Kevin Wegener

Clean Water Services
Durham
FOG to Energy

Agenda

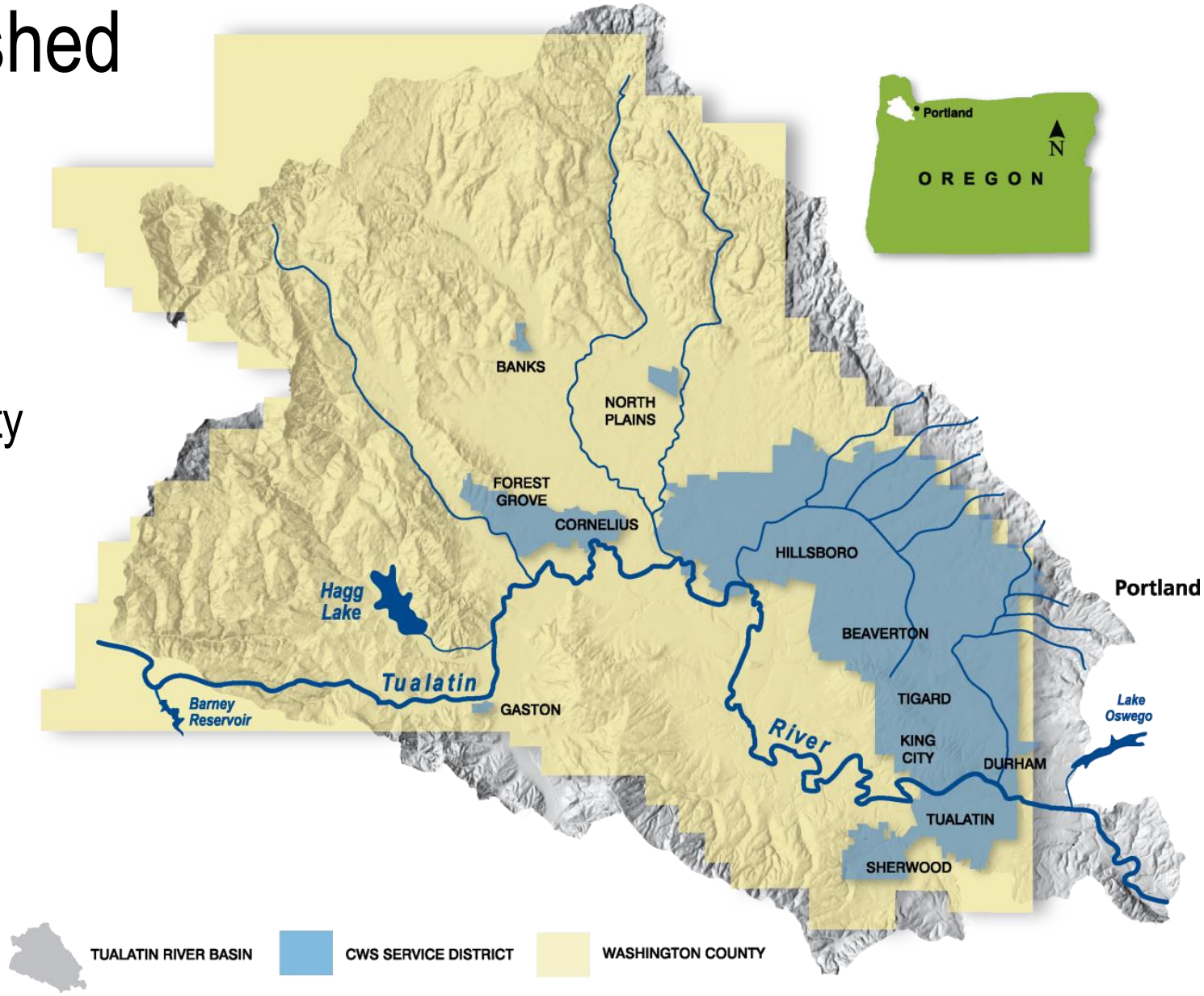
- Introduction
  - About Clean Water Services
  - What is Anaerobic Digestion and Co-digestion
  - Why Clean Water Services?
- FOG at Durham
  - Initial set up
  - Experience with FOG
  - Retro fit
- What are the benefits?
- Takeaways

About Clean Water Services

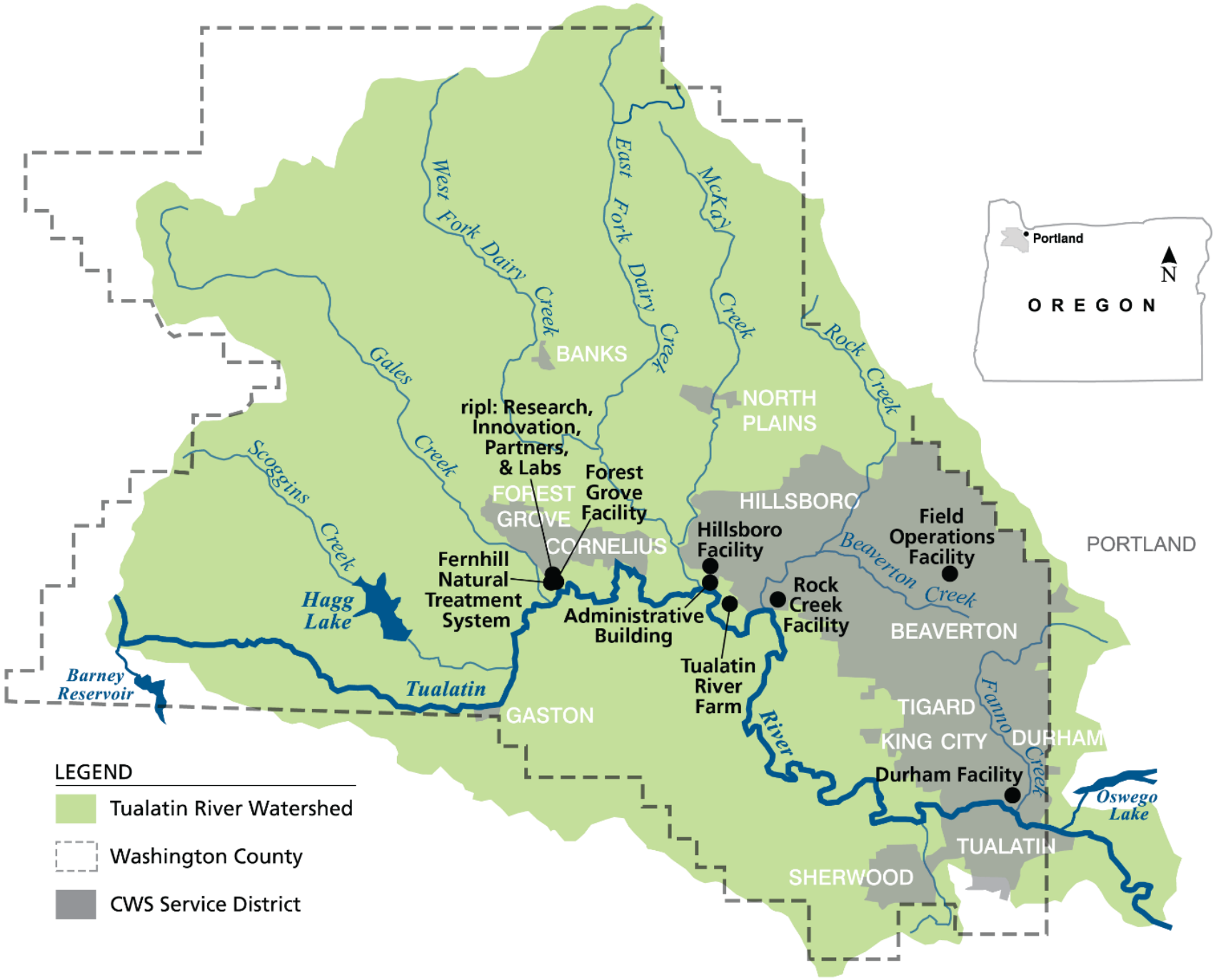
- Water resources management utility:
  - Resource recovery
  - Surface water management
  - Water security and planning
  - River flow management
- Leadership:
  - Board, advisory commission (CWAC), CEO

Tualatin River Watershed

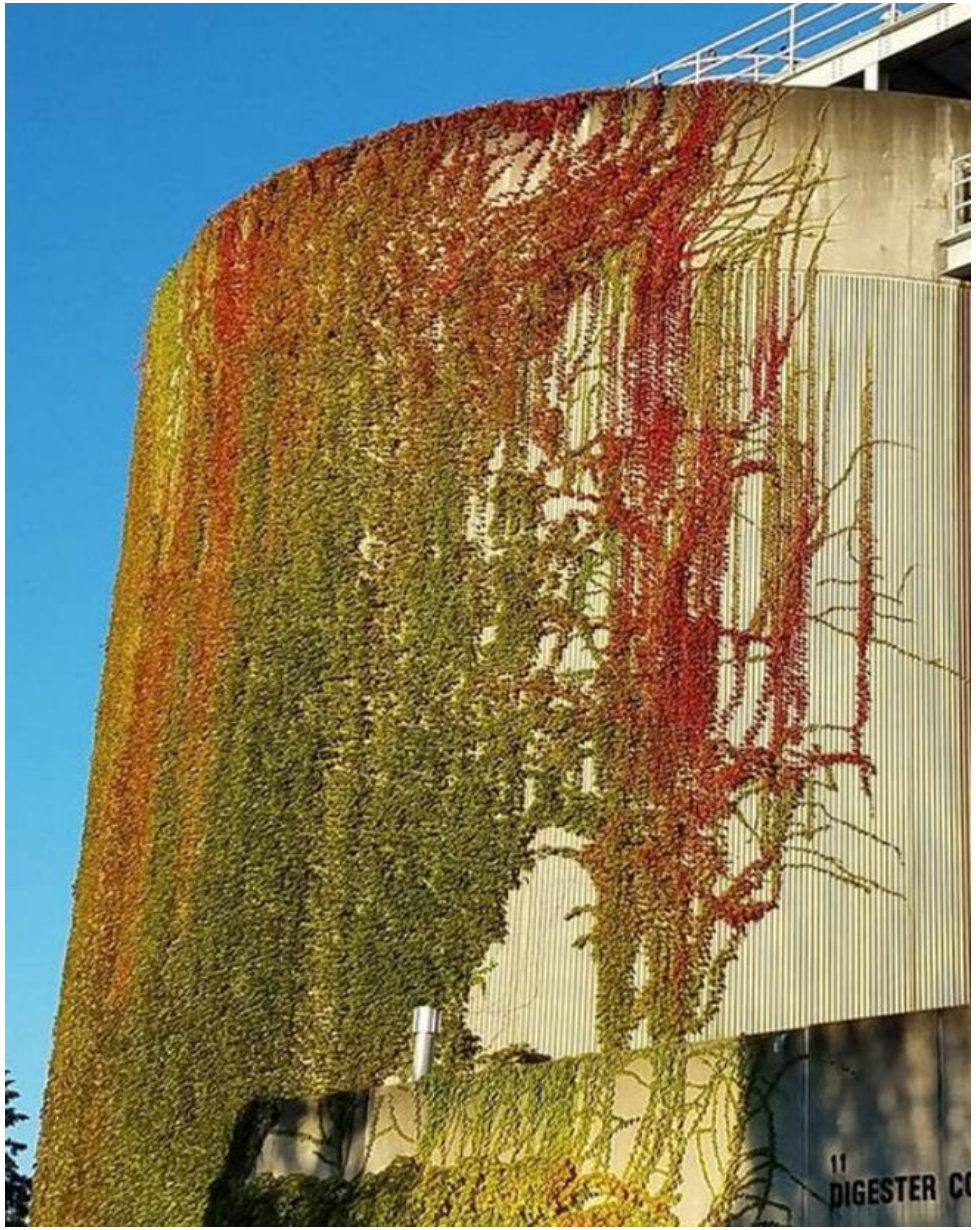
- In Northwest Oregon, east of Coast Range, west of Portland
- Urbanized area = 12 cities + portion of unincorporated county
- Strong agriculture sector
- Oregon's most racially diverse county
- One river

