

BUILDING A WORLD OF DIFFERENCE

Getting the Most Value from Digester Gas

Annual NEWEA Conference
January 30, 2019

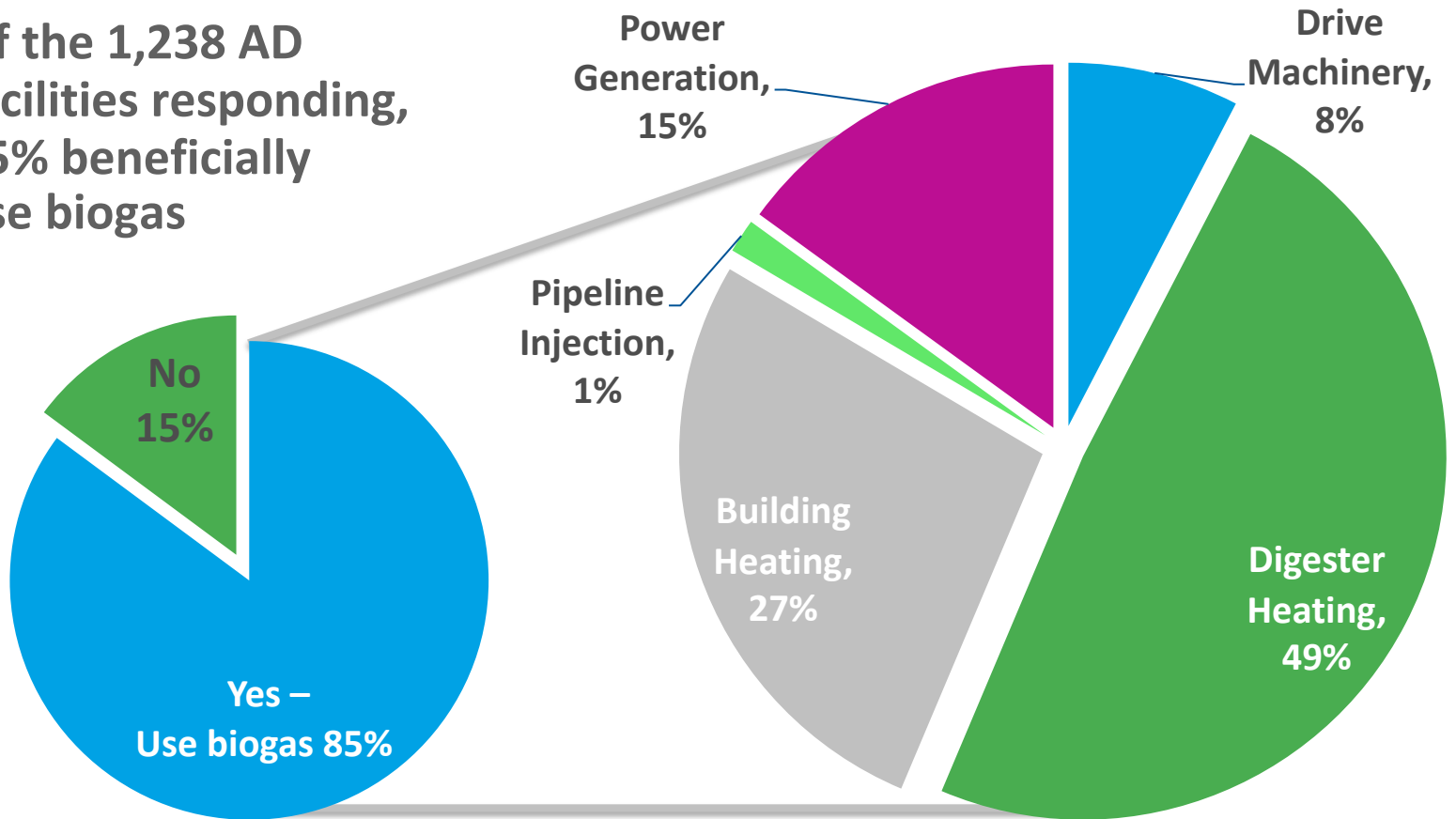
Presentation Agenda

- Uses for Digester Gas
- How do you maximize the value of digester gas ?
- Milwaukee MSD South Shore WRF Digester Gas Treatment
- City of Raleigh Bioenergy Recovery Program
- City of Janesville Digester Gas Utilization System

