



TETRA TECH



# Energy Potential from Wastewater Treatment Facilities

May 29, 2019

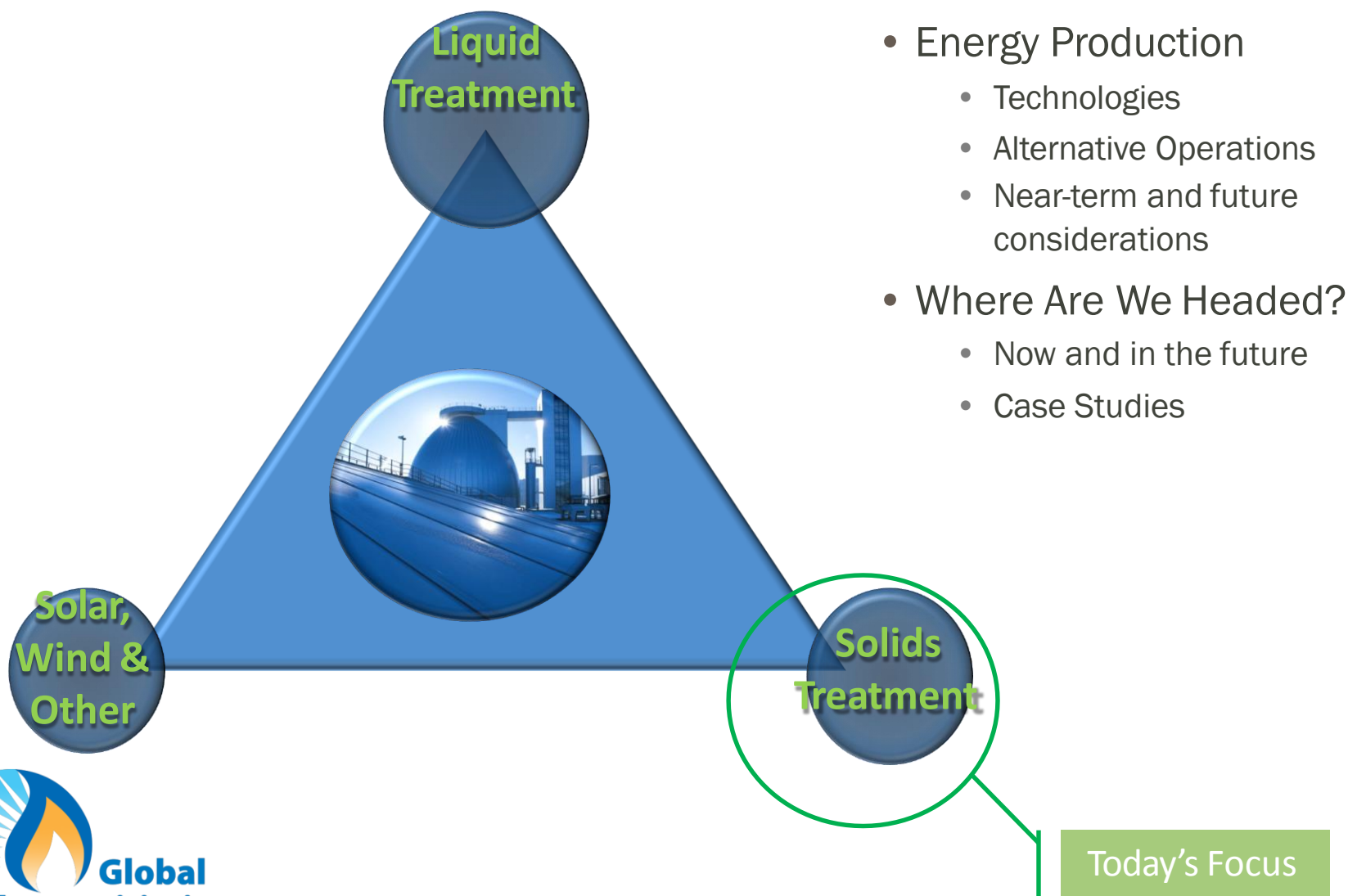