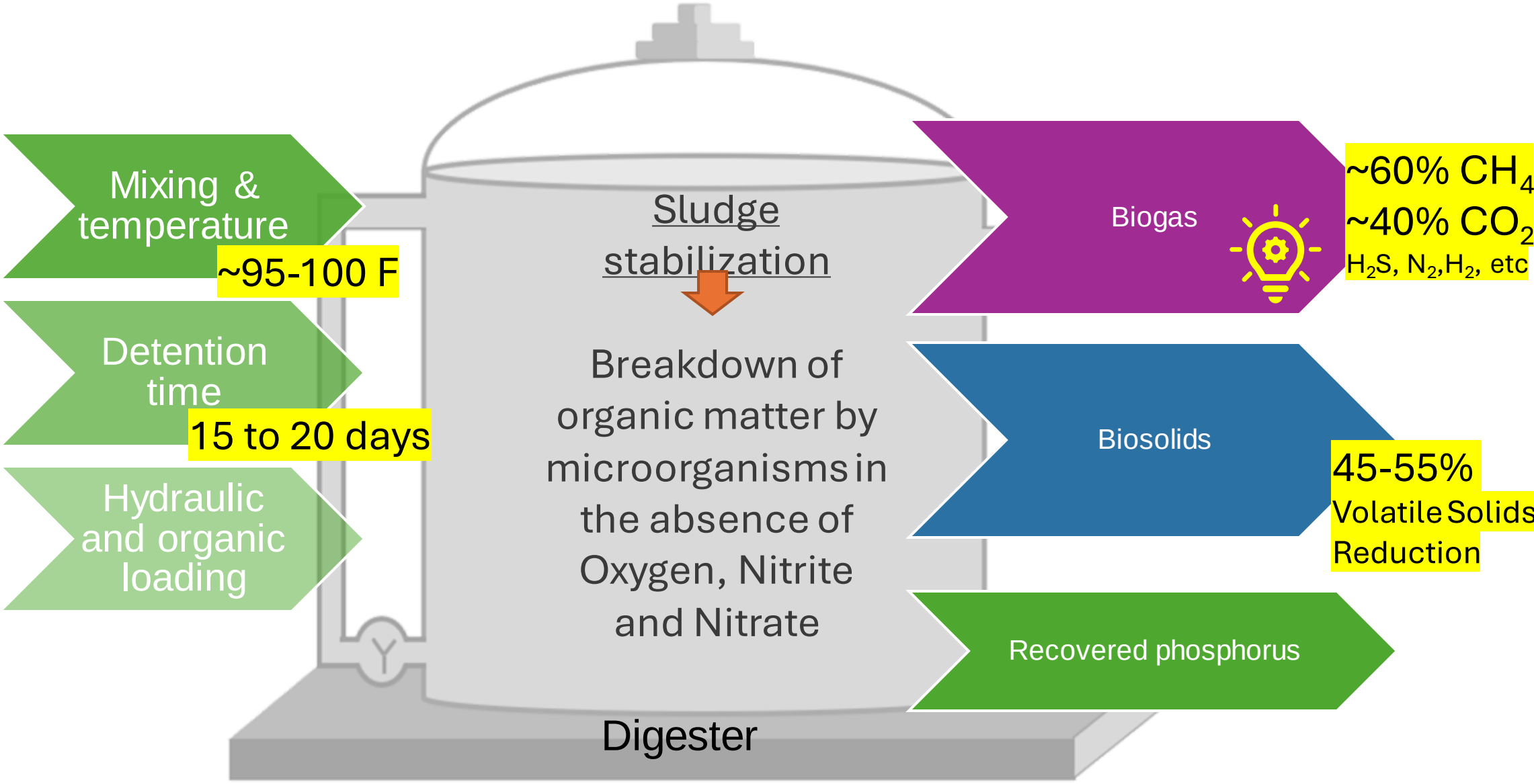


CWS Facilities

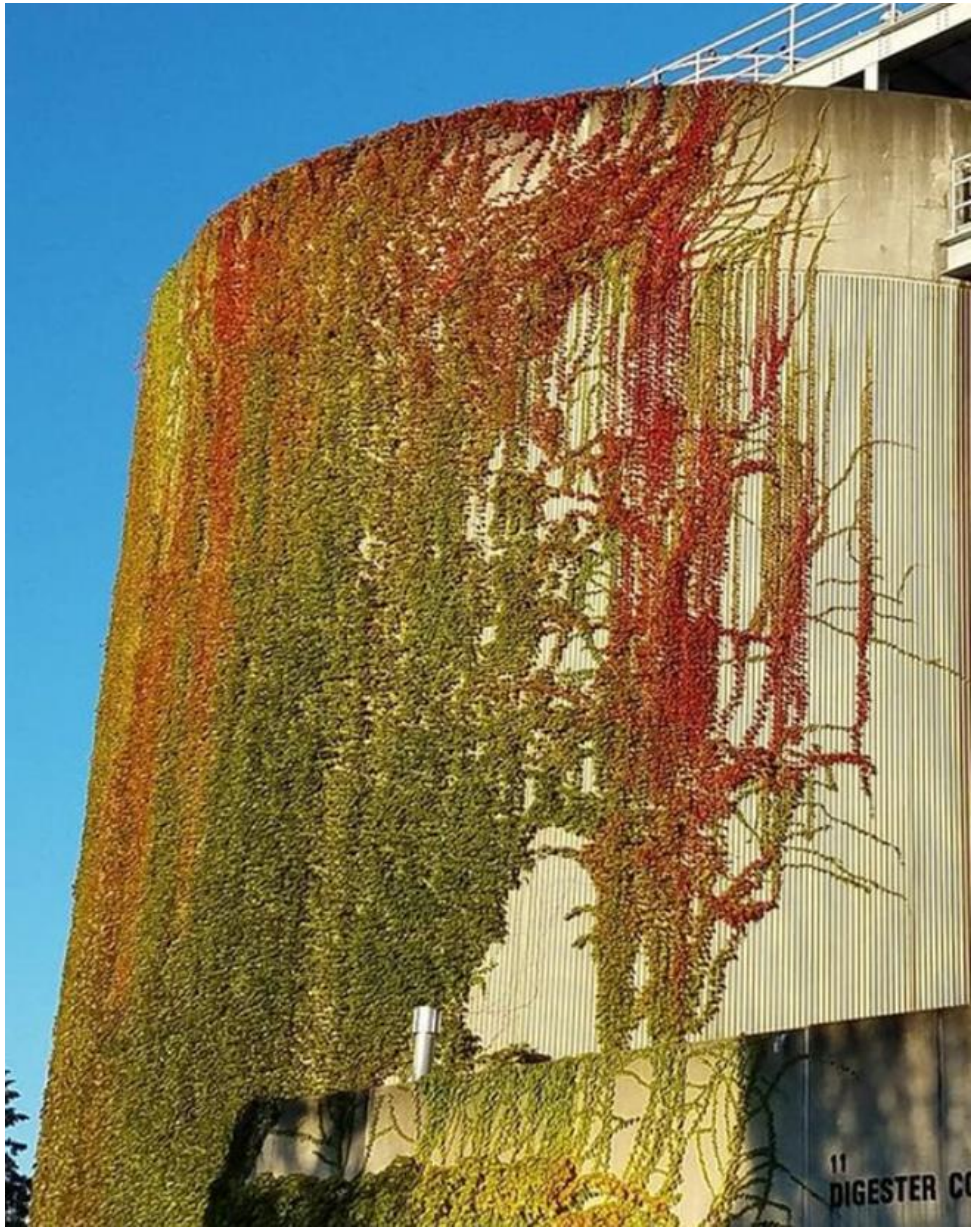


- Anaerobic digestion
  - “Biological treatment that is used to further process and stabilize solids (sludge) that are removed from wastewater during primary, secondary, and tertiary treatment”.

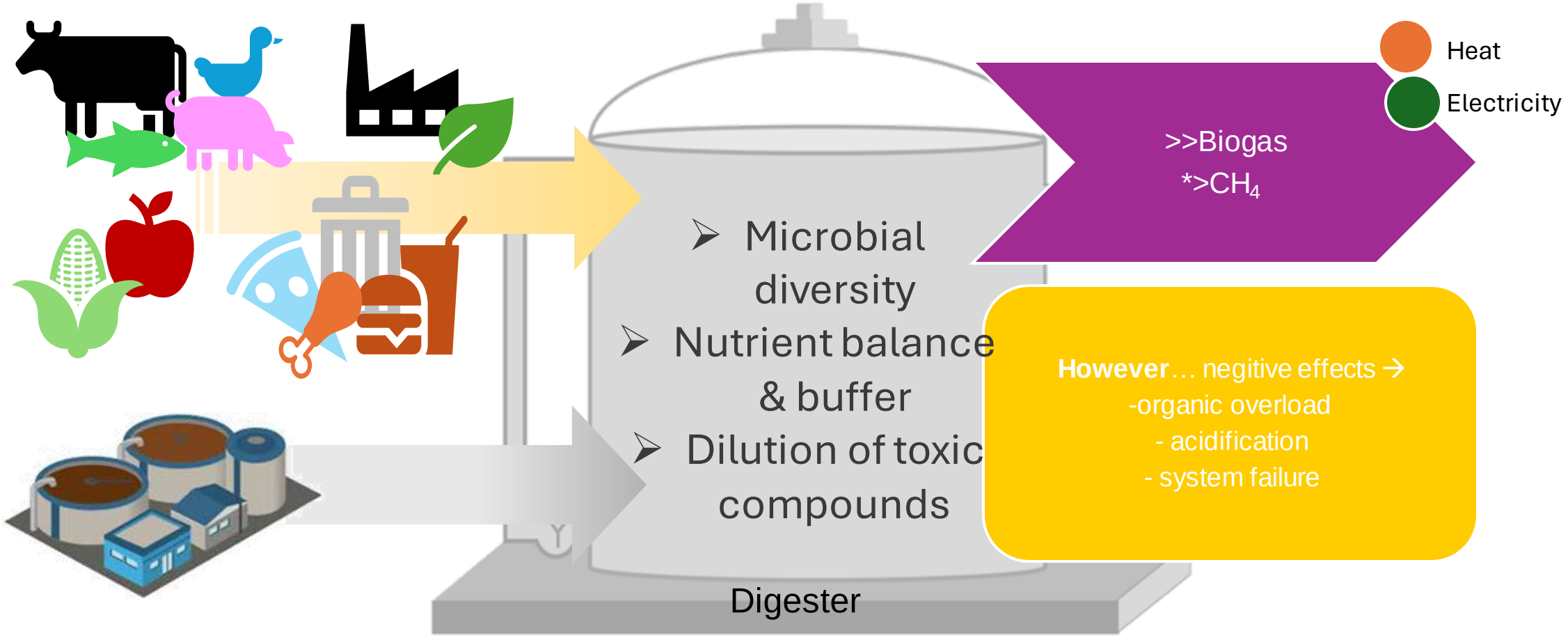



Mixing & temperature
~95-100 F
Detention time
15 to 20 days
Hydraulic and organic loading
Sludge stabilization
Breakdown of organic matter by microorganisms in the absence of Oxygen, Nitrite and Nitrate
Digester
Biogas
~60% CH_4
~40% CO_2
H_2S, N_2,H_2, etc
Biosolids
45-55%
Volatile Solids Reduction
Recovered phosphorus

- Anaerobic **Co-digestion**
  - Simultaneous digestion of two or more feedstocks
- For example, by adding organic waste streams such as FOG to sewage sludge.



- Anaerobic **Co-digestion**



Adapted from: Karki, et al., (2021). Anaerobic co-digestion: Current status and perspectives. Bioresource Technology, 330,125001.

