The City of Raleigh's Bioenergy Recovery Project: *THP Process Update at NRRRF*

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Raleigh Water

LNBA / NRCA 2022 WWTP Operators Training Workshop

August 2nd and 4th, 2022

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Bioenergy Recovery Project at NRRRF

- Comprehensive biosolids upgrade project
- Converting to advanced anaerobic digestion process with Thermal Hydrolysis Pretreatment (THP)
  - Includes biogas utilization
  - Move towards energy neutrality
  - Class A biosolids process

Presentation Outline

- Background
- Bioenergy Recovery Project Overview and Project Drivers
- Walk through of Biosolids Process / Proposed Improvements
- Biogas Utilization Overview
- Project Benefits
- Project Schedule / Status
- Transition Planning
- Construction Updates

Introduction / Background

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Neuse River RRF

- 75 mgd permitted capacity
- Advanced nutrient removal
- Centralized biosolids processing
- Historical management options:
  - Aerobic digestion → Class B liquid
  - Lime stabilization → Class A cake
  - Off-site Composting

Bioenergy Recovery Project Overview and Drivers

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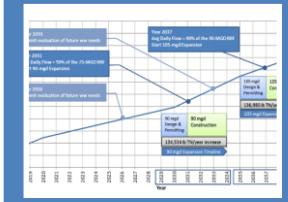
Bioenergy Recovery Project Drivers

Provide resilient and reliable biosolids management solution

- Address aging biosolids handling infrastructure
- Address uncertainty of future Class B land application



Plan for future capacity needs

- Service area flows projected to double by 2040
- Plan for long term service area biosolids needs through 2040 and beyond

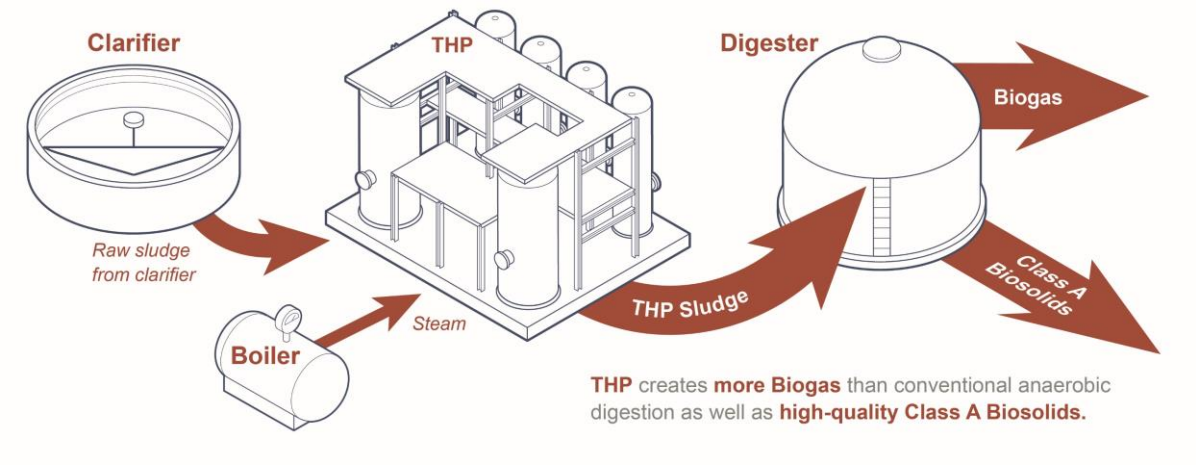
Sustainable solution for the future

- Sustainability and efficiency is a core focus of the City of Raleigh's strategic plan
- Reduce energy, chemical, and hauling demands by converting to anaerobic digestion

New Process Uses Innovative Technology for Advanced Anaerobic Digestion

Thermal Hydrolysis Process (THP)" acts as "pressure cooker" to condition solids for enhanced digestion

- *Achieves more solids reduction*
- *Generates more biogas*
- *Pasteurizes solids*