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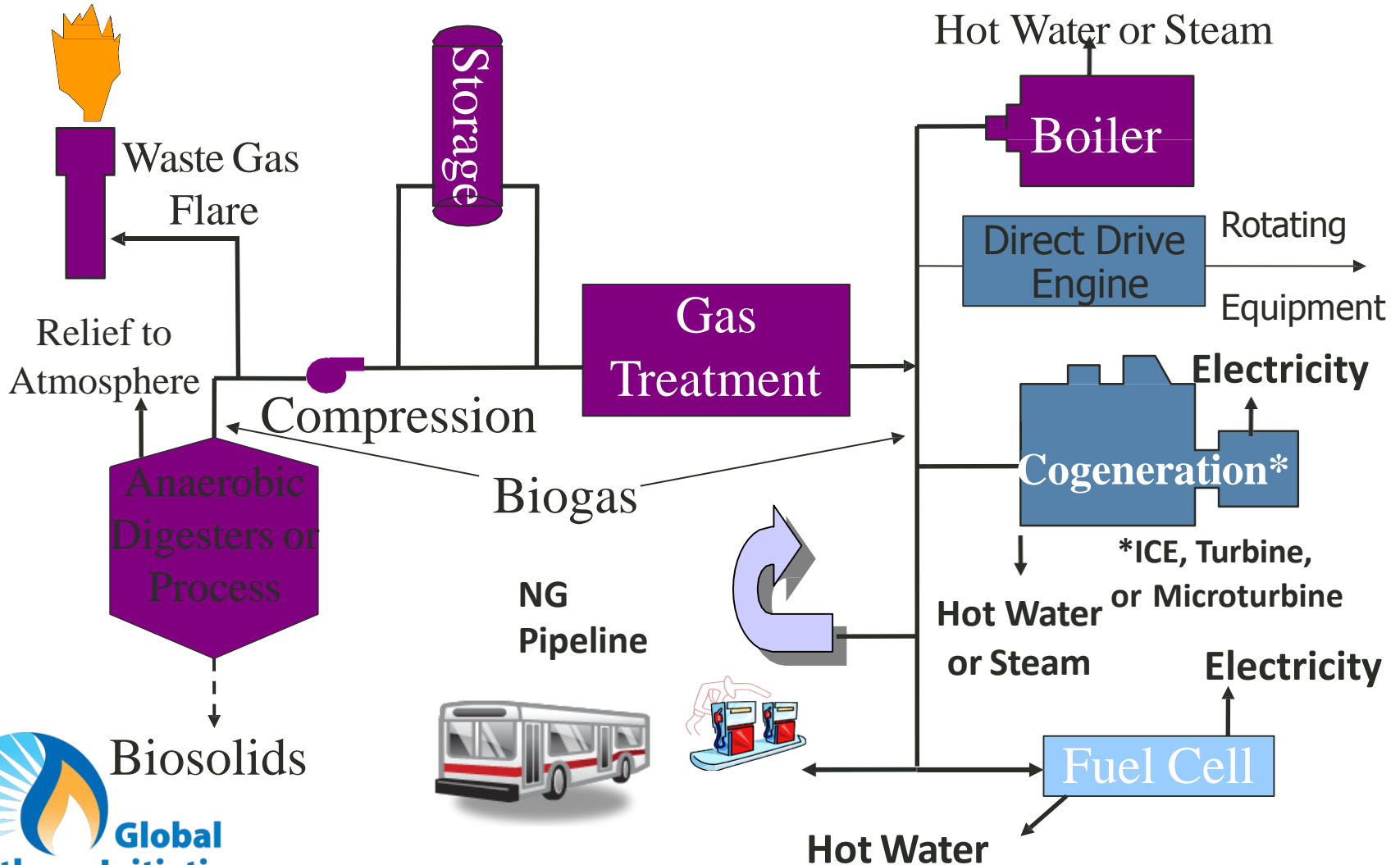
# Overview of 5/29/19