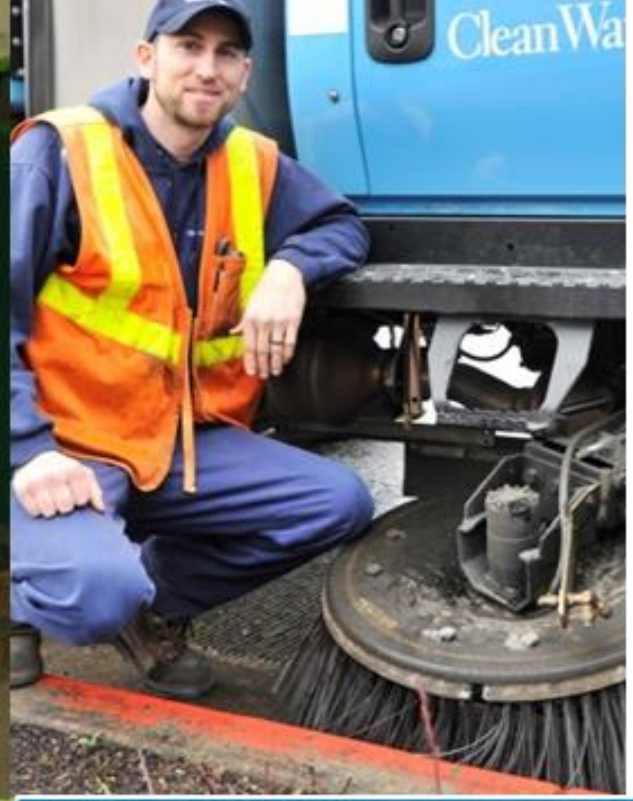
- High Strength Wastes (HSW)
  - Organic wastes
  - FOG is a high strength waste that is source separated
  - May have:
    - High biological oxygen demand
    - High solids content

- High Strength Wastes (HSW)
  - Traditional disposal (landfill, incineration, composting, animal feed) can be sub-satisfactory
    - Sustainability
    - Environmental impact
    - Investment

  - Difficult to treat at wastewater treatment plants, can be source separated:
    - Fats, Oils & Grease (FOG)
    - Some industrial organic wastes

Why CWS?

- Engaging community contributors
- Shared benefits
  - Financial
  - Environmental
  - Community service
  - Carbon foot-print



Why CWS?

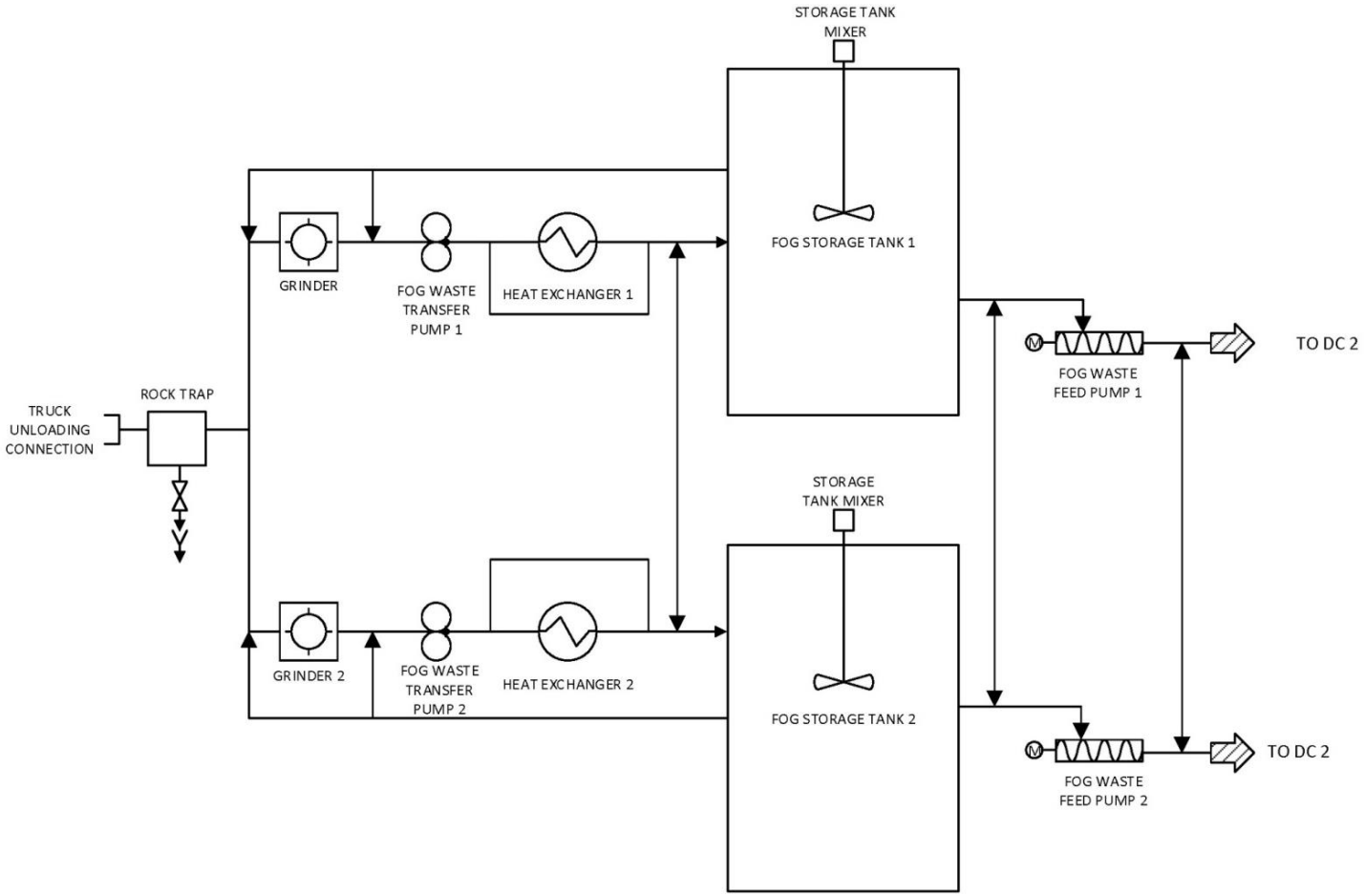
- Digestion of Municipal Sludge had limited gas production
- We have available capacity
- The District values resource recovery from waste
- Lots of incentives leading to short return on investment (largest ever ETO grant at the time)

Introduction to FOG (2015)

- Dose FOG to Digester to increase Biogas
- Use biogas to produce electricity and heat
- Collect tipping fees to cover costs of service

FOG Processing and Feeding

- Receiving
- Rock Trap
- Grinder
- Pumping
- Heating
- Storage
- Digester Feed




FOG Waste Feed
Pump #1

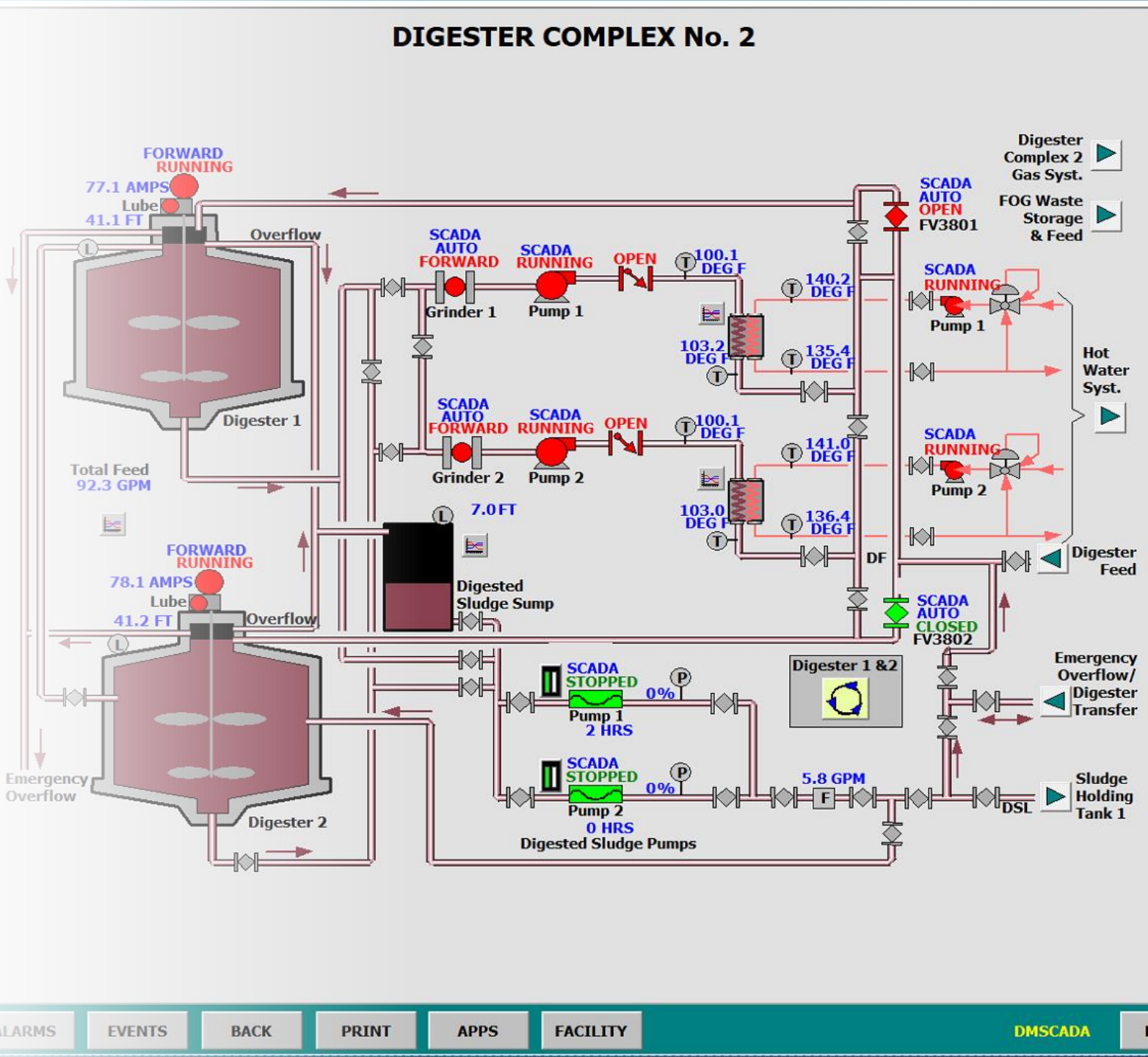

LOBELINE


IPEC

Digestion at Durham

Two 1.3 MG Digesters

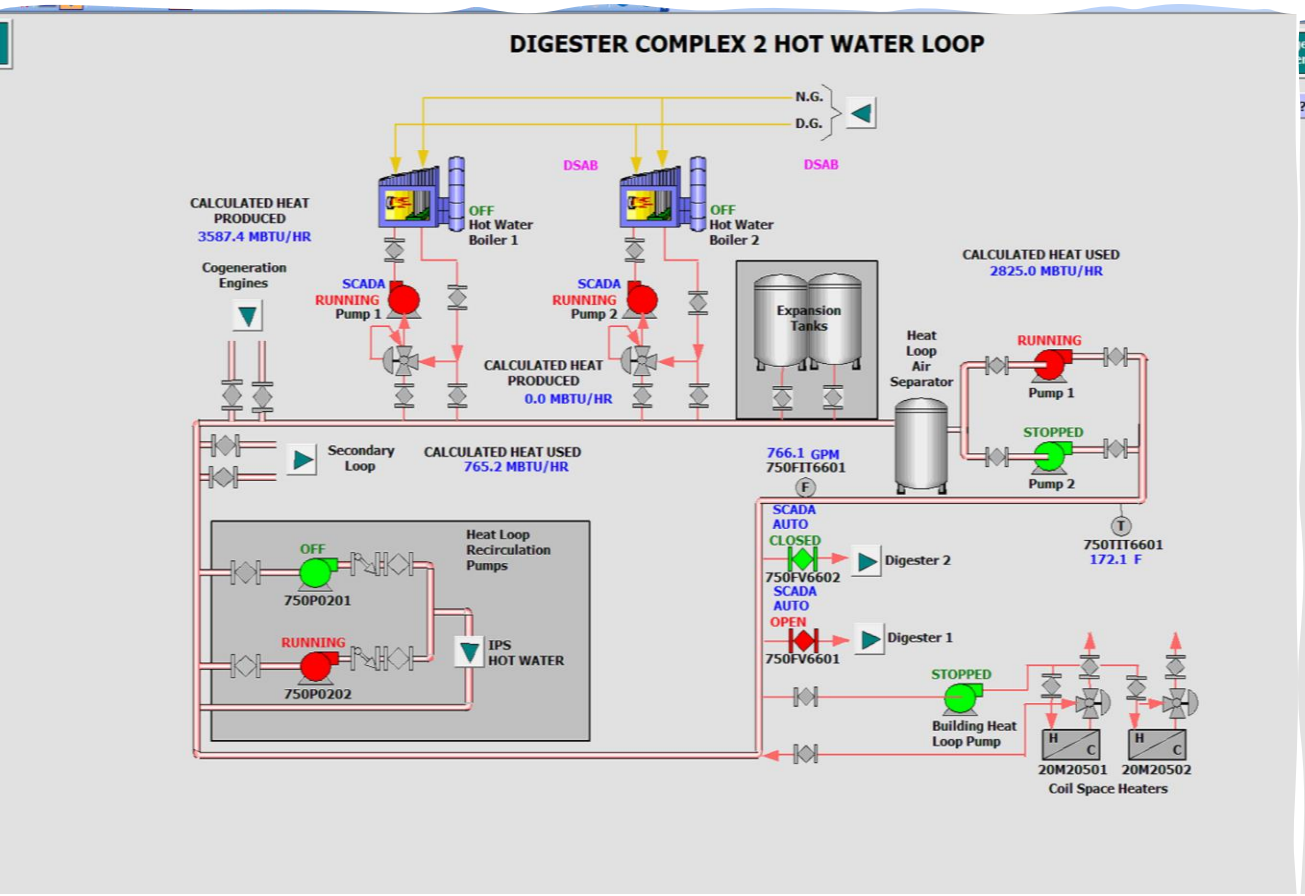
- Mesophilic
  - Run at 100 degrees F
  - Ran in parallel
- Digester Feed ratio (Lbs)
  - 29% FOG
  - 36% WAS
  - 35% Primary
- Gas Production
  - 2014 daily avg 339,356 SCF
  - 2023 daily avg 691,529 SCF

