Ann Arbor WRRF Biodigester Feasibility Study

Energy Commission Meeting

June 11, 2024

Moore+Bruggink Consulting Engineers

BLACK & VEATCH

BioWorks Energy
Advanced organics processing

BIOSOLIDS BASICS

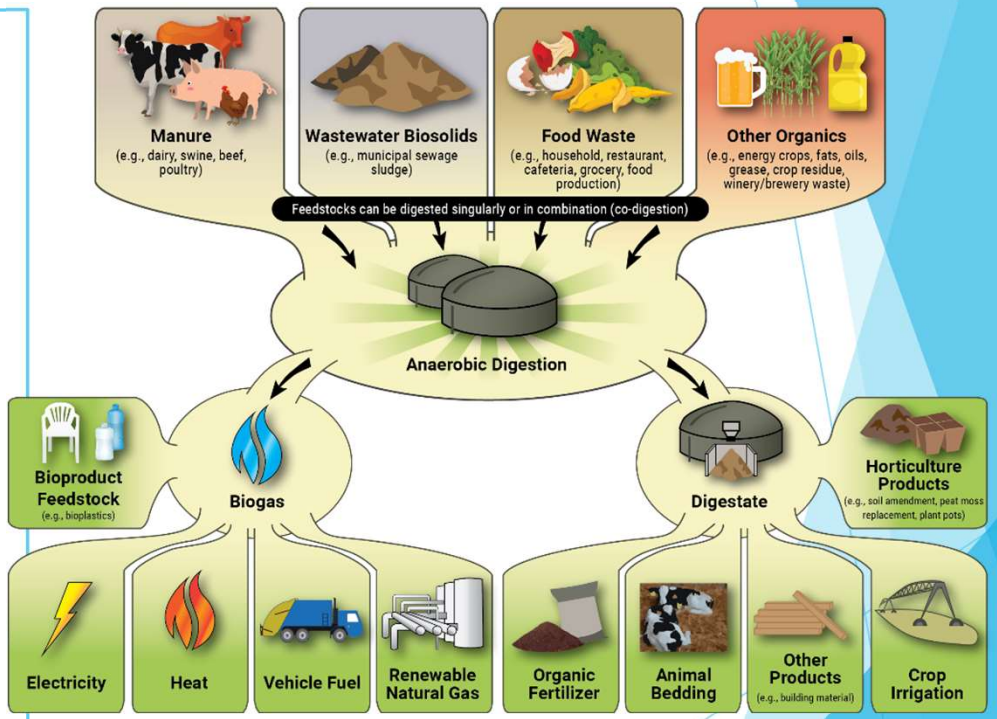
- Biosolids are generated through the wastewater treatment process.
- Common biosolids management practices:
  - Land Application
    - Requires "Class B" treatment of biosolids, at minimum
    - Impacted by:
      - Agricultural Schedule
      - Distance to Application Site
      - Regulatory Changes
  - Landfill
    - More competition for landfill space
    - Disposal costs are increasing
  - Incineration
    - Not common in Michigan

Current Practices at the Ann Arbor WRRF:

- No digestion
- Landfill disposal of dewatered biosolids
  - Currently 100% of biosolids are taken to landfill
  - Chemicals are added for odor control
- Able to lime stabilize and dispose of via land application, if desired

ANAEROBIC DIGESTION FUNDAMENTALS

- Anaerobic Digestion
  - Biological process in which microorganisms break down organic matter in the absence of oxygen.
- Benefits of Anaerobic Digestion
  - Reduce the volume of biosolids/divert materials from landfill
  - Produce biogas
  - Allows beneficial use of biosolids products
  - Reduced odors