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# Energy from Anaerobic Treatment



- Pre-processing of Sludge
- Anaerobic Treatment
- Digester Gas Utilization
  - Alternatives considered
    - Microturbines for electricity and heat
    - Internal combustion engines for electricity and heat
    - Fuel cells for electricity
    - Convert to natural gas for vehicles or other uses
- End Uses for Gas and Biosolids

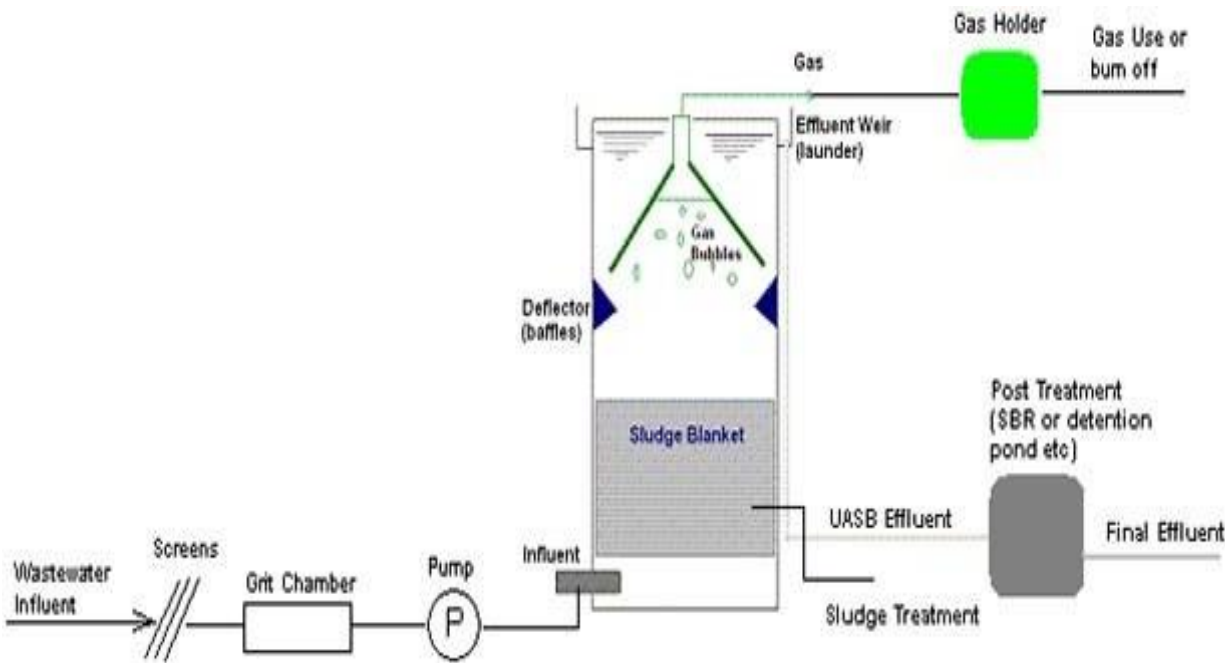
# What is Driving Biosolids Management?

- Regulations
  - Federal, State, Regional, and Local
- Energy Opportunities
- Greenhouse Gas (GHG) Reduction
  - Cost Savings
  - Carbon Footprint
- Liability and Risk Management

- Treated solid, semi-solid or liquid organic residues removed from wastewater when it is cleaned so it can be beneficially recycled or discharged
- Source of Nitrogen and Phosphorus in crop production
- Safe and effective when used properly
- Potential source of bio-energy