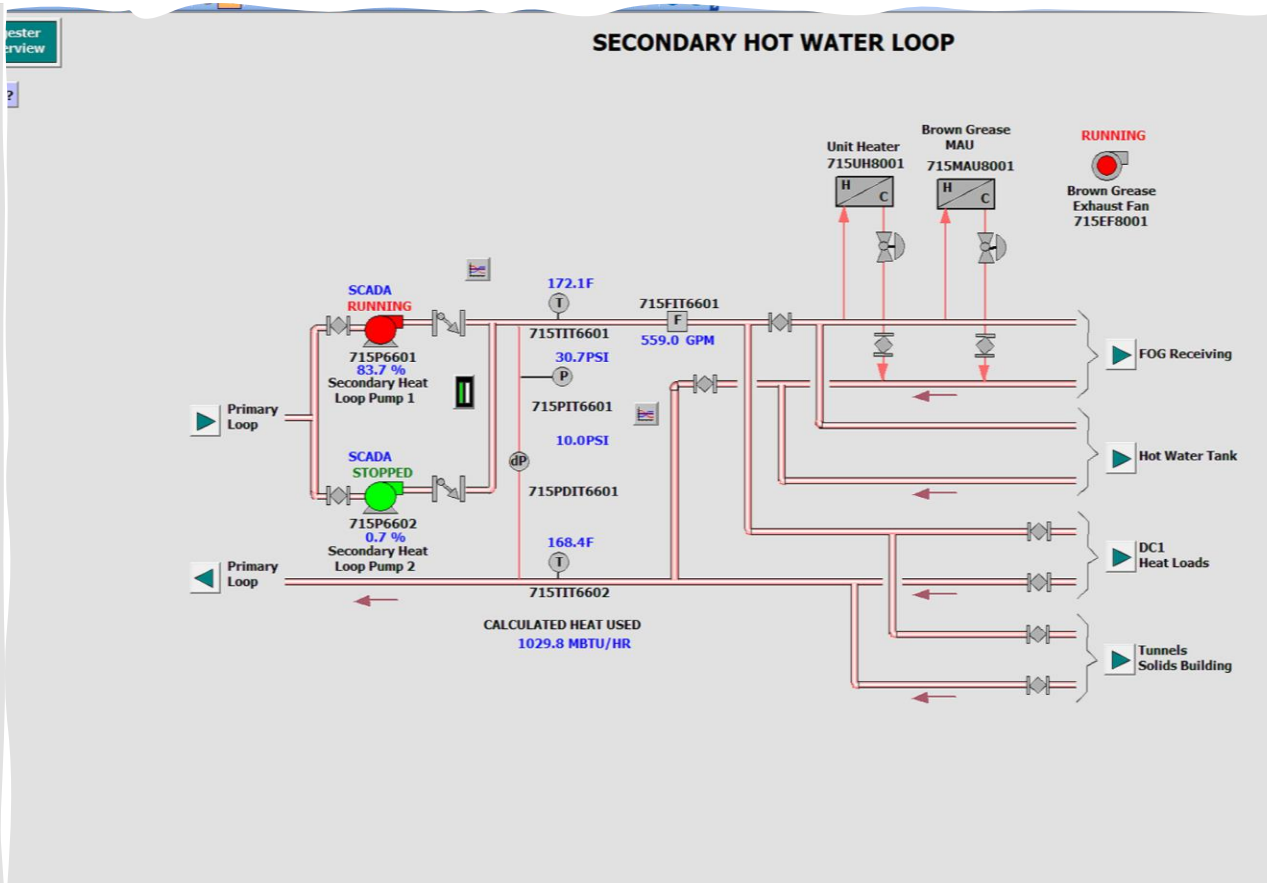


Jenbacher Engines

- 39 Liter V16 Engine with 1200 Horsepower
- 848kW
- Durham Facility has 2 of them

Heat Loop


DIGESTER COMPLEX 2 HOT WATER LOOP
N.G.
D.G.
DSAB
DSAB
CALCULATED HEAT PRODUCED
3587.4 MBTU/HR
OFF
Hot Water Boiler 1
OFF
Hot Water Boiler 2
Cogeneration Engines
SCADA
RUNNING
Pump 1
SCADA
RUNNING
Pump 2
CALCULATED HEAT PRODUCED
0.0 MBTU/HR
Expansion Tanks
CALCULATED HEAT USED
2825.0 MBTU/HR
Heat Loop Air Separator
RUNNING
Pump 1
STOPPED
Pump 2
Secondary Loop
CALCULATED HEAT USED
765.2 MBTU/HR
766.1 GPM
750FIT6601
750TIT6601
172.1 F
SCADA
AUTO
CLOSED
750FV6602
Digester 2
SCADA
AUTO
OPEN
750FV6601
Digester 1
Heat Loop Recirculation Pumps
OFF
750P0201
RUNNING
750P0202
IPS HOT WATER
STOPPED
Building Heat Loop Pump
20M20501
20M20502
Coil Space Heaters


SECONDARY HOT WATER LOOP
Unit Heater
715UH8001
Brown Grease
MAU
715MAU8001
RUNNING
Brown Grease
Exhaust Fan
715EF8001
SCADA
RUNNING
715P6601
83.7 %
Secondary Heat
Loop Pump 1
172.1F
715TIT6601
715FIT6601
559.0 GPM
30.7PSI
715PIT6601
10.0PSI
715PDIT6601
Primary Loop
SCADA
STOPPED
715P6602
0.7 %
Secondary Heat
Loop Pump 2
168.4F
715TIT6602
Primary Loop
CALCULATED HEAT USED
1029.8 MBTU/HR
FOG Receiving
Hot Water Tank
DC1
Heat Loads
Tunnels
Solids Building

Heat Loop Uses

DIGESTER HEATING

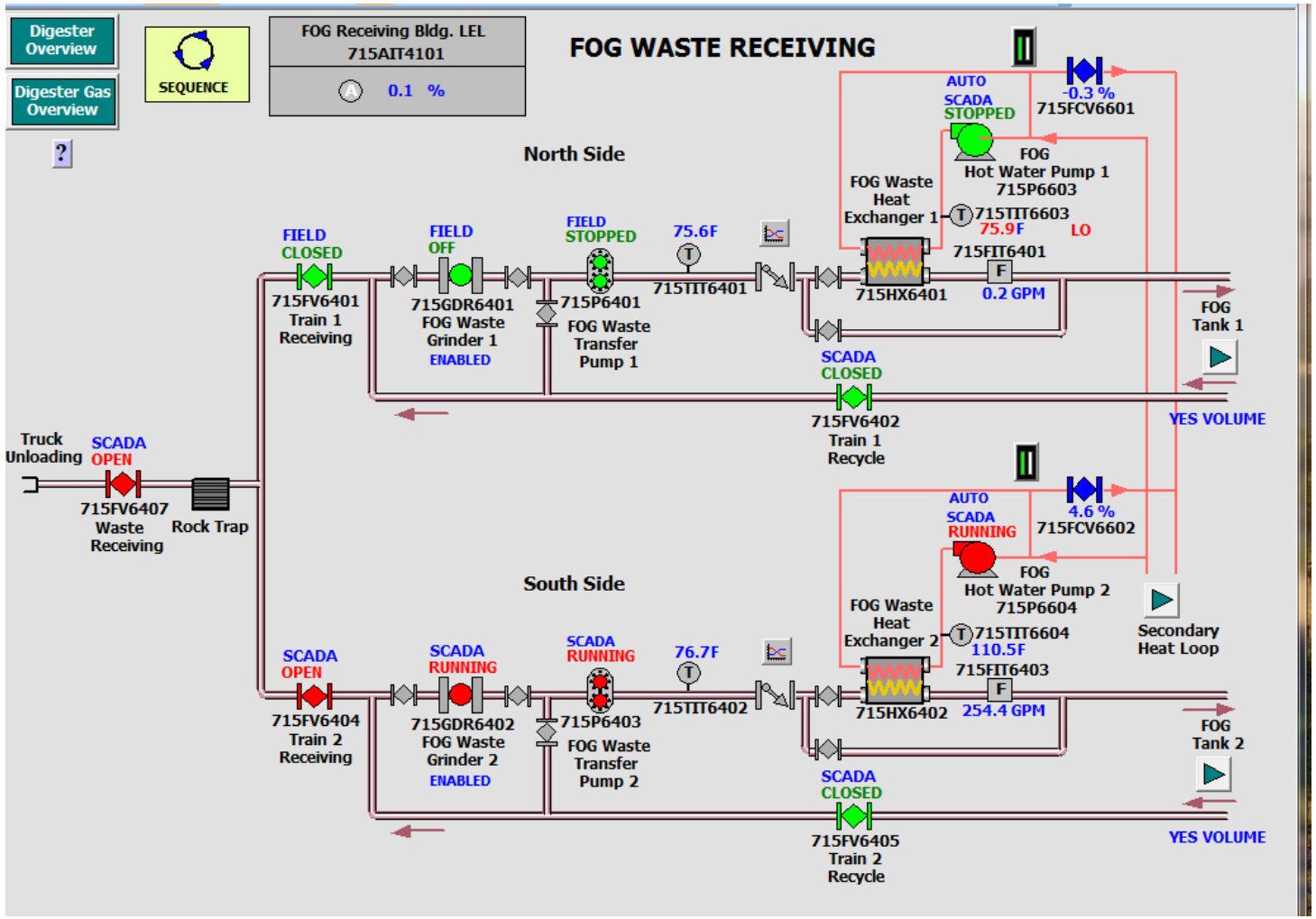
PRIMARY SLUDGE HEATING

HOT WATER FOR GREASE CLEANING AT FOG, GRAVITY THICKENERS

BUILDING HEAT

Operational Strategies

- Schedule deliveries weekly
- Operations slowly adjusts dosing to the digester to prevent upsets
- 2x daily hot water flushing of feed lines prevents clogging
- Gas production monitored for real time strength.

