Resource Recovery Could Unlock Economic Opportunity and Leverage Dormant Industrial Infrastructure

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MAINE
Portland
Augusta
Bangor
Google


ANSON
Main Street
MADISON
State Route 148
State Route 201A
Madison Paper Mill
AMSD WRRF

What to do with an abandoned mill?

Commercial/residential complex in Biddeford, Maine

Google Street View Image from the Main Street Bridge in Biddeford

What to do with an abandoned mill?

The Lofts at Lower Mills, Dorchester

Boott Mills in Lowell, MA

https://www.bostonmagazine.com/property/2018/08/08/massachusetts-mills-condos-apartments/

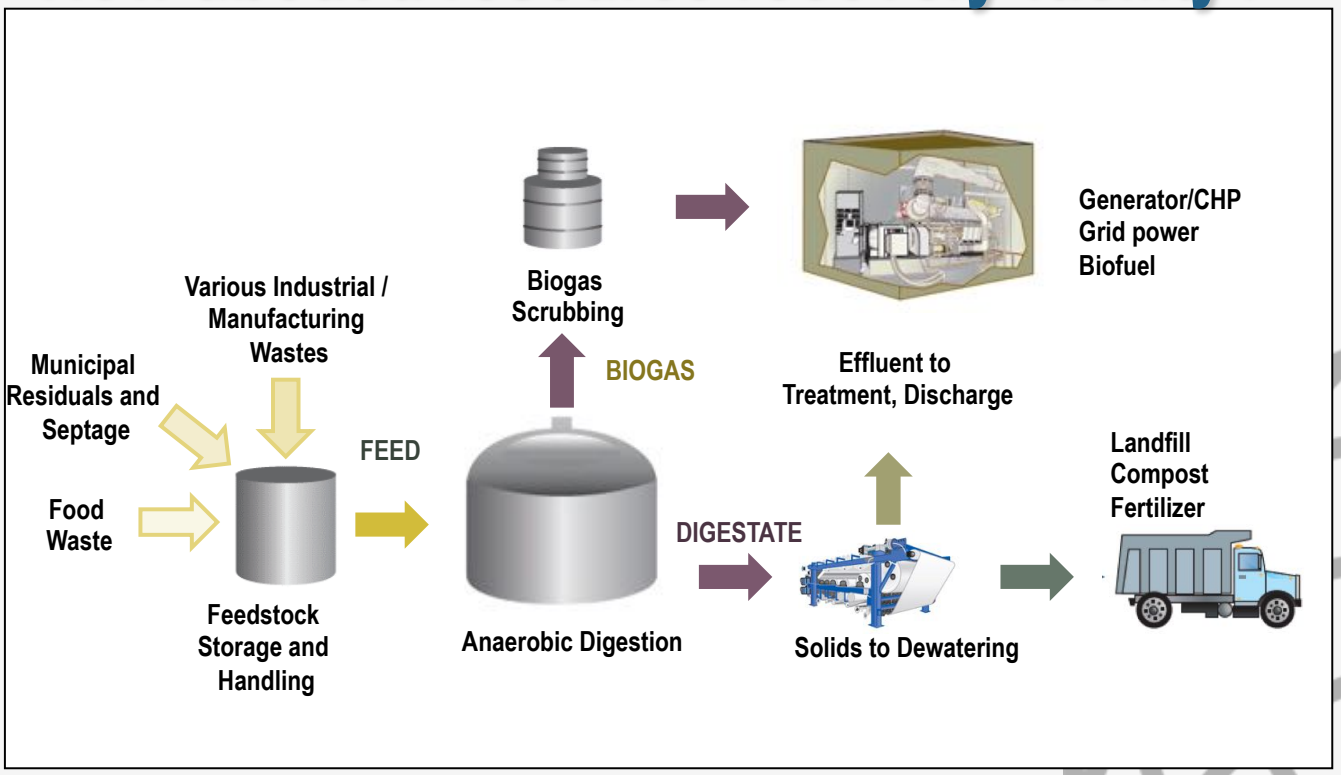
Google Satellite Imagery from Lowell, MA

What to do with an abandoned mill?

- Low density fiberboard (LDF) insulation manufacturing plant
- Non-toxic, recyclable, renewable building material that displaces petroleum-based foam insulation products
- Supports Maine's forest products industry
- Projected to bring 120+ jobs to Madison

https://www.greenbuildingadvisor.com/article/design-build-firm-seeks-toehold-in-insulation-market

How about a resource recovery facility?



Feasibility Study Components

- Existing Assets Evaluation
  - Identify equipment that could be reused to reduce capital costs
- Market Analysis
  - Identify effective business strategy given market conditions
- Conceptual Design
  - Including capital and O&M cost estimates
- Economic Model
  - Evaluate long term economic feasibility. Test a variety of business strategies and resiliency

