Metropolitan Water Reclamation District of Greater Chicago

Welcome to the February Edition of the 2026 M&R Seminar Series

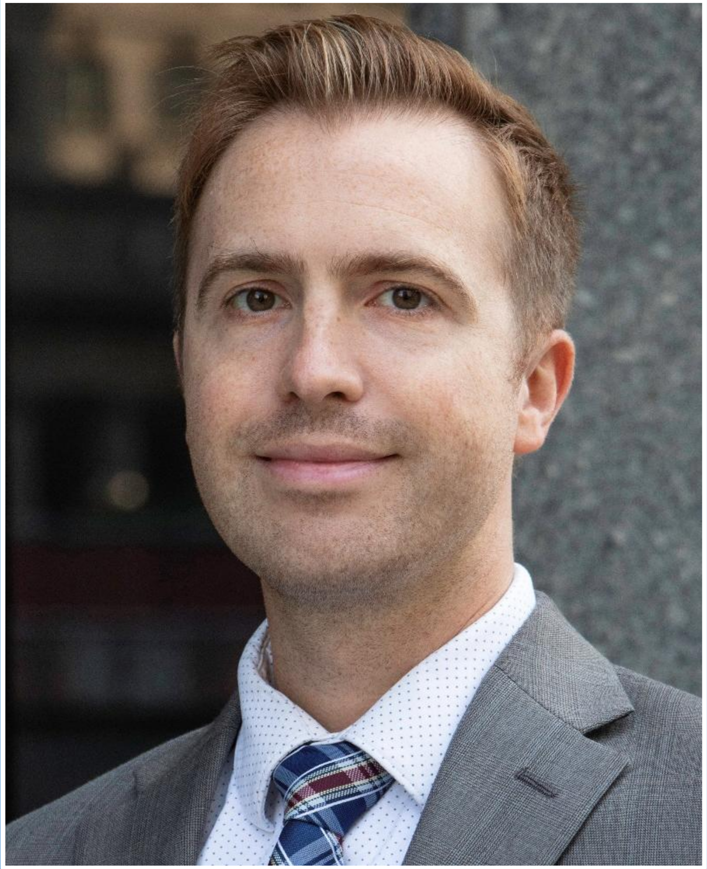
NOTES FOR SEMINAR ATTENDEES

- Remote attendees' microphones are muted at entry to minimize background noise. For attendees in the auditorium, please silence your phones.
- A question and answer (Q/A) session will follow the presentation.
- For remote attendees, please use "**Chat**" only to type questions for the presenter. For other issues, please send emails to MnRseminars@mwrd.org.
  For attendees in the auditorium, please raise your hand and wait for the microphone to ask a verbal question during the Q/A session.
- The presentation slides will be posted on the MWRD website after the seminar.
- This seminar has been approved by the Engineering Society of Illinois (ESI) for one PDH and is pending approval by the IEPA for one TCH. Certificates will be issued only to participants who attend the entire presentation. For PDH certificate seekers, **completing a brief course evaluation and submitting it are required**.

Catharine (Katie) M. Richardson, P.E. ENV SP
Associate Vice President
T.Y. LIN

Katie Richardson is a civil/process engineer at T.Y. Lin and has 21 years of experience, including 16 years working closely with utilities. She brings deep program management expertise on major initiatives that integrate effective energy management and innovative solutions to infrastructure challenges.

Michael A. Debnar, P.E.
Mechanical Group Head/Associate
T.Y. Lin



Mike Debnar, P.E. is a mechanical engineer with 15 years of experience evaluating, designing, specifying, and commissioning fuel gas systems which include utilization of digester gas. His experience with the MMSD Energy Program and South Bend CNG Improvements brings relevant insight to this seminar’s topic.

Joseph Dinkel, P.E.
Vice President, MEPIC Design Center Director
T.Y. Lin

Joe Dinkel, P.E., is a mechanical engineer with 25 years of experience evaluating, designing, and specifying fuel gas systems that utilize digester gas. His experience with South Bend Digester Gas Utilization and Oakland County Gas Utilization projects brings insight this seminar’s topic for the range of gas treatment technologies.

TYLin

Creating Renewable Natural Gas from Digester Gas

Mike Debnar, PE
Joe Dinkel, PE
Katie Richardson, PE, ENV SP

Introduction

Basic Gas Cleaning

South Bend Case Study

Digester Upgrades

RNG

Technology Evaluation

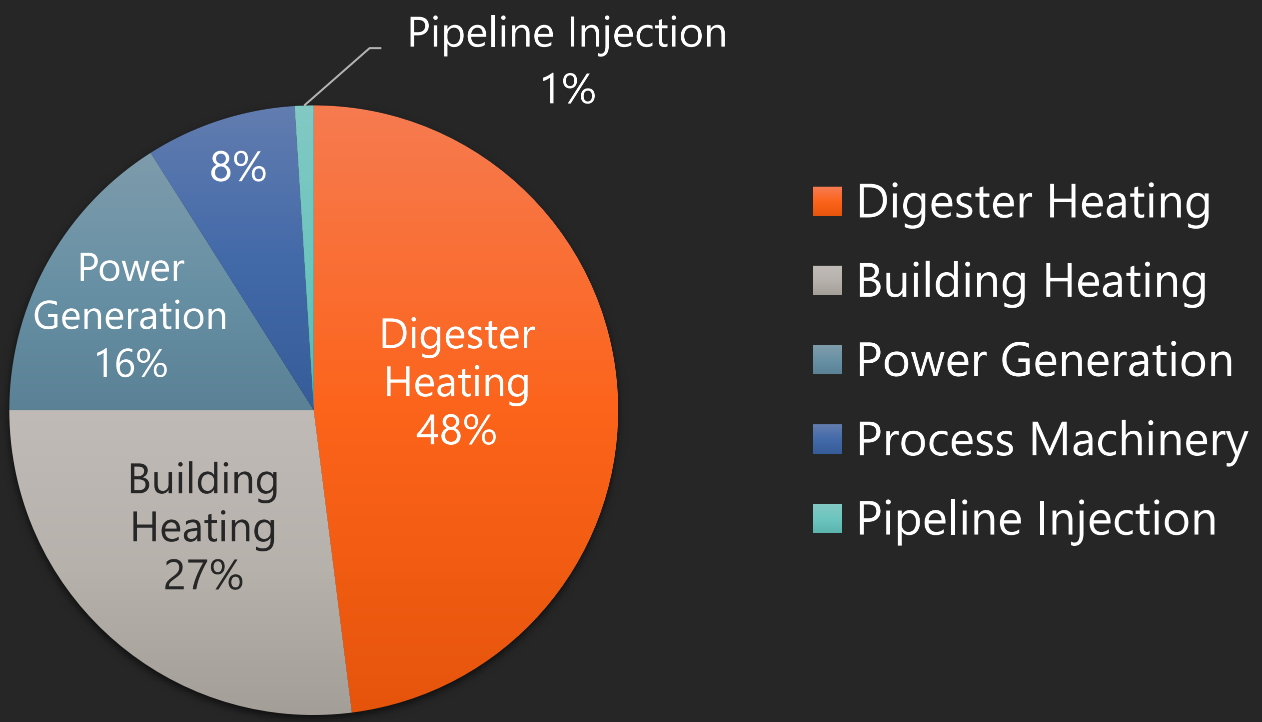
Using the RNG (RINS, RNG Process Engines, Vehicle Fueling)