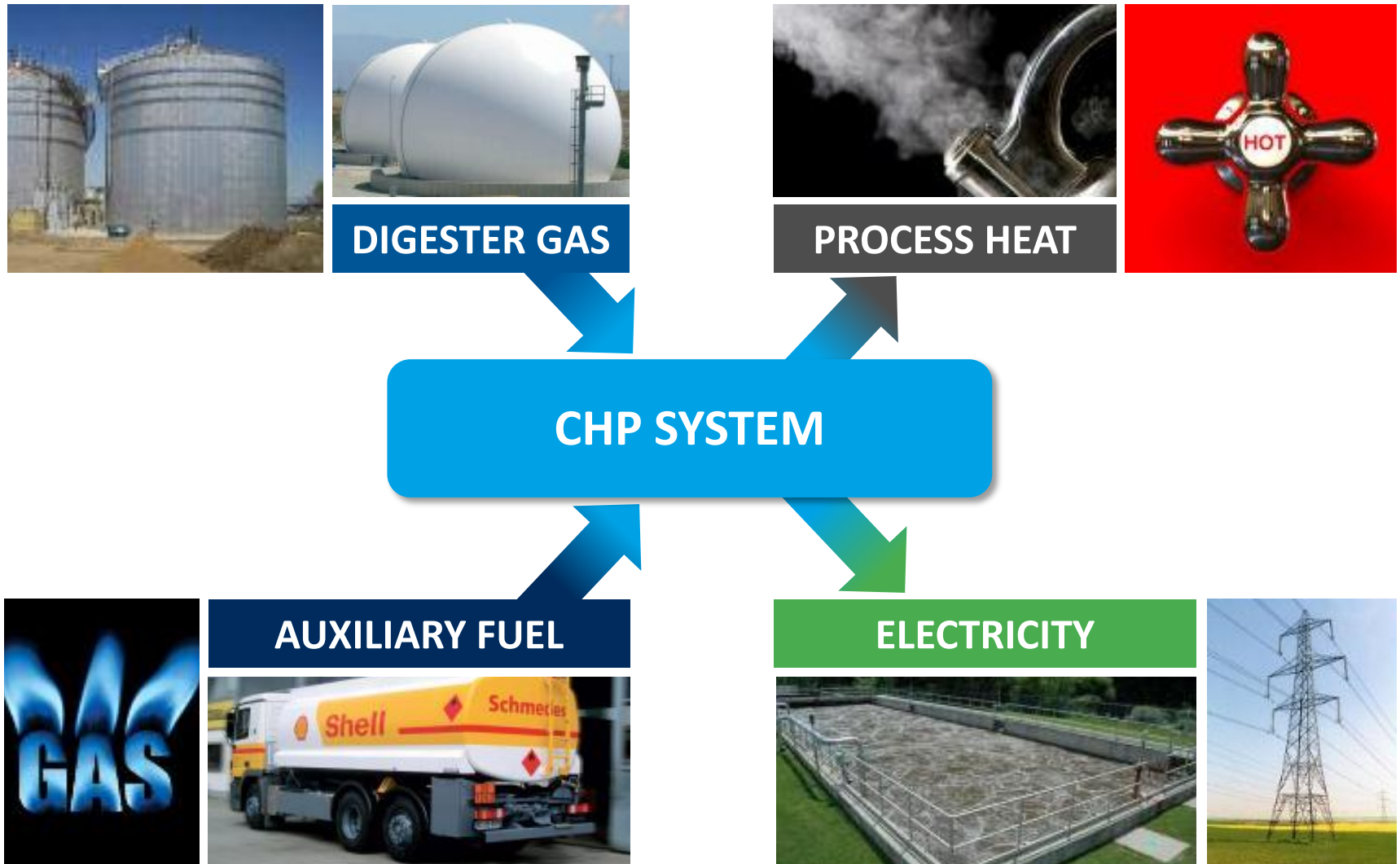


Typical Uses of Biogas-2011

Of the 1,238 AD facilities responding, 85% beneficially use biogas

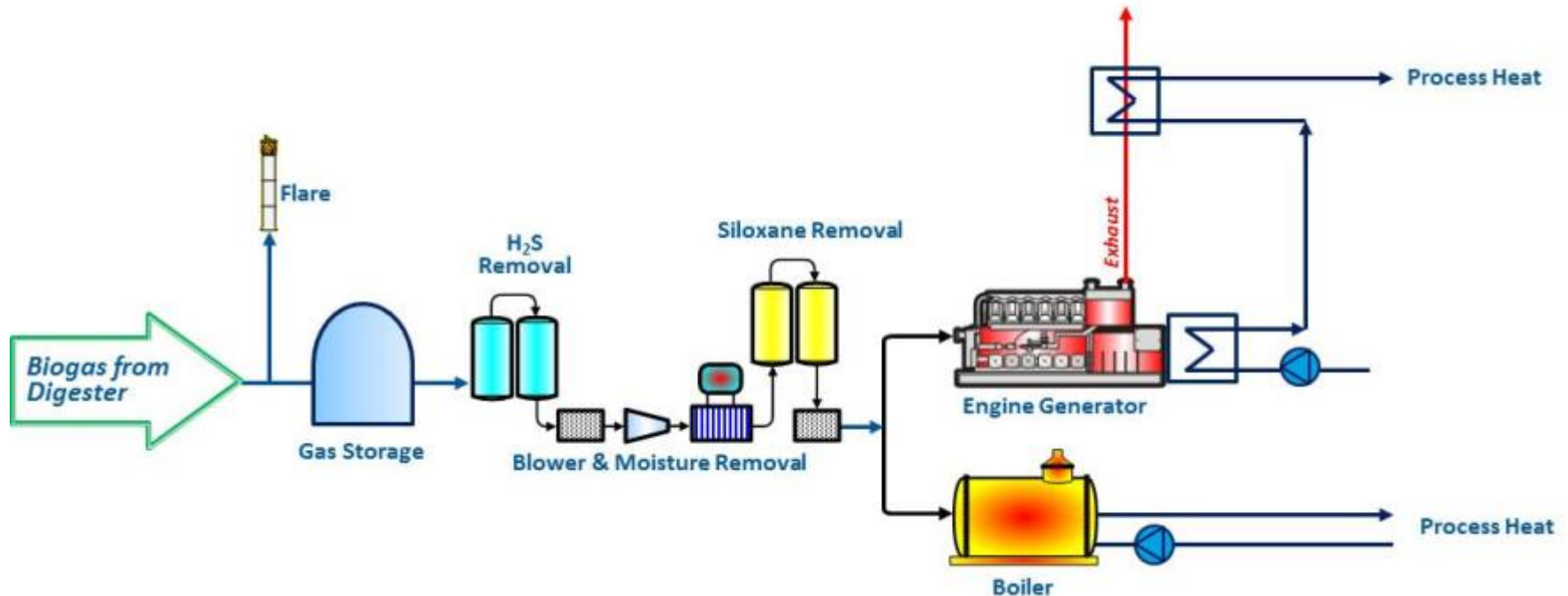


Combined Heat and Power

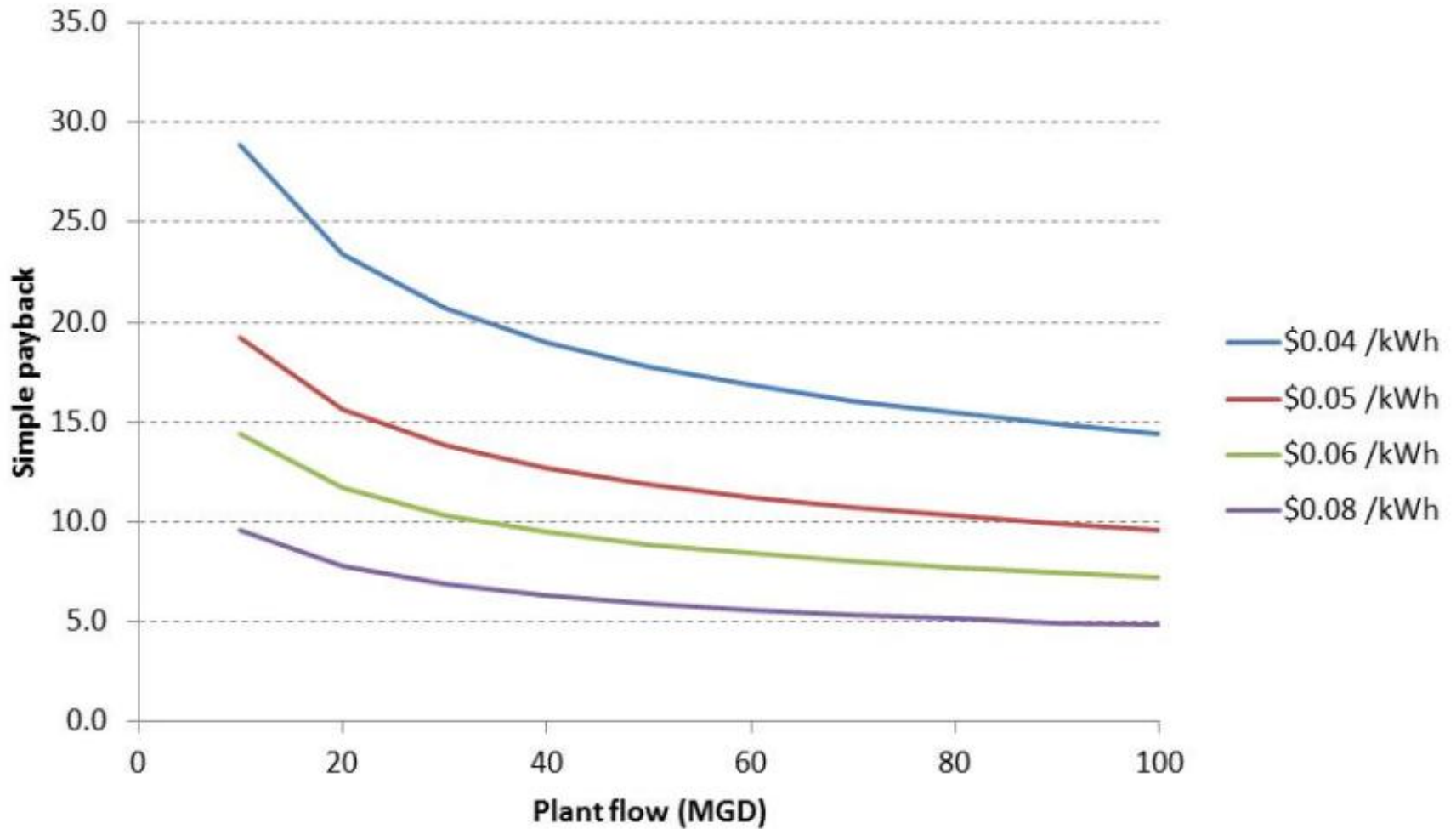


Typical CHP System Configuration

- H₂S Removal
- Moisture Removal
- Siloxane Removal
- Waste heat recovery system



CHP – Cost Viability



Potential Value



1,650 ft³ of digester gas @ 60% methane

1.0 MMBtu=1 Dtherm

Recover 940 ft³ of methane as CNG fuel