Existing Assets Evaluation - Equipment

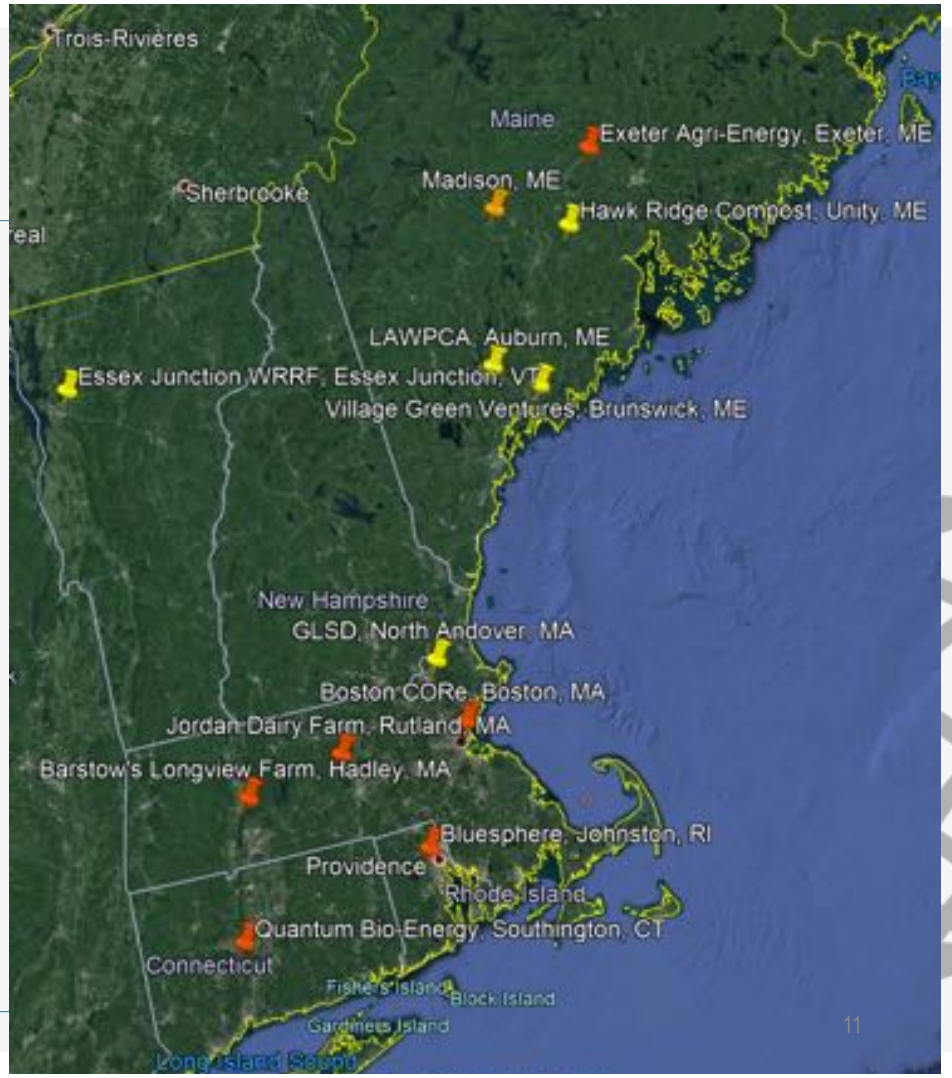
- Insulated tanks to be reused as digesters
- Smaller tanks to be reused as EQ, feedstock storage, sludge holding
- Loading docks
- Electrical substation with grid interconnection
- Natural gas pipeline connection

Existing Assets Evaluation – Other Assets

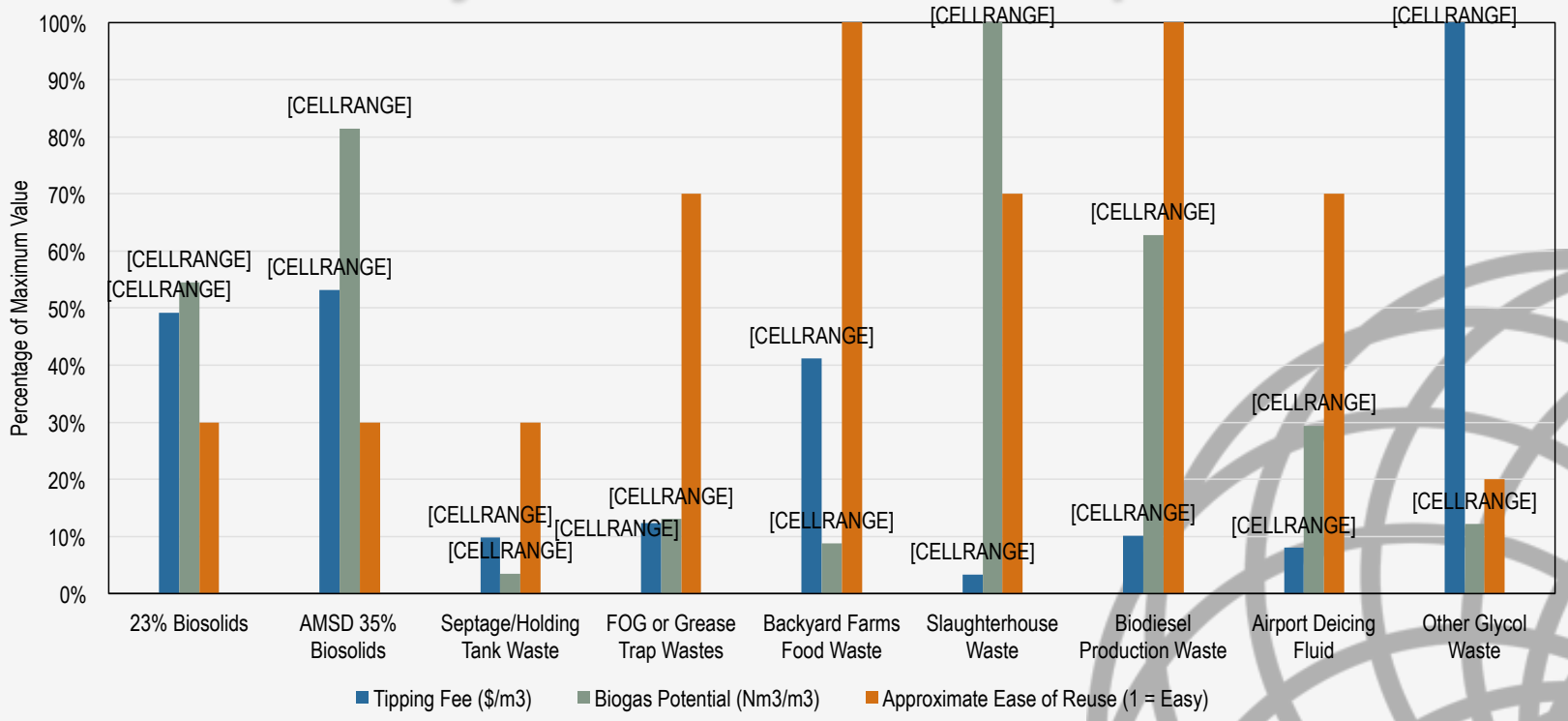
- 3.5 MGD treatment plant, currently operating at 0.3 MGD
- Existing plant takes in septage, greenhouse waste, landfill leachate, etc.
- Agreement with Crossroads Landfill

https://www.bostonglobe.com/business/2013/08/08/fidelity-johnson-takes-heavy-loss-his-pursuit-perfect-tomato/1K47Kxicqhrd35i5EKj2II/story.html

