainly CH_4 and CO_2) and leachate.

WASTE BIOSTABILIZATION IN A CONVENTIONAL LANDFILL

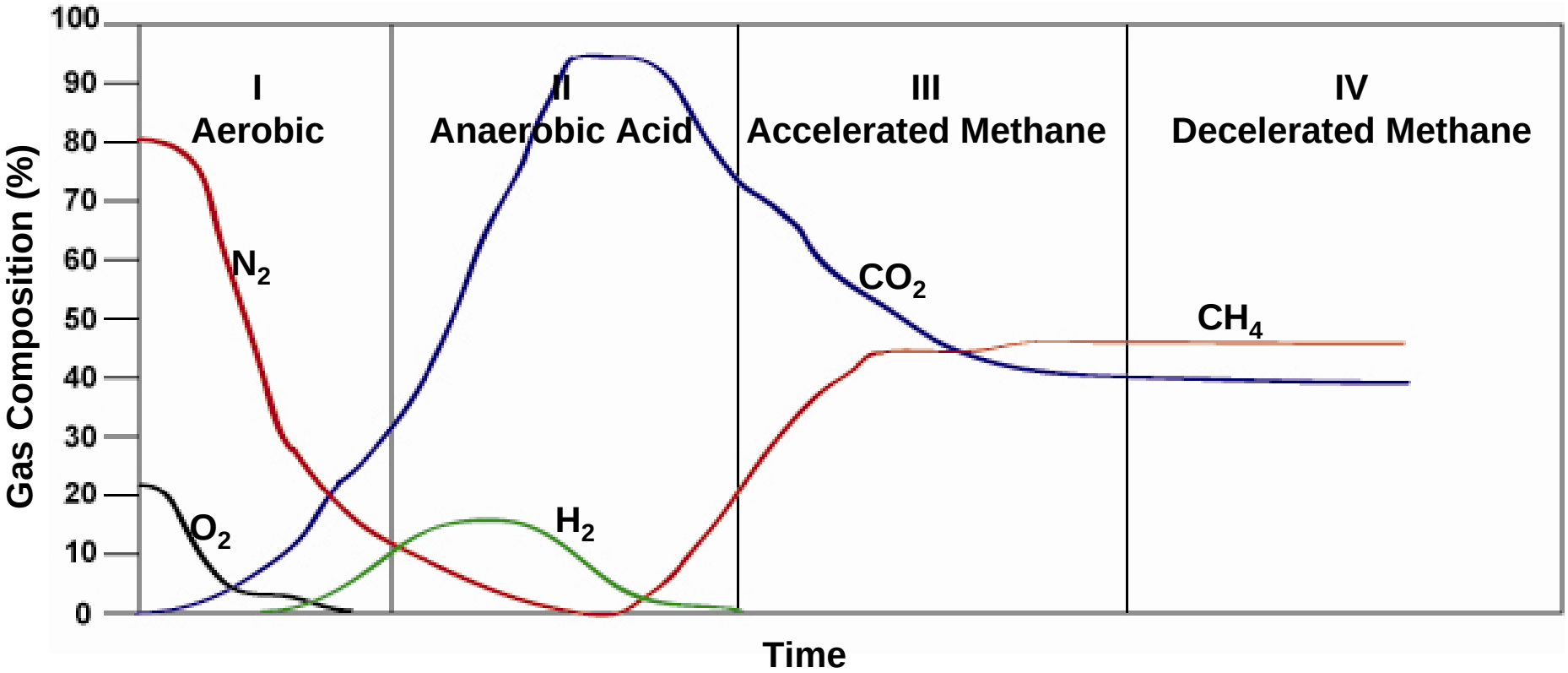


Figure 1: Phases of Decomposition of Organic Fraction in a Landfill

CONVENTIONAL VS. BIOCELL LANDFILLS

- Conventional landfills - “dry tomb” philosophy.
- Could take 100 or more years for complete biostabilization in drier climates.
- Current regulations include long-term post closure monitoring requirements.
- Biocell landfills – decomposition occurs in a shorter period of time.
- Biocell landfills are designed and operated to minimize short-term risks associated with leachate and LFG.