8.3 GGE= \$18.26 (\$ 2.20/GGE)

VS

Generate 104 kWh@ \$0.07kWh=\$7.28

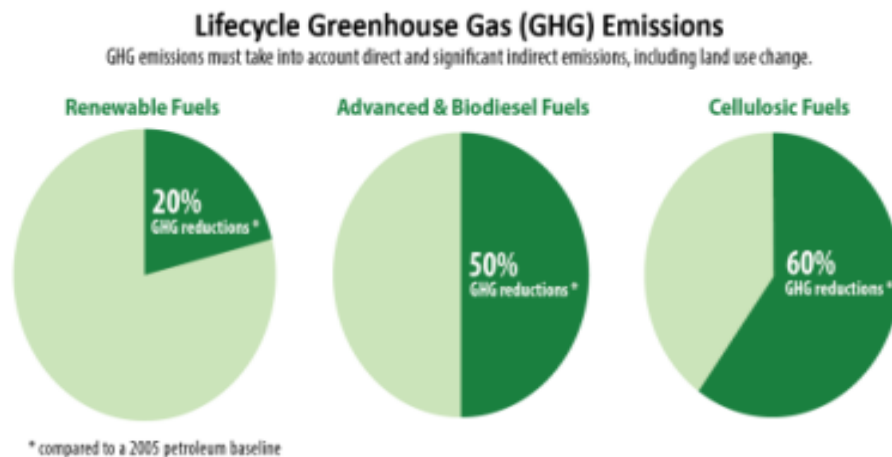
Recover 4.0 therms@ \$0.50= \$2.40

\$ 9.68



Renewable Fuel Standard-Sell gas as vehicle fuel

- Energy value based on natural gas price
 - \$5.00 Dtherm (MMBtu)
- Renewable Identification Numbers (RINs)
 - Renewable transportation fuel-USEPA Renewable Fuel Standard
 - Ethanol-based program (1 RIN= 1 gallon of ethanol= 0.077 Dth)
 - Digester gas is a cellulosic fuel= \$ 2.00/RIN= \$26.00/Dth (!)