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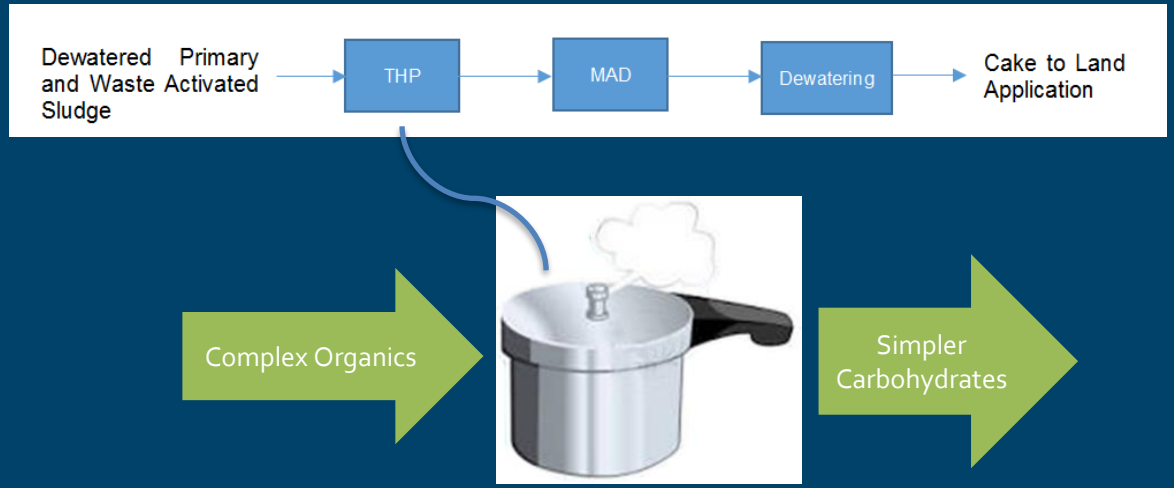


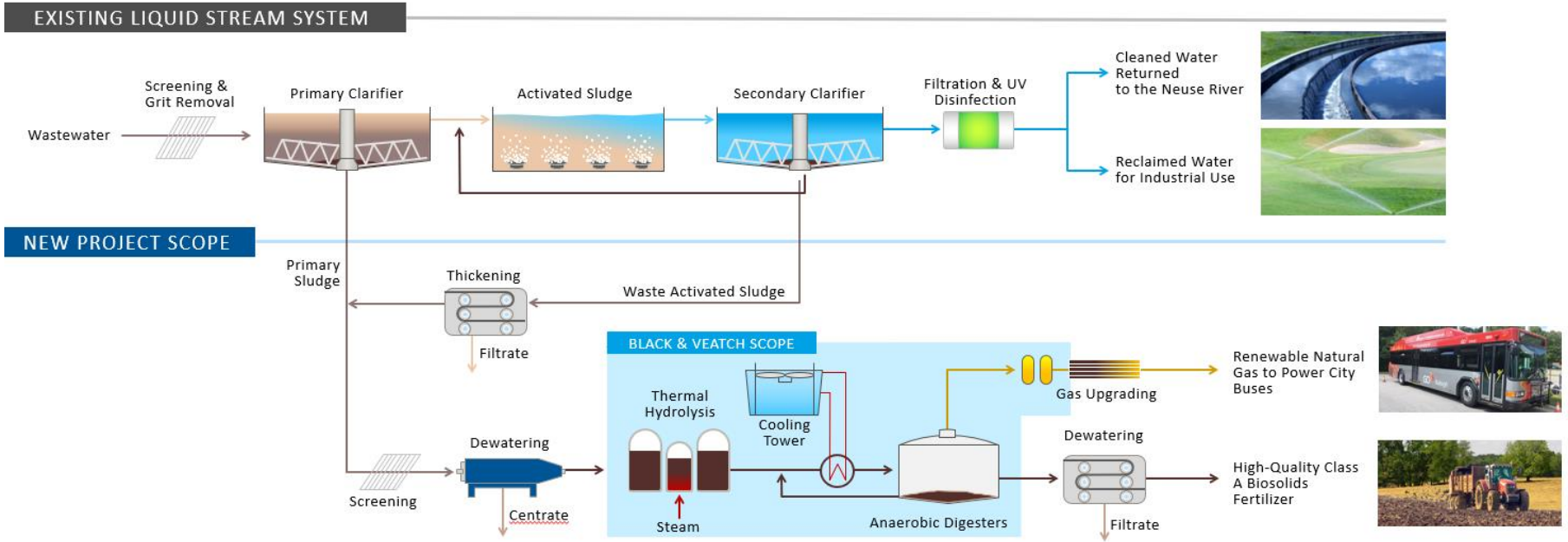
Benefits of THP

Anaerobic digester volume ↓	Capital Cost ↓
Biogas production ↑	Revenue ↑
Volatile solids reduction ↑ and dry mass ↓	Hauling Cost ↓
Final cake solids ↑	Hauling Cost ↓
Low odor, Class A product	Public Health ↑ Environment ↑