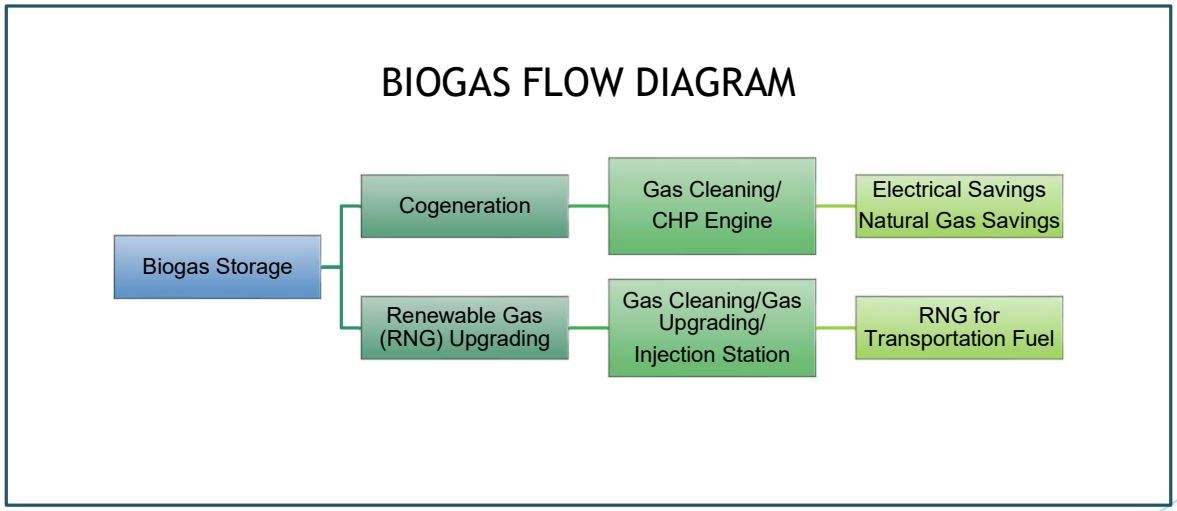
Anaerobic Digestion Feedstocks and Products
Source: EPA

ANAEROBIC DIGESTER SIZING & DESIGN

- Size considerations:
  - Solids Generation
  - Population Growth
  - Food Waste and Fats, Oils & Grease (FOG) Survey
- Evaluation based on:
  - 2 million-gallon Anaerobic Digester
  - Projected 2043 Solids Generation
  - Limited Food Waste and FOG
- Considered three locations on the WRRF site

BIOGAS HANDLING

- Biogas is a by-product of anaerobic digestion
- Biogas must be stored and cleaned/conditioned for beneficial use
- Considered two methods for biogas use:
  - Cogeneration / Combined Heat and Power (CHP)
  - Renewable Natural Gas (RNG)



SITE LAYOUT


GAS UPGRADING EQUIPMENT (FOR RNG OPTION ONLY)
GAS CLEANING SKID
FLARE
TO INJECTION STATION (LOCATION TBD)
2 MG BIODIGESTER (65' DIAMETER 105' HEIGHT INC. CONE)
HYDROLYSIS TANK (FUTURE)
BOILER BUILDING
RECEIVING STATION
ACCESS DRIVE
COGENERATION UNITS (FOR COGEN OPTION ONLY)
CONCEPT #1:
2 MG CYLINDRICAL BIODIGESTER WITH CONE-SHAPED BOTTOM (COGENERATION & RNG OPTIONS SHOWN)

FINANCIAL MODEL ACRONYMS

- CHP – Combined Heat & Power
- ITC – Investment Tax Credit
- MIRR – Modified Internal Rate of Return
- NPV – Net Present Value
- RFS – Renewable Fuel Standard
- RIN – Renewable Identification Number
- RNG – Renewable Natural Gas

FINANCIAL MODEL

MODEL INPUTS	DESCRIPTION
Capital Assets	Anaerobic Digester; CHP and RNG options
Discount Rate	3%
Depreciation	Straight-line, 30 years
Debt Service	4.5% with a 30-year term
INCOME SOURCES	
Food Waste/FOG	(1) Tipping fee (2) Increased biomethane potential
Renewable Natural Gas (RNG Option)	Sold to either the Renewable Fuel Standard (RFS) or to the voluntary offset market.
COST SAVINGS	
Electrical Generation (CHP Option)	For use by the WRRF
Odor control media; odor control additive	Less media changeout and chemical required
Landfill Fees	Reduced transportation and disposal
Food Waste/FOG	Diverts organic wastes from landfills