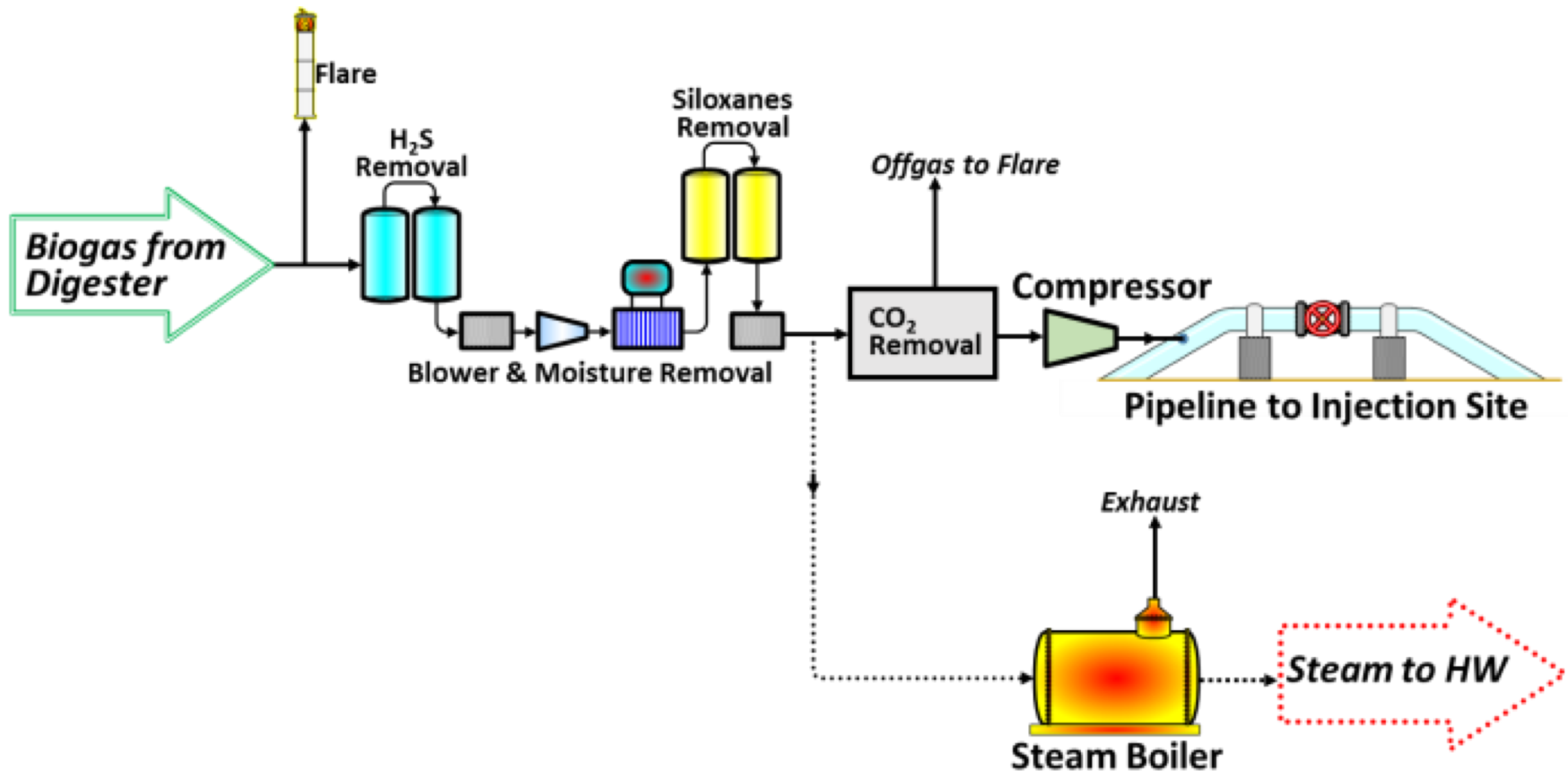
Renewable Natural Gas (RNG)

- Two primary utilization options
 - Pipeline injection
 - Direct Vehicle Fueling
- How do you get the gas to vehicles ?



General System Configuration – Pipeline Injection

- Gas upgrading and compression



Cost of Production- range of O & M costs

- **Basic Gas conditioning- \$1.00- 2.00/ MMBtu**
 - H₂S Removal
 - Moisture removal
 - Siloxane Removal

- **Gas Upgrading- \$5.00-\$8.00/ MMBtu**
 - Add CO₂ Removal
 - Drying



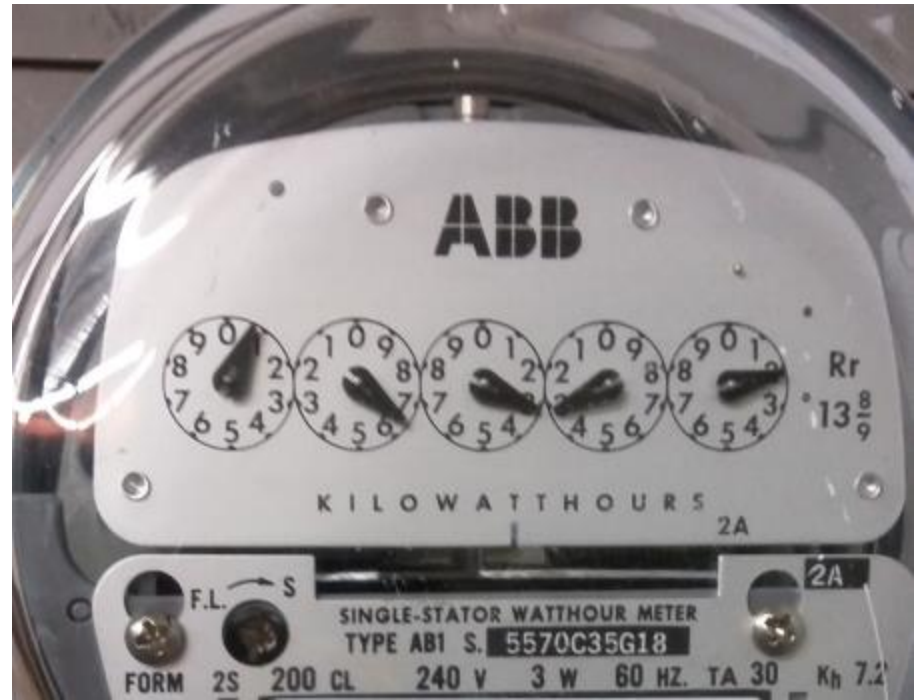
How do you Maximize Digester Gas Value ?