Evaluating Opportunities

Industry Snapshot

14,780 WRRF → 1,238 WRRF Anaerobic Digestion → 1,054 WRRF Beneficial Reuse

Biogas Utilization

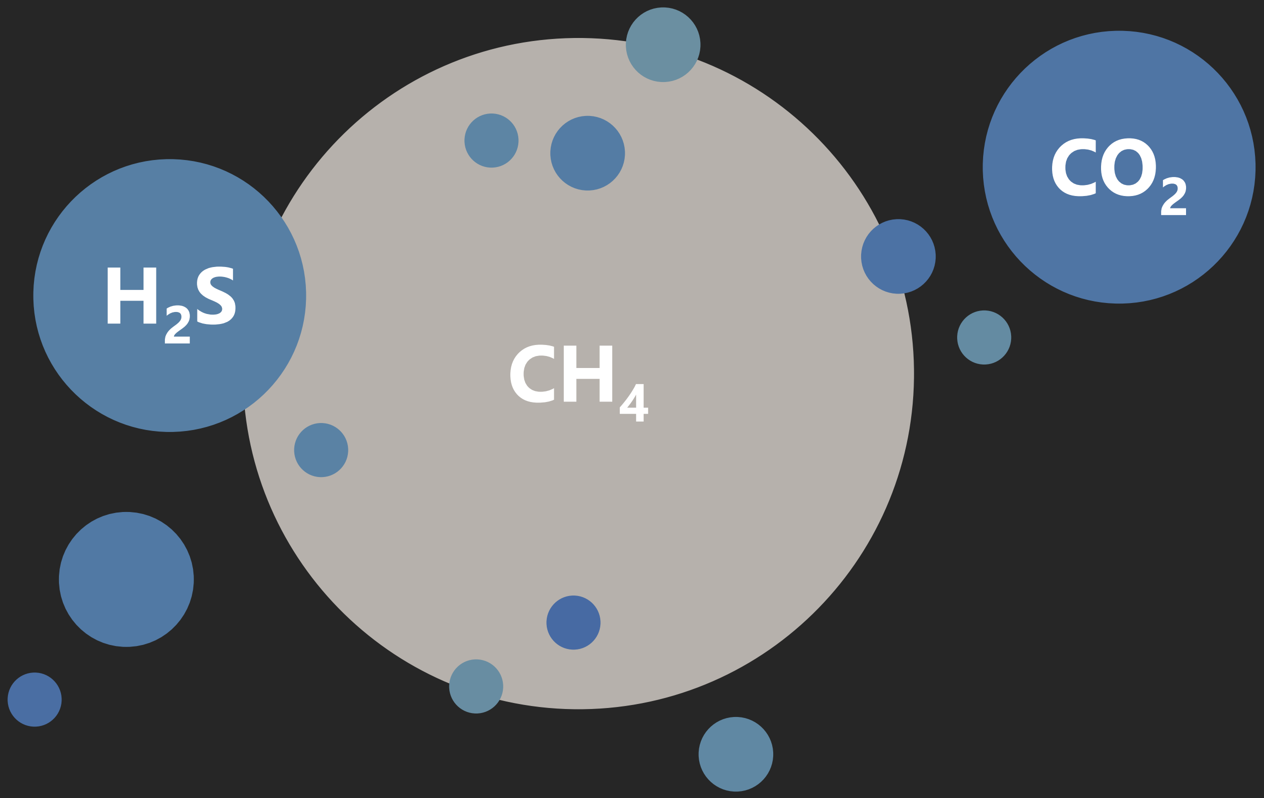


The Reason to Clean Digester Gas

SILOXANE BUILDUP ON COMBUSTION SURFACES

Gas Cleaning Considerations

- Quality of the Gas
- Gas Flow
- Energy Content
- Gas Composition
- Methane
- CO2
- H2S
- Siloxanes
- Gas Cleaning Requirements



Gas Cleaning Considerations

Current Biogas Streams

- Landfill Gas (LFG) incoming
- Digester Gas (DG) produced

Biogas Constituents

- Methane (CH_4)
- Carbon Dioxide (CO_2)
- Impurities including siloxanes, hydrogen sulfide (H_2S)
- Nitrogen (N_2), oxygen (O_2) found in LFG only

Cleaning vs. Upgrading

- Cleaning refers to removal of impurities
- Upgrading refers to the removal of CO2, to increase energy density (percent CH_4)

Renewable Natural Gas (RNG)

- RNG = Upgraded biogas with similar CH_4 content as NG (96% or above)
- NG substitute = operational flexibility
- RNG purity requirements depend on end use, may be sensitive to certain constituents

Gas Cleaning Considerations

Technology selection must balance RNG composition requirements with cost, maintenance, & operations.

Undesired constituents…	**Membrane Permeation**	**Pressure Swing Adsorption**	**Solvent Scrubbing**	**Water Scrubbing**
	filtered out by special membrane material	adsorbed by regenerative media in pressure vessels	adsorbed by chemical solvent	absorbed by water as gas passes through it
Energy Intensity	**Low**	**Low**	High	Varies
Complexity	**Simple**	Complex	Medium	**Simple**
CH_4 Purity	Lower	**Higher**	**High**	**Highest**
Consumables	Membrane	Media, if damaged	Chemicals	Water

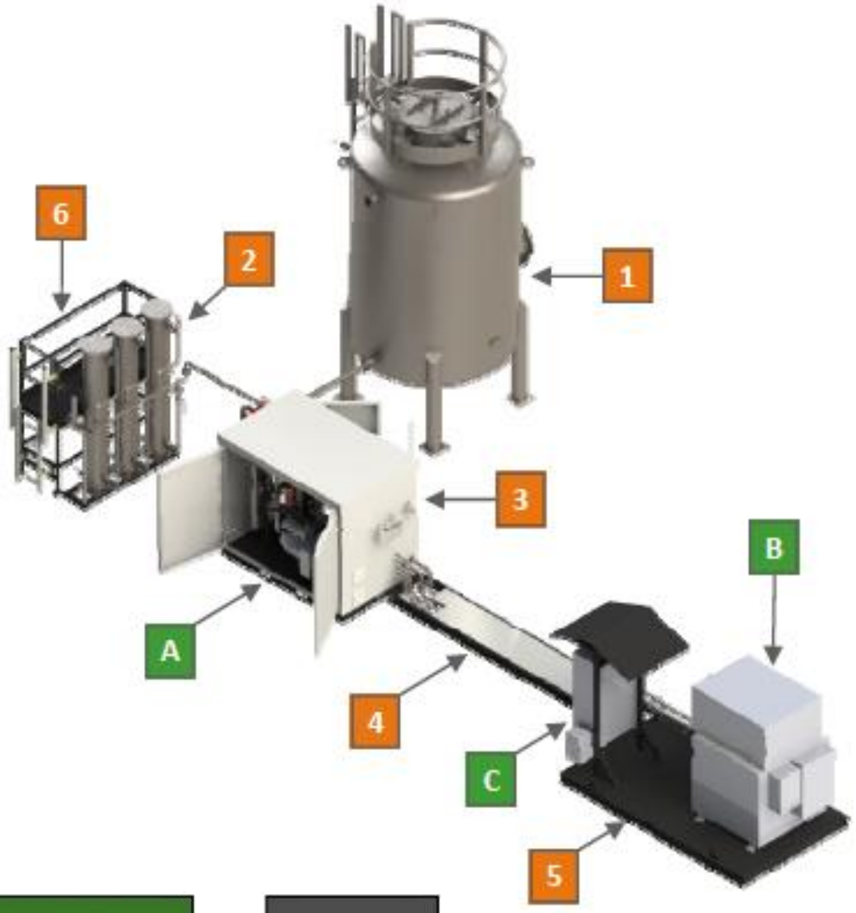
ETI Water Wash Pilot

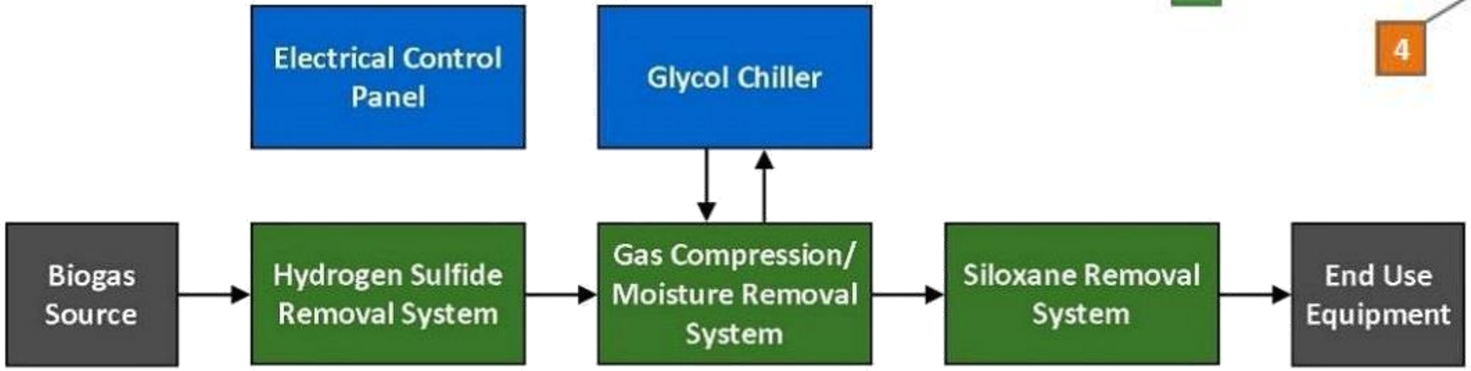
- Low energy input, uses available water pressure
- Very simple equipment & operation
- High CH_4 purity
- Not commercialized / scalability un-tested
- Unable to remove O_2 & N_2