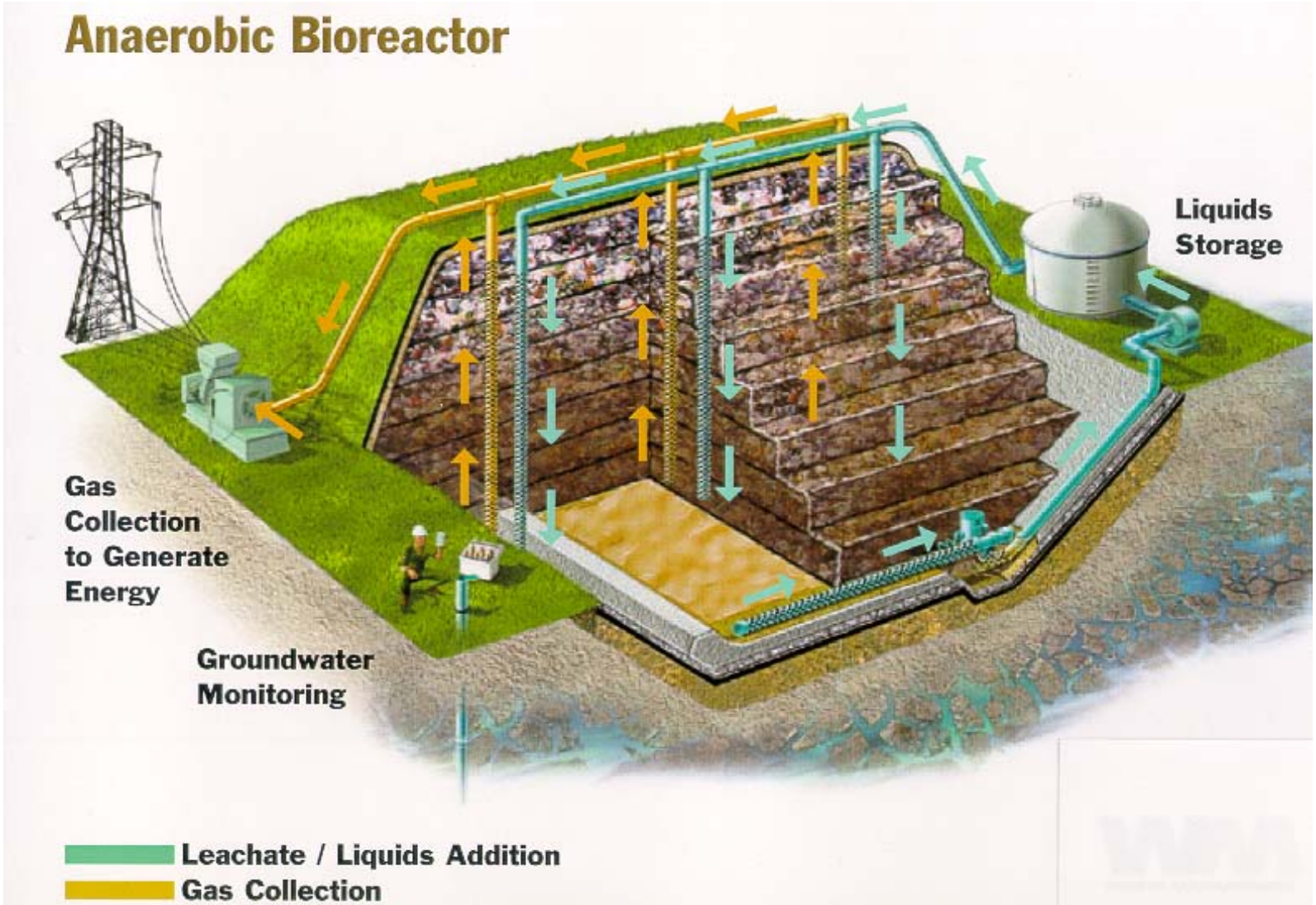
BIOCELL LANDFILLS – AN INTRODUCTION

- Designed/operated to ensure favorable conditions are created for rapid biodegradation of organic waste.
  - Landfills as "process vessels".
- The most significant factor affecting waste biodegradation is moisture.
- Leachate recirculation.
- Operated near the field capacity of the waste.
- Phases are: anaerobic, aerobic, and recovery of air space.
- Opportunity to process various organic wastes for beneficial end use.