- **Timing**
- **Opportunity**
- **Technology**



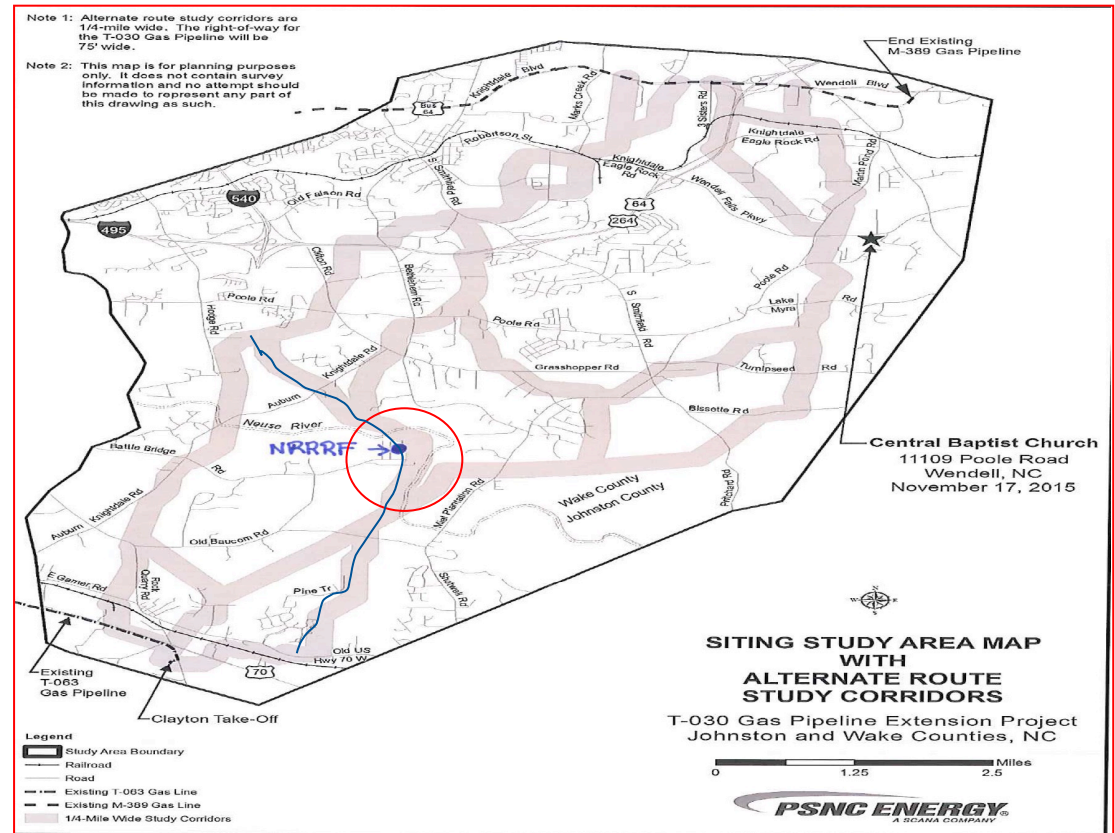
Timing

- Take advantage of time of day electric rates for CHP systems
- Apply for time sensitive grants and incentives



Opportunities

- Local vehicle fuel oftakes
- Utility Pipeline Access
- Local industry use



Technology

- Multiple Use options
- Alternative uses
- Co-digestion to increase gas production



Milwaukee MSD South Shore WRF Digester Gas Treatment Project

Timing is Everything- sort of

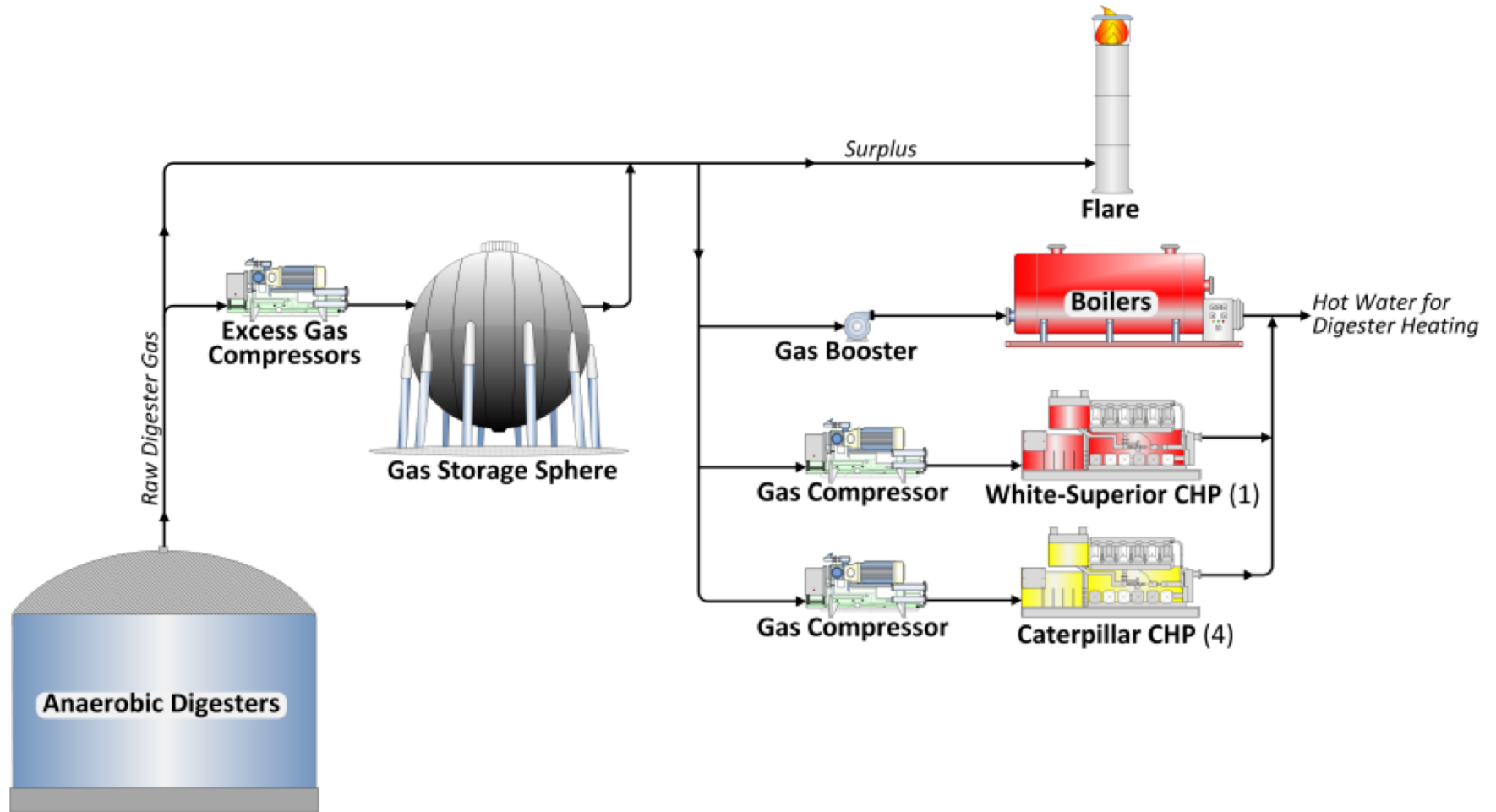


South Shore Gas Utilization System

- 4, CAT 900 kW Engine Generators
- 1, 1,500 kW White-Superior Engine Generator
- Circulating Hot Water Heat Recovery System
 - Jacket Water Cooling
 - Exhaust Boilers
 - Hot Water Boilers
- Pressurized Gas Storage Spheres
- No Digester Gas treatment

