

# Economics of Dry Batch Digestion for Small Municipalities – An Alberta Case Study

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# InnoTech Alberta

## VISION

As a premier applied research organization in Canada, InnoTech Alberta is uniquely positioned to work with industry, governments and academia to accelerate the adoption of innovative solutions as key part of Alberta's world class innovation system.



# InnoTech Alberta

## Value Proposition

- ❖ Key partner and enabler for Alberta businesses of all sizes to be globally competitive
- ❖ Accelerate the adoption of new and innovative technologies and processes by de-risking through scaling, piloting and demonstration
- ❖ A conduit for current problems facing businesses as well as a bridge to receptor capacity through creation and maintenance of relationships in critical sectors.
- ❖ World Class expertise and facilities in current and future areas important to Alberta (e.g. Oil Sands, Oriented Strand Board, super cluster strategies)

# InnoTech Alberta

- R&D alignment on 4 key sectors
  - Food & Fibre
  - Energy
  - Environment
  - Health
- Biogas Program – 15 years of Anaerobic Digestion
  - Feedstock Assessment
  - Techno-Economic Analysis
  - Process Integration Studies
  - Process Validation (pilot trials)
  - Vendor Evaluation
  - Process Optimization



# SuKarne - #5 Beef Producer in North America

- 5 Integrated Production Locations in Mexico
  - Feedlot, Feed Mill, Slaughter Plant, Rendering Plant, Composting Facility
- InnoTech Alberta approached to perform:
  - Initial waste characterization
  - Integration Study
  - Pilot Plant Construction and Consulting
- Feedlot manure, corn stover, slaughter residuals
- $3.1 \text{ MW}_{\text{ele}}$  and  $3.3 \text{ MW}_{\text{therm}}$