Gas Cleaning Basics

PRECONDITIONING

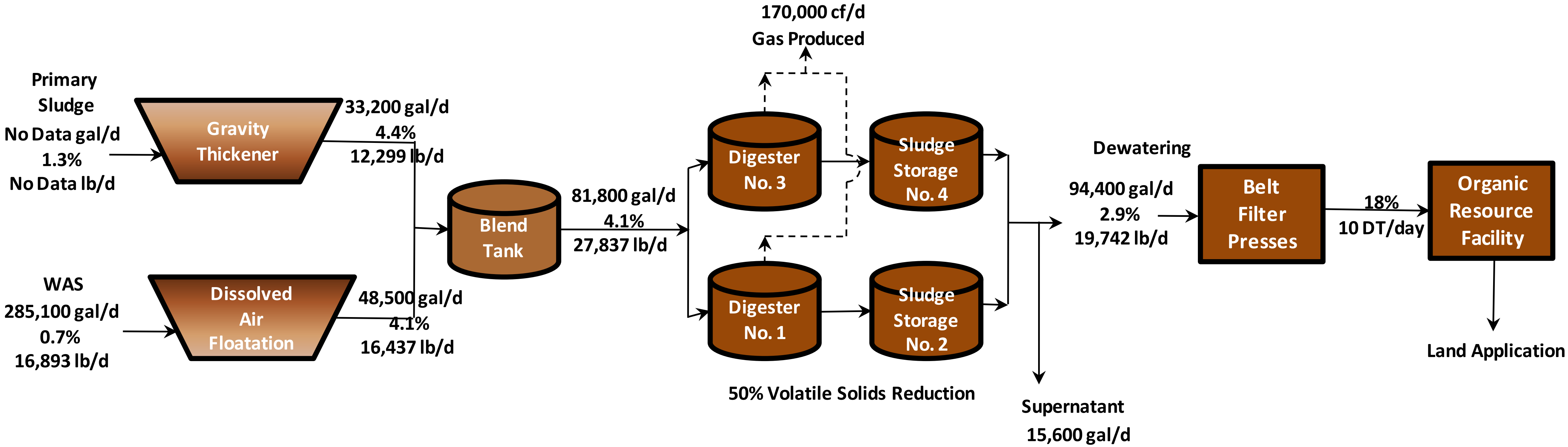
- Several Components
- Customized
- Area Classifications
- Gas Testing
- Before Detailed Design
- Frequent 1st Year
- Less Frequent After





The City of South Bend, Indiana WWTP

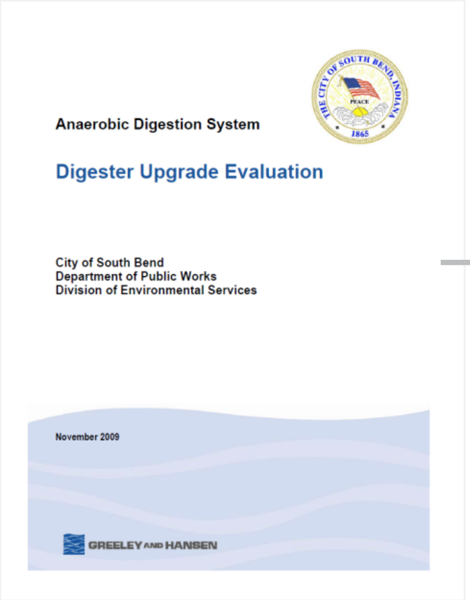
- 48.0 MGD Class IV activated sludge plant
- 4 anaerobic digesters (2 primary, 2 secondary)
- Built in 1954
- Digester No. 2 and 4 upgraded in 1988
- Gas boiler system



South Bend Project Goals

- Initial Digester Goals
- Long Term Strategy for Maintaining Digesters
- Gas Utilization Goals
- Maximize Energy Recovery
- Minimize Flaring of Digester Gas
- Demonstrate City Efforts for Sustainability and Environmental Stewardship

Long-term Biosolids Planning

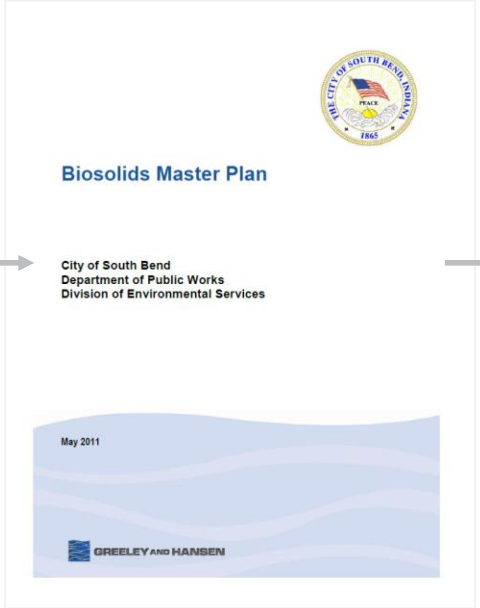

Anaerobic Digestion System

Digester Upgrade Evaluation

City of South Bend
Department of Public Works
Division of Environmental Services

November 2009

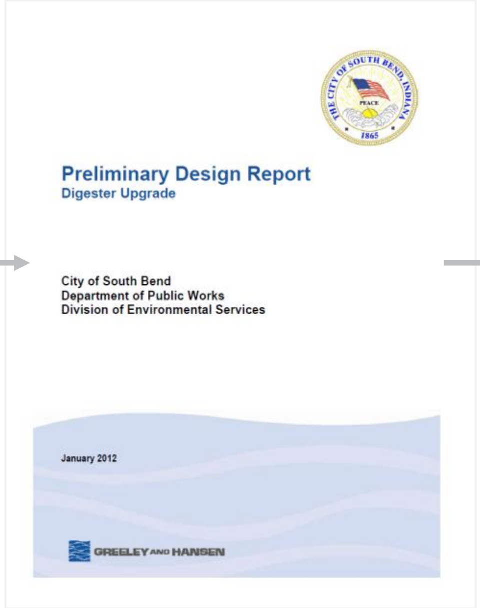
GREELEY AND HANSEN


Biosolids Master Plan

City of South Bend
Department of Public Works
Division of Environmental Services

May 2011

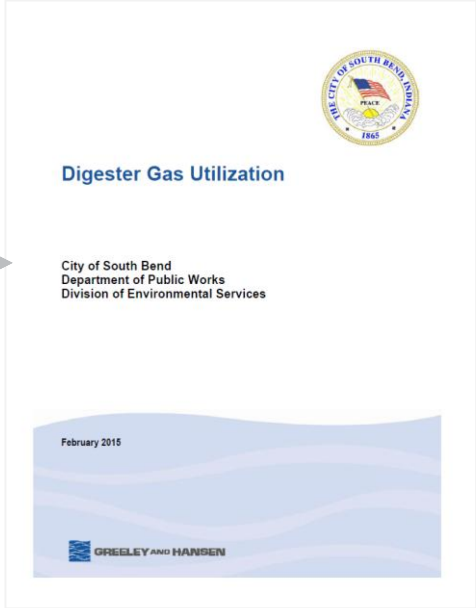
GREELEY AND HANSEN


Preliminary Design Report
Digester Upgrade

City of South Bend
Department of Public Works
Division of Environmental Services

January 2012

GREELEY AND HANSEN


Digester Gas Utilization

City of South Bend
Department of Public Works
Division of Environmental Services

February 2015

GREELEY AND HANSEN

Digester Upgrade Evaluation

2009

Biosolids Master Plan

2011

Preliminary Design Report

2012

Digester Gas Utilization Plan

2015

Phased Approach

- Digester Upgrade Phase
- Digester Upgrade Evaluation-> BMP 2011
- Preliminary Design Report
- Upgrades to Digester No. 2
- Gas Utilization Phase
- Digester Gas Utilization Report
- Digester cleaning skid to clean raw digester gas to natural gas pipeline quality.
- Gas distribution infrastructure
- Final Digester Upgrades

