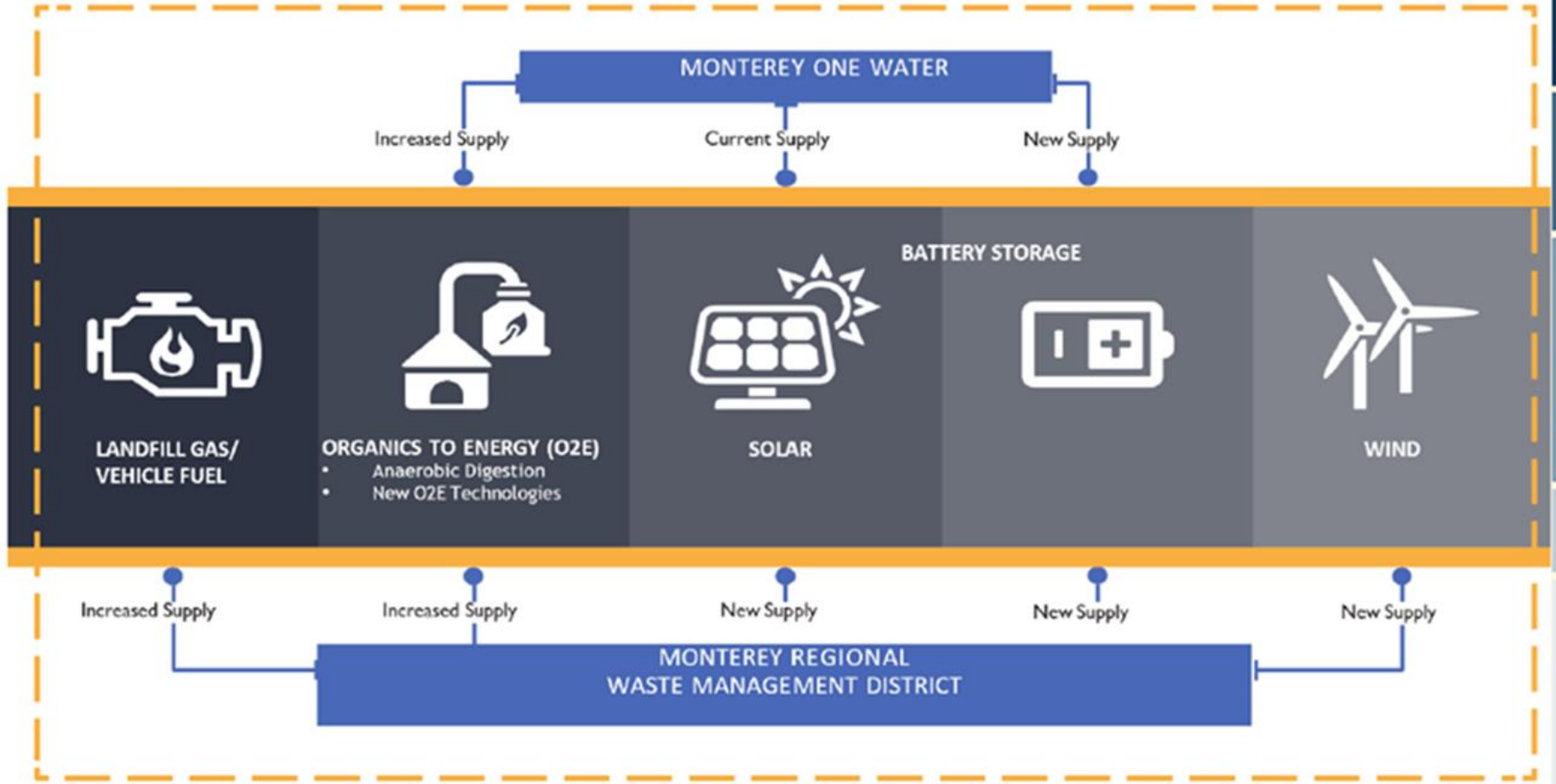
Board Meeting
April 19, 2024

Presentation of GHD's Summary Report of the Joint Feasibility Study

Director of Engineering & Compliance / Guy R. Petraborg, PE, GE

Project Manager - Black & Veatch / Derek M. Wurst, PE

Feasibility Study Vision



- Islanding capabilities to minimize power interruptions
- Sustainable power source

- Potential utility-size microgrid providing power to future desalination plant and other large energy users

- Current and projected LFG generation and collection + Potential GCCS improvements
- Digester rehabilitation for co-digestion
- PFAS destruction
- Site constraints (footprint, etc.)

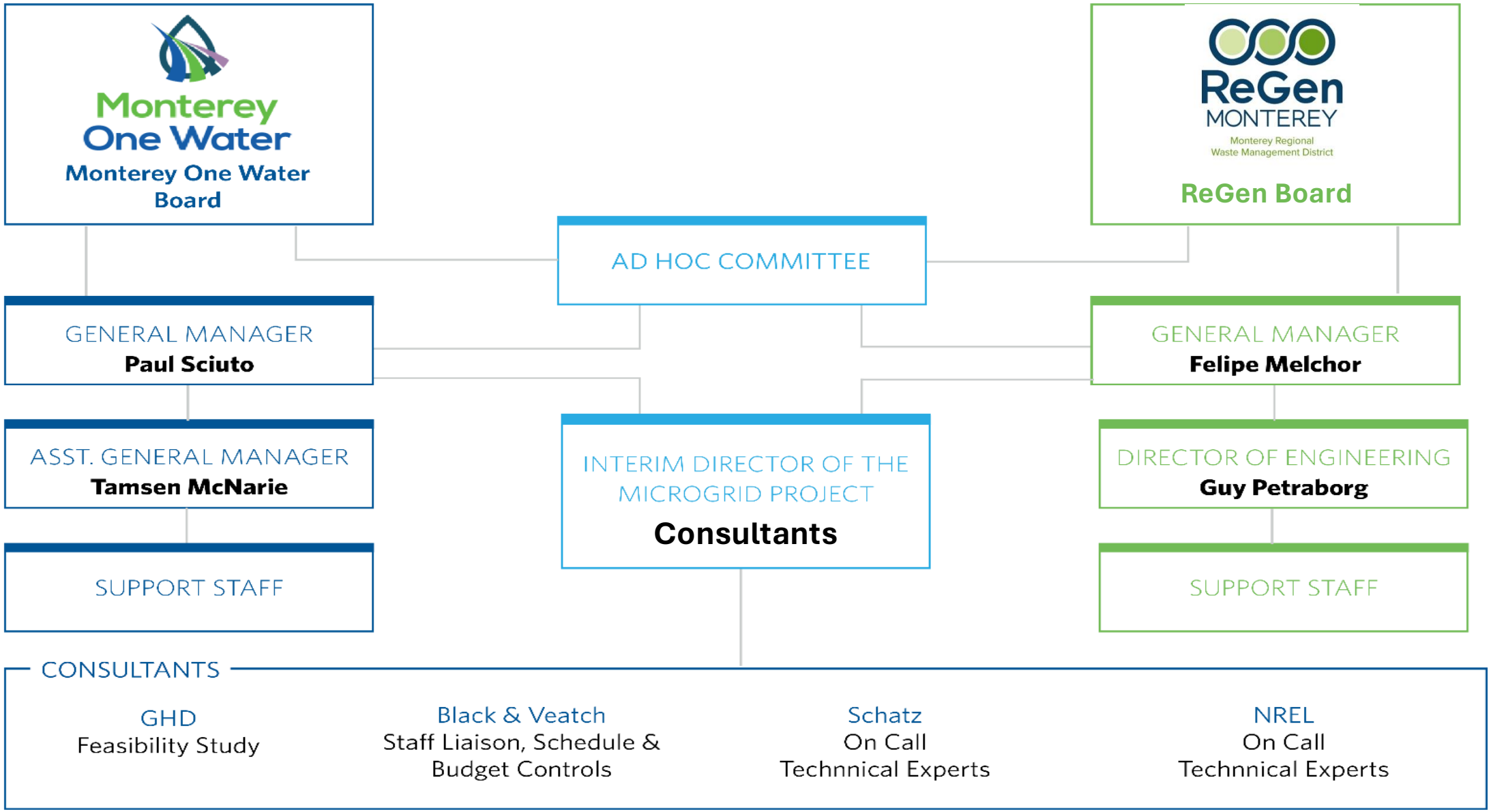
- Various project delivery options: P3, etc.