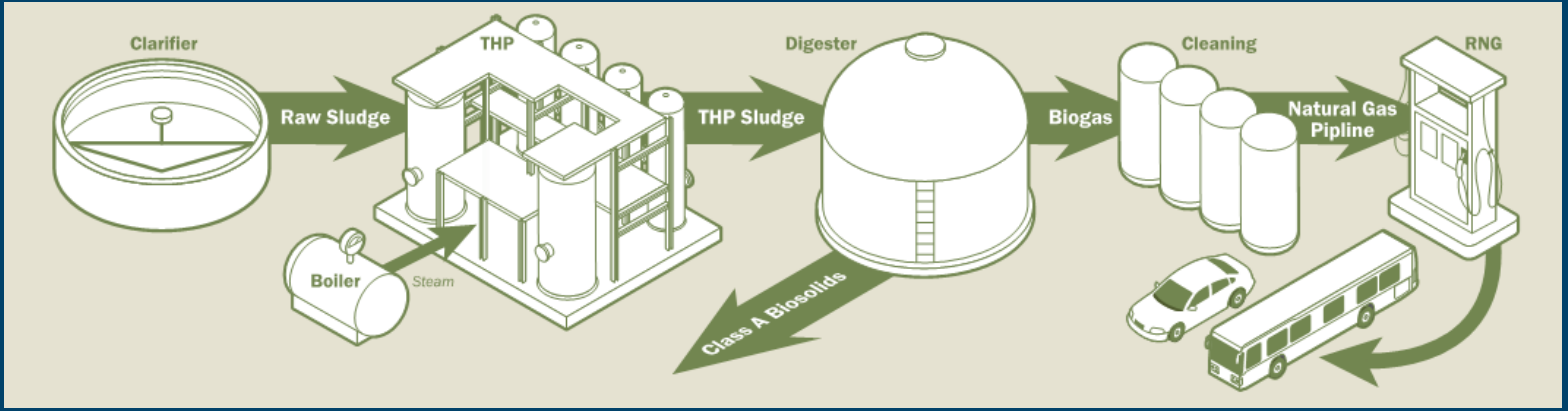
Additional THP Considerations

- Stronger side stream (N, P, and COD)
  - Sidestream deammonification system planned
  - Planned small increase in rDON
- Increased system complexity
- Potential impacts to UVT

Proposed Biosolids Process



New Process Produces Reusable Biogas and Biosolids



- Biogas will be converted into Renewable Natural Gas (RNG)
  - Plan to use as fuel for the City's Go Raleigh Bus Fleet
  - Will fuel as many as 50 buses per day
- Produces high quality, low odor biosolids
  - Meets EPA's strictest standards for Class A biosolids
  - Will be beneficially reused as a soil conditioner

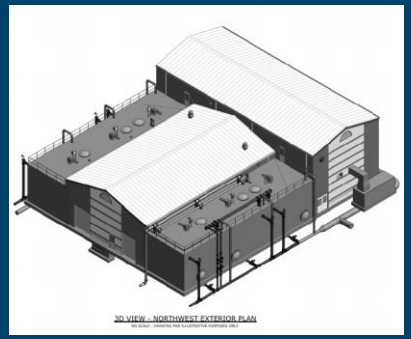
Visualization of New Residuals Handling Complex

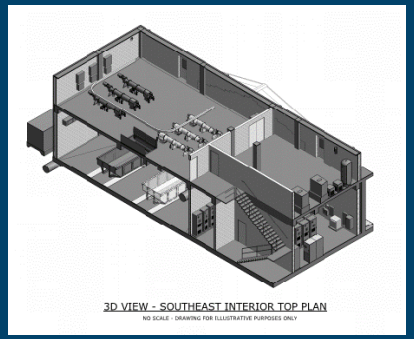
Visualization of New Residuals Handling Complex