FINANCIAL MODEL COSTS & REVENUES

COST / REVENUE	CHP SCENARIO	RNG SCENARIO
CAPITAL COST	($40.3M)	($47.6M)
ANNUAL COSTS & REVENUES: ($/year)		
O&M Costs (Variable + Fixed)	($882,000)	
Cost Avoidances • Landfill Fees (transportation, disposal, labor reduction) • Odor Control Media (GAC) Replacement • Odor Control Additive • Natural Gas Usage for Heating • Reduced Dewatering Power Demand	$717,000	
CHP Electrical Generation Value	$456,000	--
Renewable Natural Gas Value	--	$2,270,000
Voluntary Carbon Offset Estimated Revenue	--	$323,000
FOG & Food Waste Tipping Fees	$364,000	

SUMMARY OF FINANCIAL PERFORMANCE

METRIC	CHP SCENARIO (No ITC)	RNG SCENARIO (No ITC)	CHP SCENARIO (with ITC)	RNG SCENARIO (with ITC)
NPV	-$22.661M	+$21.073M	-$11.589M	+$32.418M
MIRR	-0.09%	4.31%	1.82%	4.85%
Payback (years)	n/a	20.0	n/a	15.2
Estimated Cost	$40.329M	$47.596M	$40.329M	$47.596M
ITC Direct Pay $	n/a	n/a	$12.098M	$12.396M
Final Cost	$40.329M	$47.596M	$28.231M	$35.200M

CHP SCENARIO KEY TAKEAWAYS:

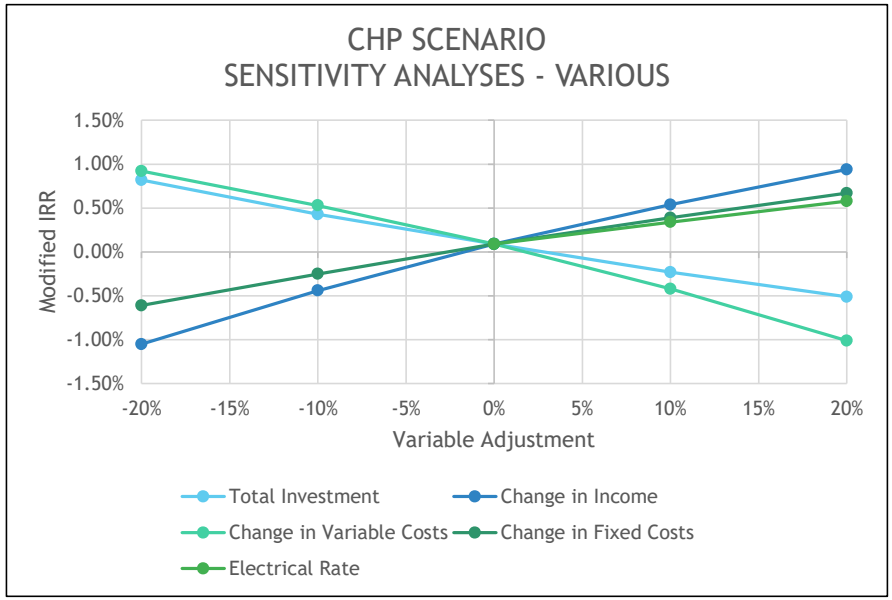
- Electrical generation ~600 kW of renewable energy to WRRF
- Surplus heat supplements natural gas normally required
- Revenue from food waste/FOG tipping fees & avoided utility costs are offset by increased cost to purchase and operate CHP unit. NPV is not positive.
- Electricity generated by a CHP currently qualifies for environmental incentives which are very minimal in value.