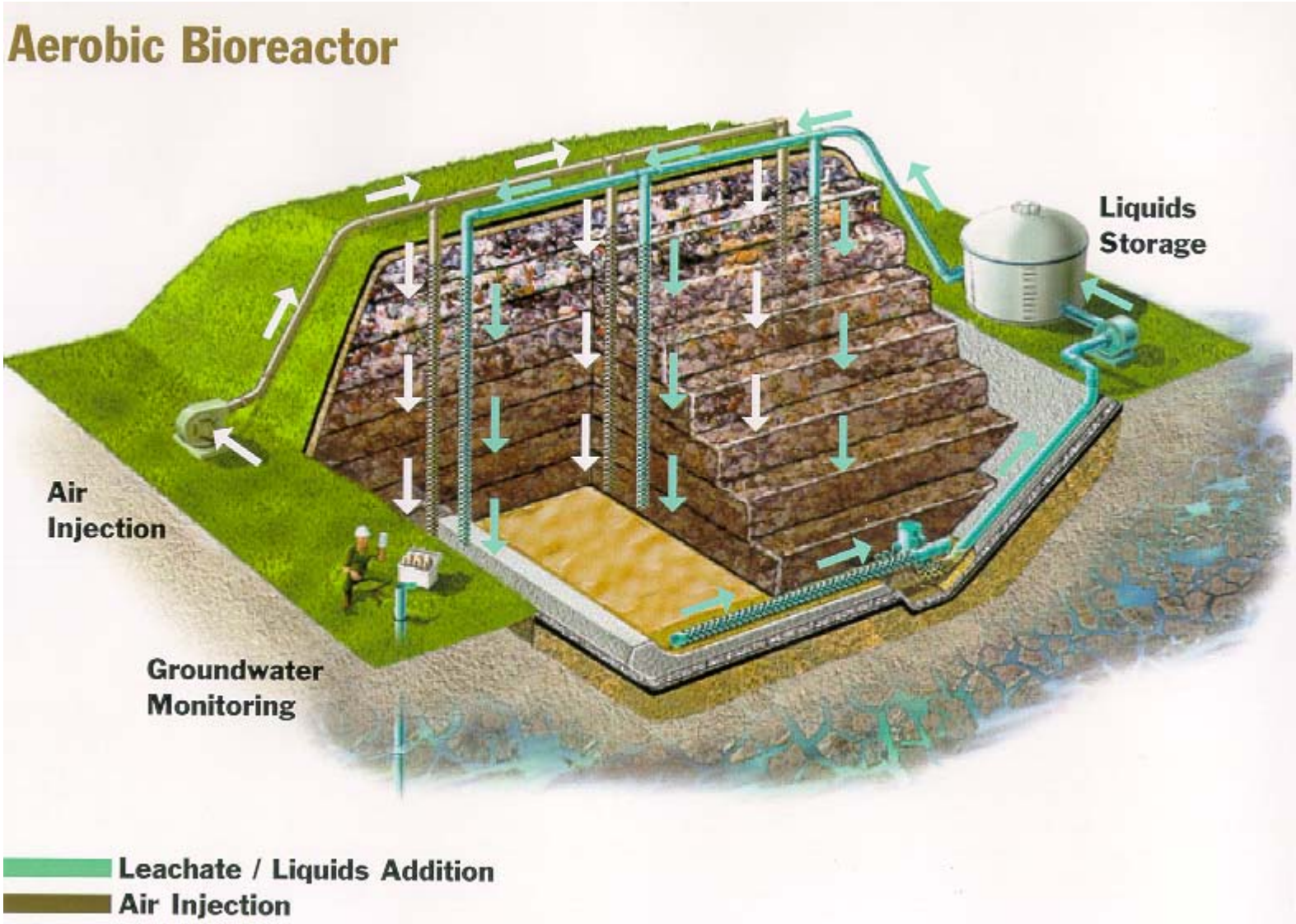
WHY BIOCELL LANDFILLS?