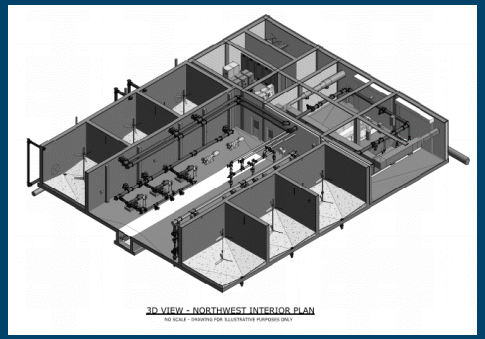
Key Components

- Reuse existing GBTs for WAS thickening
- Blended sludge screening
- Centrifuges for dewatering upstream of THP
- Single THP Train (184,000 dry lbs / day)
- Closed loop sludge cooling
- Two 2.2 MG mesophilic anaerobic digesters
- Clean gas to meet pipeline injection standards
- New BFPs + existing centrifuge for post dewatering

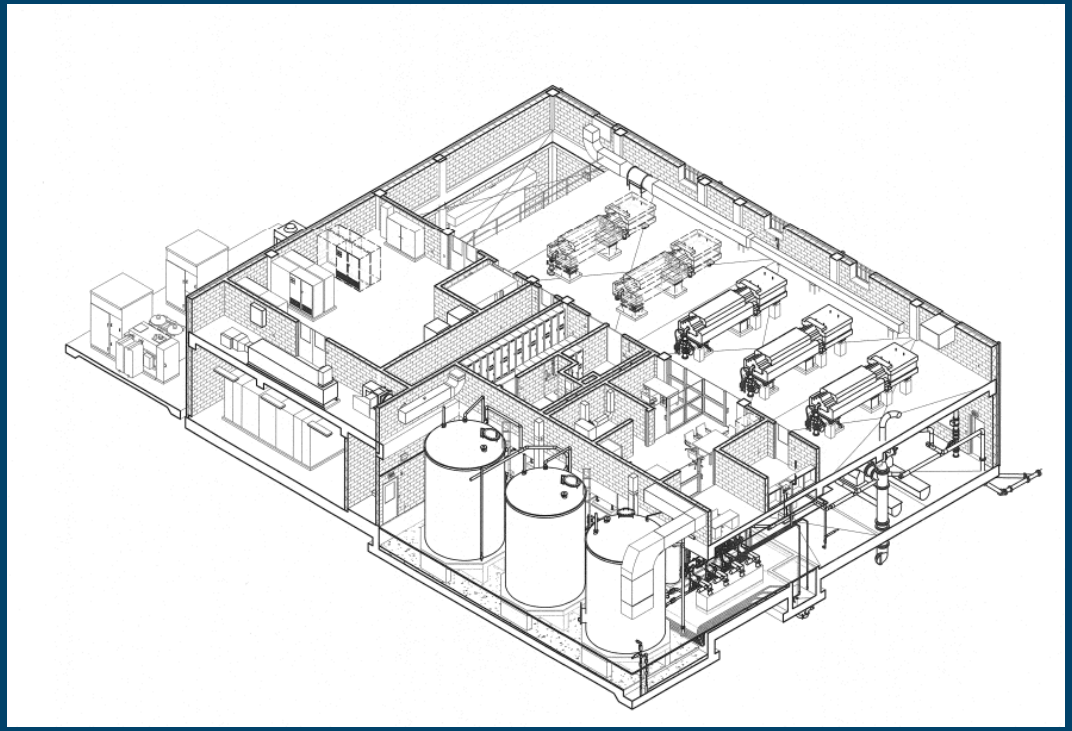
Sludge Screening



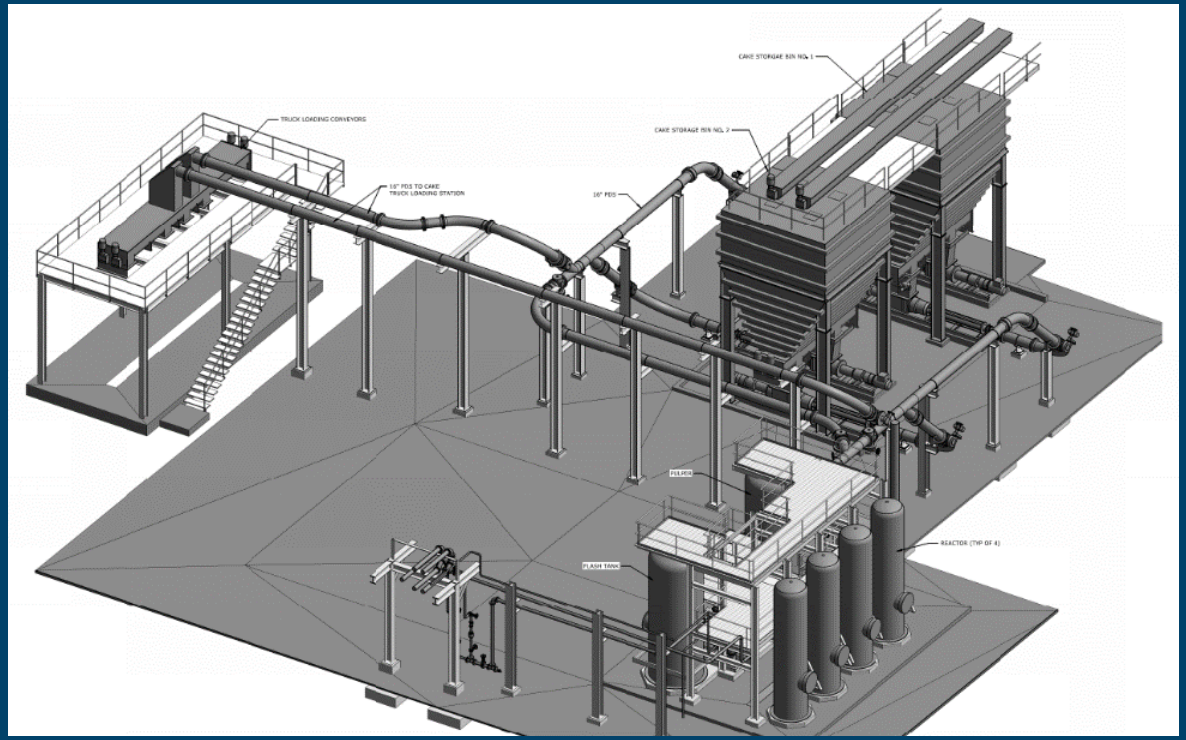




Pre-Dewatering Building Interior

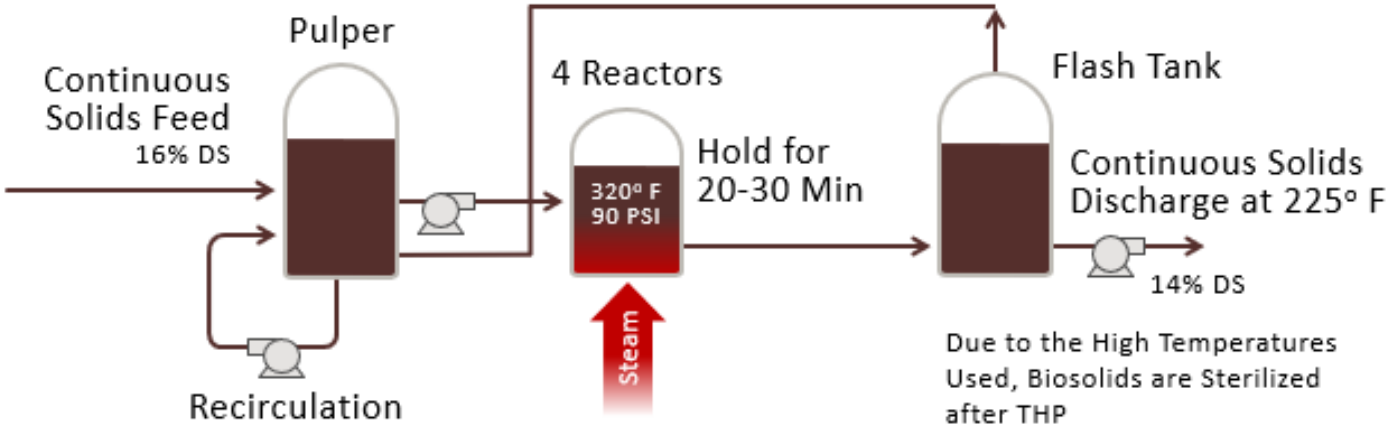


Cake Bins, Cake Load Out, THP

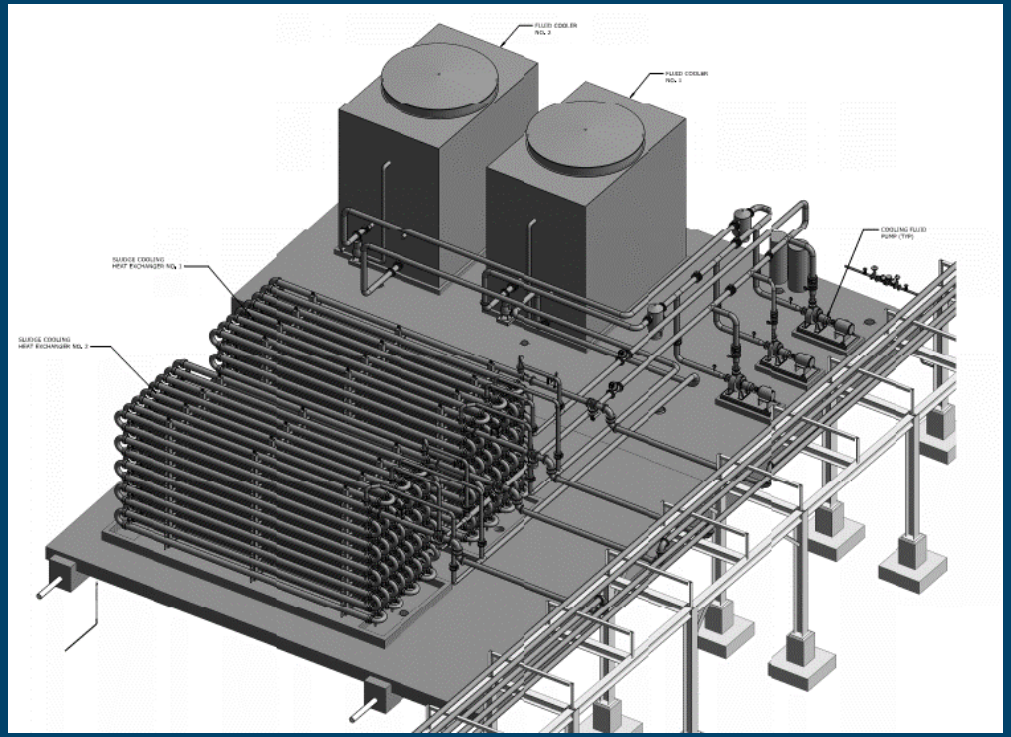


How does THP work?

How Does Thermal Hydrolysis Work?



Cooling of Digester Feed after THP



Anaerobic Digesters

Biogas Utilization Overview