Market Analysis – Competitors & Collaborators



Market Analysis – Feedstock Comparison



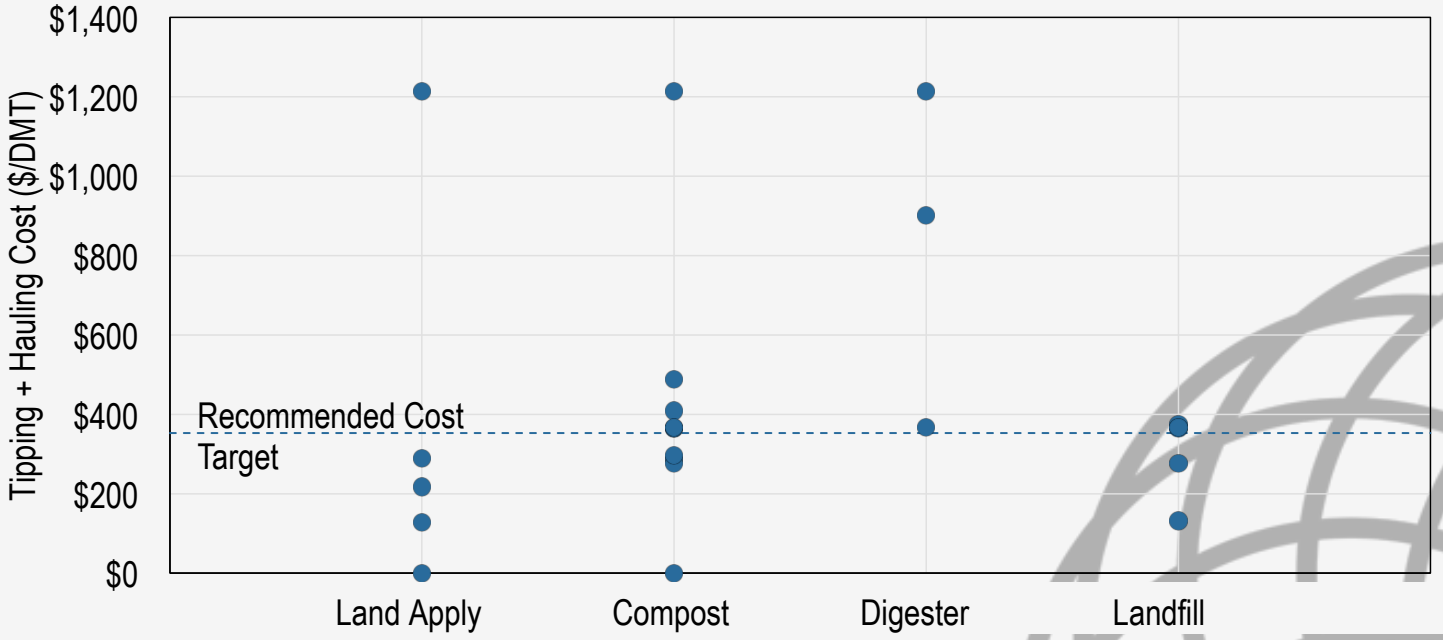
Potential Biosolids Sources (abbreviated list)

WRRF Town	Proximity (minutes)	Estimate of Current Residuals Production (gpd)[1]	Management Method
Waterville, Maine	31	5,130	570 gpd landfilled; 4,560 gpd beneficially used[2]
Augusta, Maine	49	2,590	1,700 gpd landfilled; 890 gpd beneficially used
Bangor, Maine	75	4,510	2,020 gpd landfilled; 2,490 gpd beneficially used
Portland, Maine	94	14,800	11,500 gpd landfilled; 3,260 gpd beneficially used
South Portland	101	3,480	2,490 gpd landfilled; 986 gpd beneficially used
Rockland, Maine	464	1,640	1,380 gpd landfilled; 257 gpd beneficially used
Biddeford, Maine	114	1,710	1,710 gpd landfilled

[1]As 20% solids material
[2]Beneficial use includes composting, and digestion

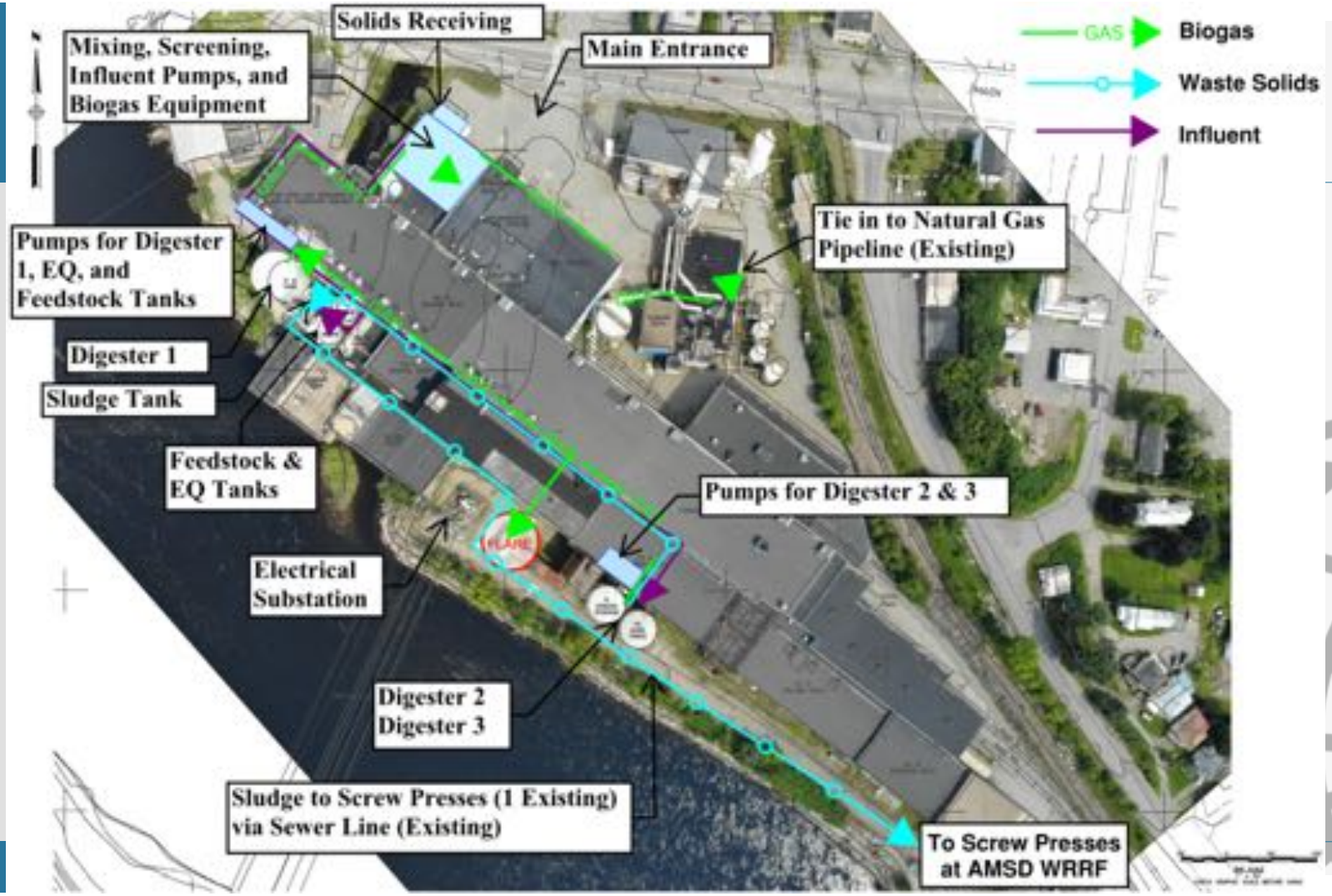
Estimate 49,000 gpd of residuals from WRRFs within a 2-hour drive of Madison; 23,000 gpd are currently being landfilled