Vendor Selection  
Consulting for Full Scale



Integration Study  
**InnoTech**  
ALBERTA



Pilot Plant Construction

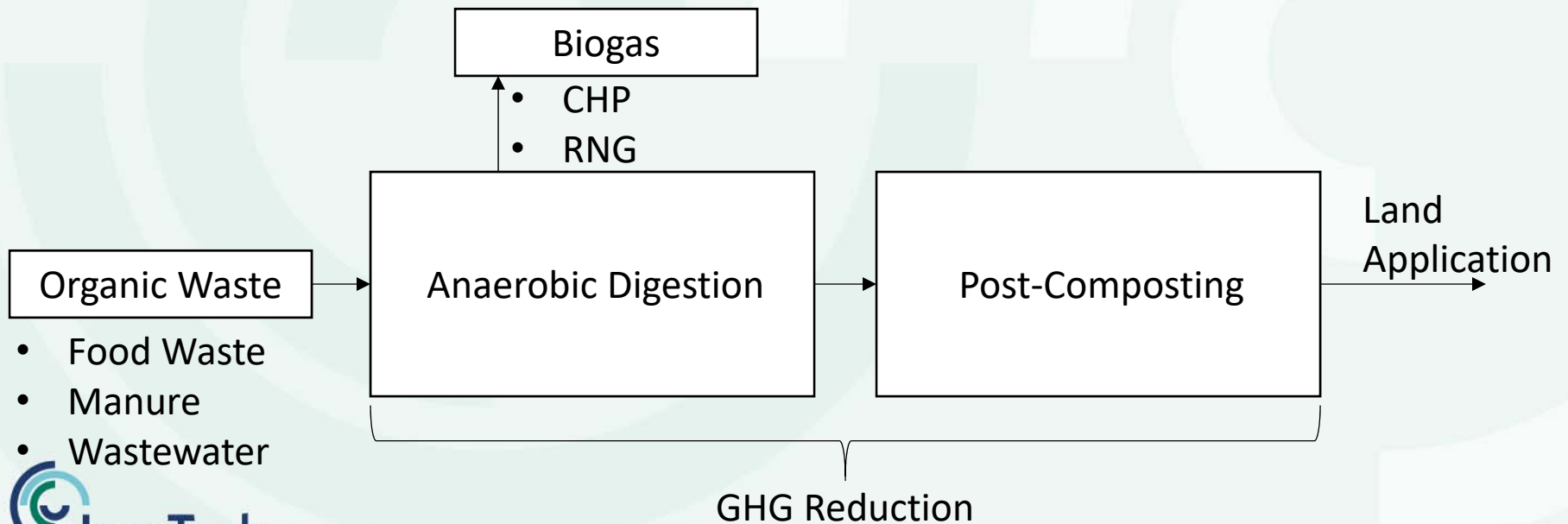


Pilot Operation Consulting



# Why Anaerobic Digestion?

- Renewable Energy Production
  - Biogas offsets fossil fuel use (savings on energy costs)
  - Energy production is renewable (carbon levy avoided)
- Waste Management
  - Landfill methane generation avoided (GHG credits)
  - Nutrient-rich compost produced (organic fertilizer)



# What's Driving Anaerobic Digestion Development?

- Federal Policy Actions
  - National carbon price - \$50 per tonne by 2022
  - Federal Clean Fuel Standard
  - Canadian Gas Association Renewable Natural Gas Target
    - 5% by 2025 and 10% by 2030
- Provincial Policy Actions
  - Climate Leadership Plan
  - Alberta Bioenergy Strategy
- Municipalities
  - Sustainability Goals
  - Increasing Landfill Tipping Fees

# The Alberta Biogas Opportunity

- Agriculture
  - Cattle - 5.4M head<sup>1</sup>
  - Pigs - 1.5M head<sup>1</sup>
  - 2.56M dry tonnes/y manure<sup>2</sup>
  - 70K dry tonnes/y deadstock<sup>2</sup>
- Agri-Food
  - Large food processing industry
  - 500K dry tonnes/y organic waste<sup>2</sup>
- Forestry
  - 4 kraft mills
  - 2 BCTMP pulp mills (both with AD)
  - 1 newsprint mill