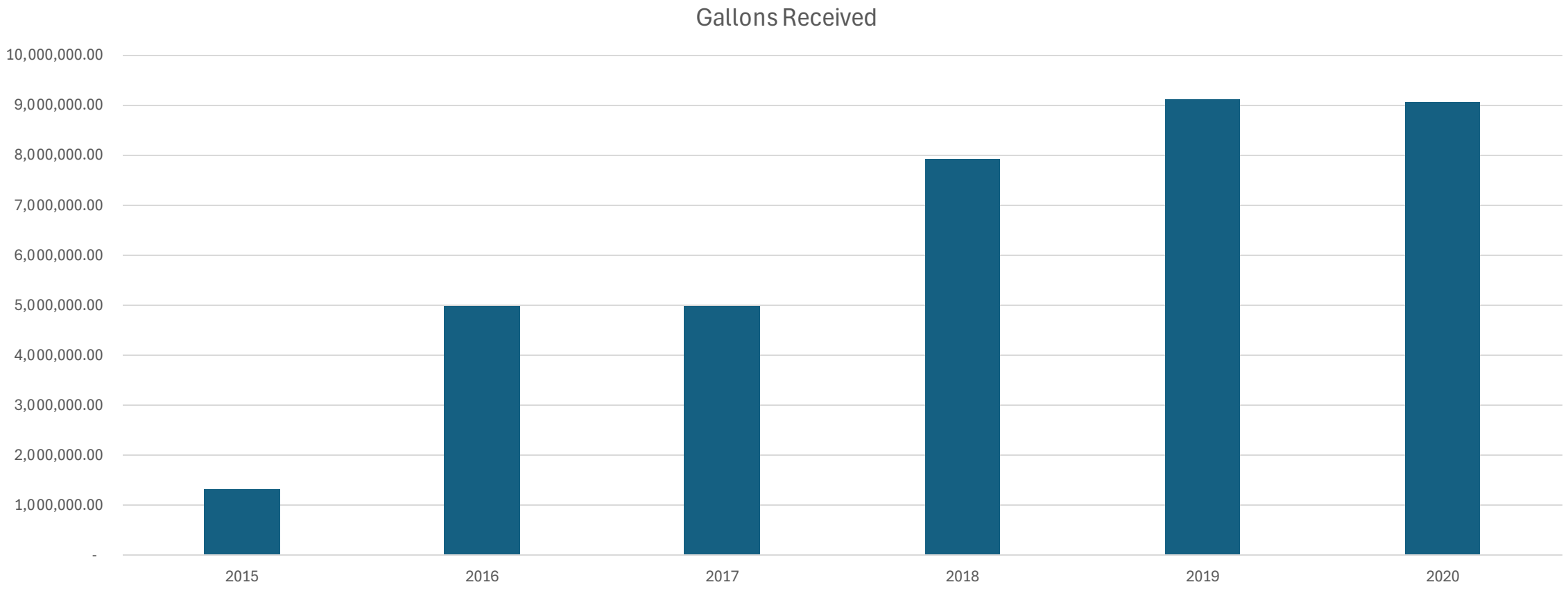


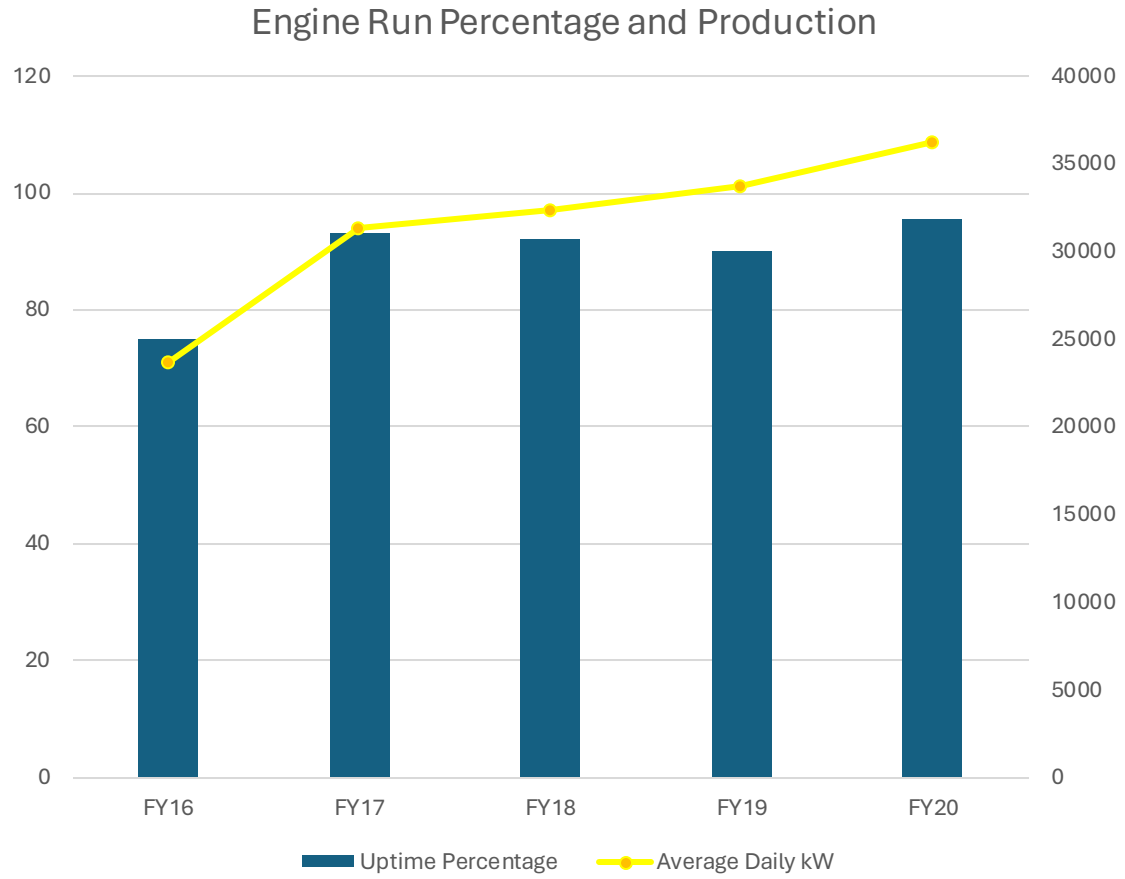
FOG Hauler Contracts

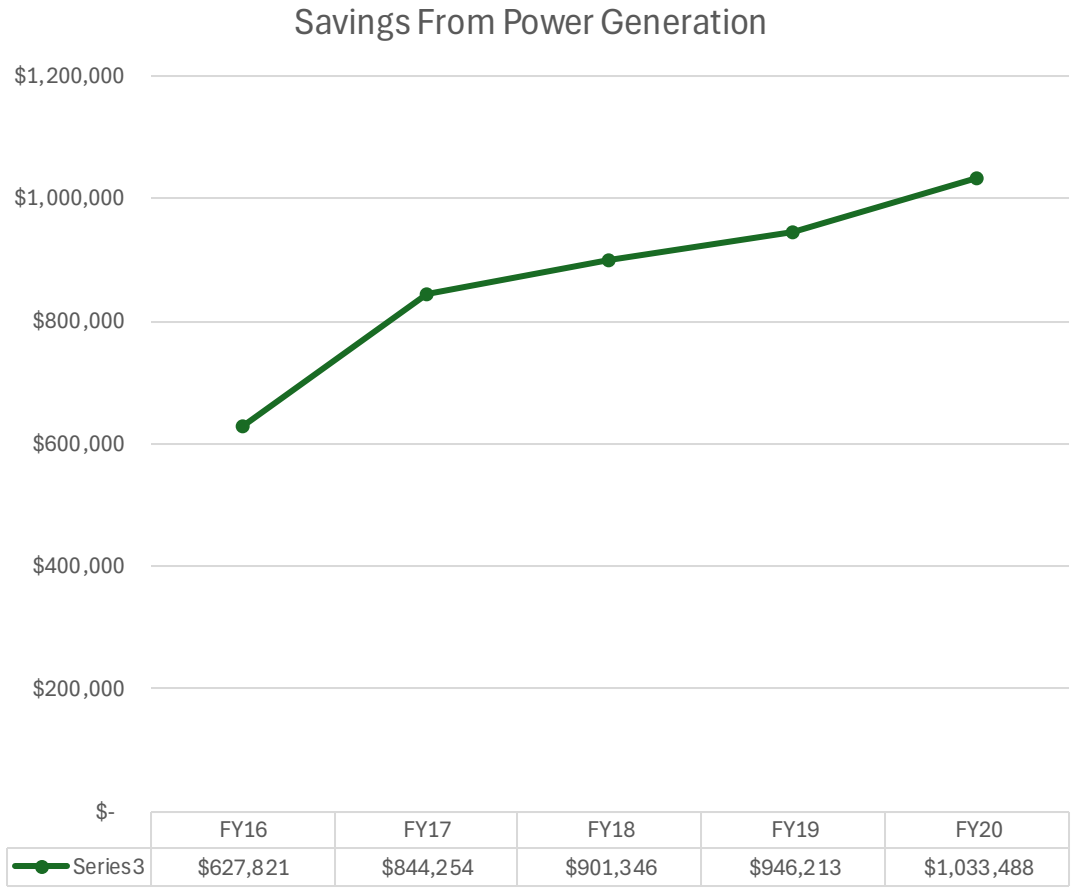
- CWS issued RFPs to FOG haulers to proposed tipping fees for 3-year contract
- 6 fog haulers use the facility and pay $0.07/gal on average
- Required pre-screening (3/8”) of FOG
- Offered $0.01 discount for matching projected vs actual delivery volume (+/- 10%)
- Limitations on “hot” fog (x2)