Market Analysis – Setting Tipping Fees



Based on surveys, recommend a hauling fee of $99/DMT

→ Tipping fee of $250/DMT


Solids Receiving
Main Entrance
Mixing, Screening, Influent Pumps, and Biogas Equipment
GAS
Biogas
Waste Solids
Influent
Tie in to Natural Gas Pipeline (Existing)
Pumps for Digester 1, EQ, and Feedstock Tanks
Digester 1
Sludge Tank
Feedstock & EQ Tanks
Pumps for Digester 2 & 3
FLARE
Electrical Substation
Digester 2
Digester 3
Sludge to Screw Presses (1 Existing) via Sewer Line (Existing)
To Screw Presses at AMSD WRRF

Conceptual Design – Biogas Utilization Options

Energy Capture	Advantages	Disadvantages
Combined Heat and Power (CHP) • Biogas dried, then treated to remove H_2S and siloxanes. • CHP Generator produces energy and transfers waste heat to hot water loop for digester contents heating.	• Less pretreatment and compression required • Low operational complexity • Electricity can be sold/used onsite • Generate heat for digestion • Generate renewable energy credits	• Generator is expensive • Sale price of electricity must be negotiated with utility company
Renewable Natural Gas (RNG) • Biogas dried, then treated to remove H_2S, siloxanes, CO_2, O_2, N_2, etc. • Compression to 100-120 psi for pipeline injection. • On-site monitoring of gas quality via gas chromatograph.	• High value renewable commodities – RINs associated with sale of RNG • Local gas provider is looking for sources of RNG	• High pretreatment and compression requirements – high electricity consumption • High operational complexity • Economics are strongly tied to the value of RINs

Conceptual Design – Cost Estimates

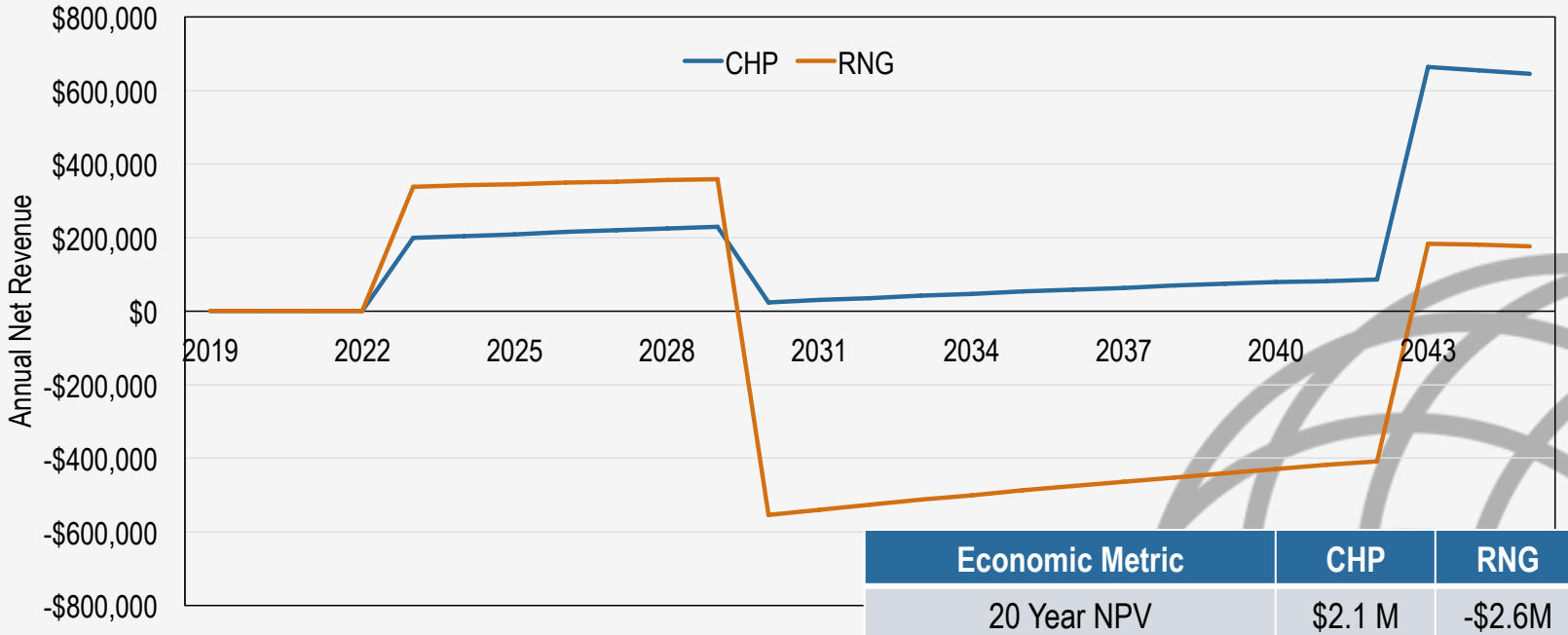
- Factored cost estimate
  - Installation costs estimated using factors and equipment cost quotes
- -30 to +50% accurate
- 20% contingency included in capital and operating costs
- Existing assets reduce capital costs by $7 million for each biogas utilization option (not considering existing treatment plant)