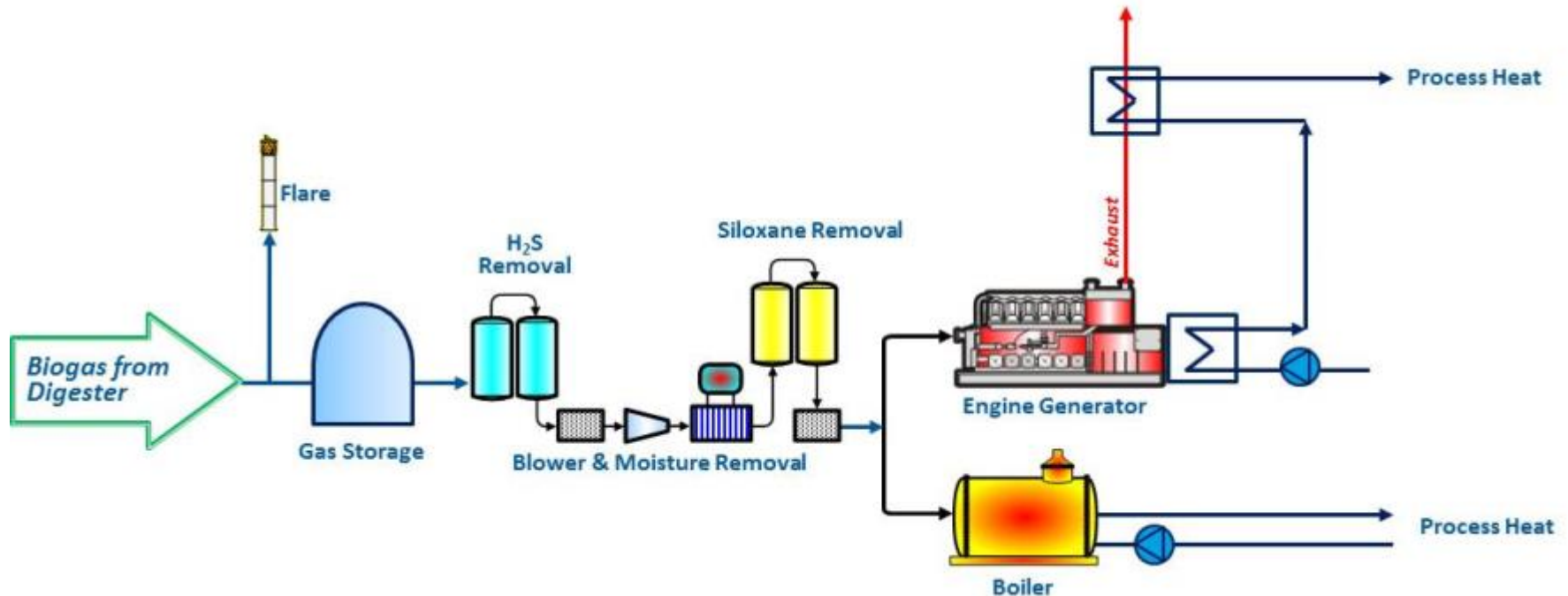


Current Digester Gas System Flow Diagram



Typical CHP System Configuration

- H₂S Removal
- Moisture removal and compression
- Siloxane Removal
- Waste heat recovery system

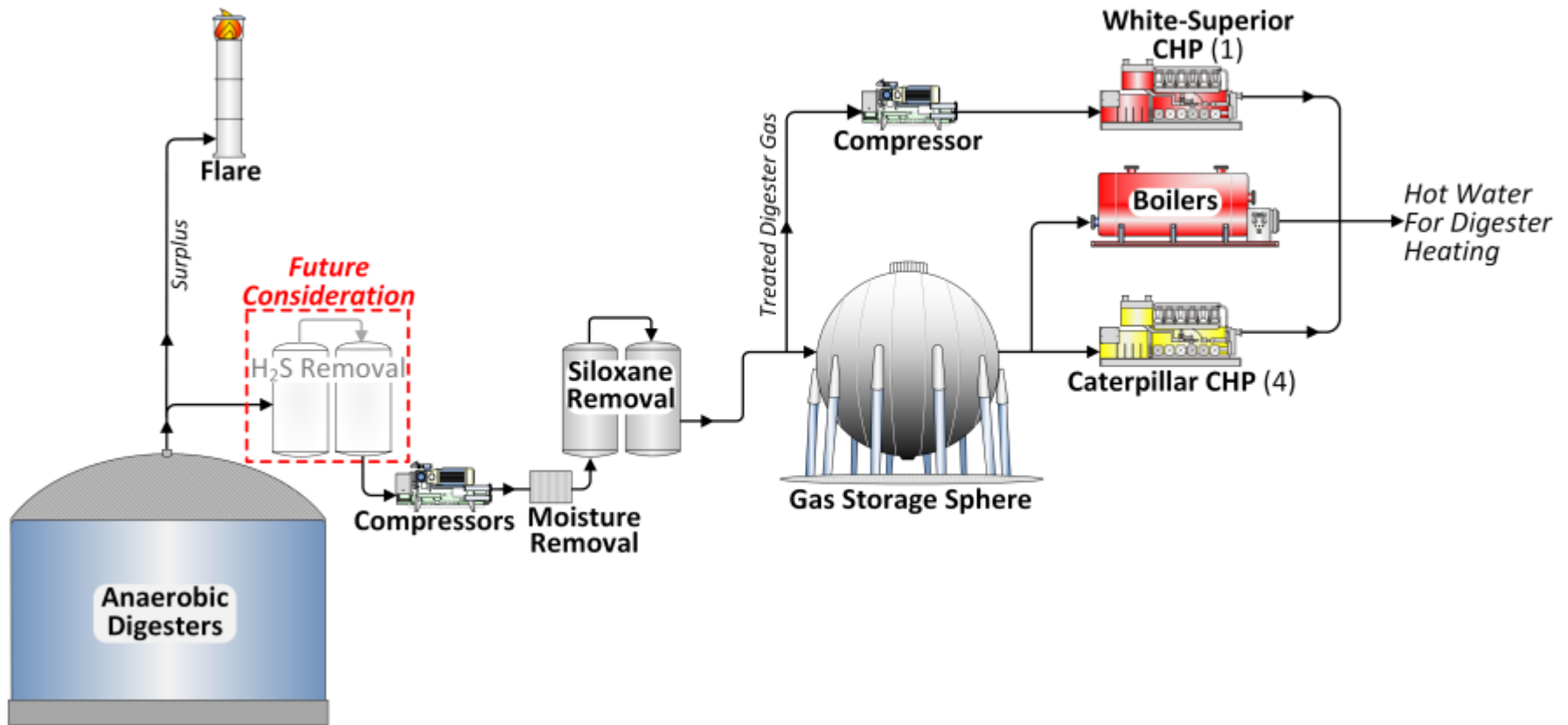


Milwaukee MSD- Gas Treatment Goals

- No liquid moisture in gas train.
- H₂S limit: CAT limit 500 ppmv+/-
 - Gas considered corrosive above 10 ppmv
- Siloxane:
 - Silica deposits cause valve and cylinder head damage; increases wear and maintenance
- Increase engine availability
- Focus on Energy Grant funding



Milwaukee MSD As-designed (in construction)