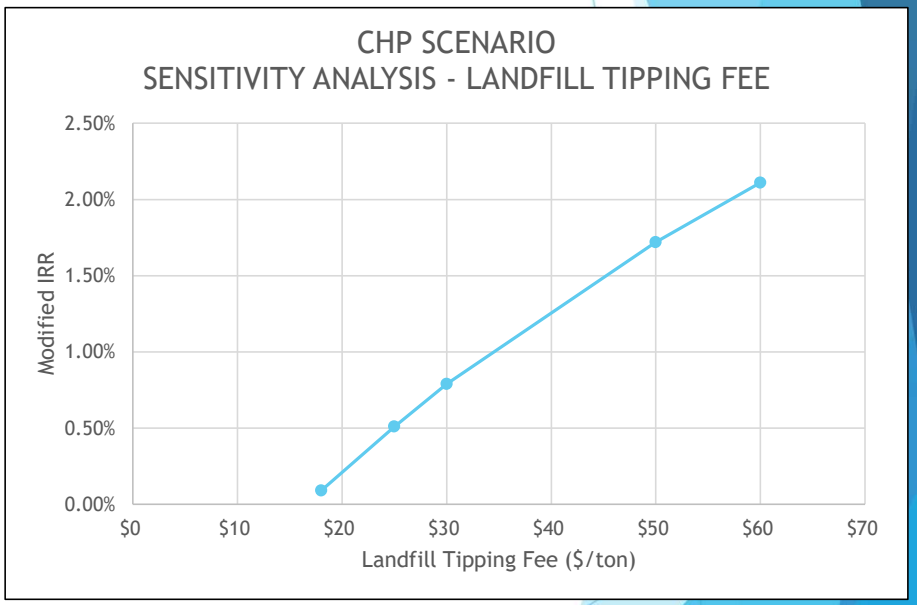
RNG SCENARIO KEY TAKEAWAYS:

- Renewable Natural Gas can earn environmental credits (RINs).
- RINs earned from the RFS program allow the facility to earn in excess of $2 million per year.