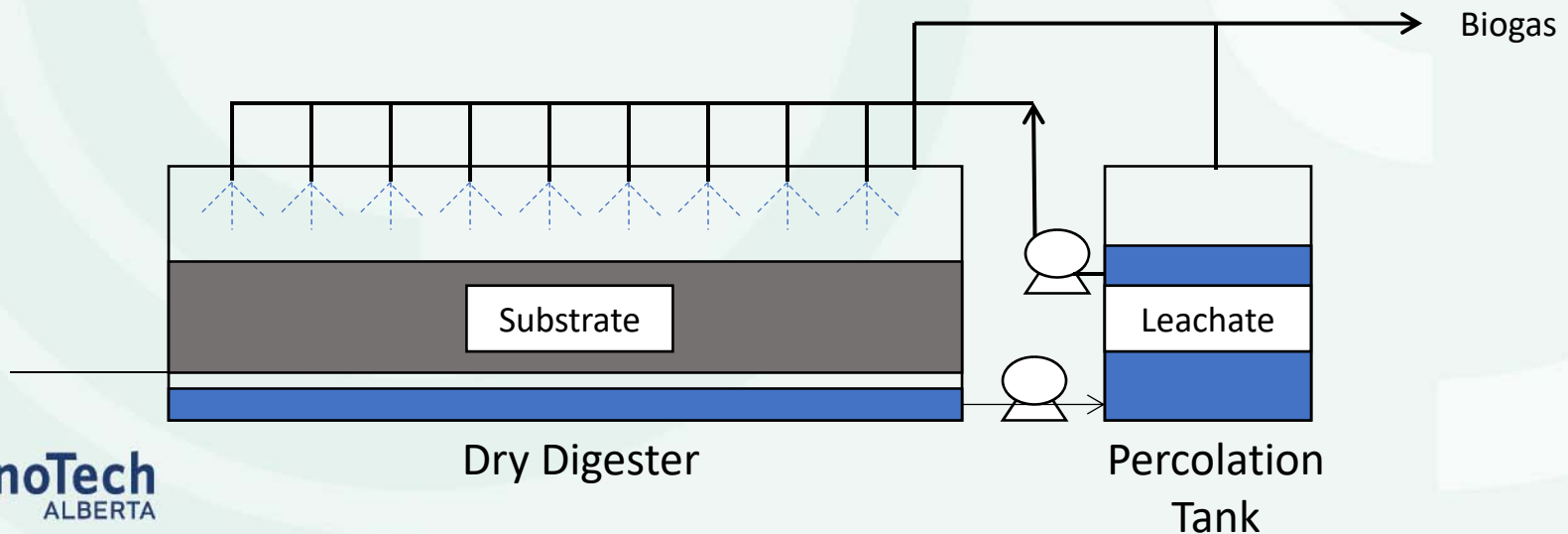
# The Alberta Biogas Opportunity

- Municipal Organic Waste<sup>1</sup>
  - Alberta's municipal solid waste – 1052 kg per capita per year
  - Approximately 284 kg organic waste per capita per year
- Emergence of Dry Digestion in Western Canada
  - Harvest Power Richmond, BC - 40K tpy opened in 2013
  - City of Edmonton HSAD Project - 40K tpy in 2017
  - Surrey Biofuel Facility – 115K tpy in 2017



# Dry Batch Anaerobic Digestion

- Non-flowing waste streams
- Horizontal bunkers
- Retention time 15-40 days
- Liquid waste is percolated so material must be permeable
- Recycle used to inoculate and optimize the digestion process



# Surrey Biofuel Facility

- Public-Private Partnership
  - Surrey and Orgaworld Canada
- \$67.6M Capital Budget
  - 25% capital support



- 115,000 tpy organic waste
- 120,000 GJ RNG annually
- 45,000 tpy Grade A Compost
- 3,500 tpy Ammonium Sulphate

# Edmonton High Solids Anaerobic Digester

- City-owned
- \$30.8M Capital Budget
  - ~33% capital support
- Integrated into composting facility



- 40,000 tpy organic waste
- 12.5 million kWh annually
- 45,300 MMBTU annually
- 20,000 tpy Grade A Compost



# Small-Scale Dry Batch Digestion Systems

- Waste volumes of < 5000 tpy
- Digesters are pre-fabricated and shipped
- Well-suited for remote locations with high transportation costs (work camps, small municipalities)
- Several European-based vendors





# Oil Sands Work Camp Study<sup>1</sup>

- Pilot Trial – Food waste and cardboard
- Digestion 50% volume, 37% mass reduction
- Compost 80% volume, 70% mass reduction
- Economics of 3000 tpy facility determined
- Interest from several companies