Digester Information

Digester Characteristics	
Dimension	25ft x 100ft dia
Volume, mgal	1.99
Build date	1954
VS Reduction	55%
VS Loading lbs VS/1,000 cf	43
HRT	44
Flow	90,000

Gas Characteristics	Value
Design Flowrate, scfm	215
CH_4, % by volume	63.4
CO_2, % by volume	36.4
H_2S, ppb	2200
Total Sulfur, ppb	3039
Siloxane, ppb	3085

TYLin

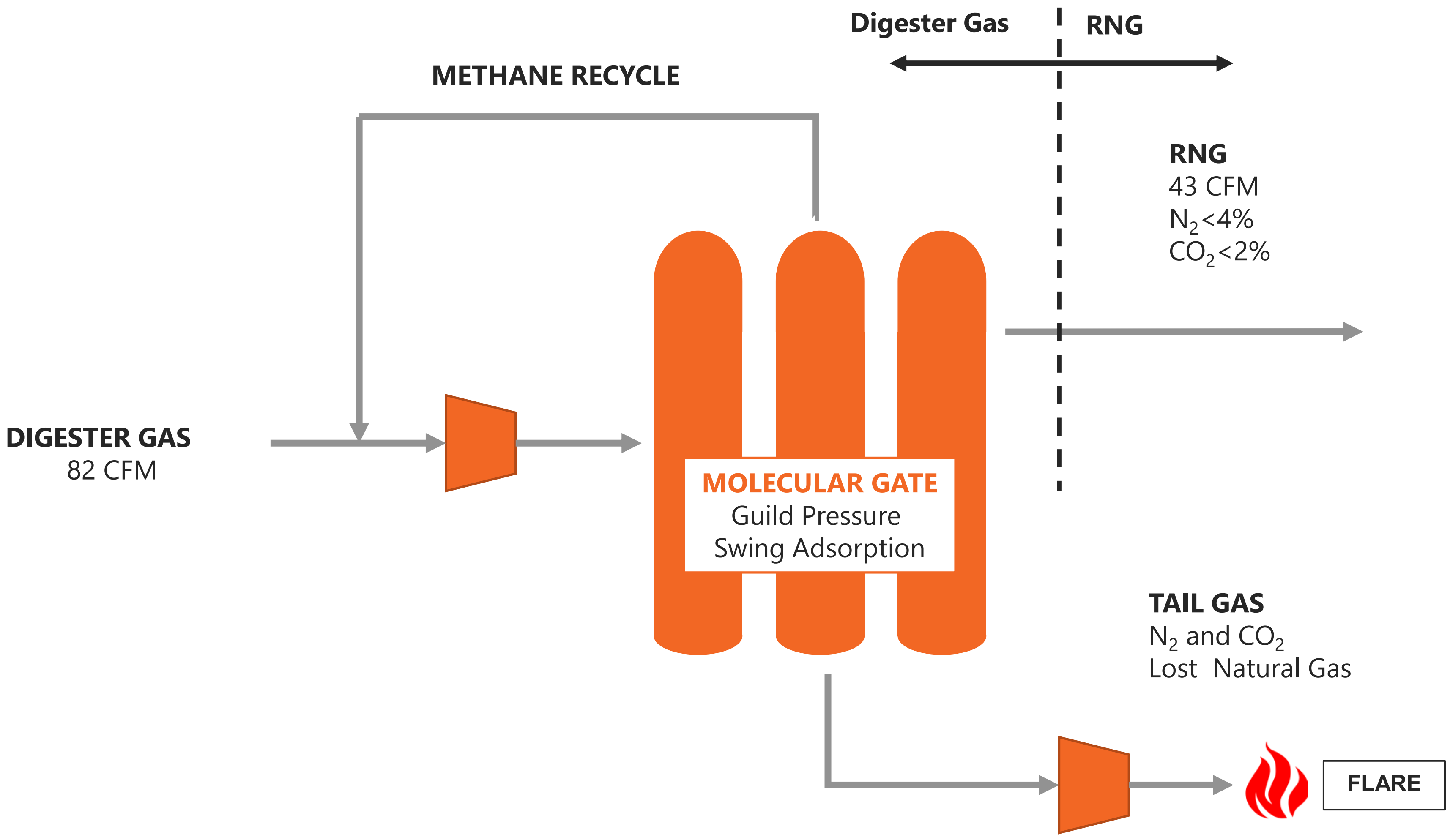
Digester No. 2 Upgrades

- Four 20 Hp external draft tube mixers (0.025-0.04 Hp/1,000 gal)
- Gas holder cover
- Centrifuge Flygt N-technology pump
- Flex type broiler
- New sludge and digester gas piping, valves and gas appurtenances

Technology Evaluation

	Guild Associates, Inc.	UNISON SOLUTIONS	APPLIED FILTER TECHNOLOGY biogas innovation
Capital	$714,000	$ 565,000	$2,702,000
O&M	$40,000	$130,000	$60,000
20 Year LCCA	$1,183,000	$1,940,000	$3,310,640
Technology	Pressure Swing Adsorption and Physical	Membrane and Physical	Scrubber, chemical, physical
Removal	CO_2, N_2, Siloxanes, H_2S, and VOCs	CO_2, Siloxanes, H_2S	CO_2, N_2, Siloxanes, H_2S, and VOCs
Advantages	Regenerable Media Operational Flexibility Low O&M Cost	Low Equipment Cost Smaller Footprint	10 year gas Quality Guarantee Low O&M
Disadvantages	Higher Capital Cost	High O&M Limited Warranty Non-regenerable Filters Short media and membrane life	High Capital Cost Media non-regenerable Short Media Life