- *Anaerobic treatment can be used to treat the liquid stream.*



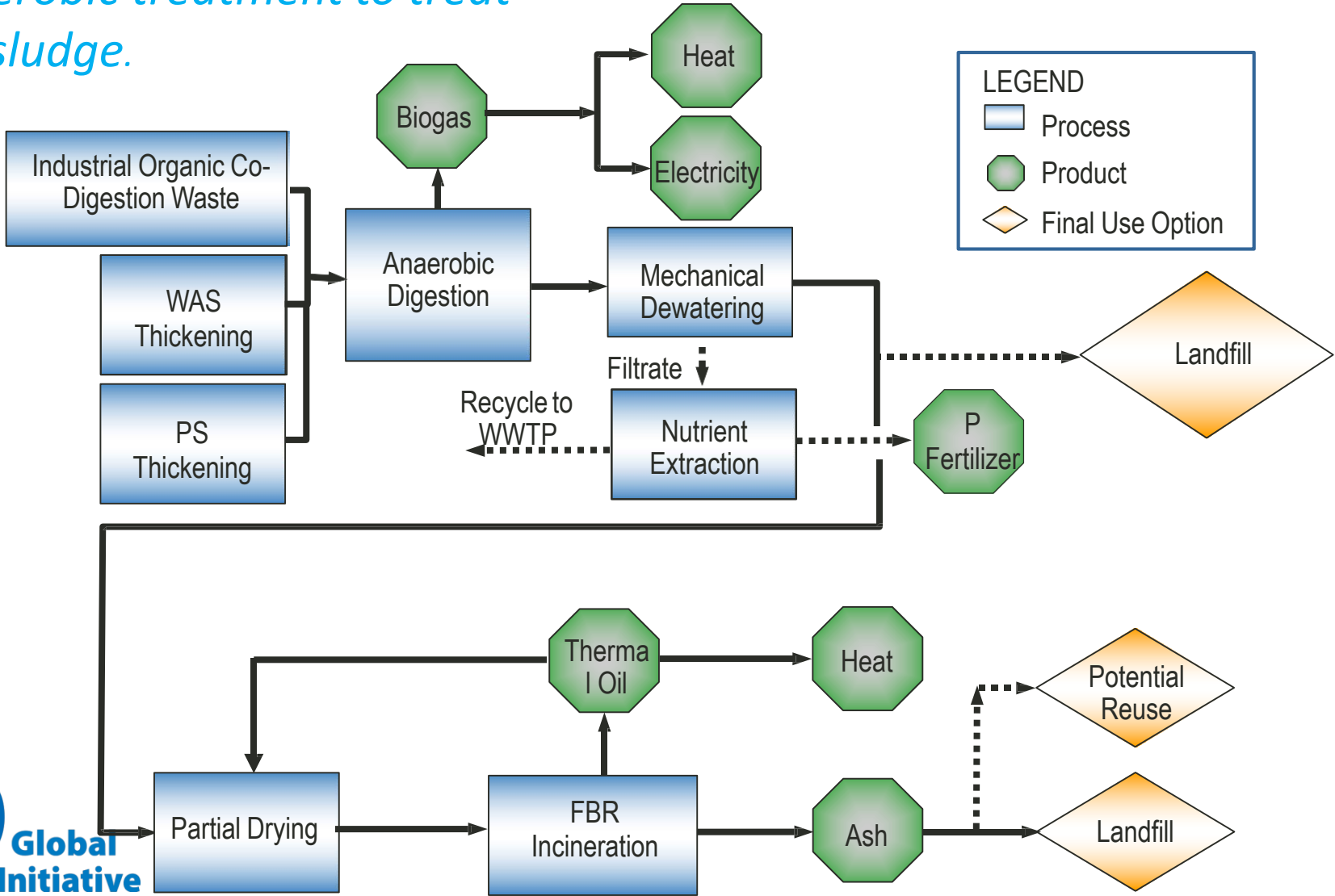
- Anaerobic treatment of full waste stream
- Provide post-treatment for effluent
- Further process for reuse and energy recovery

*Multiple suppliers of anaerobic treatment systems are available.*



# Energy Resources in Sludge

- Anaerobic treatment to treat the sludge.



## Facilities Visited:

- Nur-Sultan – 254 MLD Capacity
- Taldykorgan – 36 MLD
- Almaty – 640 MLD
- Shymkent – 150 MLD



## Prefeasibility Studies:

- Nur-Sultan: Potential Reduction GHG Emissions
  - kg CO<sub>2</sub>e from 88,500 to 61,000 to 81,600 depending on type of improvements
- Taldykorgan: Potential Reduction GHG Emissions
  - kg CO<sub>2</sub>e from 13,800 to 8,700 to 8,500 depending on type of improvements

## Nur-Sultan

- Energy Potential – 66 kW
- Total Capital Cost - \$100 to \$110 million

## Taldykorgan

- Energy Potential – 8.3 kW
- Total Capital Cost - \$ 30 to \$ 35 million

\$ - US Dollars

# Biogas for Energy Opportunity by Facility Size

Facility Description	Range (MLD)	Range (LPS)	Biogas Project Feasibility
Small	< 10	< 100	Unlikely
Medium	10 to 60	100 to 700	Worth Evaluating
Large	60+	700+	Strong Consideration