40 Days AD

80 Days Composting

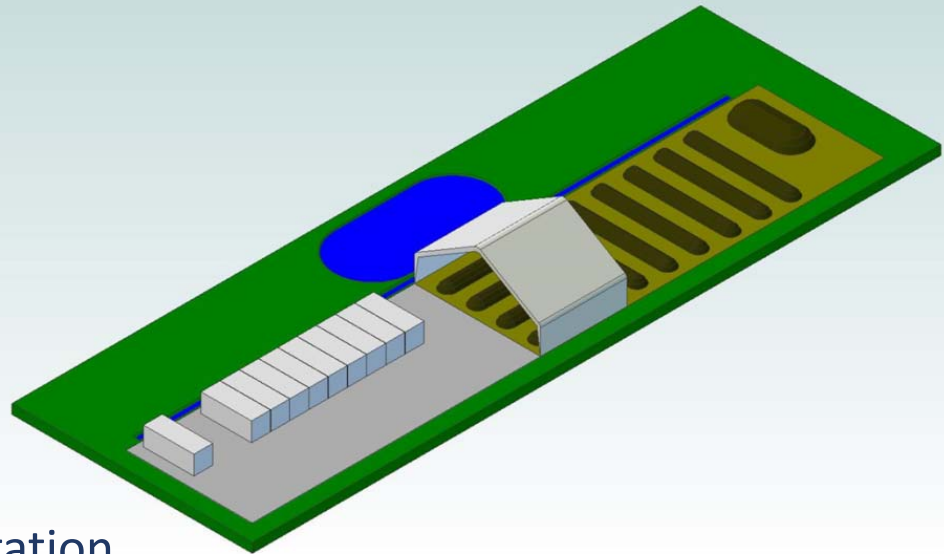


# Policy Drivers for Dry Batch Digestion

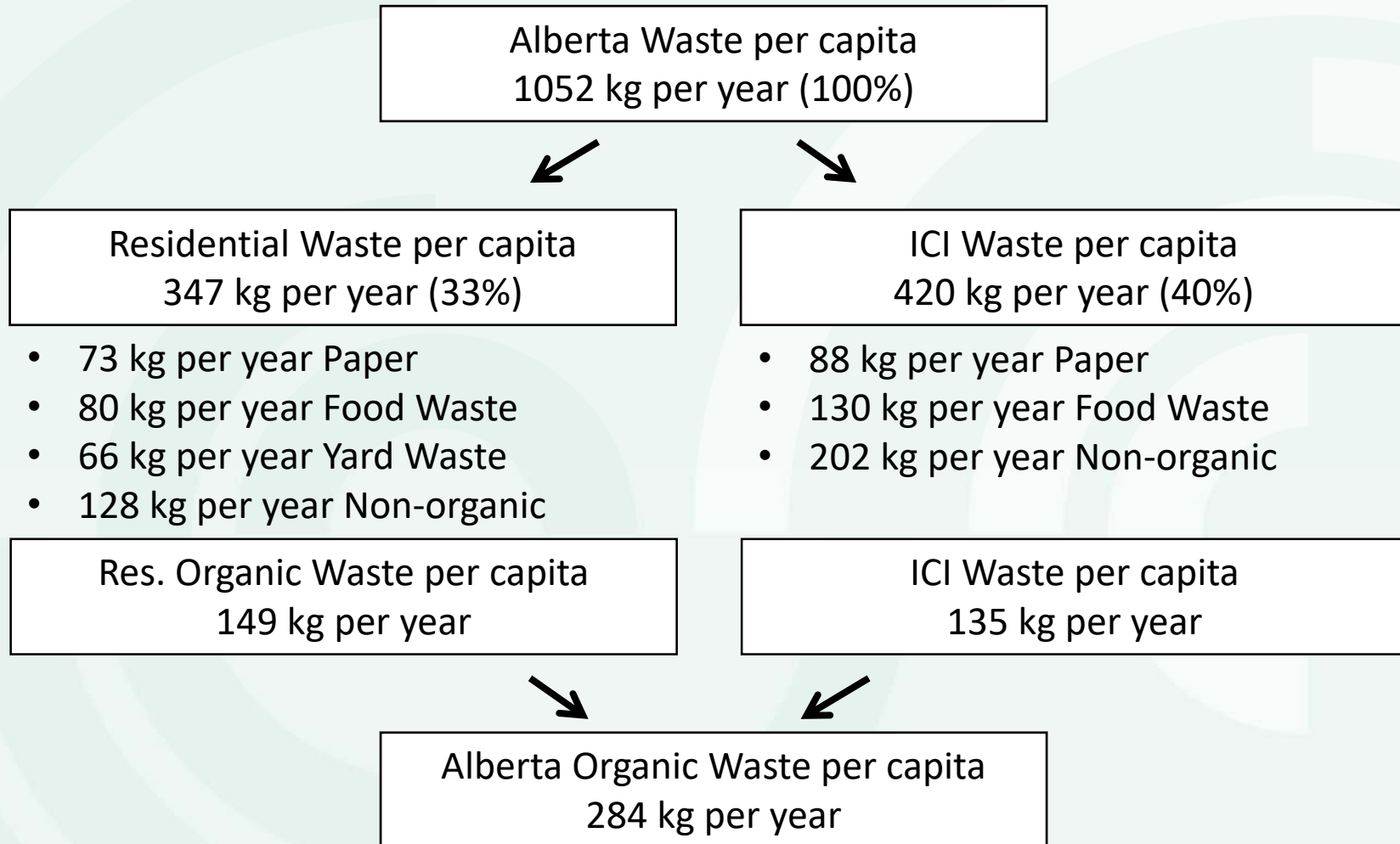
- Alberta Climate Leadership Plan
  - Carbon Levy \$30 per tonne CO<sub>2</sub>e for 2018
  - \$3.4B for large scale renewable energy and bioenergy initiatives (Budget 2016)
  - \$2.2B for green infrastructure (Budget 2016)
- Alberta Waste Diversion Targets
  - 50% reduction of organic waste to landfill by 2030 (AI-EES Business Plan 2015-18)
- Municipal Sustainability Goals
  - Devon Alberta: A Net Zero Community by 2050