Gas Cleaning Process



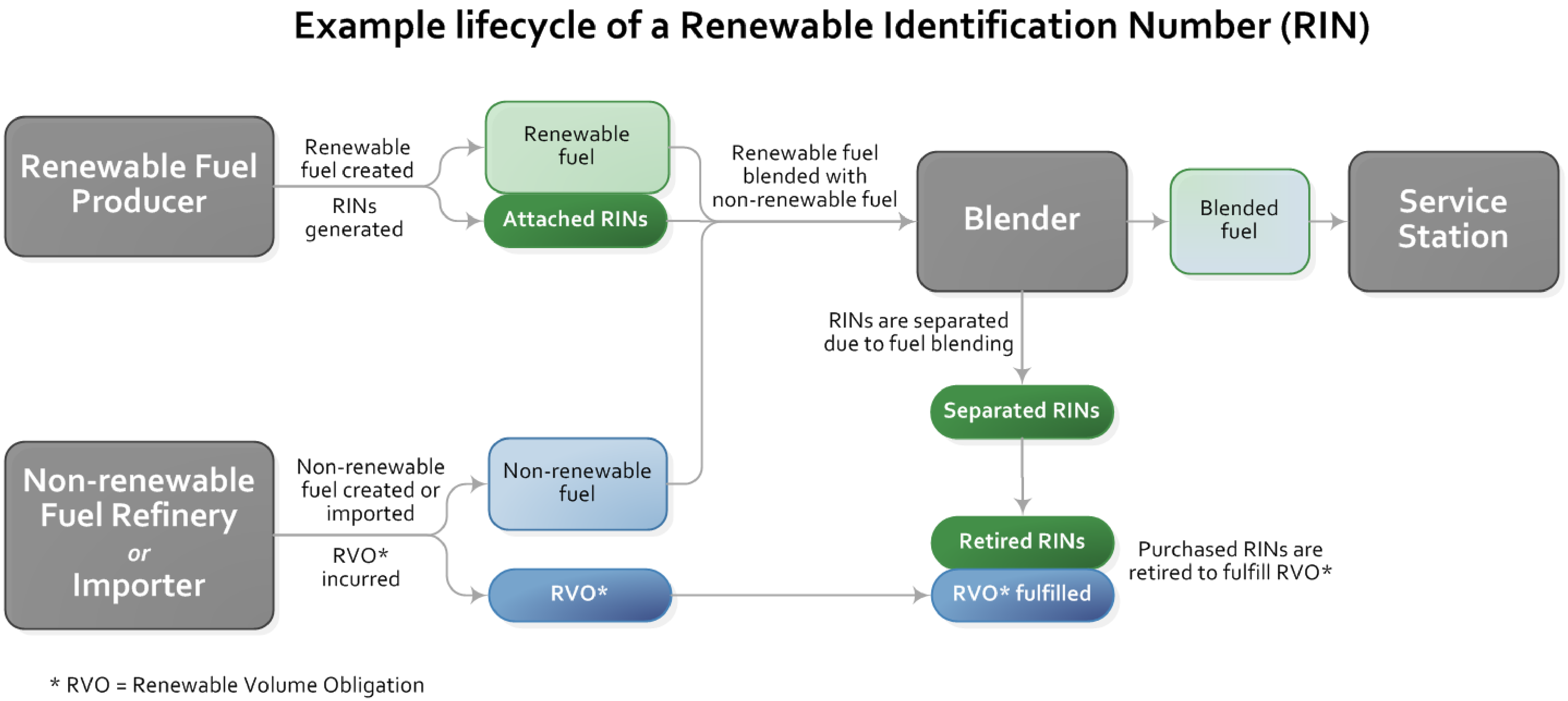
Gas Utilization Options

- Sell natural gas to fuel blender and monetize RINs
- Supply RNG to boiler and two natural gas engines
- RNG to City fleet CNG vehicles

RNG and RINS

- 100-year paradigm for digester gas
- DG not able to compete commercially with natural gas
- Foundational Regulations:
- Energy Policy Act of 2005
- Energy Independence and Security Act of 2007
- Volatility of RFS program over the years
- Congress set schedules through 2022, EPA post 2022
- Renewable Volume Obligation (RVO) rule making changes
- Small Refinery Exemption (SRE) changes
- eRINs and advanced feedstocks
- Slow adoption for pipeline owners
- 6/2025 EPA recommends limiting foreign biomass feedstocks and eliminating foreign renewable electricity for eRINs

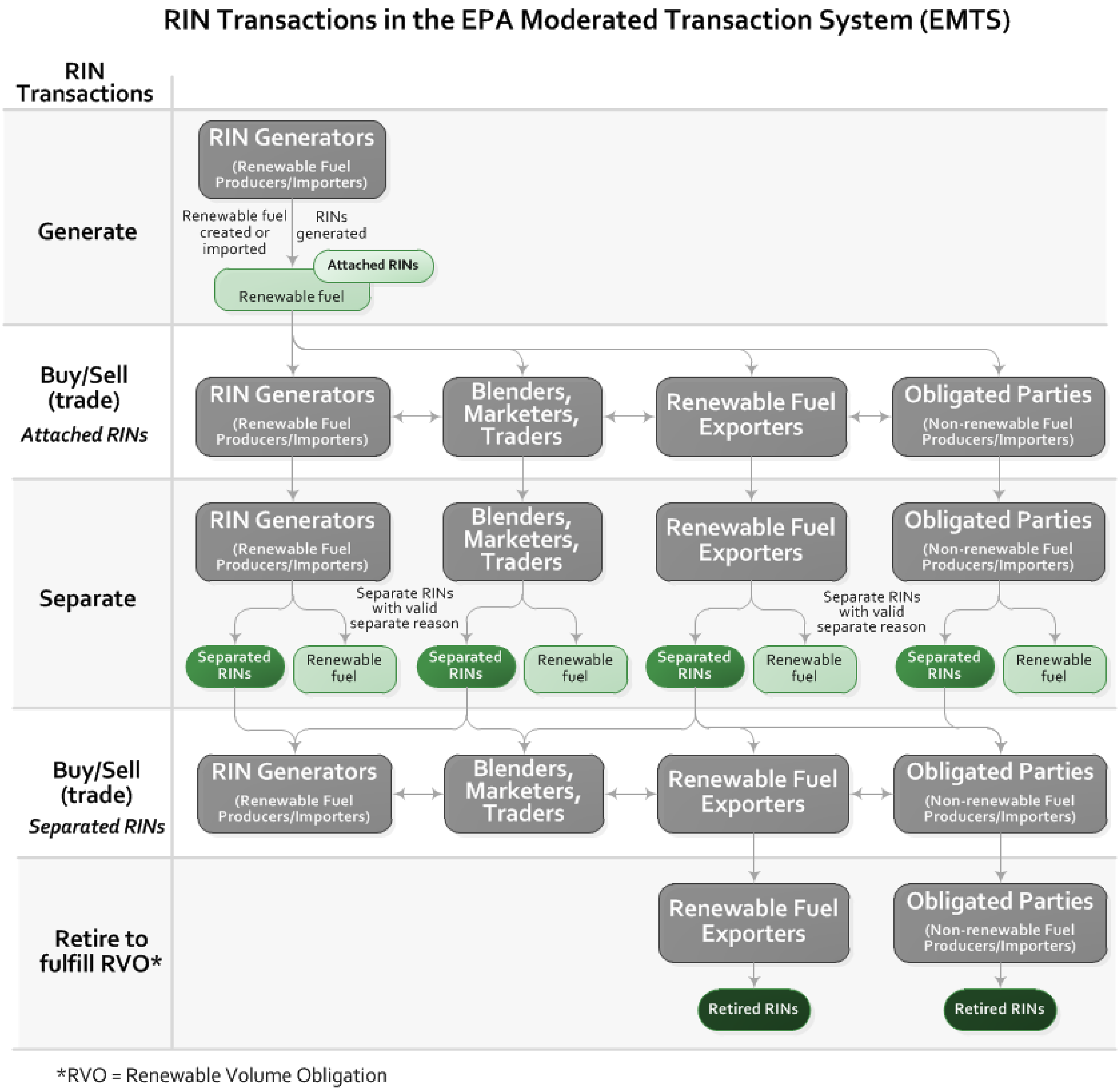
RNG and RINS



TYLin

RNG and RINS

Source – epa.gov
Updated 12/31/2025

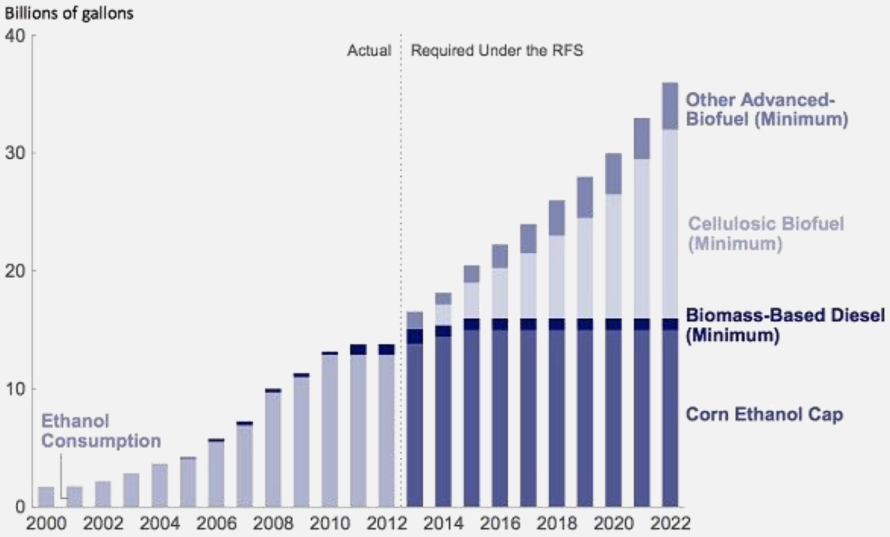


TYLin

RNG and RINS

PROJECT EVALUATION

- The Renewable Fuel Standard requires RINS to offset Transportation Fuel, Heating Oil, or Jet Fuel used in the Market
- Digester Gas Qualifies as
- D-3 Cellulosic Biofuel
- D-5 Advance Biofuel
- Viable Revenue for RNG
- 1 RIN = 77,000 BTUs
- 1 Therm = 1.3 RINS
- Purchased NG = $0.80/Therm
- Ave. Value of D3 = $1.89/Therm
- Typically Requires a 3rd Party Contract to be used to offset Transportation Fuel
- Must Meet Min. Production Requirements of Local Gas Utility