- Potential exists for air space recovery.
- Lower costs associated with leachate treatment. No need for treatment at wastewater treatment plants or purpose-built facilities.
- LFG recovery and treatment.
- Lower long-term risks (e.g. leachate and LFG).
- Lower post closure costs (e.g. leachate disposal and LFG).
- Potential for resource recovery and recycling.
- Potential for greenhouse gas (GHG) emission reduction.
- Potential to generate energy.

ANAEROBIC PHASE OF BIOCELL LANDFILL



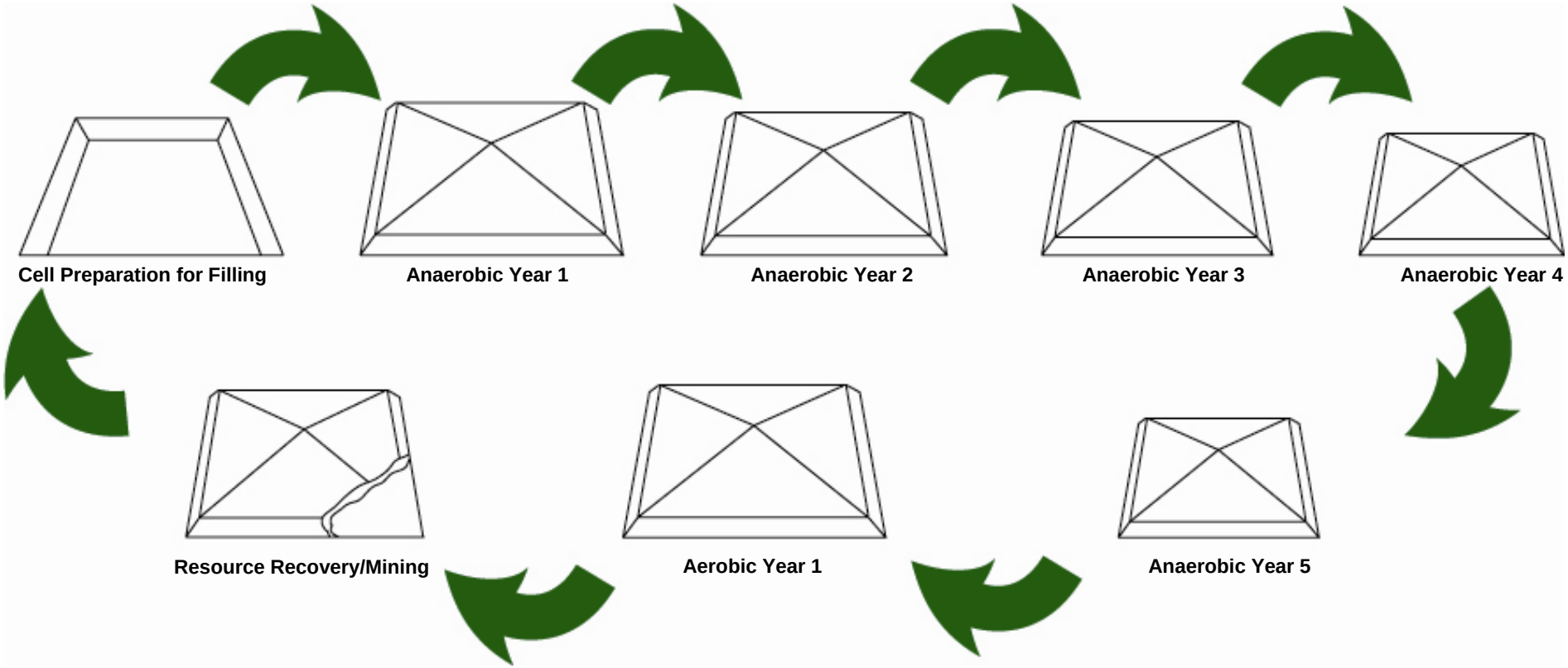
AEROBIC PHASE OF BIOCELL LANDFILL



CASE STUDY: CITY OF CALGARY SUSTAINABLE LANDFILL BIOCELL

- Genesis.
- Pilot facility for a full-scale biocell landfill.
- Potential sustainable waste management option for The City of Calgary.
- Contains 55,000 tonnes of residential organic waste.
- Incorporates the advantages of anaerobic and aerobic processes.
- Unique project – developed the term Landfill Biocell (LBC).
- Research – University of Calgary was involved.

SUSTAINABLE LANDFILL BIOCELL CONCEPT



LBC DESIGN

- Components of the LBC:
  - Groundwater Control System (in-gradient).
  - AENV Compliance (permeability).
  - Composite Liner System.
  - Leachate Collection and Storage System.
  - Liquid Injection System.
  - Common LFG Collection / Air Injection System.
  - Bio-cap Intermediate Covers.
  - Final Cover.

DESIGN CHALLENGES

- Higher initial infrastructure capital costs versus conventional landfills.
- Supplementary moisture sources may be required.
- Subsidence (i.e. Instrumentation Cluster Wells).

LBC CONSTRUCTION

LBC CONSTRUCTION CONTINUED

LBC FILLING

- Bag breaking.
- Density of waste.
- Subsidence.
- Intermediate bio-cap.

LBC CONTROL SYSTEM

- Main performance parameters for process monitoring, control, and evaluation – temperature, gas concentration, and moisture content.
- Liquid injection and gas collection are controlled.

LBC CONTROL DURING CONSTRUCTION

BIOCELL OPERATIONS

- DBM was based on source separated organics but the biocell was filled with residential MSW.
  - Source separated organics was not considered feasible at the time.
  - Filling operations were taking a long time so residential trucks were diverted to the biocell from both Shepard and East Calgary Landfills.
- Positives:
  - Very good gas production and quality.