# Potential Business Model for Alberta

- Municipalities
  - Build/Own/Operate Model
  - Provincial incentives for cash flow neutrality
- Province
  - Carbon Levy
    - \$30 per tonne in 2018
  - Offset Protocol
    - Landfill methane mitigation
  - Capital Assistance
    - CCEMC-like structure



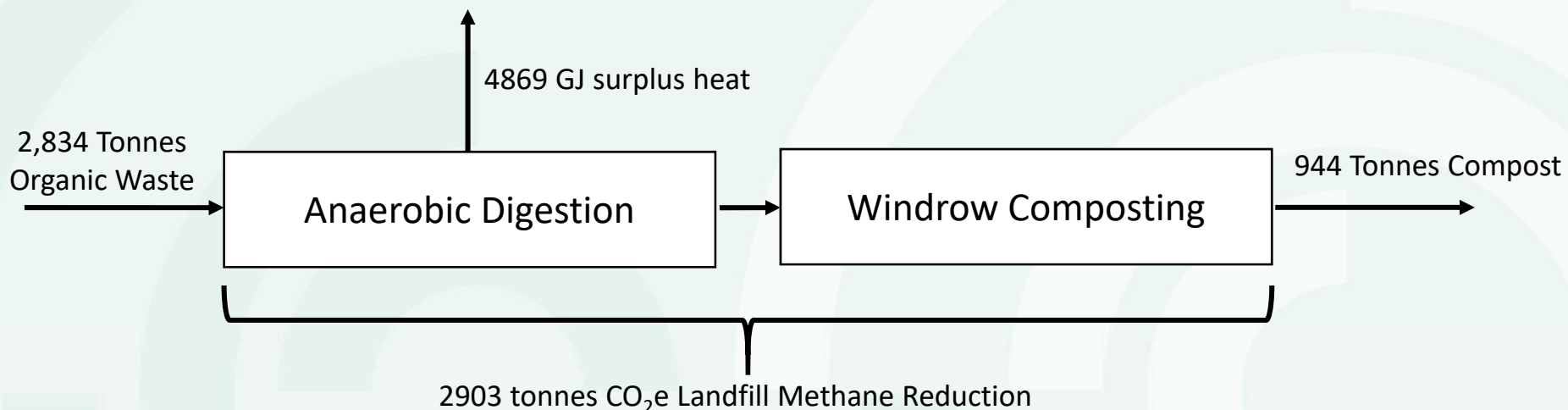
# Dry Batch Digestion Model



- 10,000 people will produce 2840 tonnes organic waste annually
- 30,000 people will produce 8520 tonnes organic waste annually

# Dry Batch Digestion Model

Town of 10,000 Residents



Revenue Source	Price	Annual Revenue	Percent Total Revenue
Tipping Fees	\$51 per tonne	\$ 144,534.00	54%
Landfill Methane Mitigation	\$30 per tonne CO <sub>2</sub> e	\$ 87,090.00	32%
Thermal Energy (Delivered)	\$5 per GJ	\$ 24,345.00	9%
Compost Sales	\$15 per tonne	\$ 14,160.00	5%