- SB1383 Organics Diversion Targets
- LCFS & RIN credits for LFG to vehicle fuel
- Minimize financial impact to rate payers
- Grant funding

Feasibility Study History

- Fall 2017 ReGen approves Feasibility Study Vision
- 2018-2021 Promote Feasibility Study vision to M1W
- Fall 2021 Boards form Joint Ad Hoc Committee
- May 2022 Joint Project Director hired
    - Vacated Fall 2022 / Interim Consultant support
- June 2022 Feasibility Study RFP Issued
    - Sent to 31 firms; Received 10 proposals
    - GHD ranked #1 by joint selection committee
- Sept. 2022 Cost Sharing Agreement for Planning Phase
- October 2022
    - Contract awarded to GHD
    - Secured support assistance from the National Renewable Energy Lab (NREL)
    - Secured support services from Schatz Energy Center at Cal Poly Humboldt
- Grant - M1W received EPA grant for $169k for planning

2022 – 2024 Project Updates to Ad Hoc Committee


Monterey One Water
Monterey One Water Board
ReGen MONTEREY
Monterey Regional Waste Management District
ReGen Board
AD HOC COMMITTEE
GENERAL MANAGER
Paul Sciuto
GENERAL MANAGER
Felipe Melchor
ASST. GENERAL MANAGER
Tamsen McNarie
INTERIM DIRECTOR OF THE MICROGRID PROJECT
Consultants
DIRECTOR OF ENGINEERING
Guy Petraborg
SUPPORT STAFF
SUPPORT STAFF
CONSULTANTS
GHD
Feasibility Study
Black & Veatch
Staff Liaison, Schedule & Budget Controls
Schatz
On Call Technnical Experts
NREL
On Call Technnical Experts

Introduction

Abbreviations

AD	Anaerobic Digestion
AWPF	Advanced Water Purification Facility
BESS	Battery Energy Storage System
CAPEX	Capital Expenditures
CHP	Combined Heat and Power
CPRG	Climate Pollution Reduction Grants
kV	kilovolt
kW	kilowatt
EPA	Environmental Protection Agency
GHG	Greenhouse Gas
LCFS	(California) Low Carbon Fuels Standard
M1W	Monterey One Water
MW	Megawatt
PFAS	Per- and Polyfluoralkyl Substances
PG&E	Pacific Gas & Electric (gas and electric utilities)
PV	Solar Photovoltaics
PWM	Pure Water Monterey
R-CNG	Renewable Compressed Natural Gas
Regen	ReGen Monterey
RIN	Renewable Identification Number
RNG	Renewable Natural Gas
RTP	Regional Treatment Plant
SB1383	California Senate Bill 1383 Lara, Chapter 395, Statutes of 2016
scfm	Standard Cubic Feet per Minute
SVRP	Salinas Valley Reclamation Project
tpy	tons per year
TS	Total Solids