SENSITIVITY ANALYSES – CHP SCENARIO*

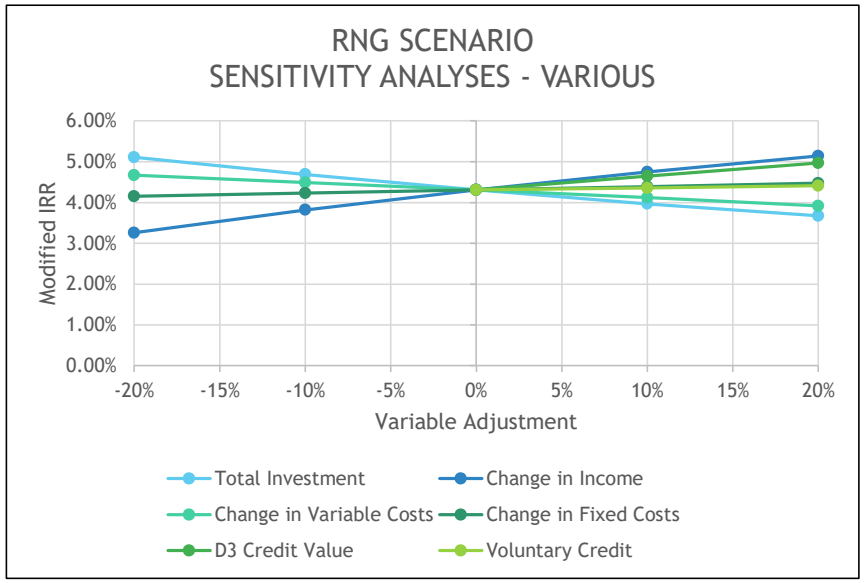
* ANTICIPATING NO ITC

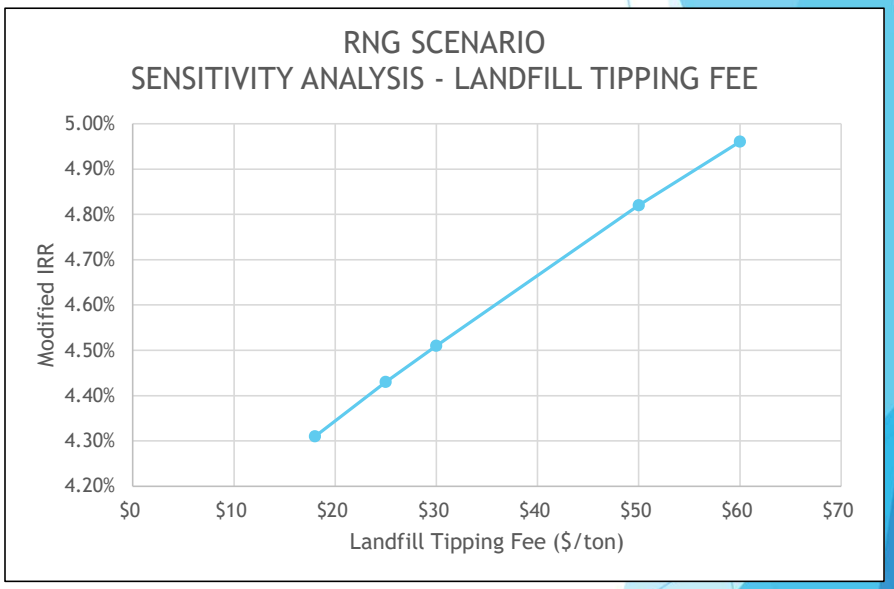




SENSITIVITY ANALYSES – RNG SCENARIO*

* ANTICIPATING NO ITC





CLEAN ENERGY INCENTIVES

INCENTIVE	DETAILS
Investment Tax Credit (ITC)	Available under the Inflation Reduction Act. Allows entities without federal tax liability to claim the "direct pay" provision for an ITC.
Renewable Energy Credits (RECs)	Utilities and Retail Suppliers of Electrical Power in Michigan are required to utilize cleaner sources of energy via Public Act 235 of 2023. • 50% renewables by 2030 • 60% renewables by 2035 • 80% clean energy by 2035 • 100% clean energy by 2040
eRINs (electronic-RIN)	Not yet authorized by the federal EPA. If authorized, the program would increase CHP projected revenues and result in both a positive NPV and IRR.
State of Michigan Clean Fuel Standard	This legislation is under consideration in the Michigan legislature. Seeks to reduce carbon emissions from the transportation sector by replacing diesel and gasoline with alternative fuels with lower Carbon Intensity numbers. In addition, biogas generated electricity would qualify as an alternative fuel to provide power for EV charging stations.
More Mature Voluntary Carbon Offset Markets	As demand for RNG increases, the voluntary RNG market is expected to expand.

FUNDING OPPORTUNITIES

FUNDING SOURCE	DESCRIPTION	FUNDING DETAILS
WIFIA Loan	• Low-interest loan pegged to US Treasury • Single, fixed rate • Flexible repayment structure • Can be combined with other funding sources • Biodigesters are regularly funded	• Current rate: ~4.5% • Loan for up to 49% of total project costs • Minimum project cost = $20M • Very long term (35 years post-Substantial Completion)
MI Clean Water State Revolving Fund (SRF) Loan	• Very low interest loan • Principal forgiveness option • Annual funding • No biodigester/biosolids projects were selected for funding in last round	• Current rate for 30-yr loan: 2.75% • 20 or 30 year loans • Median loan: $5.5M • Maximum loan: $120M
Grants	Examples: • EPA-Supporting Anaerobic Digestion in Communities Grant • EPA-Climate Pollution Reduction Grant Program	• Opportunities come and go • Timing and monitoring are critical
Tax Credits	Examples: • Investment Tax Credit for Energy Property • Qualifying Advanced Energy Project Tax Credit • Clean Electricity Investment Tax Credit or Production Tax Credit • Clean Fuel Production Tax Credit	• Eligibility and amount are determined by construction start, project characteristics, ultimate energy use, etc. • Can be as high as 50%, but realistically closer to 30%-40%