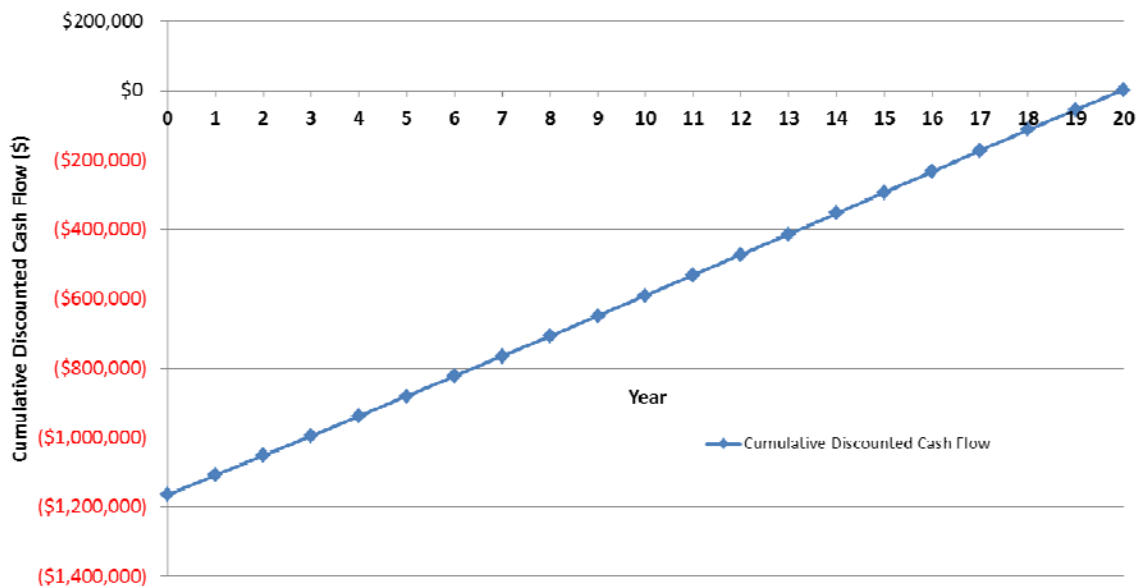
- Revenue is minimally dependent on energy prices



# Dry Batch Digestion Model

Project is cash-flow neutral with capital support consistent with historical support levels

Annual Revenue		
Fossil Fuel Replacement	\$	24,345
GHG Mitigation	\$	87,107
Reduced Landfilling Related Costs	\$	153,522
Compost Sales	\$	14,160
<b>Total Revenue</b>	<b>\$</b>	<b>279,134</b>
Annual Operating Costs		
Dry Digester Operating Costs	\$	131,932
Windrow Composting Operating Costs	\$	54,725
<b>Total Costs</b>	<b>\$</b>	<b>186,657</b>
<b>Capital Cost</b>	<b>\$</b>	<b>1,552,834</b>
Capital Assistance (25%)	\$	388,209
<b>Capital Cost Incured by Investor</b>	<b>\$</b>	<b>1,164,626</b>
<b>EBITDA</b>	<b>\$</b>	<b>92,477</b>
		8%
<b>Amortization &amp; Int Payment (@3%)</b>	<b>\$</b>	<b>78,281</b>
<b>Profit (pretax)</b>	<b>\$</b>	<b>14,196</b>
		1%
Simple Payback		12.6 years



Cash-flow neutral tipping fee under alternative scenarios:

- Organics Landfill Ban, No Capital Support
- Organics Landfill Ban, No Capital Support, \$12 per GJ
- Organics Landfill Ban, No Capital Support, \$30 per GJ

\$96 per tonne  
\$84 per tonne  
\$53 per tonne

## Summary

- InnoTech Alberta has significant expertise to help de-risk your biogas-related projects
- Dry digestion is emerging as the technology of choice for energy recovery from municipal organic waste
- Economics are driven by tipping fees and landfill methane mitigation
- Premium renewable energy prices can significantly reduce the required tipping fees
- Small-scale systems are an economically viable solution for small municipalities under a build-own-operate model

## Questions?