Overall Study Approach

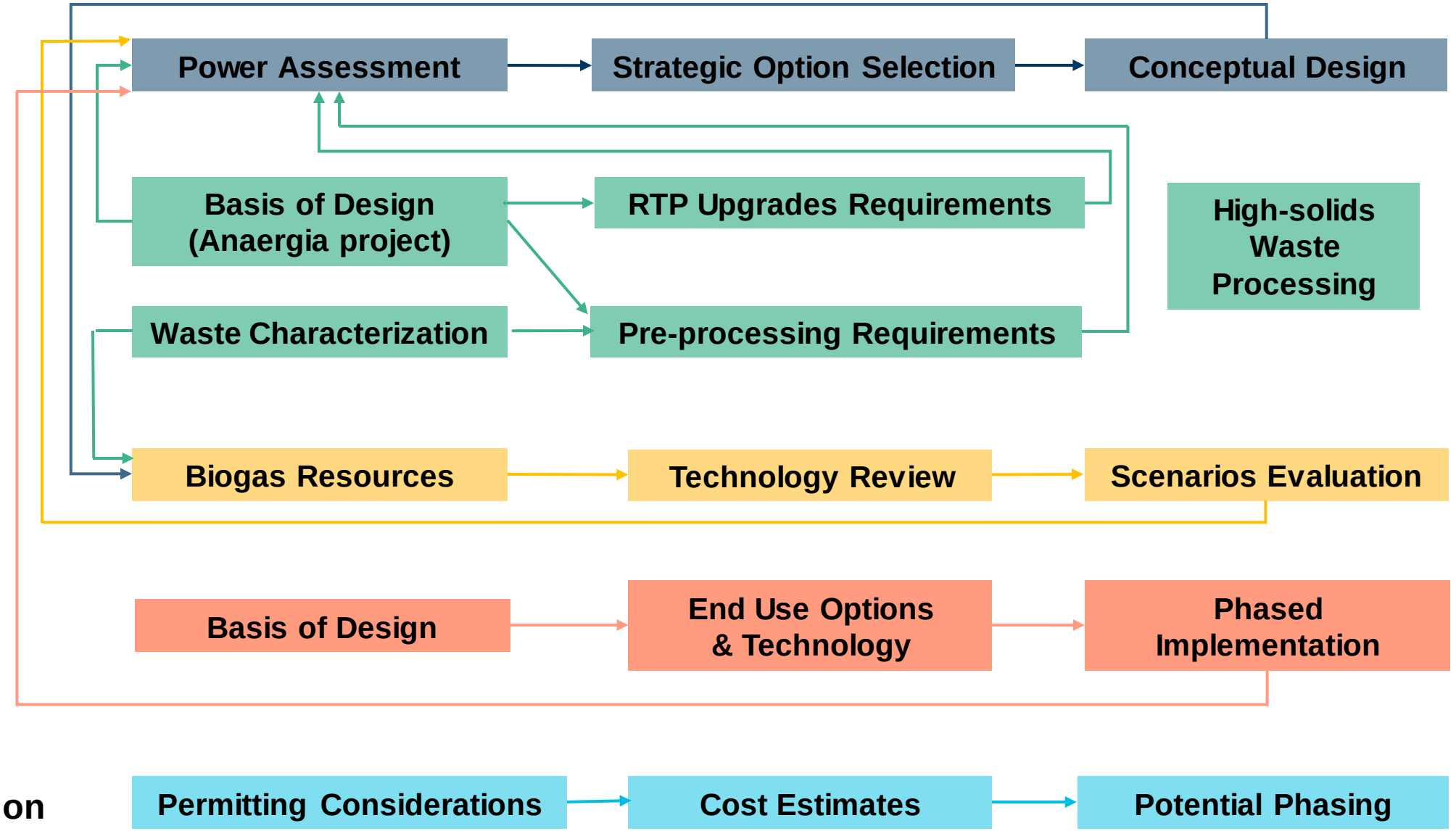
Chapter 2:
Base Case Electrical Network

Chapter 3:
Codigestion Project

Chapter 4:
Biogas Utilization

Chapter 5:
Biosolids Management

Chapter 6:
Path to Implementation

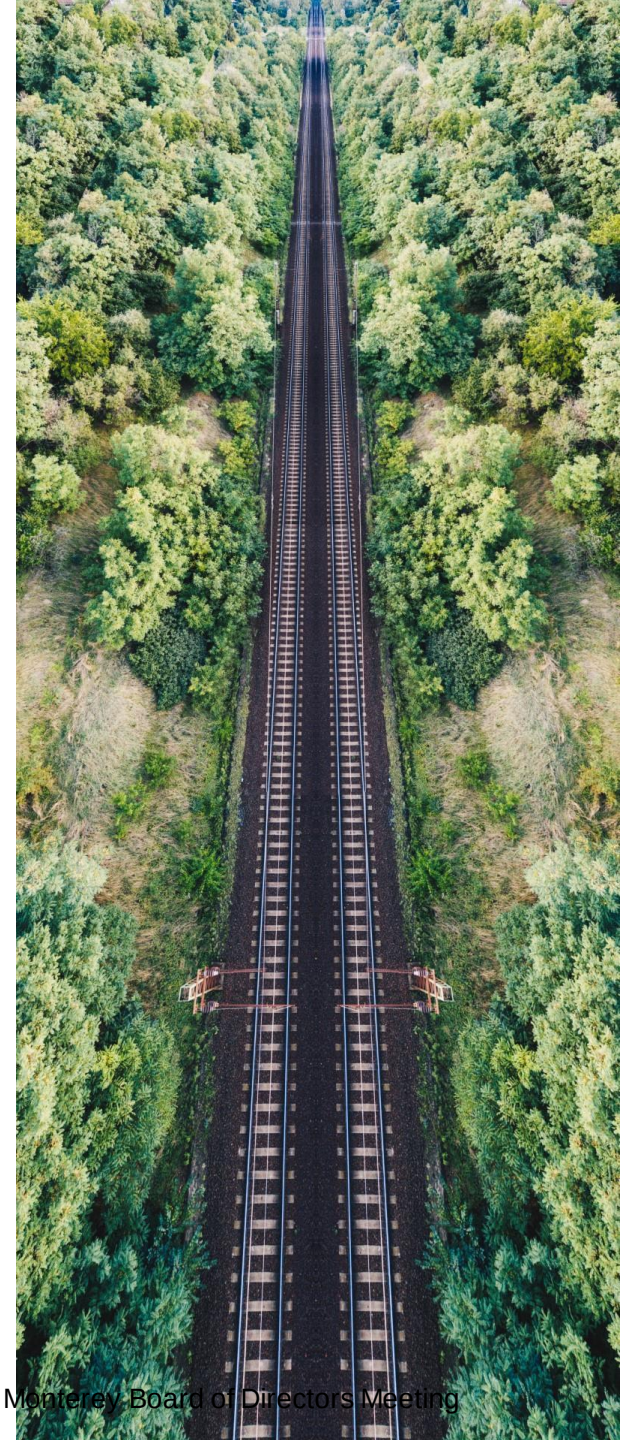


Base Case Electrical Network

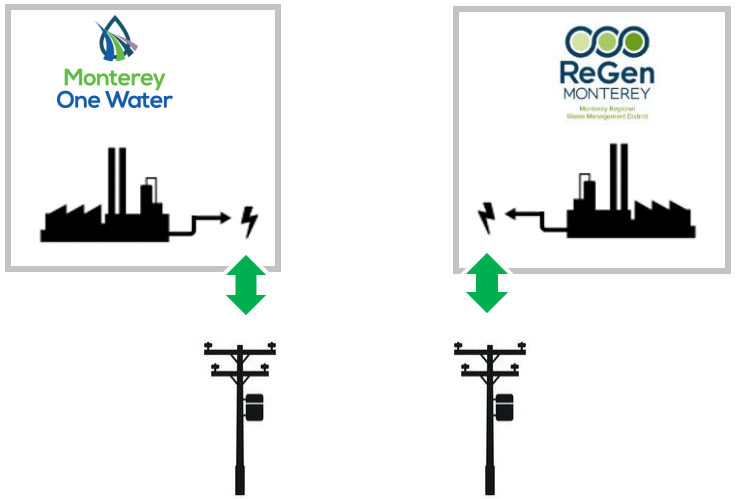
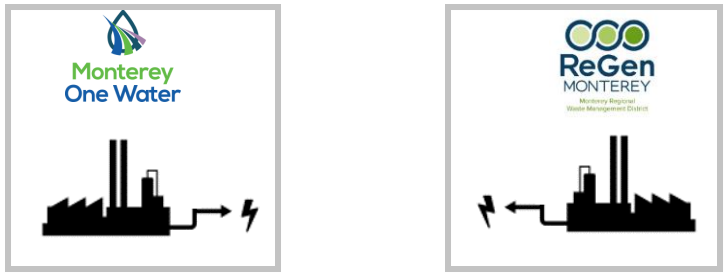
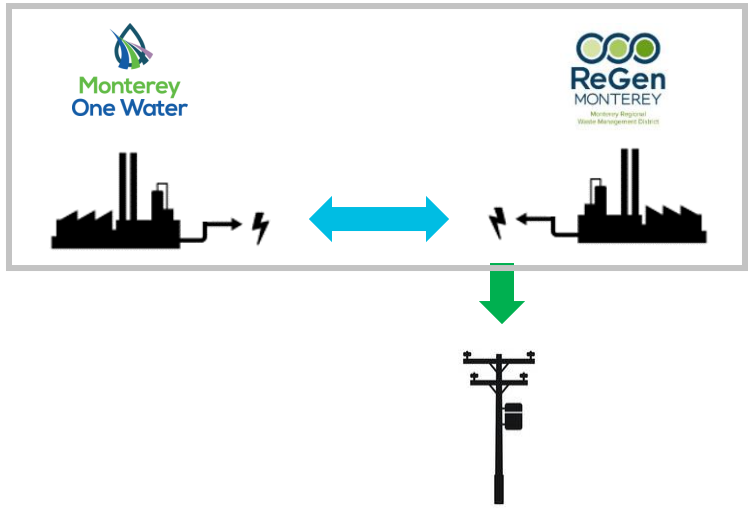
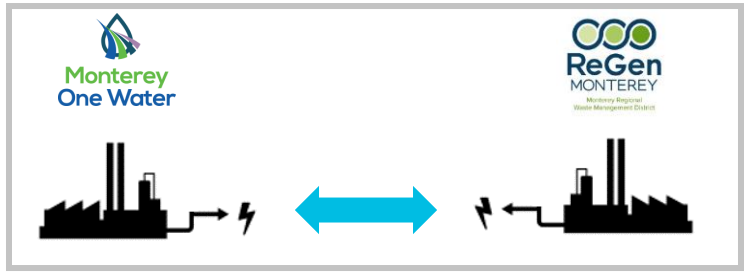
Guiding Principles for the Study

From February 8, 2023 workshop with Agencies staff:

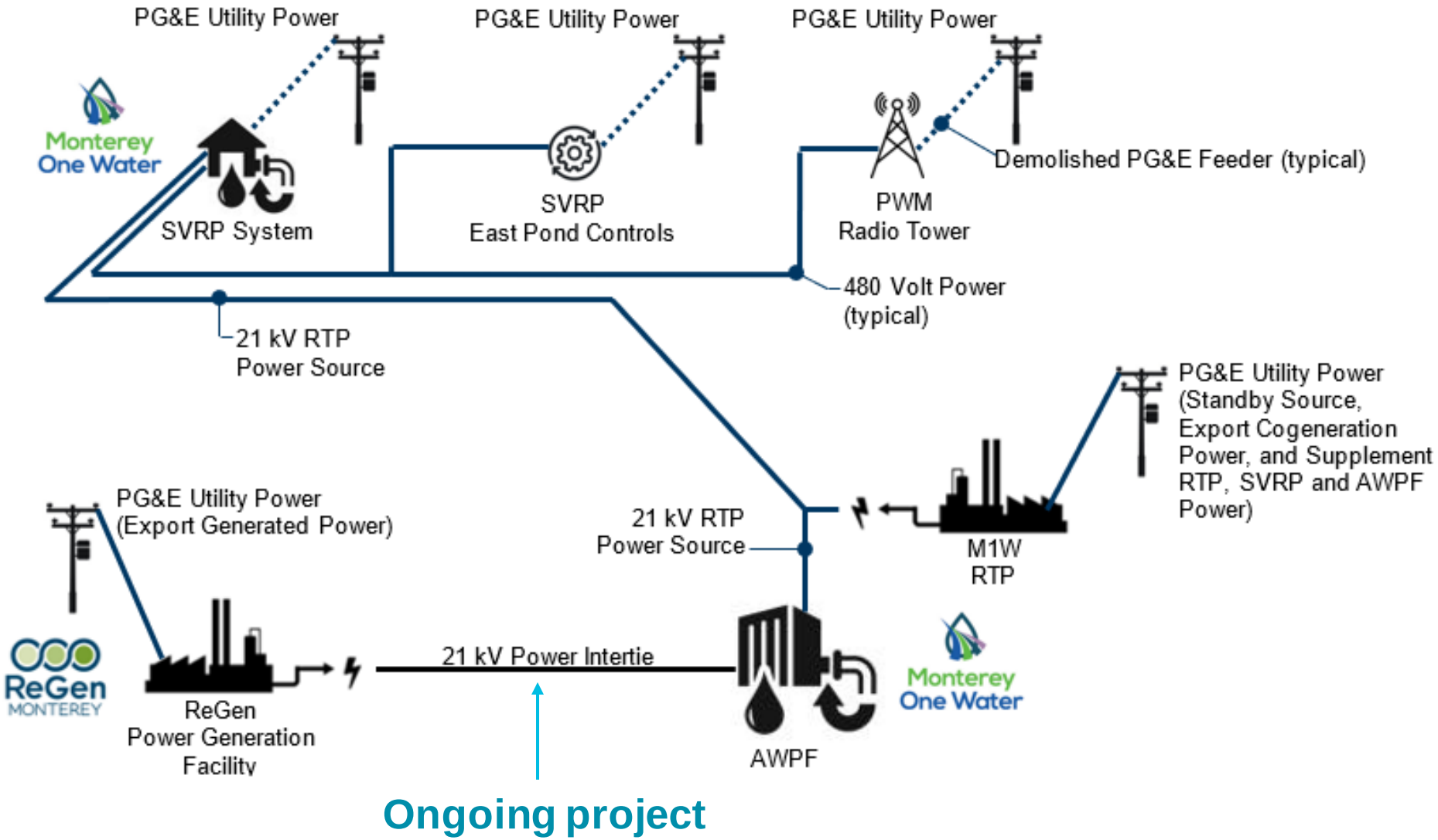
- Provide a **safe** and secure power distribution system
- Achieve operational **resilience**
- Maintain and improve energy **reliability**
- Provide power from **sustainable** sources
- Achieve energy **independence** from the serving utility
- Make best and greatest use of **biogas**
- Reduce facility operational energy **costs**
- Support **State and Federal** initiatives to create a cleaner and safer environment
- Contribute to the **health** and safety of the community
- Reduce regional greenhouse gas (**GHG**) footprint
- Increase **revenue** from ReGen's onsite landfill gas fueled power generation system
- Preserve **landfill capacity** by redirecting organics to non-disposal alternatives