Year	LFG Volume (m^3)	Methane Volume (m^3)	% Methane
2007	548,015	290,448	53.0 %
2008	555,288	280,420	50.5 %
2009	445,002	234,024	52.6 %

  - LFG generated from the Biocell represents about 30 - 35% of the total volume recovered at the Shepard landfill site. Plays an important role in the generation of electricity at the site.

BIOCELL OPERATIONS

- Issues:
  - Failure of the facility's automated controls and instrumentation caused by lightning strike. System could function safely manually, but automated control and data collection systems were affected.
  - Landfill Gas Collection Manifolds.
    - Issues with freezing during cold weather.
    - Manifolds were designed to come to ground level concrete pad prior to joining LFG collection network. Condensation froze and eventually blinded the manifolds for LFG for the first winter.
    - First covered with soil, then covered with small structures with explosion-proof heating.

BIOCELL OPERATIONS

- LFG seepage at seam where bottom liner meets top liner (GSM). Capped with clay to minimize emissions.
- Temperature probes faulty. 49 installed, 11 functioning.
- Some areas of the biocell appear to have unsaturated portions where gas production is low. Potentially crushed leachate return piping during construction.
- Settlement gauges which went out of range during filling operations.

LOOKING TO THE FUTURE

- Repairs to be made to return biocell to full automation.
- Must then look to the aerobic phase of biocell operation.
  - Once aerobic phase is completed and cell excavated, we will get a clear picture of how the waste has decomposed, what is required operationally (screening, etc.), and how the materials of construction fared.
- Next step will be to reuse the reclaimed airspace and look towards building another, or a series of, biocells.

CONCLUSION

- Diversion strategies will need to acknowledge that, even with aggressive diversion programs, some percent of organic waste will remain in the MSW waste stream.
- Biocells reduce long term risks associated with conventional landfills.
- Biocells treat waste as a resource.
- Biocells could provide a sustainable method of managing organic fraction of MSW.
- Biocells could provide a sustainable method of managing other organic wastes as a resource.

QUESTIONS?