# Some U.S. Examples

## OVERVIEW:

- WWTP located in the Las Gallinas Valley between Novato and San Rafael, in Marin County, California
- Small WWTP
  - 2.9 million gallon per day (MGD) capacity (13.3 megaliters per day (MLD))
  - 15000 gallons of sludge processed/day (56,800 litre/day)
- Two anaerobic sludge digesters
- Average of 32 standard cubic feet per minute (scfm) [0.9 m<sup>3</sup>/min ] of 63% methane content gas available
- Digester gas used for process heating and electrical generation with microturbines and vehicle fueling

## PROJECT DRIVERS:

- Reduce Energy Consumption and Greenhouse Gas Emissions
- Reduce operating costs for vehicle fleet
- California Financial Incentives



# Grand Junction, Colorado - Persigo WWTP

## OVERVIEW:

- WWTP located in western Colorado
- Small-Medium WWTP (8.2 MGD) [37.3 MLD]
- Two anaerobic sludge digesters producing 120,000 cf/day (3,400 m<sup>3</sup>/day) gas
- Pipeline to vehicle fueling station
- Digester Gas used for vehicle fueling and process heating

## PROJECT DRIVERS:

- National Renewable Identification Number (RIN) program made it financially viable
- Payback period less than 5 years and improved as RIN values increased.
- Renewal and rehabilitation work on the WWTP was needed, but anaerobic digesters were there and would stay
- RNG is good public relations and the facility serves city, county and private customers



# Metro Wastewater Reclamation District

## Robert W. Hite Wastewater Treatment Plant, CO, USA



### OVERVIEW

- 220 MGD (832 MLD) Capacity
- Located in Denver Colorado
- 220 MGD (832 MLD) Capacity
- Biogas produced by 12, two-phase anaerobic digesters
- Combined Heat & Power with 2, 3.1 MW Turbines
- Generates: 4-5 MW electrical power (depends on gas quantity)
- Power used at the WWTP or sold to local Utility
- Cogeneration system operated by a private contractor

### PROJECT DRIVERS:

- Economy of scale allowed relatively short payback
- Digestion was well established from the day the facility started
- Nearby public utility generating station allowed flexibility in design and operation
- Sophisticated staff and management saw the benefits early on





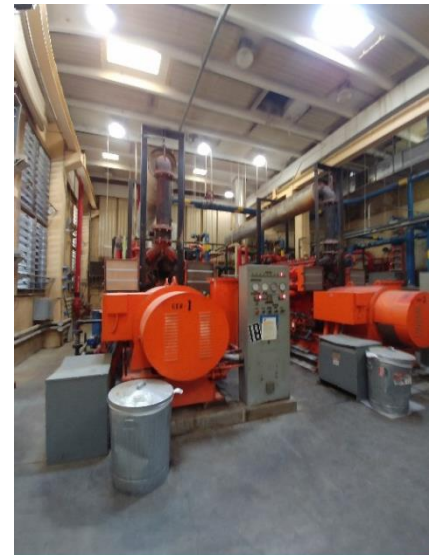
# Boulder, Colorado RNG Project

## OVERVIEW:

- WWTP located Colorado
- Medium WWTP (25 MGD) [95 MLD]
- Two anaerobic sludge digesters producing 150 ft<sup>3</sup>/min (4.2 m<sup>3</sup>/min) gas
- Digester gas sold to local utility

## PROJECT DRIVERS:

- National Renewable Identification Number (RIN) program made it financially viable
- RNG is good public relations and helps confirm the City's commitment to sustainability
- City desires to minimize greenhouse gas emissions
- Existing cogeneration equipment needed to be replaced due to age and high cost to maintain.



- Opportunities for energy recovery from Biogas are available in Kazakhstan
- Adding composting or further treatment to produce “High-Quality” reusable solids does not significantly reduce GHG emissions
- Treatment to produce “High-Quality” solids products are not cost effective at this time
- Before moving forward with any biogas projects, additional engineering and economic studies are needed.