Power Generation Modes of Operations

	WITH UTILITY GRID	ISLAND MODE
AGENCIES OPERATING INDEPENDENTLY		
AGENCIES OPERATING COLLECTIVELY		

Base Case Electrical Network



Infrastructure Requirements & Cost Estimates

Description	Trigger	Timeline	CAPEX	CAPEX PLUS*
ReGen system improvements (7 x 1.6 MW new gensets, additional building, electrical equipment and electrical network controls)	Installation of 21kV electrical intertie to M1W AWPF.	Staged implementation within a 10-year period	$18M	$33M
M1W system improvements (4 x 1.5 MW new CHPs with new building, electrical equipment and electrical network controls)	Downward trend of Combined Heat Power unit reliability	Within 5 years of noticeable downward trend in CHP unit reliability	$26M	$49
M1W 21kV Electrical interconnections to: RTP and SVRP combined	Completed construction of RTP 21kV switchgear replacement	Within 5 years of completion of the RTP 21kV switchgear replacement	$4M	$8M
M1W Battery energy system storage (BESS)	Replacement of CHP units	Within 3 years of replacement CHP units, or as part of the CHP unit replacement	$14M	$25M
M1W Solar photovoltaic (PV)	Available funding	Within 2 years of available funding	$9M	$17M
		Total	**$ 71M**	**$131M**

* ***CAPEX PLUS includes Design Contingency (10%), Sales tax, GC, Bonds, OH & Profit (32.75%), and Accuracy for Class V estimate (30%)***

Co-Digestion Processing

Co-Digestion Processing

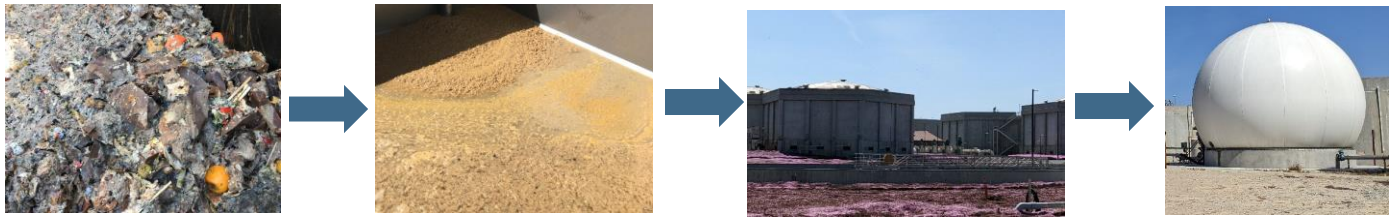
Design Basis:

Co-Digestion of organic slurry

- Anaergia contract ($4M CalRecycle grant):
  - ❖ polishing system
  - ❖ buffer tank
  - ❖ new mixers in each digester
- Digester gas production will increase from an average of **~370 scfm to ~700 scfm** (normalized to 50% methane)

Pre-Processing Requirements (depending on organics source):

- Pre-processing is key for wet digestion
- Highly dependent on input waste characteristics
- **Estimated capital investment is ~$43M**



RTP Improvements Triggered:

- Improved digester mixing (already being procured)
- Digester heating
- Biogas handling, storage & uses
- Improved dewatering
- Additional side-stream treatment

scfm: standard cubic feet per minute

Infrastructure Requirements & Cost Estimates

Process Area	Proposed Improvement	CAPEX Estimate	CAPEX PLUS*
Digester Heating	Steam piping replacement and thermal lagging	$2M	$3.7M
	Larger natural gas fired boiler to meet heat demand of digesters if biogas cogen system went offline	$1.2M	$2.2M
Biogas Handling	Biogas extraction pipework replacement	$1.4M	$2.6M
	Larger biogas compressor to meet pressure requirements of new CHPs and handle peak gas flow	$0.5M	$0.9M
Gas Storage	Larger high pressure gas storage holder	$3M	$5.6M
Sidestream Treatment	Ammonia sidestream treatment	$6.9M	$12.8M
Sludge Thickening	Additional sludge thickener to enable recuperative thickening when one digester is offline (optional – depending on biosolids management approach)	$1.8M	$3.3M
	TOTAL RTP IMPROVEMENTS NEEDED FOR CODIGESTION	**$16.8M**	**$31.1M**

Estimated costs for Cogeneration and Dewatering are presented separately in Chapter 2 “Base case electrical network” and Chapter 5 “Biosolids Management”, respectively.

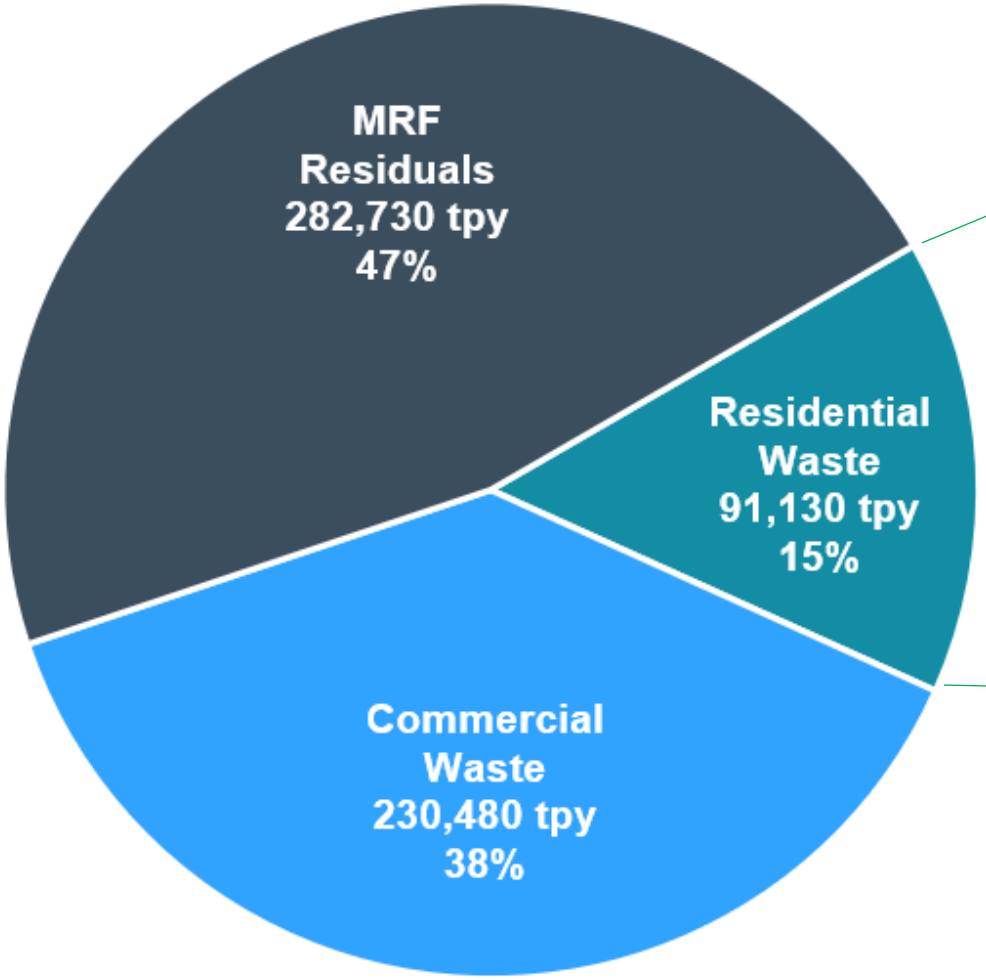
* ***CAPEX PLUS includes Design Contingency (10%), Sales tax, GC, Bonds, OH & Profit (32.75%), and Accuracy for Planning Level estimate (30%)***