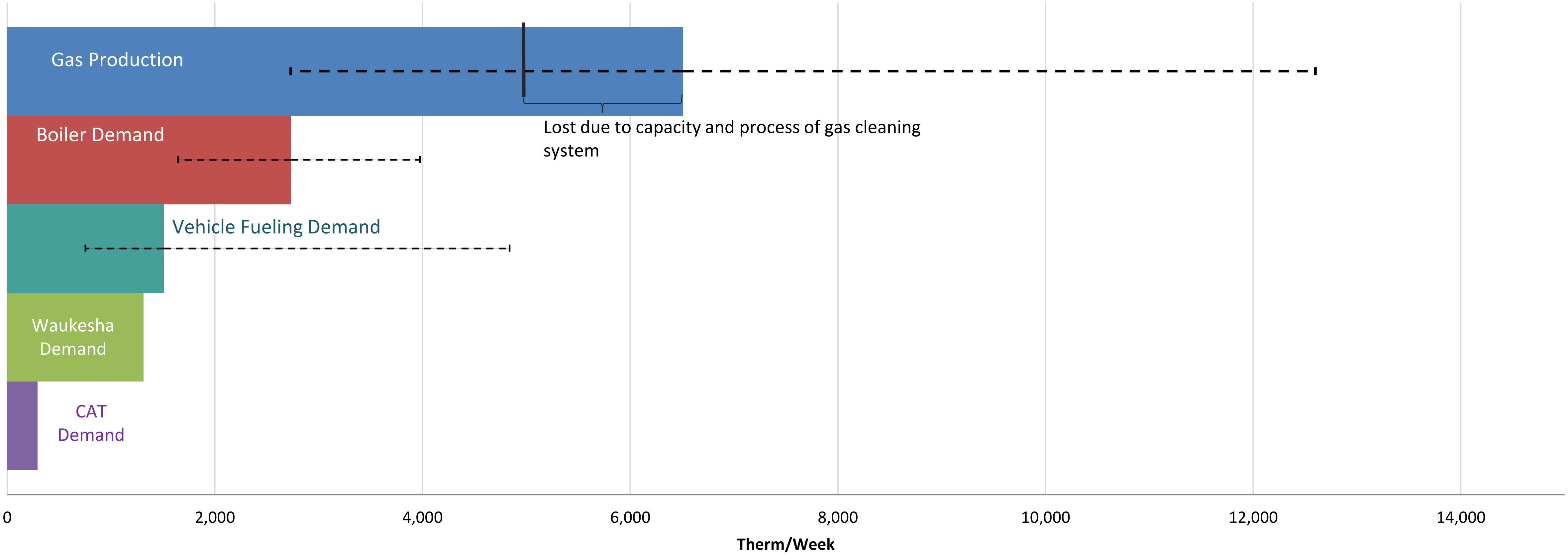


RIN Category	Code	Spot Price ($)	Previous	4 Week Avg.
Cellulosic	**D3/D7**			
Current Yr		1.8400	1.3300	1.4575
Previous Yr		1.3400	0.6400	0.8150
Biodiesel	**D4**			
Current Yr		0.7700	0.8025	0.7813
Previous Yr		0.7800	0.8025	0.7850
Advanced Biofuel	**D5**			
Current Yr		0.7550	0.7825	0.7675
Previous Yr		0.7525	0.7775	0.7600

2015 Evaluation – Many changes in markets, technology, and regulations over the last 11 years.

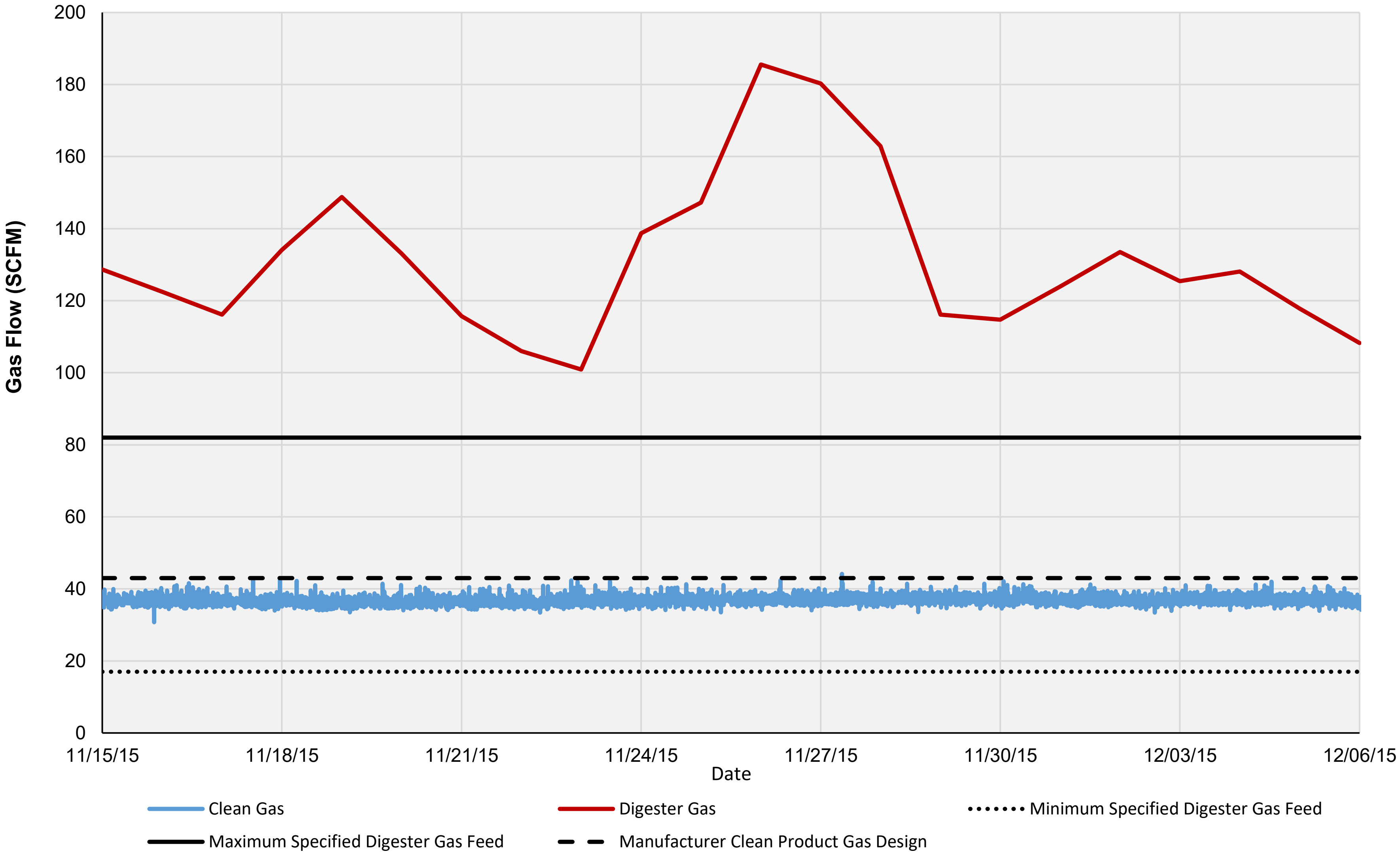
End User Evaluation

DIGESTER GAS PRODUCTION AND DEMAND



Status of Gas Utilization

South Bend WWTP Digester No. 2 Upgrade and Digester Gas Cleaning Gas Cleaning Product Analysis