H₂S < 100 ppm – iron addition for P removal

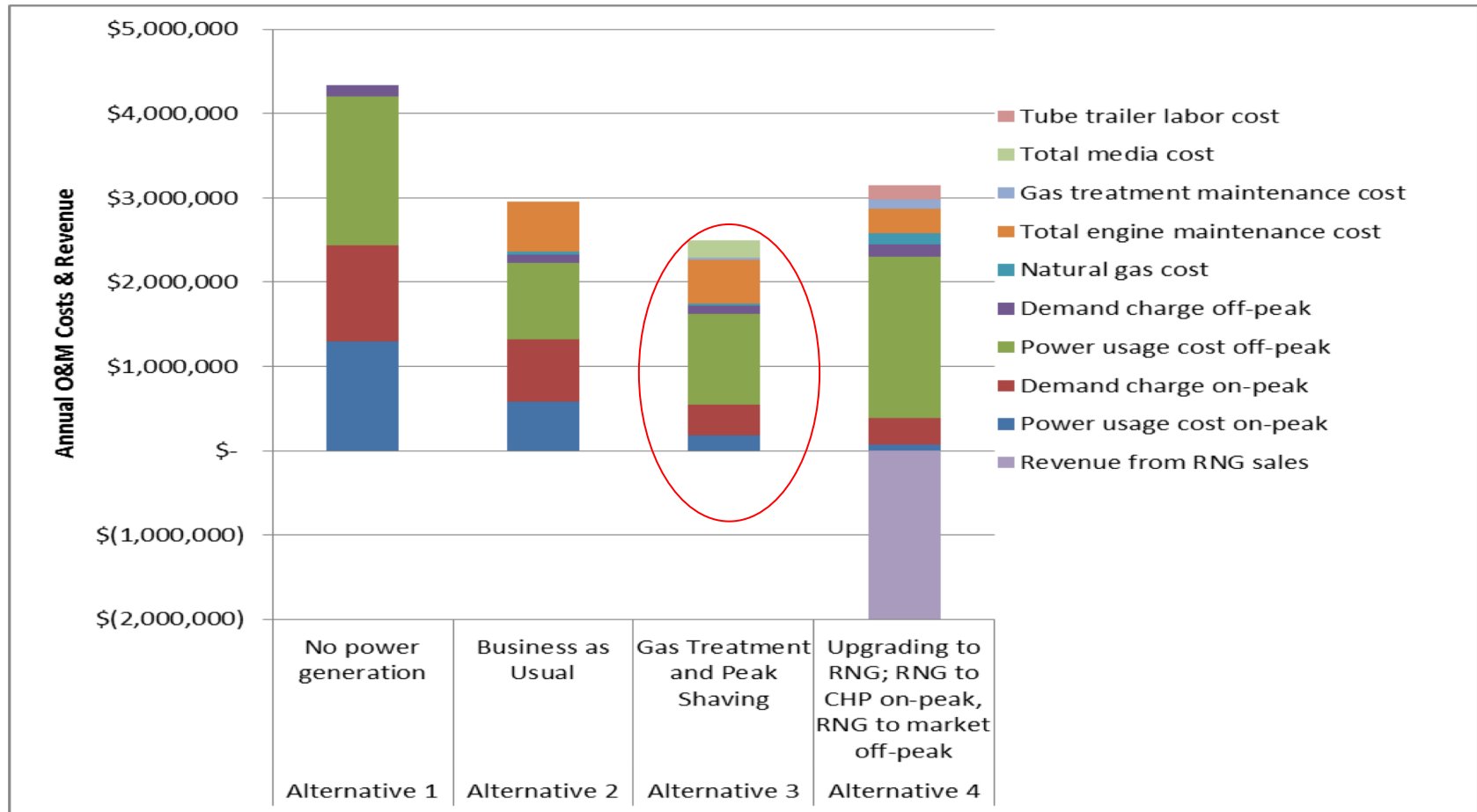


Gas Storage Benefits

- **Good Timing: Increase on-peak use**
 - **Off-Peak Electrical Rate: \$0.053/ kWh energy charge**
 - **On-Peak Electrical Rate-Monday-Friday 10 am-10 pm**
 - **\$0.074/kWh energy charge**
 - **\$14.00/ kW demand charge**
 - **On-peak cost= \$0.126/kWh with level demand**
 - **Actual on-peak cost \$0.146/kWh**
- **Store clean dry gas-ride out compressor downtime**
- **Steady gas flow**