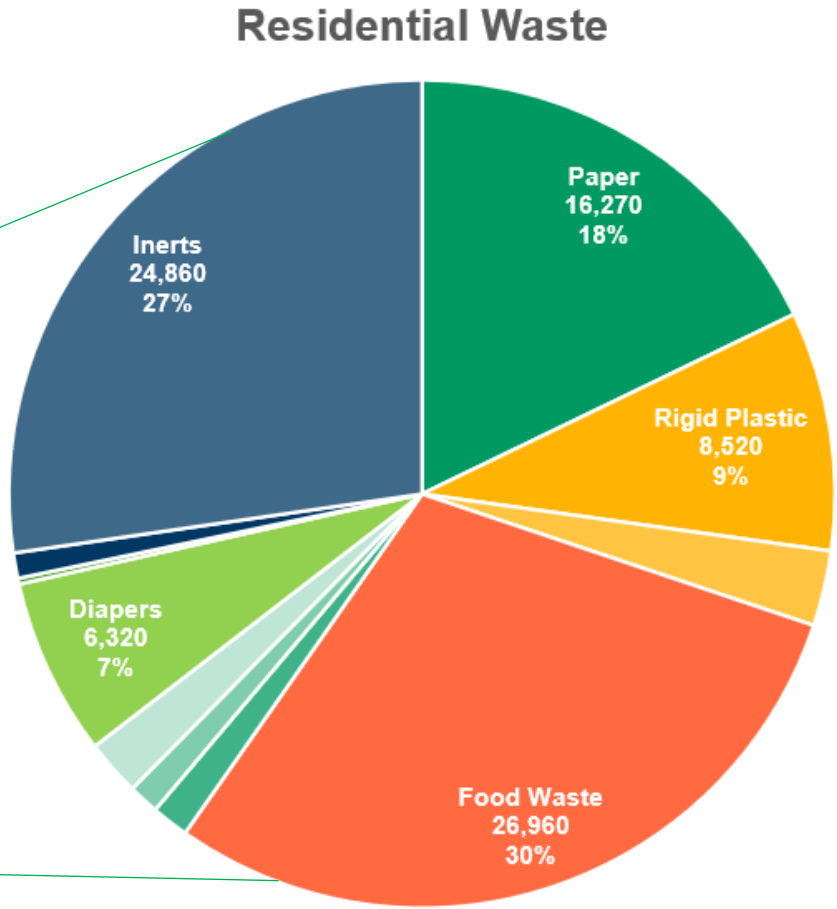
High-Solids Waste Processing

→ **Composting, Plug Flow AD, Dry Batch AD**

Waste Characterization

600,000 Tons/Year (tpy) currently landfilled at ReGen





Potential mixed waste processing to extract food waste from 91,000 tpy residential waste

Overview of Organics Processing Technologies

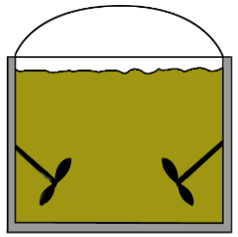
ANAEROBIC DIGESTION (AD) PROCESSES (produces biogas)

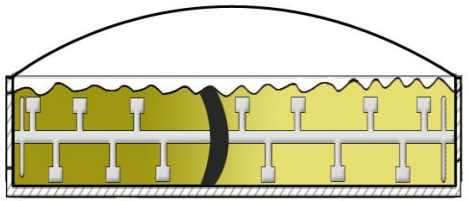
AEROBIC PROCESSES (no biogas)

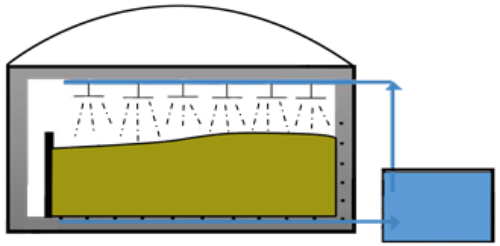
Low-solids (Total Solids < 15%)

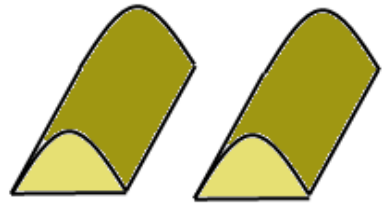
High-solids (Total Solids > 15%)

Wet AD	Plug Flow	Dry AD	Composting
Food waste only	**Food waste & Green waste** (need green waste for structure) **Lower biogas** production than wet AD		**Green waste only, or Green waste & Food Waste**
Pre-processing is key	Can accommodate more contamination but **post-processing** required (plug flow and dry AD digestate is typically composted and screened)		
Vertical infrastructure	**Horizontal** or **Vertical** infrastructure	**Horizontal** infrastructure	**Horizontal** infrastructure





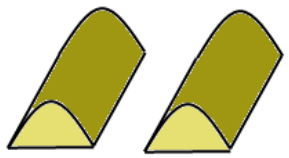


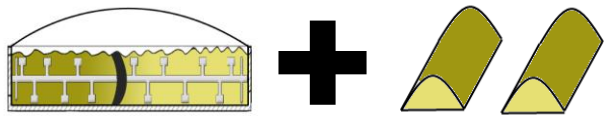


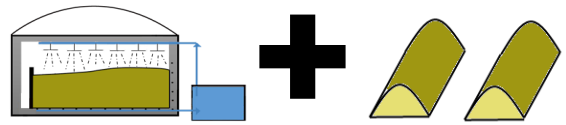
Conceptual Cost Estimates

High-solids waste processing options to process 91,000 tpy residential waste

Area	Composting	Plug Flow AD + Composting	Dry AD + Composting
Pre-processing (residential waste)	$55-75M	$55-75M	$55-75M
Digester system	Not applicable	**$25-30M**	**$25-30M**
Compost system	$8-10M	$8-10M	$8-10M
Compost post-processing	$5-10M	$5-10M	$5-10M
TOTALS	**$68-95M** $740-1,030 per ton residential waste $3,100-4,300 per ton recovered organics before composting	**$93-125M** $1,010-1,360 per ton residential waste $4,230-5,700 per ton recovered organics before AD	**$93-125M** $1,010-1,360 per ton residential waste $4,230-5,700 per ton recovered organics before AD