CHP Project Costs	**$14,500,000**
Estimated Range: -30% to +50%	$10.2 - $21.9 million
RNG Project Costs	**$14,700,000**
Estimated Range: -30% to +50%	$10.3 - $22.1 million

Economic Model – Baseline Condition

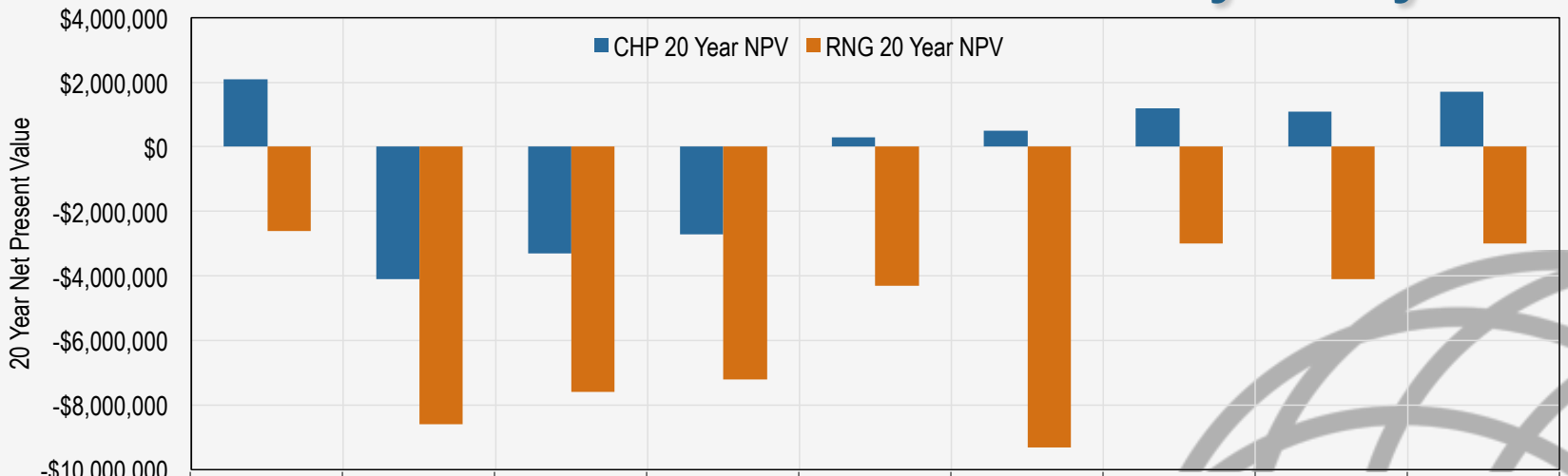
- Feedstocks:
  - 15,000 gpd of dewatered WRRF residuals
  - 23,000 gpd septage
  - 1,300 gpd food waste
  - Plus grease trap waste, slaughterhouse waste, airport deicing fluid, glycol waste, biodiesel production waste
- Sold price
  - Electricity = $0.08/kWh
  - RECs = $0.048/kWh
  - Natural gas = $7.00/MMBTU

Economic Model – Baseline



Economic Metric	CHP	RNG
20 Year NPV	$2.1 M	-$2.6M
Corrected Payback Period	15	30
Yrs of Negative Cash Flow	0	13