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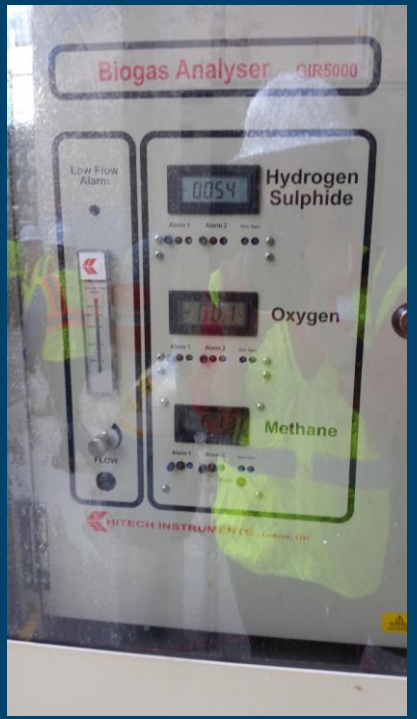
Biogas Components

- Methane (CH_4)
  - Typically 50 - 70% of biogas
- Carbon Dioxide (CO_2)
- Other constituents that also may need to be treated
  - Moisture
  - Hydrogen Sulfide (H_2S)
  - Siloxanes
  - VOCs



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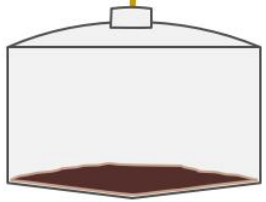