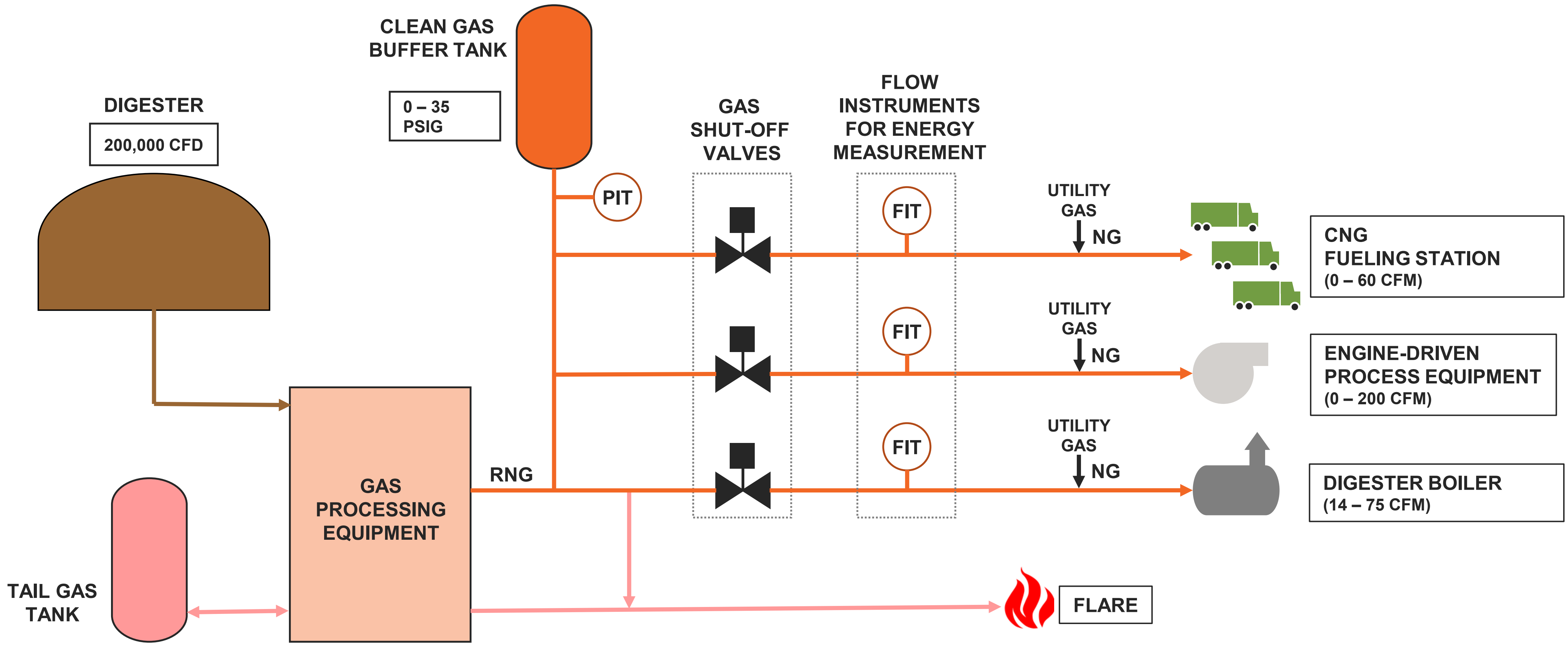


TYLin

South Bend WWTP Digester Gas Utilization System

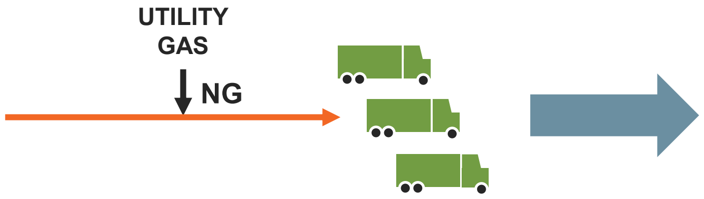
Initial Vision – Prioritize clean gas to specific users.

Change Perspective to overall.



Carbon Footprint Reduction

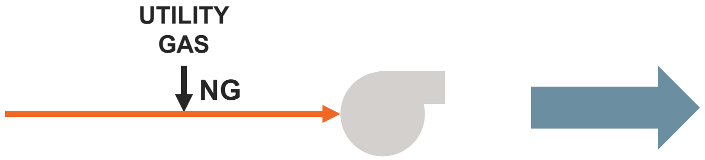
Vehicle Fuel System



Reduction in CO_2
170 MT/yr

36 

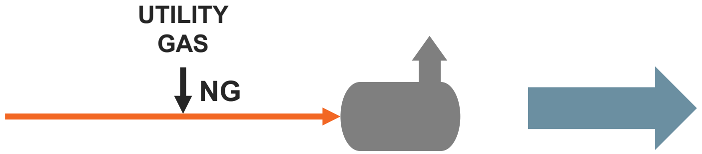
Natural Gas Engines



Reduction in CO_2
284 MT/yr

60 

Natural Gas Boiler



No additional reduction

Next Steps

PHASE 2

TYLin

South Bend RNG Facility

TYLin

Future Considerations

PHASE	DESCRIPTION OF IMPROVEMENTS	YEAR
Phase 1	Digester No. 2 Upgrade and Digester Gas Cleaning	2013
Phase 2	WWTP Digester Gas Utilization	2017
Phase 3	Digester No. 1 and 3 Upgrades (Cover, Boilers, Piping, External Draft Tube Mixers)	TBD
Phase 4	CNG Compressor and Filling Improvements	2025

MMSD Energy Baseline Demand with Planned and Recommended Improvements

Facility	Energy Demand				Renewable Gas Available		
	Electricity		Gas	Total	LFG	DG	Total
	MMBTU	kWh	MMBTU	MMBTU	MMBTU	MMBTU	MMBTU
Conveyance	9,160	2,684,500	2,100	11,260	0	0	0
Administration	8,200	2,400,000	25,300	33,500	0	0	0
JIWRF	305,400	89,500,000	979,200	1,284,600	1,175,000	0	1,175,000
SSWRF	108,800	31,890,000	153,410	262,210	0	473,880	473,880
Total	431,560	126,474,500	1,160,010	1,591,570	1,175,000	473,880	1,648,880

Energy demand does not include inefficiency of electricity generation from generators.