Economic Model – Baseline Sensitivity Analysis

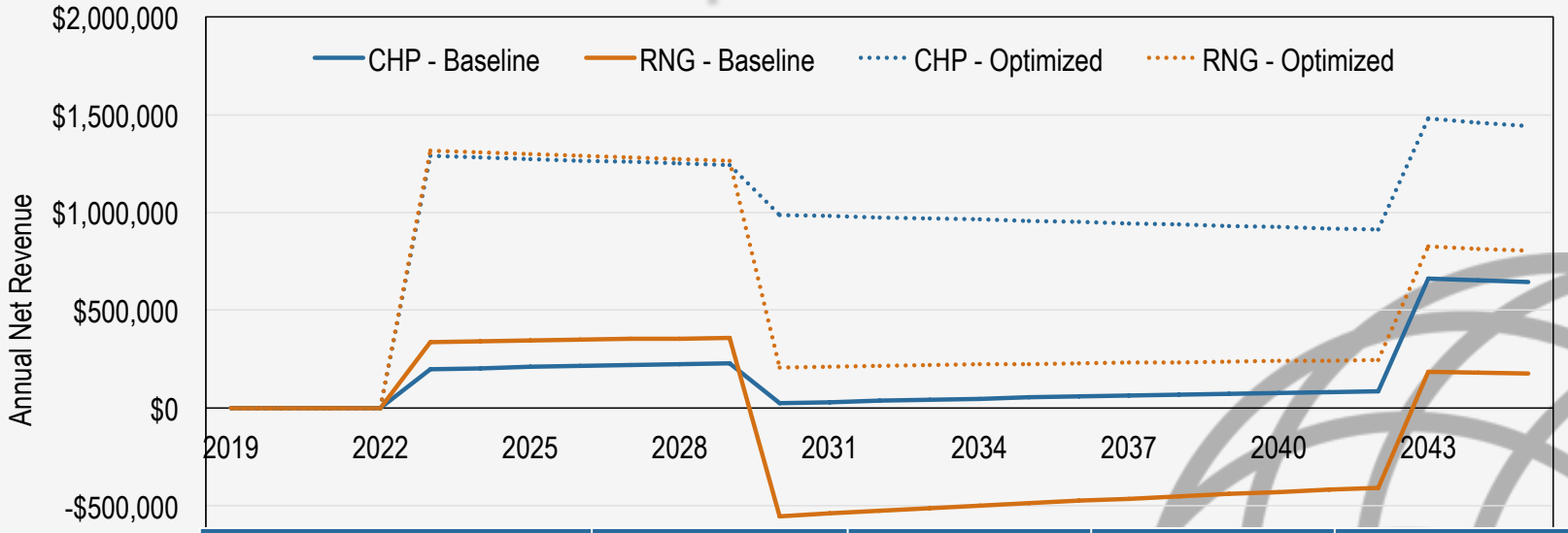


	Baseline	Capital Cost	Solids Disposal Rate	Feedstocks	Loan Rate	Energy Credit End Year	Real Discount Rate	Primary Income Rate	Grants
Optimized Value	N/A	CHP = $14.5M RNG = $14.7M	$46/WMT	Optimized	2.15%	2030	1.30%	$0.080/ kWh $2.25/D3 RIN	3% Principal
Tested Value	N/A	CHP = $21.9M RNG = $22.1M	$97/WMT	Low Market Analysis Estimate	3.5%	2022	2.00%	$0.067/ kWh $1.75/D3 RIN	No Grant

Economic Model – Optimized Scenario

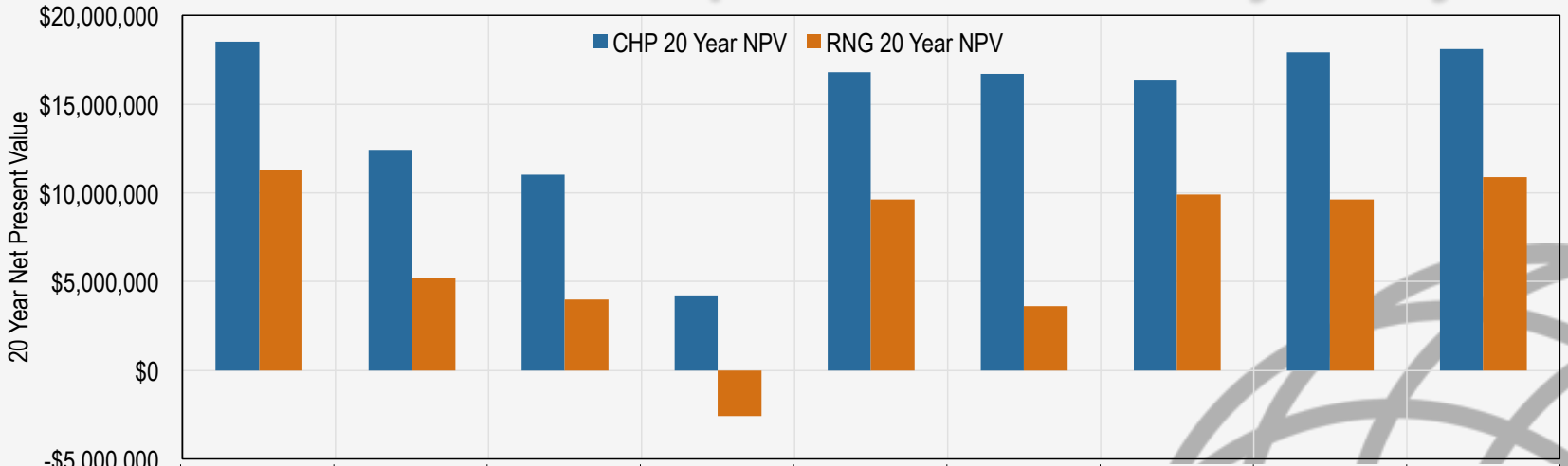
- Increase septage feedstock from 23,000 to 56,000 gpd.
- Increase outside WRRF residuals from 13,200 to 15,200 gpd.
- Eliminate dilution water.
- For CHP biogas utilization, sell 50% of the net electricity at the market rate (median price of $0.105/kWh), and sell 7,500 MMBTU/yr of heat.
- Bring in additional income from renting 80,000 sf of the mill at a rate of $4/sf/year ($320,000).

Economic Model – Optimized Scenario



Economic Metric	CHP – Optimized	RNG Optimized	CHP – Baseline	RNG - Baseline
20 Year NPV	$18.5M	$11.3M	$2.1 M	-$2.6M
Corrected Payback Period	7	7	15	30
Yrs of Negative Cash Flow	0	0	0	13

Economic Model – Optimized Sensitivity Analysis



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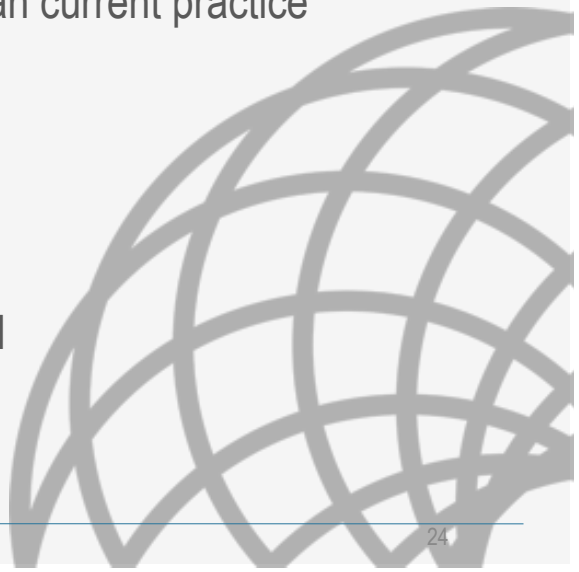
Environmental Benefits

- Plant will generate more energy than it consumes. For CHP,
  - Net 5,000 MWh/yr electricity (80% of gross, enough to power 480 homes)
  - Net 11,000 MMBTU/yr heat (45% of gross)
  - Project had significantly better GHG emissions than current practice

- Additional net environmental benefits if:
  - Compost or land apply digestate
  - Take in feedstocks that are currently landfilled
  - Target residuals that cannot be beneficially reused



Economic Benefits

- Un-quantified benefits from a renter:
  - Additional tax income
  - Additional employment opportunities
  - Attract other grant opportunities associated with economic development
  - Potentially generate organic waste
  - Potentially take in digestate and reduce management costs
- Town will minimize project risks by:
  - Finding a renter
  - Long term contracts with feedstock source and digestate managers
  - 20+ year loan with reasonable interest rate
  - Wait for renewable energy market extension and/or use biogas for CHP

Comparing Resource Recovery to GO Labs Plant

Municipally Operated Resource Recycling Facility	GO Labs LDF Insulation Manufacturing Plant
• Opportunity to sequester carbon in soil amendments	• Sequester carbon in building insulation
• Supplant use of fossil fuels for electricity/heating	• Supplant use of fossil fuels for insulation materials
• Long term employment of >5 people depends on finding a renter	• Long term employment of 120+ people
• Town bears risk of investment	• Private company bears risk of investment

Questions?