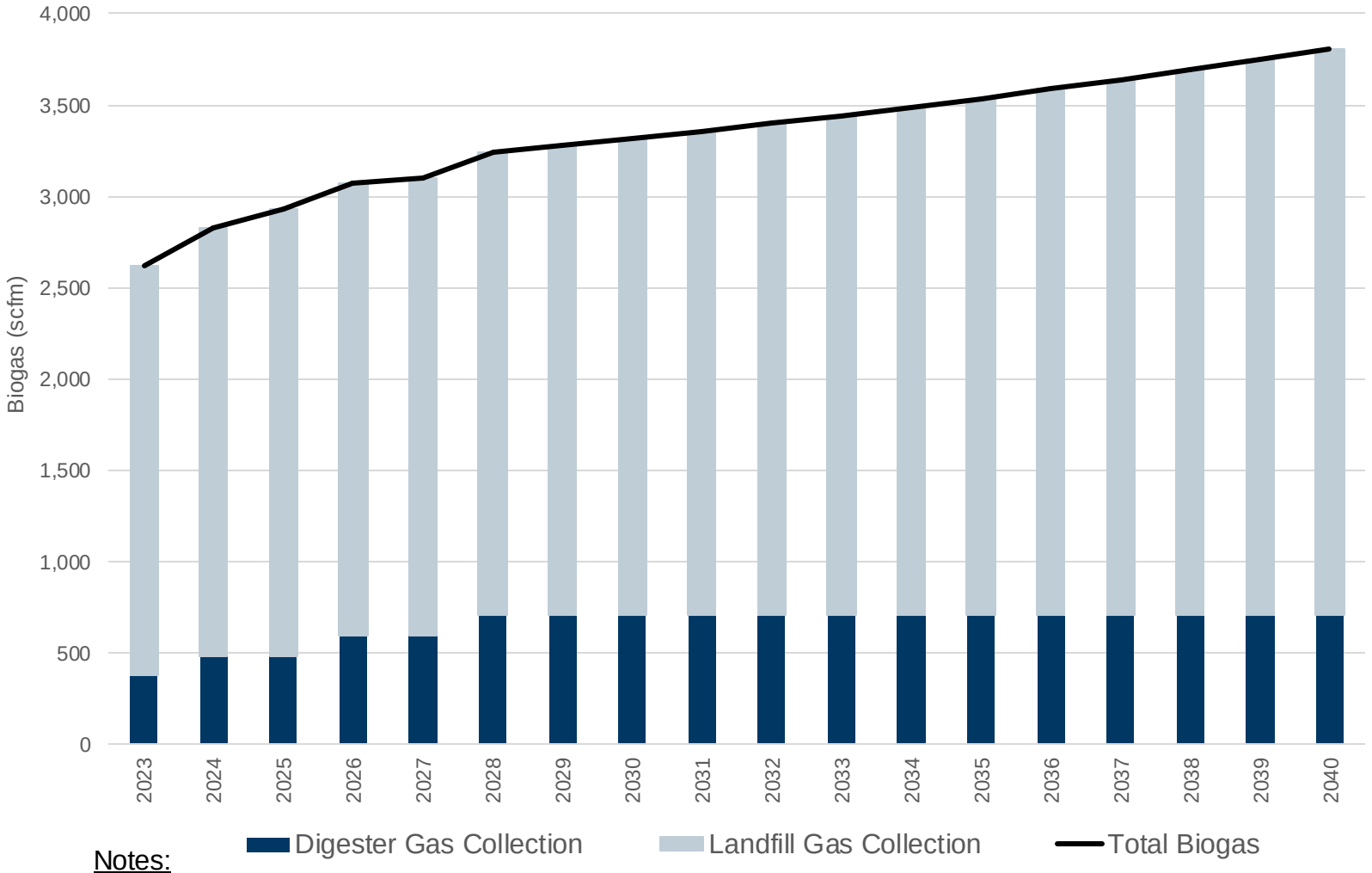






Biogas Utilization

Biogas Resources



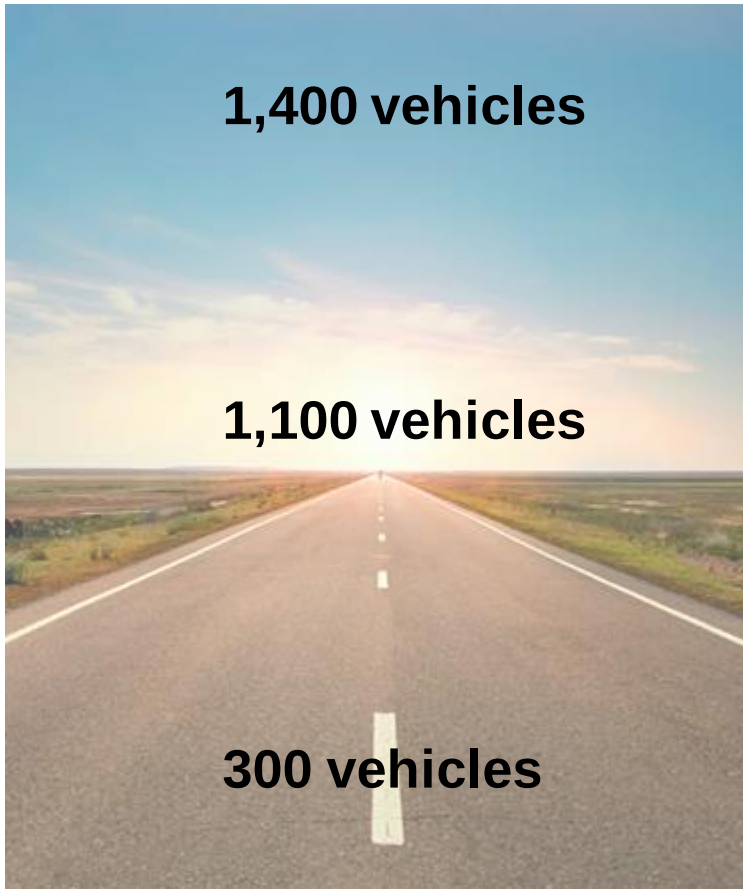
	Current		Future
TOTAL BIOGAS	**2,600 scfm**	→	**3,800 scfm in 2040**
LANDFILL GAS	**2,250 scfm**	→	**3,100 scfm** in 2040
DIGESTER GAS	**371 scfm**	→	**700 scfm** starting in 2028 with codigestion

Notes:

- All gas normalized to 50% methane
- scfm: standard cubic feet per minute
- Landfill gas flows shown are gas collected, assuming 94% capture efficiency of gas generated
- Landfill gas production estimates assume 75% landfill diversion of organics per SB1383

Biogas Resources

		Number of homes that could offset fossil natural gas per year		Number of CNG vehicles that could be fueled per year
TOTAL BIOGAS	3,800 scfm	12,200 homes	OR	1,400 vehicles
ReGen MONTEREY LANDFILL GAS	3,100 scfm	9,600 homes		1,100 vehicles
Monterey One Water DIGESTER GAS	700 scfm	2,600 homes		300 vehicles



Notes: CNG: Compressed Natural Gas

Selection of Biogas Utilization Scenarios

1 **Technology Review** →

- High-level review of 13 technologies. Selected 3 technologies for further review:

Combined Heat and Power (CHP)

Renewable Natural Gas (RNG)

Renewable Compressed Natural Gas (R-CNG)

2 **Base Case Electrical Network Requirements** →

- Digester gas (700 scfm) + A portion of landfill gas (1,100 scfm) → Electricity and heat for ReGen & M1W needs
- **After the base case electrical network requirements are met, there is about 1,000 scfm excess landfill gas initially, increasing to 1,900 scfm in 2040.**

3 **Scenarios Evaluated for Utilizing <u>Excess</u> Biogas** →

Scenario 1: Electricity Generation – distribute to PG&E electric grid

Scenario 2: RNG Production – inject into PG&E gas network

Scenario 3: RNG and R-CNG Production – inject into PG&E gas network + onsite CNG fueling station

<u>Notes</u>: All gas normalized to 50% methane

Financial Estimates

- **Scenarios 2 & 3 could generate significantly more revenues than Scenario 1.**
- However, Scenario 1 is based on a current revenue source & technology and would likely be easier to implement.

	Scenario 1: Electricity[1]	Scenario 2: RNG[2]	Scenario 3: RNG + R-CNG[2]
CAPEX PLUS[3]	$27M	$67M	$83M
Total Operating Costs (2026-2040)	$27M	$60M	$75M
Total Revenues (2026-2040)	$69M	$224M	$233M
Total Net Revenues[4] (2026-2040)	**$16M**	**$97M**	**$78M**

Notes:

[1] Scenario 1 assumes electricity revenue at current rates through CAISO ($0.1045/kWh). Scenario is sensitive to operations & maintenance (O&M) costs – assumed lower O&M costs than current ($0.075/kWh) since new gensets would be in place

[2] Scenarios 2 and 3 assume revenue from RINs and LCFS (RNG used in the transportation industry). If the Agencies want to reduce market risk, a contract with the utilities (e.g., PG&E) or another long-term gas offtaker should be considered – revenues would be reduced but reliable for a set contract term.