RWWU Energy Roadmap Study
Project Objectives

- Identify the optimal energy plan for Racine
- Develop new strategies regarding Net Zero
- Consider the greenhouse gas footprint and future energy demands
- Evaluate partnerships with utilities and other entities

TYLin

Non-Domestic Pipeline Solutions

WABASH RIVER ENHANCEMENT CORPORATION

- Redevelopment of Riverfront
- Assets for Residents
- Beautification

Cargill

- Advancing Sustainability
- Trust Based Partnerships
- Supply Chain Resilience

LAFAYETTE RENEW
WATER · ENVIRONMENT · COMMUNITY

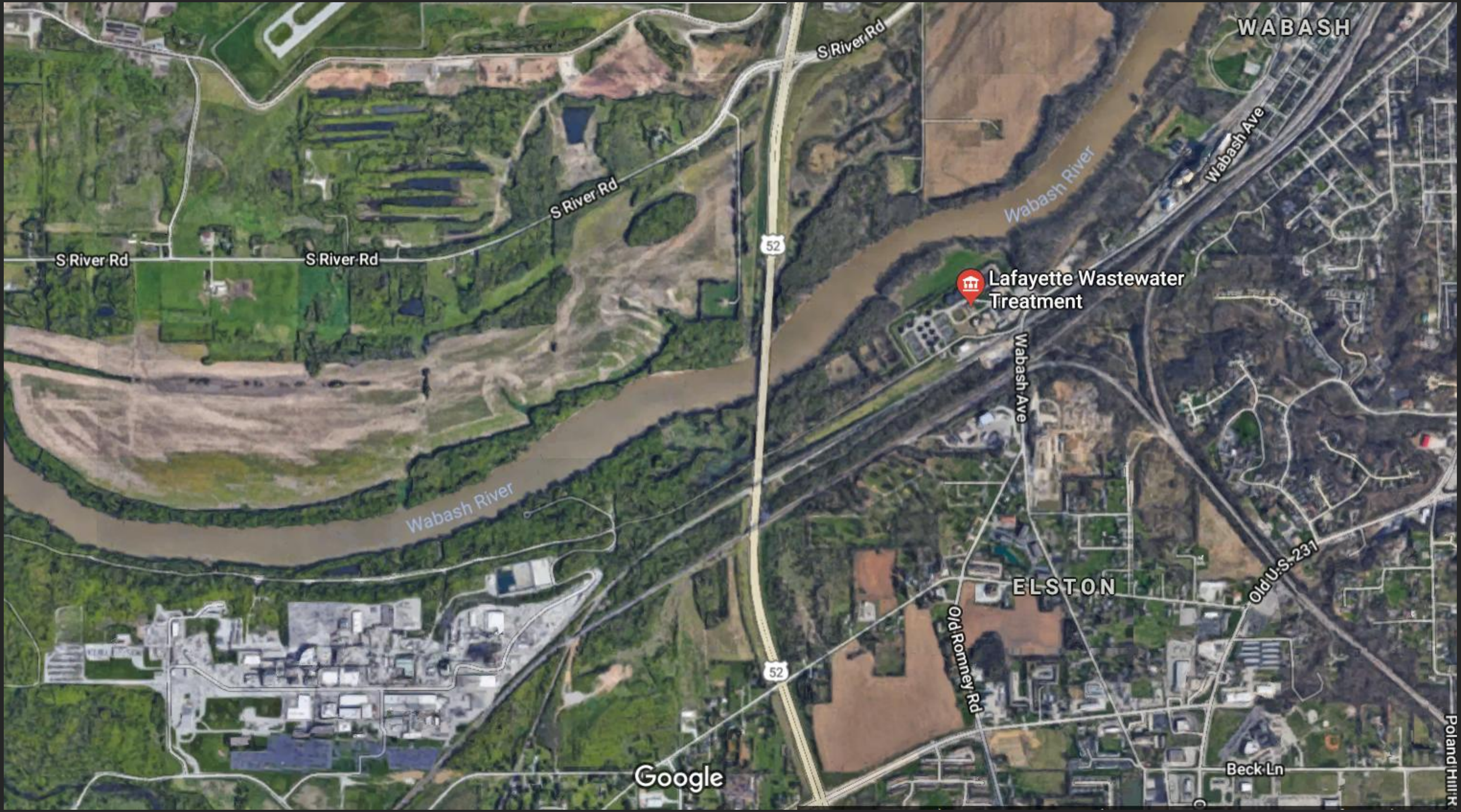
- Stewards of the Environment
- Industry Partnership
- Transforming the Community

CITY OF LAFAYETTE

- Economic Resilience
- Assets for Residents
- Beautification

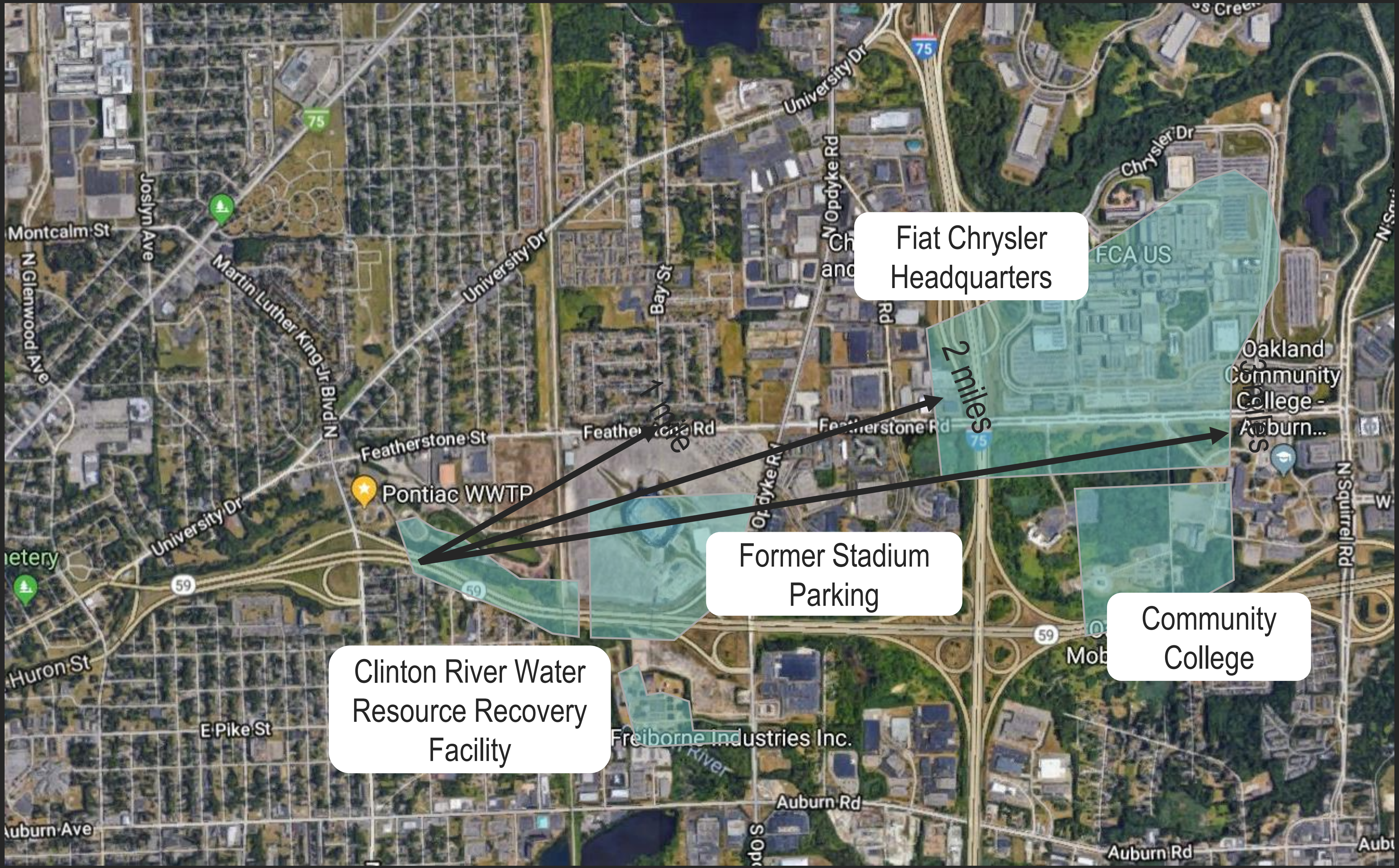
TYLin

Stakeholder Example – Lafayette Renew



TYLin

Potential Stakeholders



Acknowledgements

City of South Bend

– Al Greek, Utilities Director
– Jacob Klosinski, PE, Assistant City Engineer
– Operations and Maintenance Staff

TYLin

Questions?

Mike Debnar

michael.debnar@tylin.com

Joe Dinkel

joseph.dinkel@tylin.com

Katie Richardson

catharine.richardson@tylin.com

TYLin

Thank You

TYLin

For PDH Certificate seekers,

The link to the new on-line course evaluation form has been posted in the Chat. The link is also available on the District website. The form will only be available online until the start of next month's seminar. Please be sure to fill it out and submit promptly.