Experiences with FOG
The Good

Growth over time

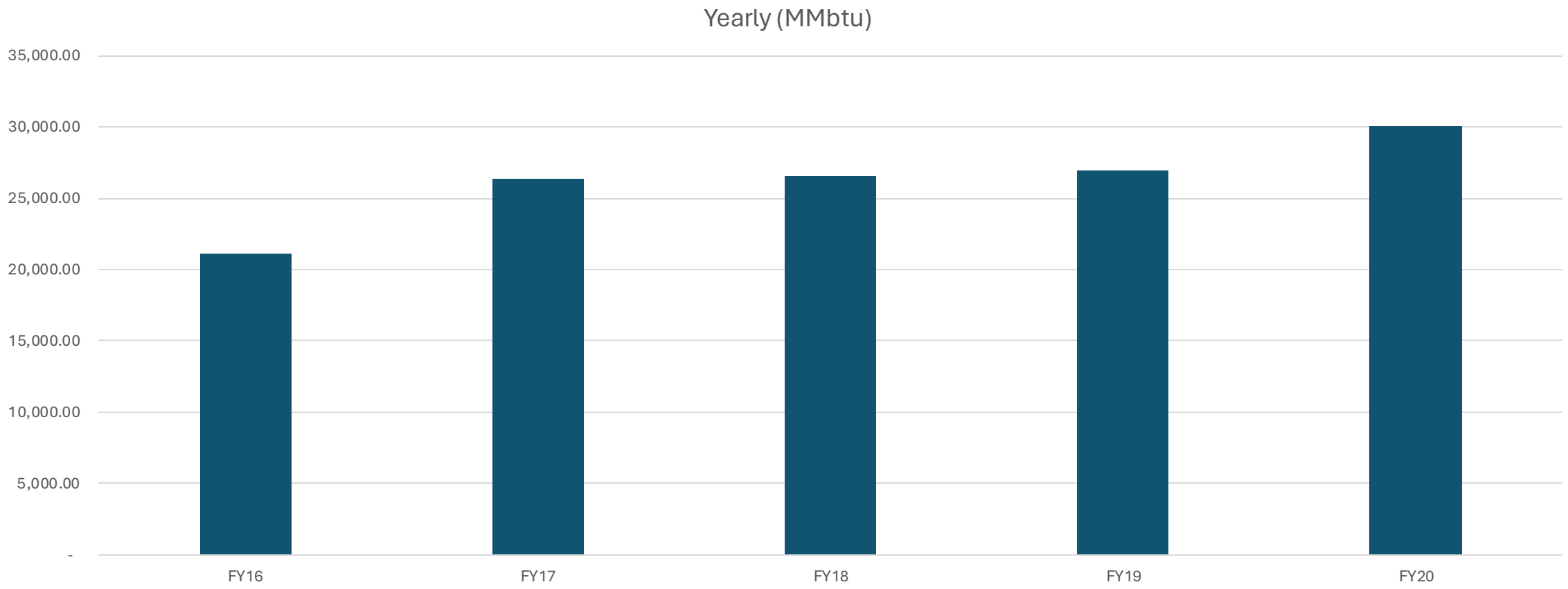






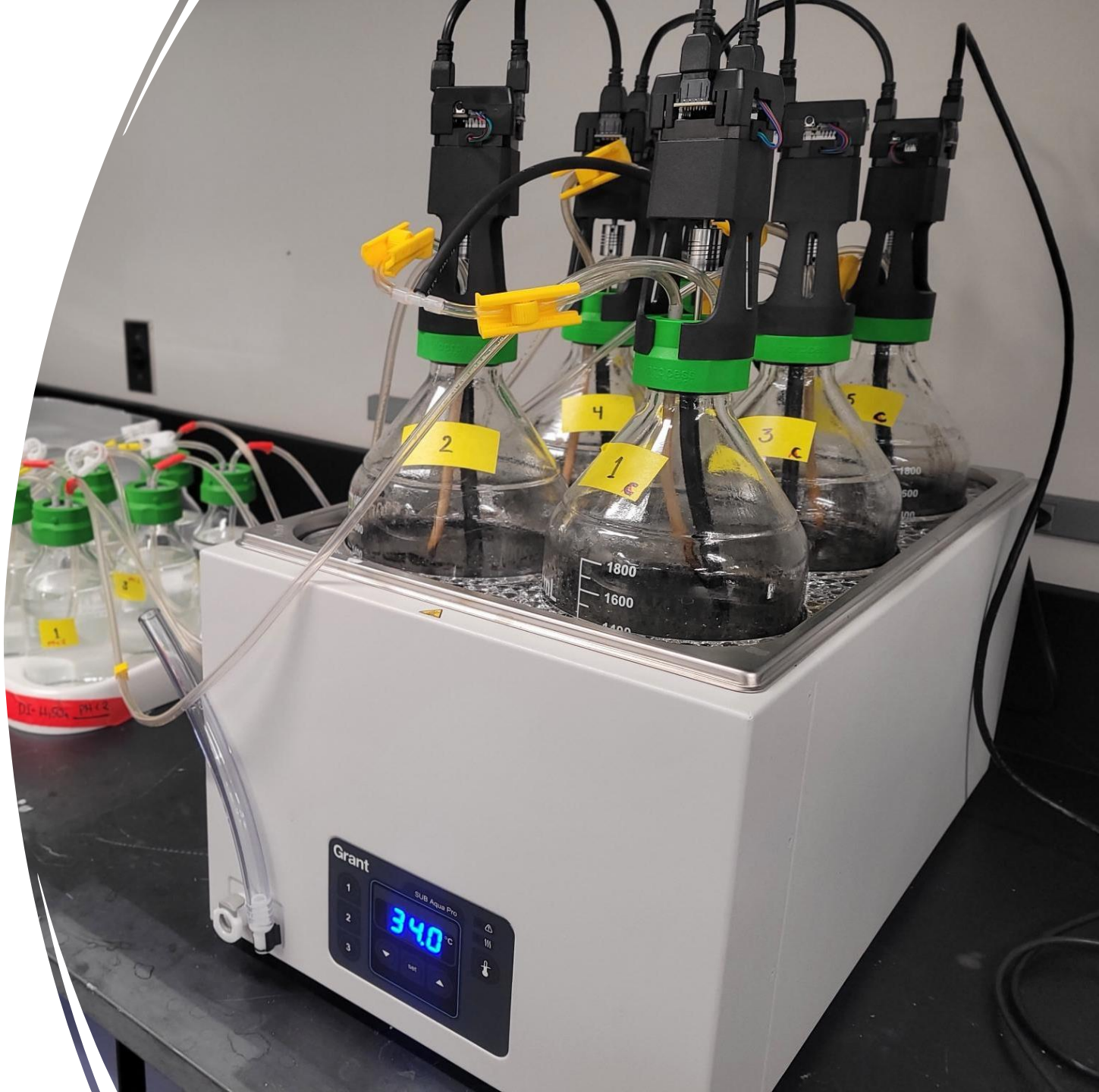
Engine Run time and Production

Heat Loop Generation

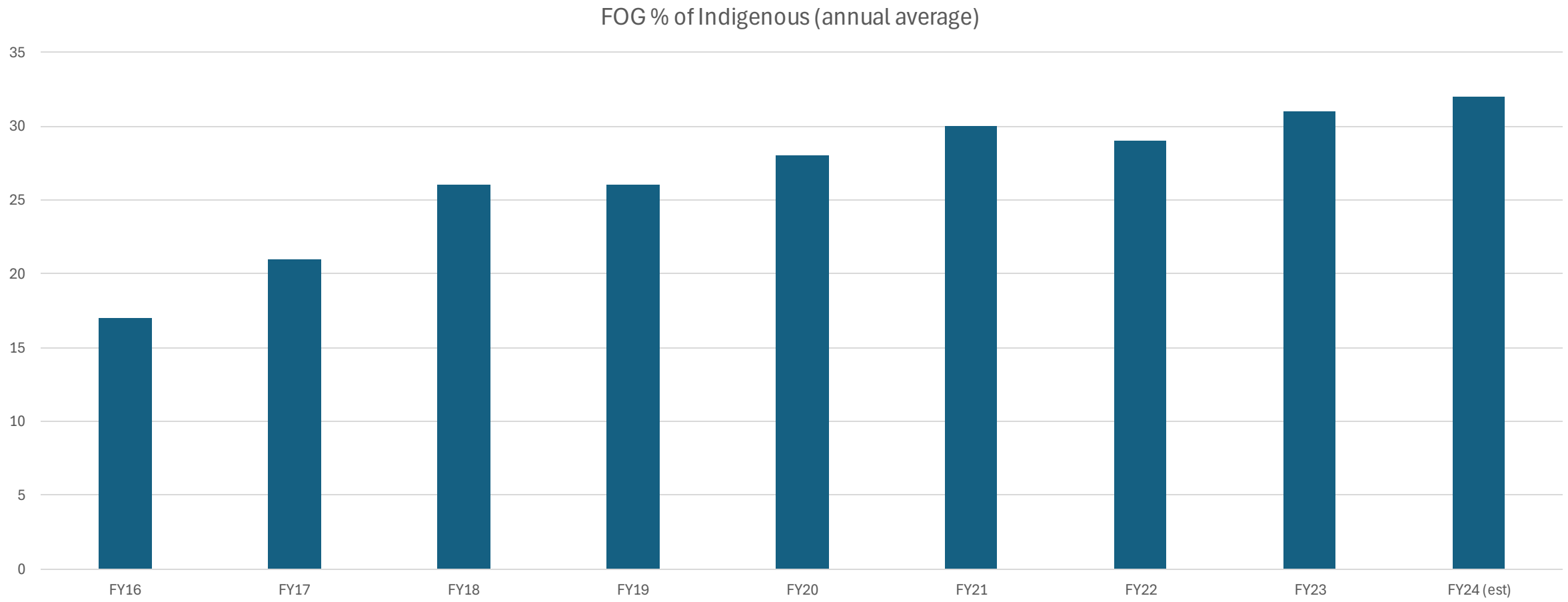


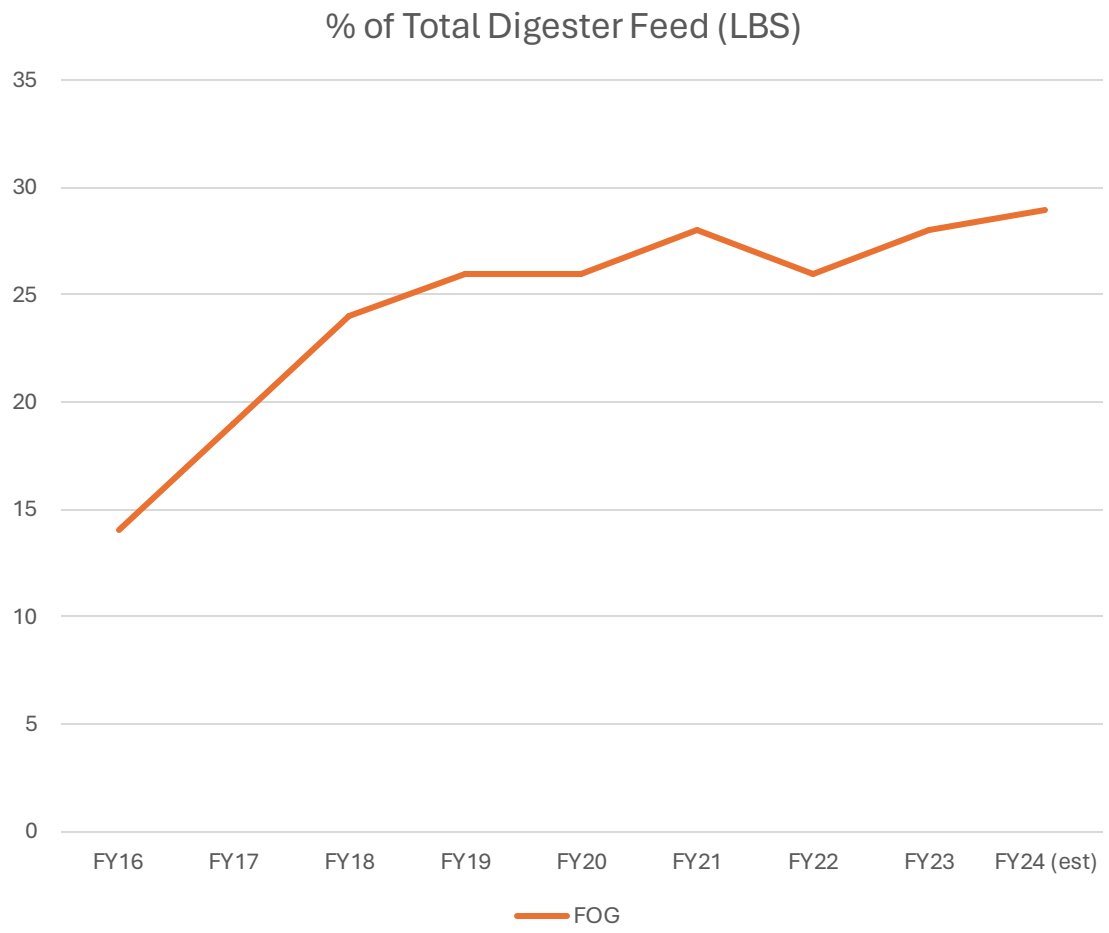
Digester Stability

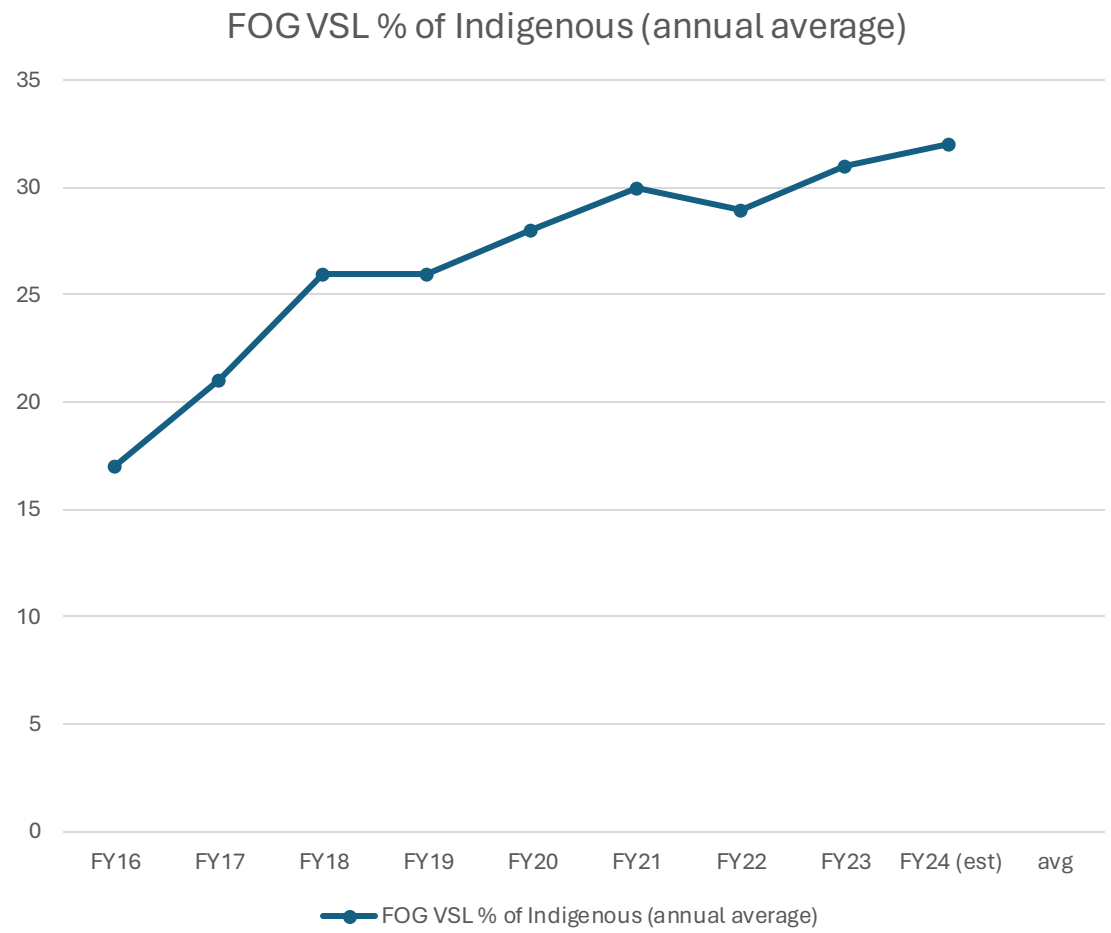
- More resilience shown on in house stability tests
- Have increased %FOG over industry standards without issue.
- Increase in FOG % ratio over time graph insert