[3] CAPEX PLUS includes Design Contingency (10%), Sales tax, GC, Bonds, Overhead and Profit (32.75%), and Accuracy for Planning Level estimate (30%)

[4] Total Net Revenues = Total Revenues – Total OPEX – CAPEX PLUS

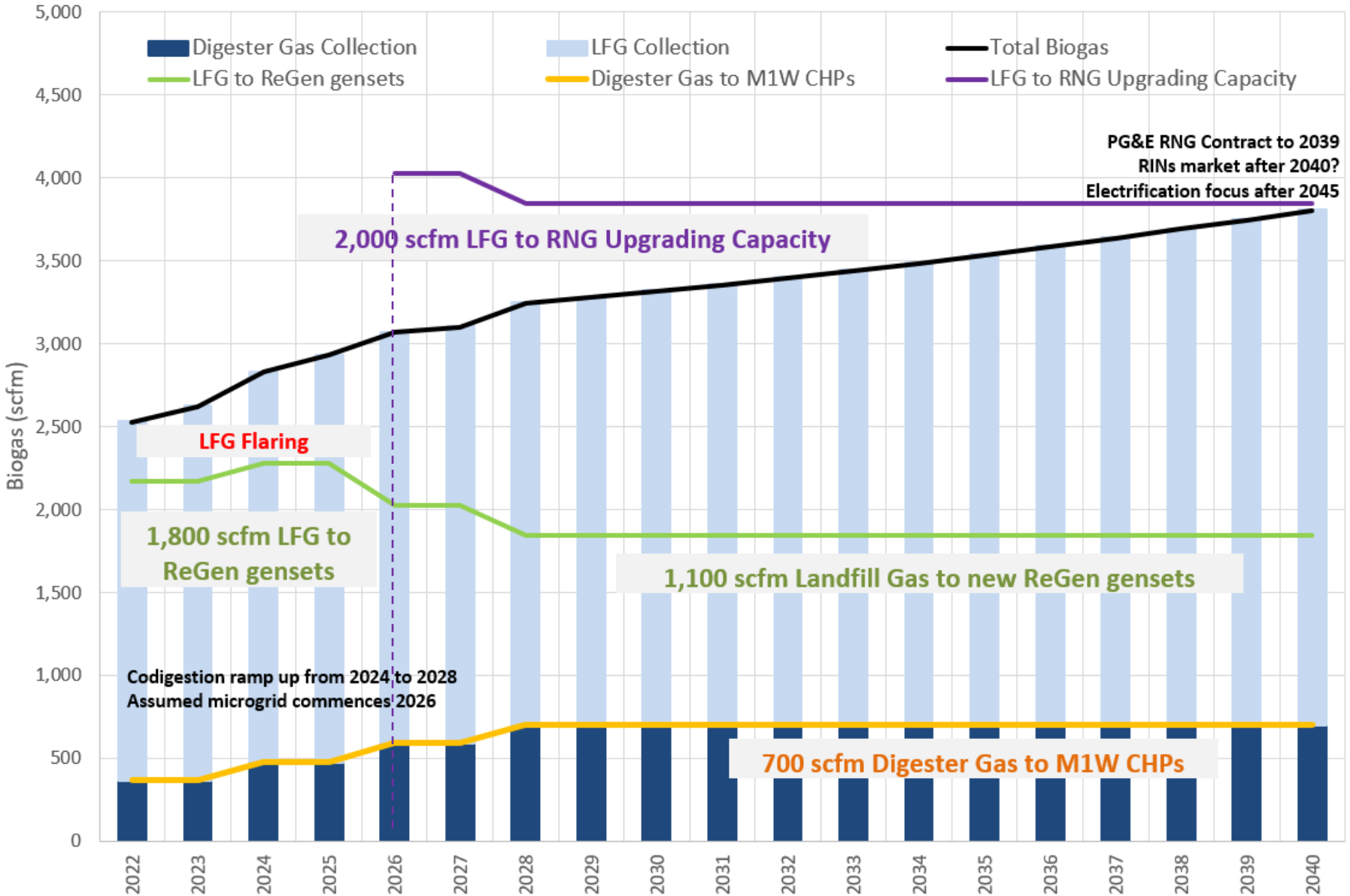
Scenarios Evaluation

Recommendation: Scenario 2 – RNG

Category	Criteria	Weighting	Scenario 1: Electricity	Scenario 2: RNG	Scenario 3: RNG + R-CNG
Technical Performance	Reliability	10%	4	3	2
Operations & Maintenance	Complexity	10%	5	2	1
Integration with Existing Facilities	Footprint	5%	4	3	2
	Modular expandability	5%	3	3	2
Environmental and Community Impacts	GHG emissions	35%	1	5	5
Financial Considerations	Capital costs	10%	5	2	1
	O&M costs	10%	5	2	1
	Revenue generation	15%	1	4.5	5
Total rating score		**100%**	**55%**	**73%**	**64%**

Rating key ranges from 1 (much worse) to 5 (much better) compared to other scenarios. Total rating score calculated as the sum of the products of weighting and rating.

Recommended Biogas Utilization



Biosolids Management

Biosolids Management Decision Factors

1 Current Conditions and Potential Quantities of Material



→

- Current: AD + Screw presses + Drying bed + Landfill
- Screw presses **past useful life** and produce cake at only 16% TS
- Current: **~7,200** dry tpy | With codigestion: **~9,200** dry tpy
- With improved dewatering: **~40,000 tpy cake** at 25% TS
- Potential with drying: **~10,000 tpy pellets** at 95% TS
- Potential with pyrolysis: **~7,000 tpy of biochar**

2 End Use Options & Technologies Review

→

- Reviewed technologies and potential markets for end products:
  - ❖ Cost of disposal for Class A liquid, Class B cake, and limited market interest for dried biosolids (non-uniform particles)
  - ❖ Potential sales value for **compost**, **pellets** and **biochar**

3 Regulations & PFAS Considerations

→

- Per SB1383, **non-disposal alternative** needed by Jan 1, 2025.
- As M1W wants to address PFAS, it is recommended to focus on **dewatering improvements** as an initial step as it would be required for any future **advanced thermal treatment** technologies (e.g., pyrolysis) which have shown promise in managing PFAS in biosolids.