Anaerobic Digesters

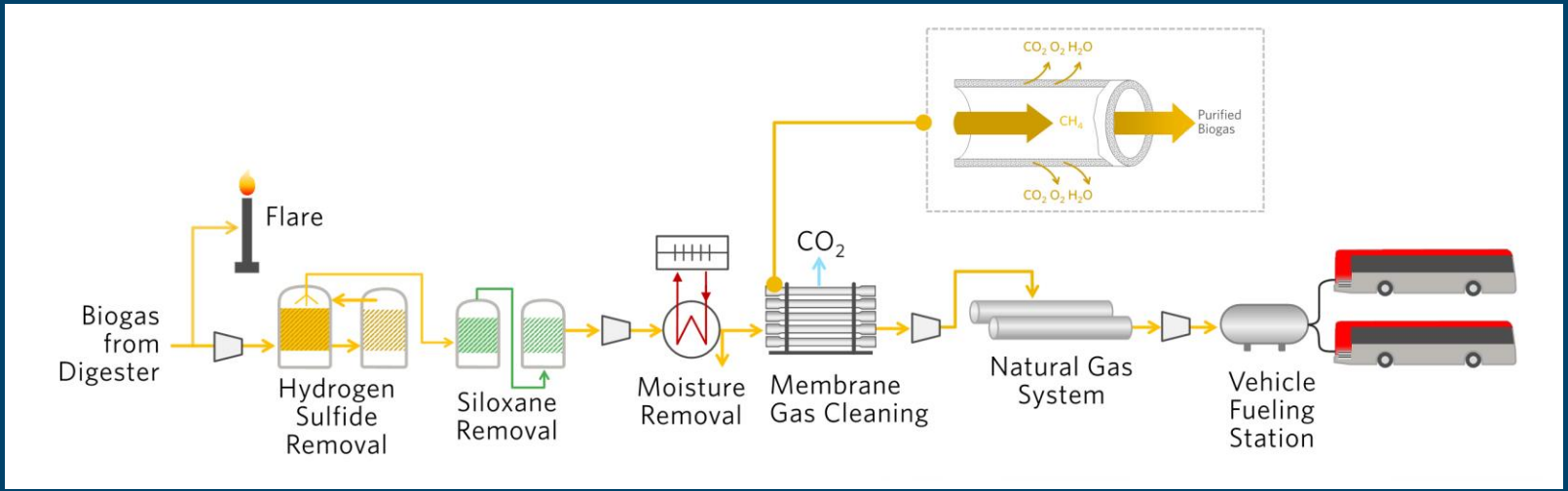
Gas Upgrading

Renewable Natural Gas to Power City Buses

What Does Biogas Upgrading Do?

- Removes impurities in biogas (hydrogen sulfide, water, siloxanes, carbon dioxide)
- Produces Renewable Natural Gas for injection into gas grid / use as vehicle fuel