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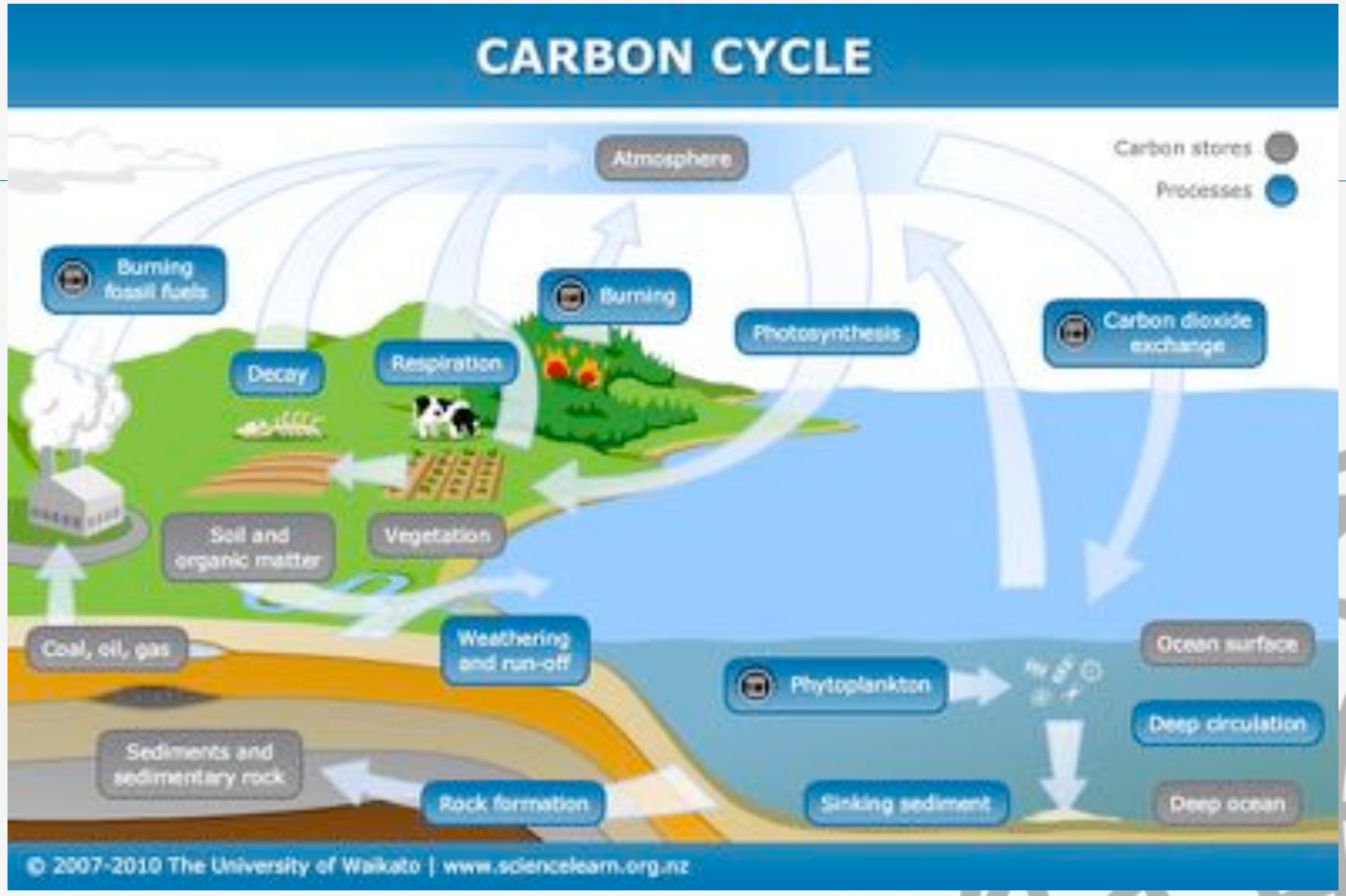
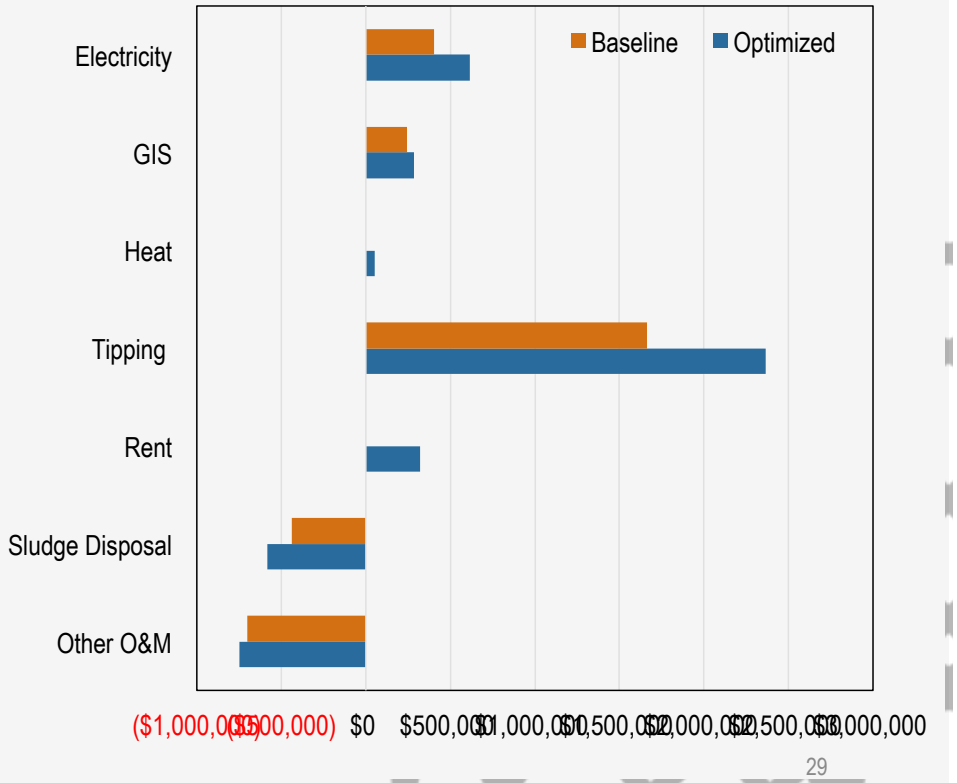