End Use Options & Technologies Review



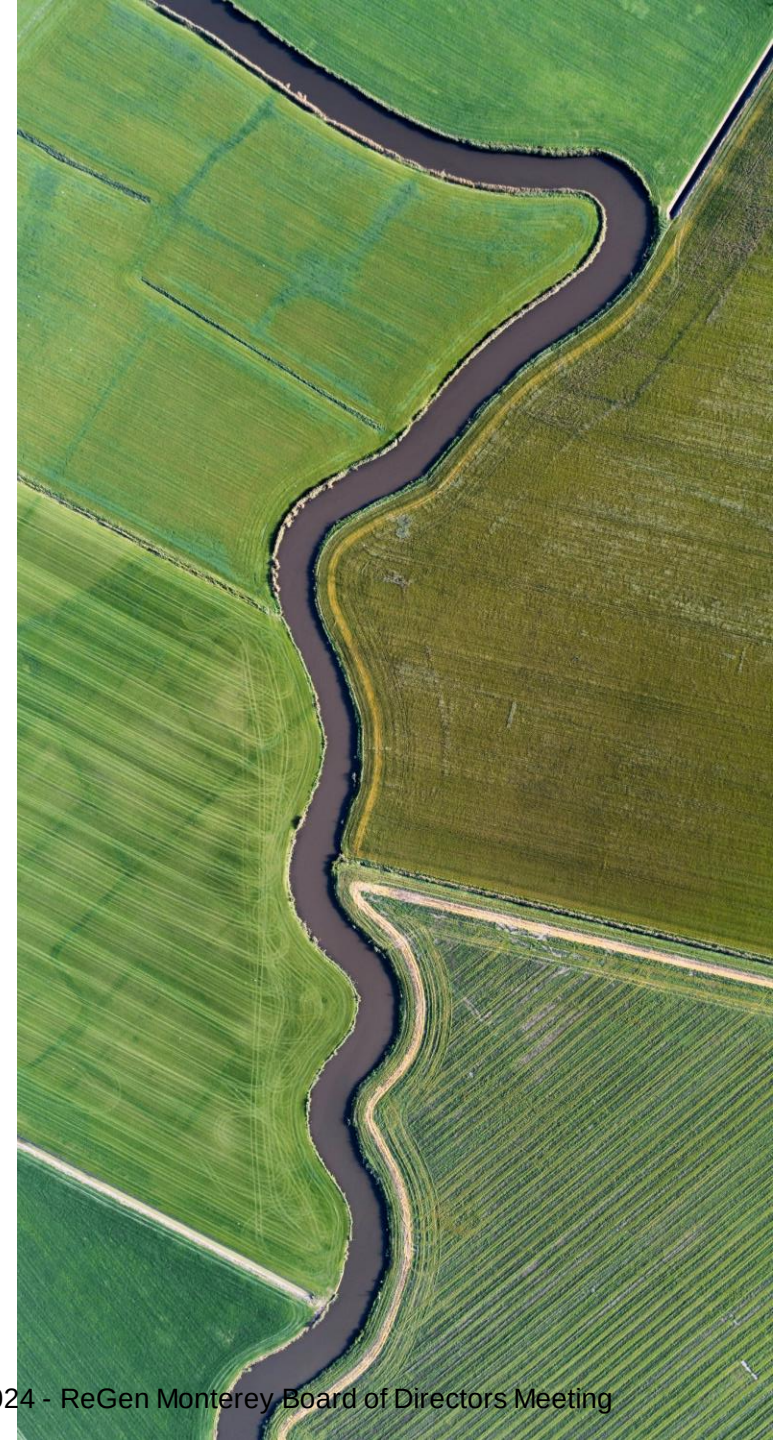



	Traditional Biosolids Management Options			Advanced Thermal Treatment		
End Product Type>>	**Class A Liquid**	**Class B Cake**	**Compost**	**Dried Biosolids: Pellets**	**Dried Biosolids: non-uniform particles**	**Biochar**
Technology / Process Used	Hydrolysis	Dewatering	Dewatered cake to composting	Dewatered cake to rotary drum dryer, or similar	Dewatered cake to belt dryer, or similar	Dewatered cake, to dryer, to pyrolysis unit
Drawbacks	Handling, cost to dispose	Handling, cost to dispose	Large footprint, odor control, education related to feedstock	High value markets are not well established in CA; system breakdowns / maintenance	Handling (dusty / light), cost to dispose;	Only one facility running at commercial scale in US
Energy Recovery	None	None	Some heat	Yes (heat)	Yes (heat)	Yes (from syngas)
Addresses PFAS	No	No	No	Somewhat: less pellets needed for the same nutrient value thus lowering PFAS release		Yes (limited research to date)
Typical Market Value	Cost of disposal: $3/ton for liquid	Cost of disposal: $50-70/wet ton for cake	Sales value: $18-40/ton	Sales value: $20-30/ton	Limited market interest if in non-uniform – Cost of disposal similar to Class B cake	Sales value: $50/ton for soil applications $200/ton for concrete applications

Proposed Implementation Strategy

- **Phase 0 (immediate term) - Agreement with third party**
  - ❖ Need alternative to landfilling biosolids by January 1, 2025
- **Phase 1 - Dewatering improvements**
  - ❖ Achieve at least 25% TS cake dryness and increase the flexibility of options available for further thermal treatment after dewatering
- **Phase 2 - Potential drying step**
  - ❖ Allow potential advanced thermal treatment in the future, reduce operating costs (no haulage costs) and generate pellets which currently have market demand and somewhat address PFAS
- **Phase 3 - Potential advanced thermal treatment**
  - ❖ If PFAS become an immediate concern such as through legislative changes

Note: Some phases are optional and/or can be combined



Planning Level Cost Estimates

CAPEX Estimates:

	Phase 1 - Dewatering Improvements	Phase 2 - Addition of Sludge Drying	Phase 3 - Addition of Advanced Thermal Treatment
CAPEX PLUS*	**$28M**	**$46M**	**$19M**

Annual OPEX Estimates:

	Phase 1 - Dewatering Improvements	Phase 2 - Addition of Sludge Drying to Dewatering Operation[1]	Phase 3 - Addition of Advanced Thermal Treatment[2]
Estimated Operating Expenses (Haulage of byproducts, Power, Natural Gas, Polymer and other consumables)	$3.1 – 4.6M	$1.8M	$1.8M
Estimated Revenue from Each Phase	$ -	$0.25M (sales of pellets)	$0.3M - $1.6M (sales of biochar)
NET OPEX (Revenue deducted from OPEX)	$3.1 – 4.6M	$1.5M	$0.4 – 1.4M

Notes:

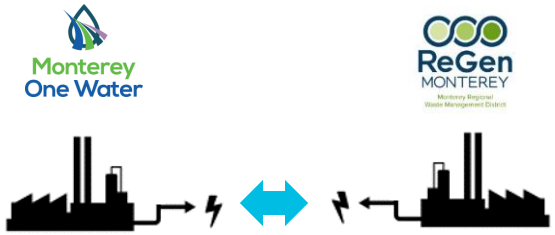
1. Dewatering system is running, but no longer hauling cake.
2. OPEX costs for dewatering and dryer must remain, as dried product is feedstock for advanced thermal treatment.

* ***CAPEX PLUS includes Design Contingency (10%), Sales tax, GC, Bonds, OH and Profit (32.75%), and Accuracy for Planning Level estimate (30%)***

→ Path to Implementation

Feasibility Study Summary

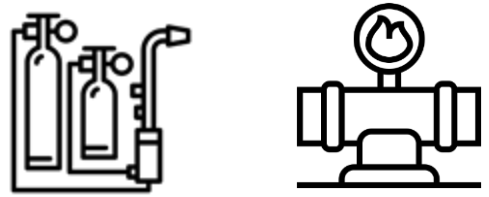
ELECTRICAL UTILITY RELIABILITY



Onsite electricity generation from biogas for ReGen and M1W needs + 21kV intertie between facilities

Potential future batteries and solar PV

BIOGAS UTILIZATION



Excess biogas upgraded to RNG for pipeline injection and sale

CO-DIGESTION

Source clean organic slurry or preprocess waste onsite

RTP plant improvements for co-digestion

BIOSOLIDS MANAGEMENT

No landfilling

Address PFAS

Improved dewatering

Potential future advanced thermal treatment

Capital Investment Required

Project Component	Investment	Triggers
Base Case Electrical Network	**$131M**	
ReGen system improvements (New gensets, building & electrical controls)	$33M	Installation of the M1W AWPF 21kV electrical intertie.
M1W system improvements (New CHPs, building & electrical controls)	$49M	Downward trend of CHP unit reliability
M1W 21 kV RTP, AWPF and SVRP interconnections	$8M	Completed construction of RTP 21kV switchgear replacement
M1W Battery Energy Storage System (BESS)	$25M	Replacement of CHP units
M1W Solar Photovoltaics (PV)	$17M	Available funding
Co-Digestion Infrastructure	**$74M**	
Organic waste pre-processing	$43M	Depending on sourcing of organics for codigestion
RTP plant improvements	$28M	Triggered by codigestion project
Recuperative thickening - Optional depending on biosolids management	$3M	If used, implement before 1st digester cleaning
Excess Gas Utilization	**$67M**	
Landfill gas to pipeline (2,000 scfm capacity)	$67M	Main revenue potential
Biosolids Management	**$93M**	
Dewatering improvements	$28M	Enables alternative pathways to landfilling
Potential future drying	$46M	Enables advanced thermal treatment
Potential future pyrolysis	$19M	When PFAS becomes an immediate concern
Total	**$365M**	

Capital investment shown includes Design Contingency (10%), Sales tax on materials (7.75%), General conditions (8%), Bonds and insurance (2%), Overhead and Profit (15%), and Accuracy for Class V estimate (30%)

Key Considerations for Next Steps – Phase 2 ??

- **Electrical Network:**
  - Do the Agencies want to implement the base case electrical network (nested electrical networks)?

- **Co-Digestion:**
  - How do the Agencies want to source the organics for co-digestion?
    Do the Agencies prefer to invest in additional infrastructure to pre-process onsite or source from third parties?

- **Biogas:**
  - With the excess gas after the base case electrical network needs are met, do the Agencies want to produce electricity (current technologies well known by both ReGen and M1W) or do the Agencies prefer to produce RNG for pipeline injection to target higher revenues?

- **Biosolids:**
  - Do the Agencies want to move ahead with dewatering improvements in the near future (to achieve at least 25% TS cake dryness) to increase the flexibility of options for further thermal treatment after dewatering?