Increased Dosing over time







Relationship to overall Feedstocks

Experiences with FOG
The Bad

Grit Management

- Significant grit in influent
- Failed coating at concrete and created more grit
- Wear on all mechanical equipment
- Accumulation in digester
- Confined space entry to remove grit manually

Equipment failures

- Valves/Check Valves
- Rock Trap
- Storage Tanks
- FOG Receiving Pumps (Rotary Lobe)
- Feed Pumps (Pro CAV)
- Tank Mixer
- Heat Exchanger
- Odor Control
- Flow Meter
- Feed Lines
- Digester Gas water seals
- Lack of ability to enforce rules

Durham WRRF –Experiences with FOG

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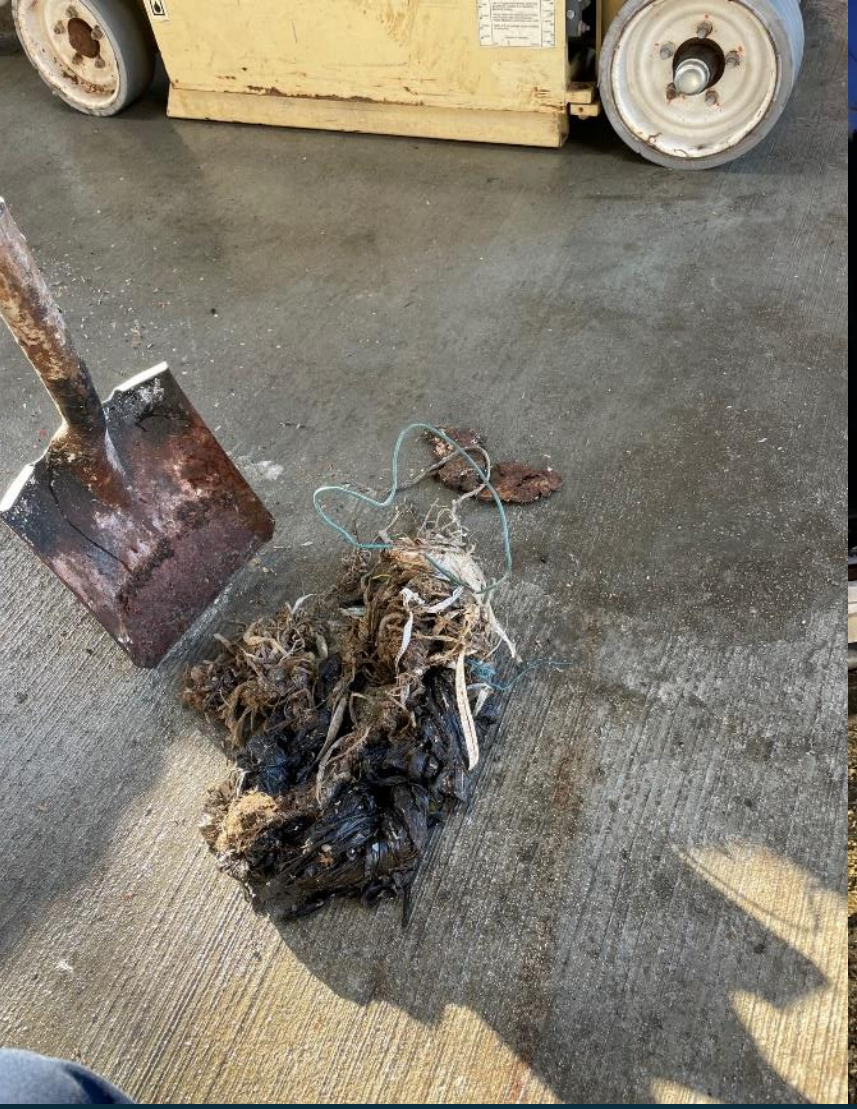


Durham WRRF –Experiences with FOG

Hauler Management

- Contract enforcement
- Challenging to coordinate deliveries with demand
- Following offloading SOPs
- Metering for Billing
- Equipment damage
- Communication

Strains on Staff Morale

- Constant clean-up efforts
- Adjustments to feed
- Failing equipment
- Out of specification FOG
- Time spent at Facility

Durham Facility – Improvement needed!

Improvements with FOG

Innovation!

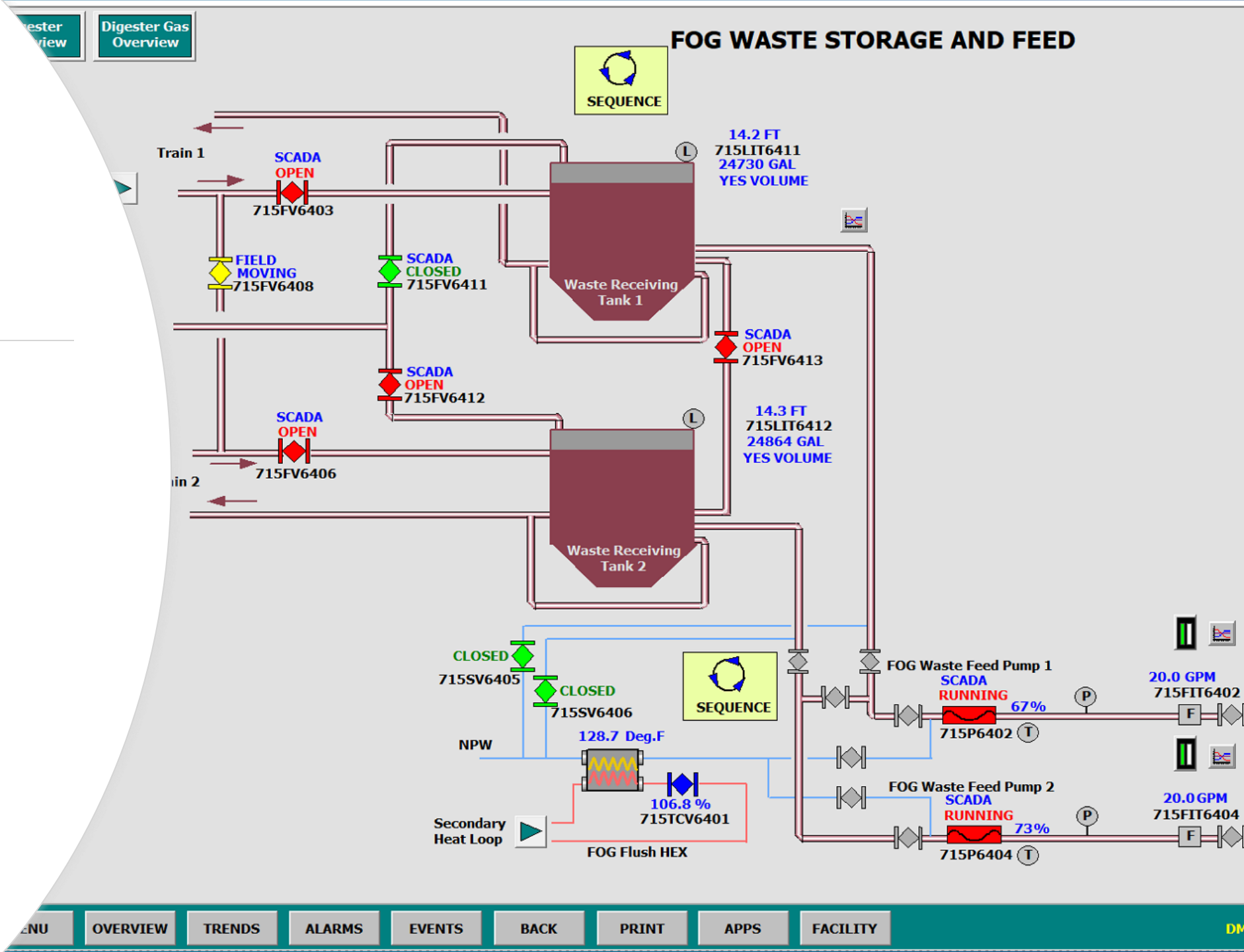
- Screening
- Grit removal
- Valve replacements
- Piping pathways
- Gas system
- Staffing/Management
- Training and SOPs
- Billing method
- More contracts

Grit and Large Debris Removal

Improvements with FOG

More Operational Capacity

- Original- 44,000 gallons
- New- 52,000 gallons



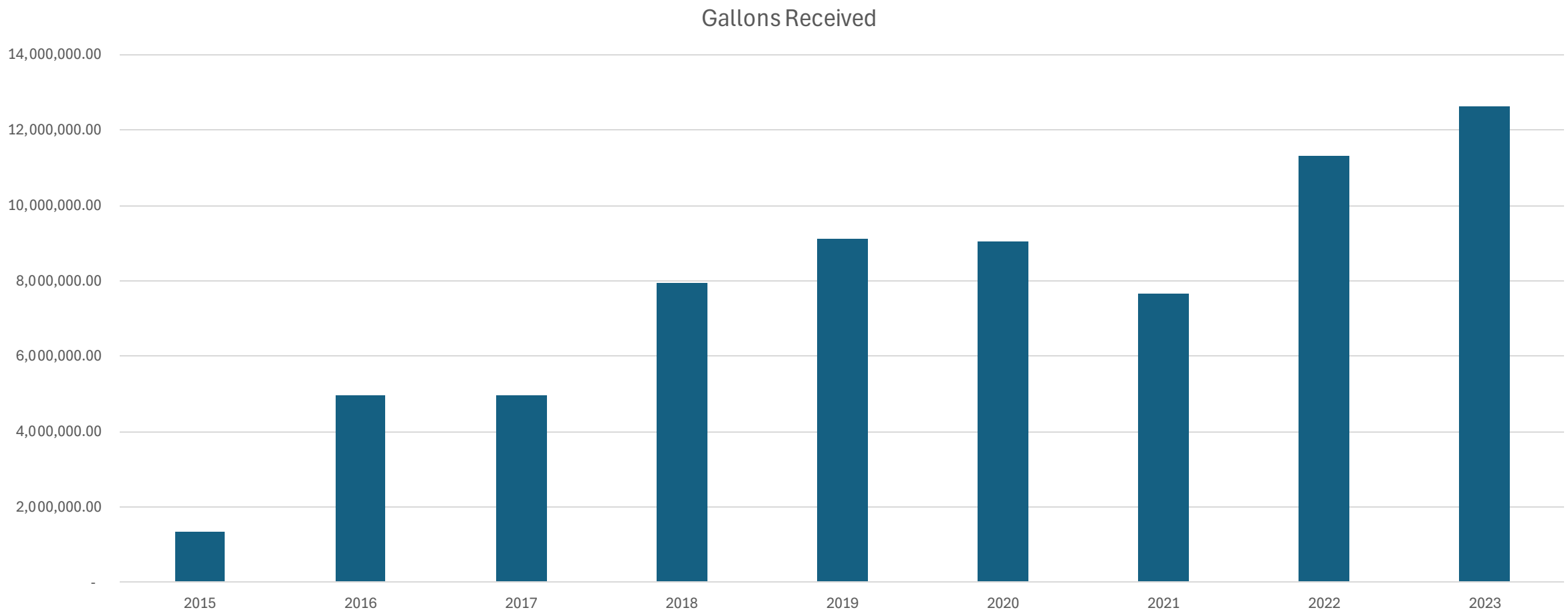
Hauler Management

- Increased # of suppliers
- Weekend rate discount
- Billing by truck capacity
- Hauled waste attendant