Recommended Digester Gas Utilization Option



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Project Benefits

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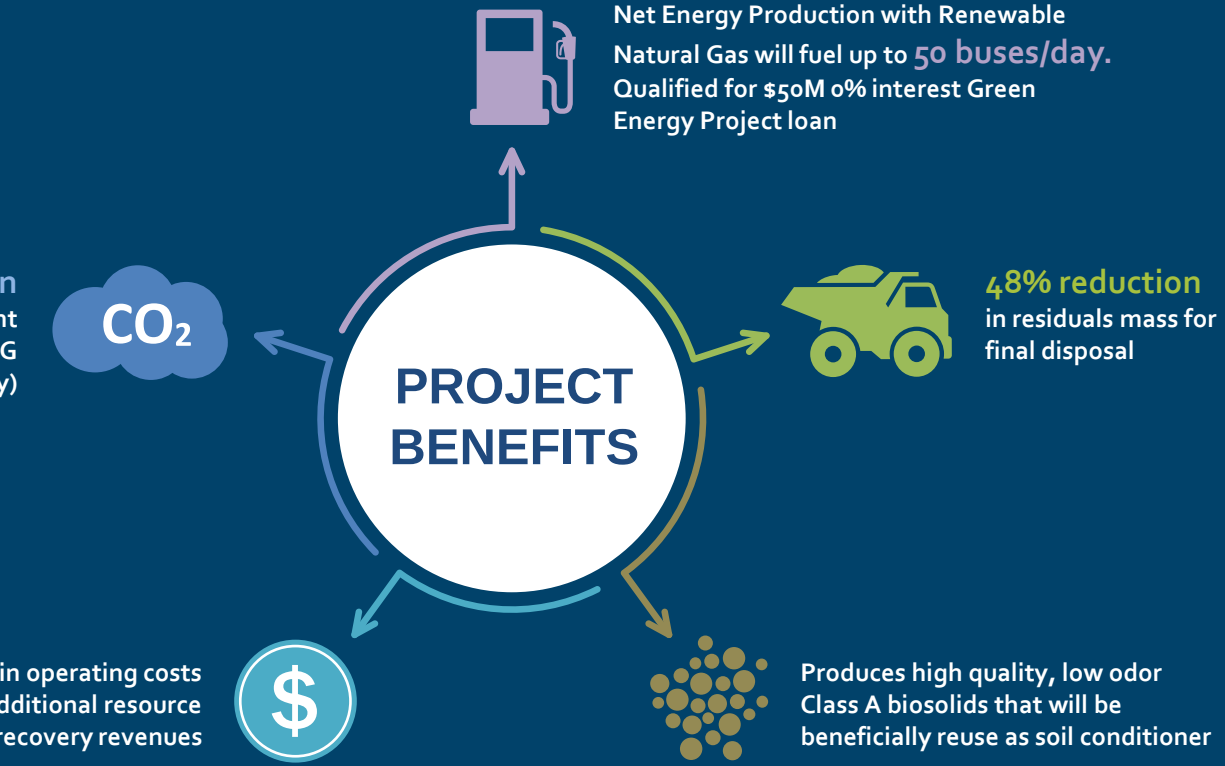

Net Energy Production with Renewable Natural Gas will fuel up to 50 buses/day. Qualified for $50M 0% interest Green Energy Project loan

Estimated 11% reduction in City's carbon footprint (based on 2014 LGO GHG Emissions Inventory)

48% reduction in residuals mass for final disposal

Reduction in operating costs with additional resource recovery revenues

Produces high quality, low odor Class A biosolids that will be beneficially reuse as soil conditioner

Project Schedule

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Project Schedule

- Early construction work began in 2019
- Groundbreaking in October 2019
- Major construction work began 2020
- Commissioning complete 2023

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Transition Planning

Transition Planning at NRRRF

- Heavy focus on effective solids management during different construction phases
  - Thickener building rehab
    - All WAS co-settled in primaries
  - Dewatering building and Cake Bin Rehab
    - Temporary belt filter press operation
  - Final dewatering start-up
    - Temporary cake storage on covered pad

Transition Planning at NRRRF

- Monthly Commissioning Planning Meetings
  - Digester seeding and commissioning planning
  - Process monitoring planning
  - O&M and Training planning for new processes
- O&M budgetary projections during commissioning and following start-up of new process
- Planning for additional staffing needed
- Class A Biosolids Marketing Evaluation initiated

Transition Planning – What's Next

- Training, training and more training
- Pre-Conditioning start-up planning
- Pre-Conditioning Commissioning
- Steam and THP Commissioning
- Digester Seeding, Digester Ramp Up
- Disinfection of final dewatering processes
- Final dewatering of digested solids
- Digester Gas Treatment System Commissioning

Building on Knowledge Gained for THP Transition Planning at NRRRF

- Knowledge sharing with existing installations
  - Process monitoring planning
  - Digester commissioning planning
  - O&M planning for the RNG conditioning system
  - O&M planning for THP system
- Participating in WEF RISE Focus Group on Improvements to THP
- Participating in applied research to guide decision making for future projects
  - UWC FOG Co-Digestion Project – input for potential future FOG co-digestion
  - Sidestream bench-scale study – input for operating future sidestream process

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November 2020 Construction Site Photo

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November 2021 Construction Site Photo

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THP System Installation February 2022

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April 2022 Construction Site Photo

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April 2022 Construction Site Photo

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July 2022 Construction Site Photo

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Thank you!

- Thank you to entire team involved with NRRRF Bioenergy Recovery Project

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