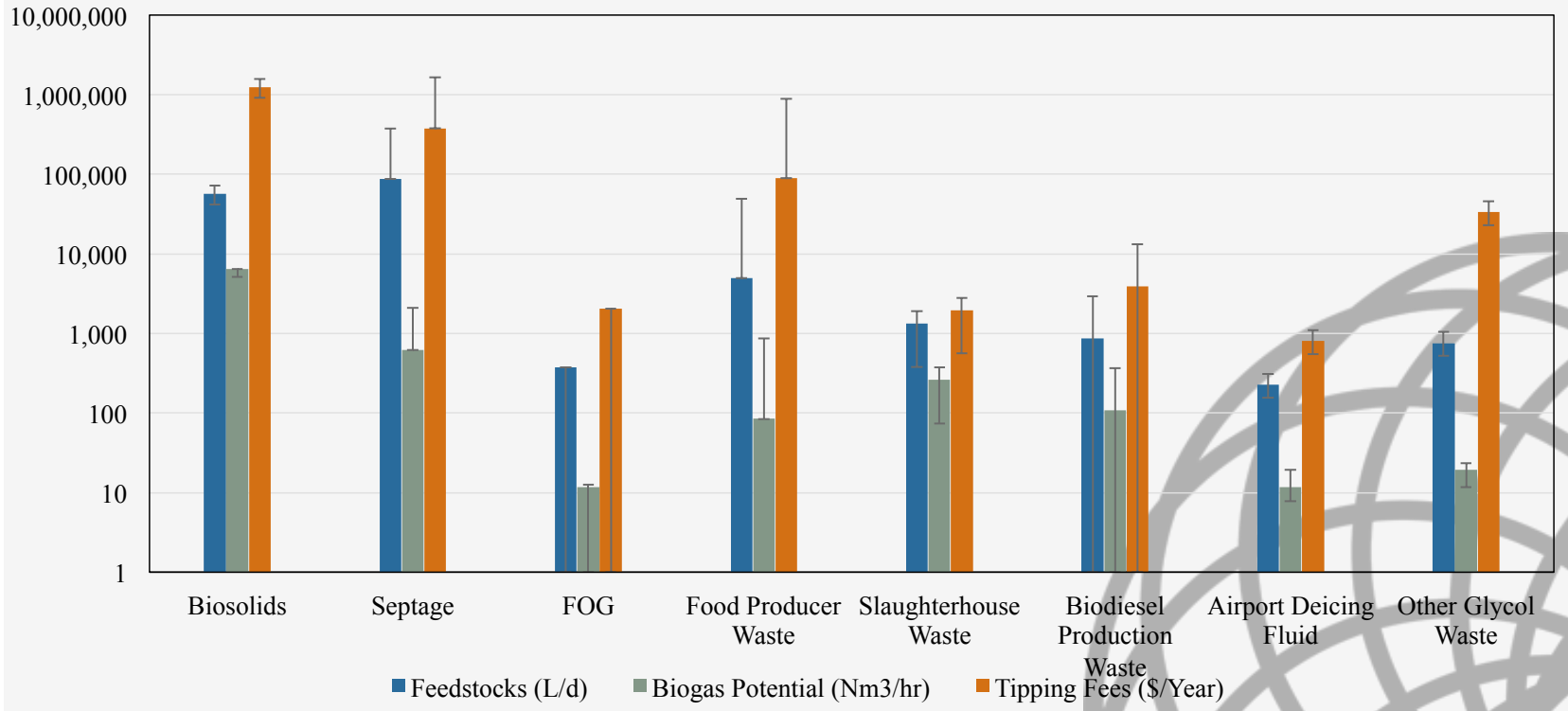
https://www.sciencelearn.org.nz/image_maps/3-carbon-cycle

Economic Model – Optimized Scenario – CHP

Economic Outputs		Optimized	Baseline
20 Year NPV		$18,500,000	$2,100,000
Corrected Payback Period		7	15
Years of Negative Cash Flow		0	0
Revenue	Total	**$3,640,000**	**$2,300,000**
	Electricity	$616,000	$401,000
	GIS	$283,000	$242,000
	Heat	$53,000	$0
	Tipping	$2,367,000	$1,661,000
	Rent	$320,000	$0
Cost	Total	**$1,330,000**	**$1,140,000**
	Sludge Disposal	$582,000	$439,000
	Other O&M	$746,000	$703,000



Market Analysis – Inputs to Design Basis



Conceptual Design – Big Ticket Items

- Cake Hopper - $235,000
- Sludge Strain Press - $155,000
- Liquid Feedstock Screen - $181,000
- Dual Membrane Tank covers - $400,000 for 3 tanks
- Digester External Draft Tube Mixers - $460,000 for 3 tanks
- Screw Press - $400,000
- CHP Biogas Polishing - $565,000
- CHP Generator -$960,000
- RNG PSA and H_2S scrubber - $1,600,000

Economic Model – Baseline Condition

- Renewable commodity market end year 2030
- 20-Year CWSRF Loan with 2.15% interest and 3% principal forgiveness
- Digestate disposal at $42/WT
- Thicken digestate to 35%
- Real discount rate of 1.3%

- Payback periods of >10 years for baseline condition → not attractive to private developer