Improvements/New Challenges

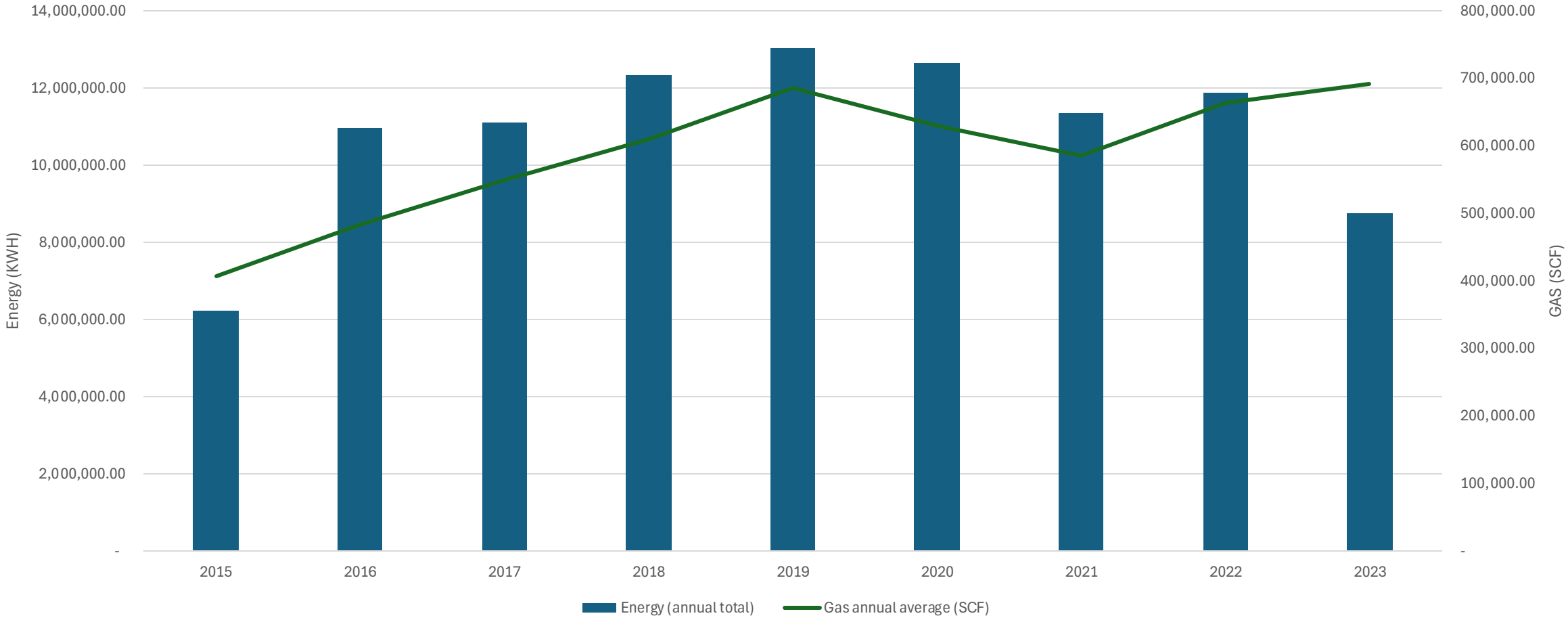
Screening



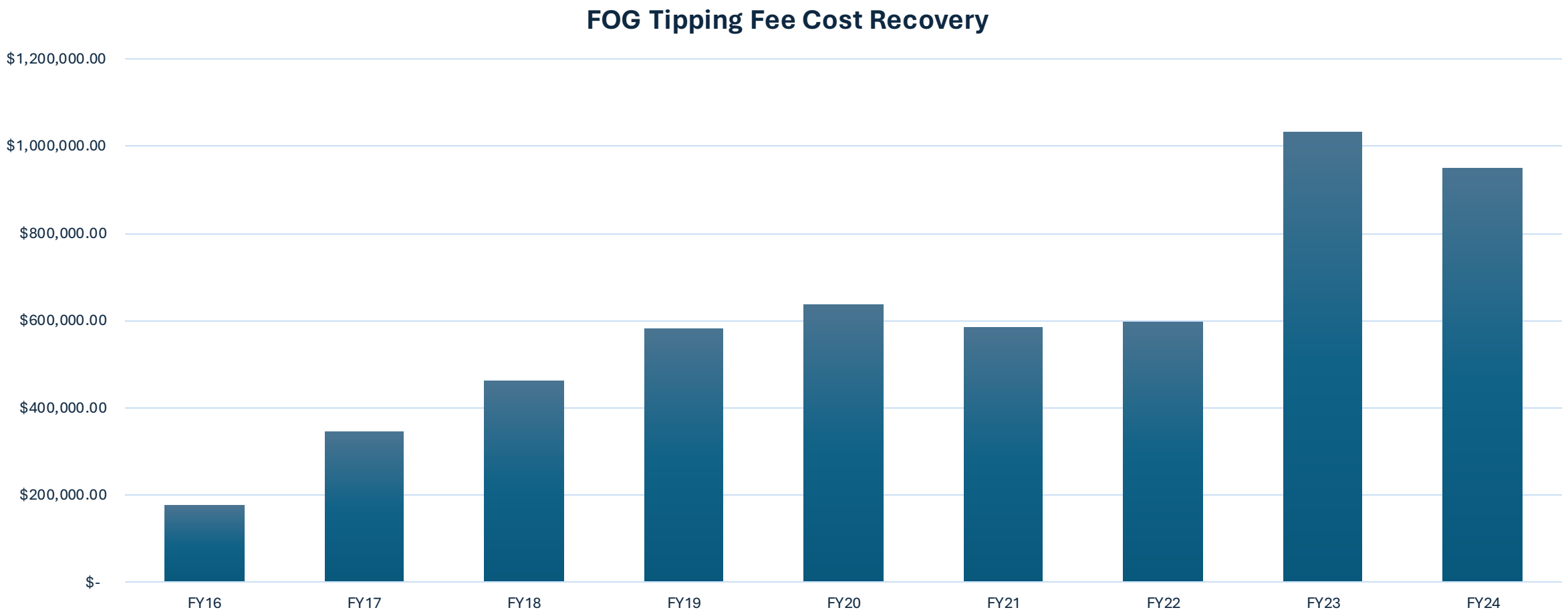



FOG Gallons Received

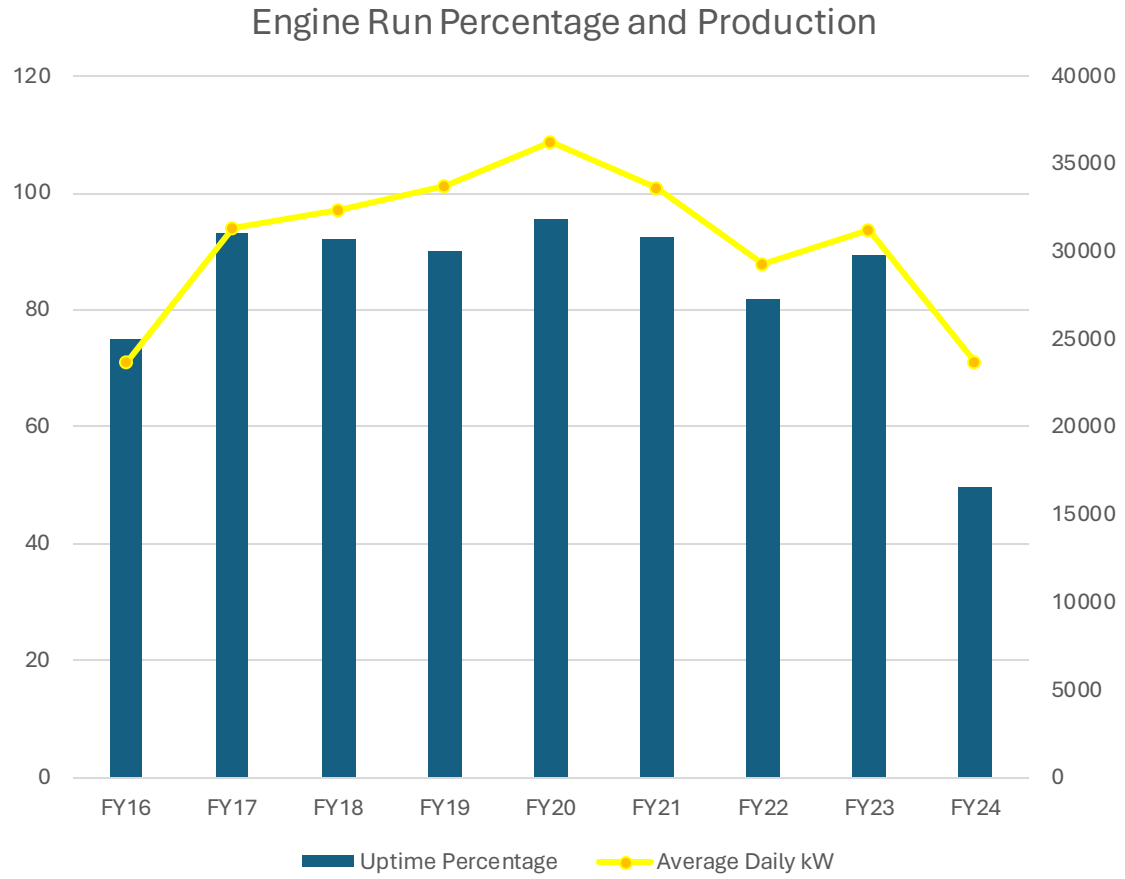
Yearly totals

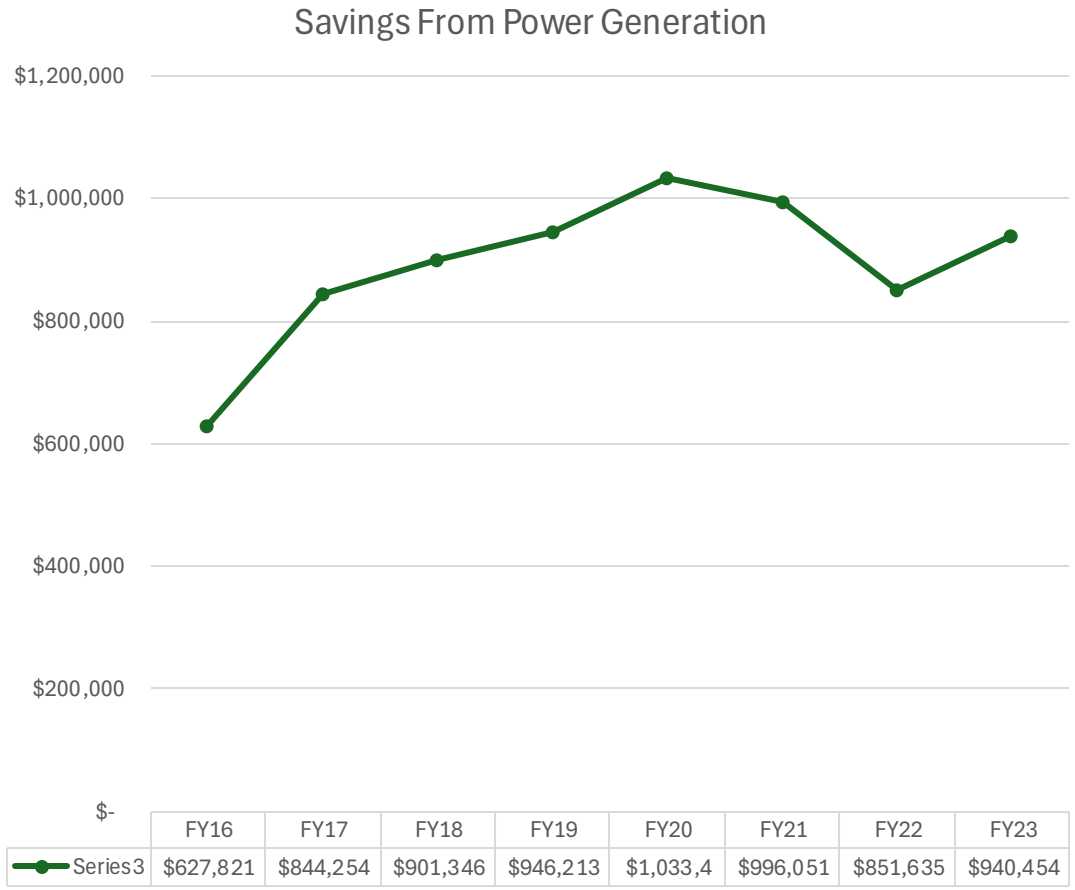


Durham WRRF –Experiences with FOG



What are the benefits?





Engine Run time and Production

Still to come

- Trial of new offloading pump materials
- Increased hot water capacity

Durham WRRF – Experiences with FOG

- FOG
  - High value!
  - High investment!

Takeaways

HIGH VALUE/HIGH INVESTMENT

DON’T GO CHEAP

SERVE COMMUNITY

TURN WASTE INTO RESOURCES

INCREASE DIGESTER STABILITY

Thank you

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