A²ZERO INITIATIVE

MOVE THE CITY TOWARDS CARBON NEUTRALITY BY 2030

FOUR SECTORS OF CARBON NEUTRAL STRATEGIES PER A²ZERO PLAN	
ENERGY	**MOBILITY**
Production of renewable sourced energy from digester biogas	Production of renewable fuel from digester biogas that can be utilized in vehicles or to produce electricity for electric vehicles
Production of renewable biogas in place of fossil fuels	
ADAPTATION & RESILIENCE	**RESOURCE REDUCTION**
Digestion fits into the enhanced use of green infrastructure	Food waste can be diverted from landfill to the digester
Digestion creates a more resilient wastewater treatment system and local economy	Composting can support beneficial reuse of stabilized biosolids

ENVIRONMENTAL BENEFITS OF A BIODIGESTER

- Greenhouse Gas (GHG) Reduction
- Diversion of Organics from Landfill
- Heat & Power or Natural Gas Generation from a Renewable Fuel Source
- Fuel & Chemical Savings
- Odor Reduction

THESE BENEFITS COMPLEMENT THE A²ZERO PLAN GOALS AND INITIATIVES

GREENHOUSE GAS (GHG) ANALYSIS

BIOSOLIDS EMISSIONS ASSESSMENT MODEL (BEAM) RESULTS

Results are shown as *Mg/yr CO_2 Equivalent/dry ton solids/day processed*

Parameters	Baseline Scenario	Ann Arbor Scenario	
	Lime/Landfill	Lime/Landfill	AnD/Landfill
Thickening (Mg/yr)	3.72	3.72	3.72
Anaerobic Digestion (Mg/yr)	0	0	(109.82)
Dewatering (Mg/yr)	4.93	4.93	2.96
Lime Stabilization (Mg/yr)	69.31	69.31	0
Transportation (Mg/yr)	3.11	3.11	2.03
*Landfill (Mg/yr)	793.73	510.90	50.71
Total (Mg/yr)	874.80	591.97	-50.41

*Landfill emission went down from 510Mg/yr to 50Mg/yr because biodegradable organic was significantly reduced after digestion, so most of the CH4 emissions were avoided.

1 Megagram (Mg) = 1 Dry Metric Ton (Mt)

CITY OF ANN ARBOR CARBON NEUTRALITY PRIORITIZATION FRAMEWORK

(Preliminary Evaluation Performed by the Project Team)

PRIORITIZATION FRAMEWORK										
	-2	-1	0	1	2	3	4	5	6	
GHG MITIGATION CRITERIA										
High Long-Term GHG Reduction Potential					2					
High Short-Term GHG Reduction Potential					2					
COST CRITERIA										
City Cost Effectiveness					2					
City Relative Cost (Capital)					2					
City Relative Cost (Operation)					2					
Residential and Business Cost Effectiveness					2					
Resident and Businesses Relative Cost (Capital)				1						
Resident Relative Cost (Operation)					2					
FEASIBILITY CRITERIA										
Technological Feasibility					2					
Current Policies or Ordinances					2					
Jurisdictional Control / Ease of Implementation					2					
Implementation Timeframe				1						
Public Acceptability				1						
CO-BENEFITS										
Affordability on Low-Income Residents				1						
Equity				1						
Historical Injustice			0							
Pollution Prevention				1						
Health and Well Being				1						
Reliability				1						
Resilience				1						
Job Development				1						
Resource Preservation				1						
Safety				1						
Social Capital, Culture, and Community			0							
Dollars Stay in Local Economy				1						
Scalable				1						
TOTAL SCORE AND PERCENTAGE OF MAXIMUM POSSIBLE POINTS:									**34**	**72%**

Thank you!

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Consulting Engineers

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