Impact of peak shaving



46% more gas flow on-peak using storage



City of Raleigh Bioenergy Recovery Program

Neuse River Resource Recovery Facility

Opportunity Comes Knocking

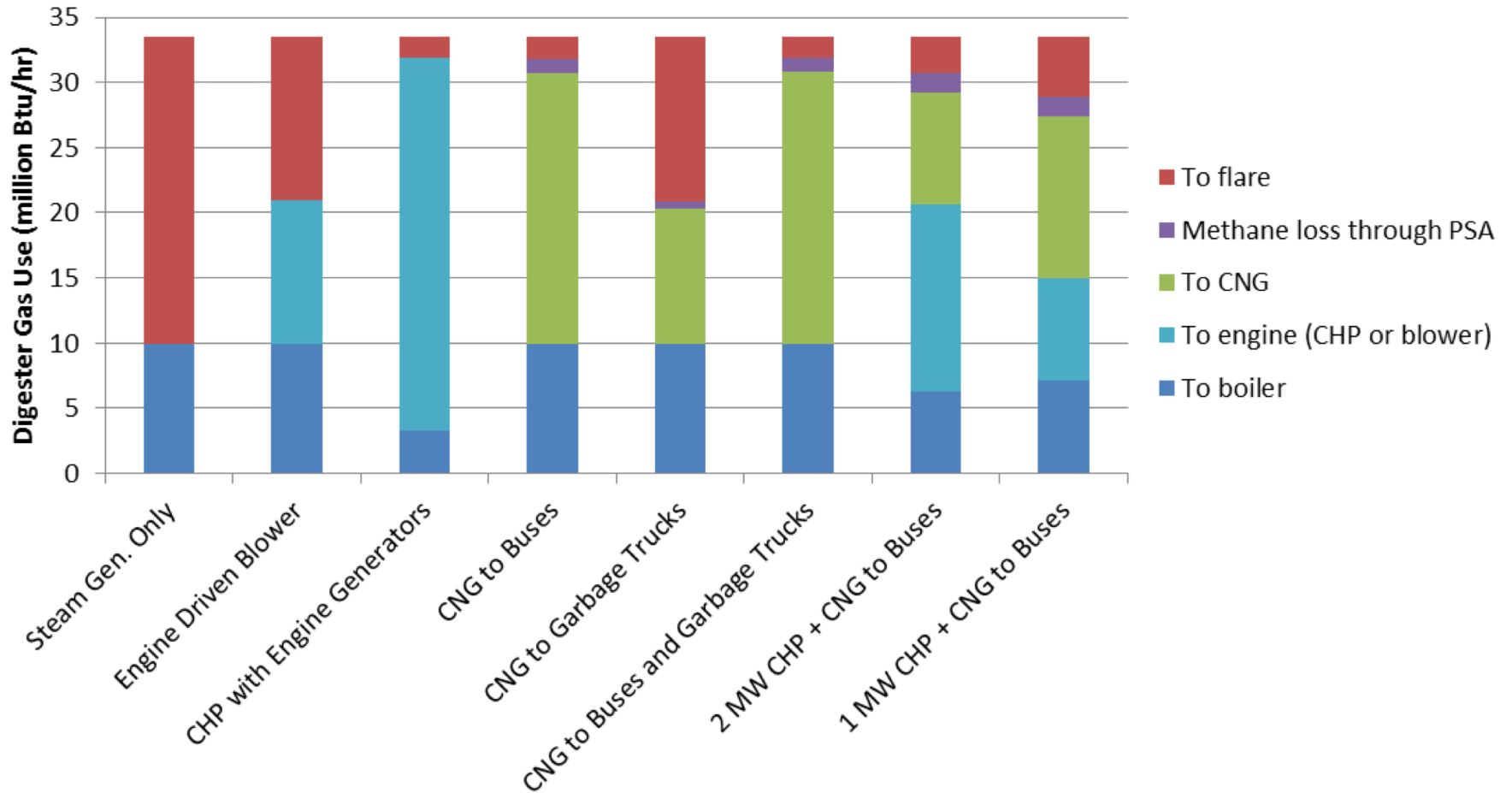


Background

- **New project to replace existing aerobic digestion system with:**
 - Thermal Hydrolysis
 - Anaerobic digestion
 - Gas utilization
 - Sidestream treatment
 - Other associated facilities
- **Capacity:**
 - WWTP: 90 mgd (ultimate)
 - Gas Production: 1,442 scfm
 - Gas Energy: 14,038 KW or 48 mmBTU/h



Results – Biogas Usage



Pipeline Injection Alternative

- **Considerations-opportunities**

- City bus fleet conversion likely > 5 yrs away
- **New PSNC regional gas pipeline on NRRRF Site-**
- Wheel gas to bus fleet- collect RINs

- **New options**

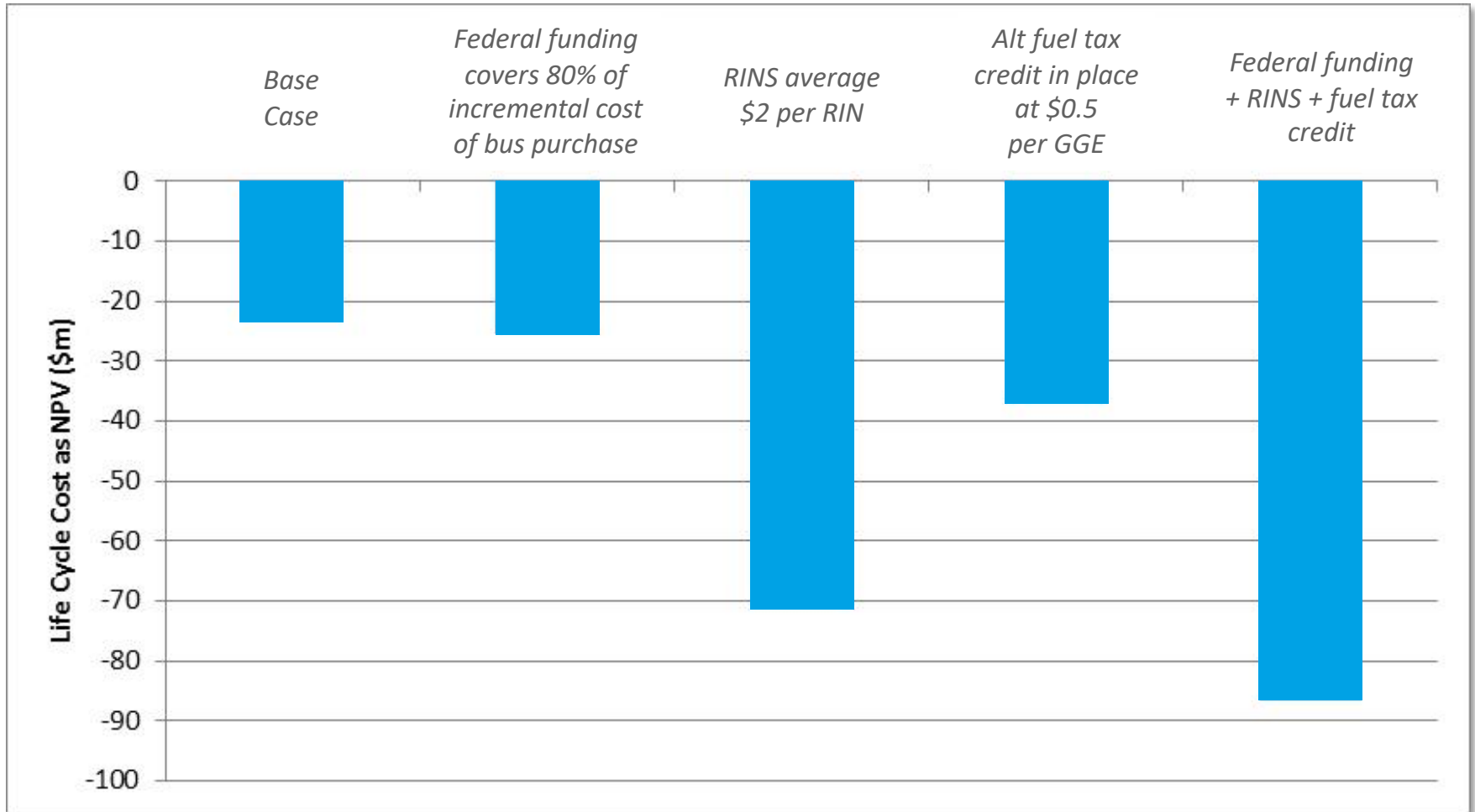
- Direct sale to PSNC
- Third party offtake agreement-facilitate RINs

- **Phased RNG Alternative**

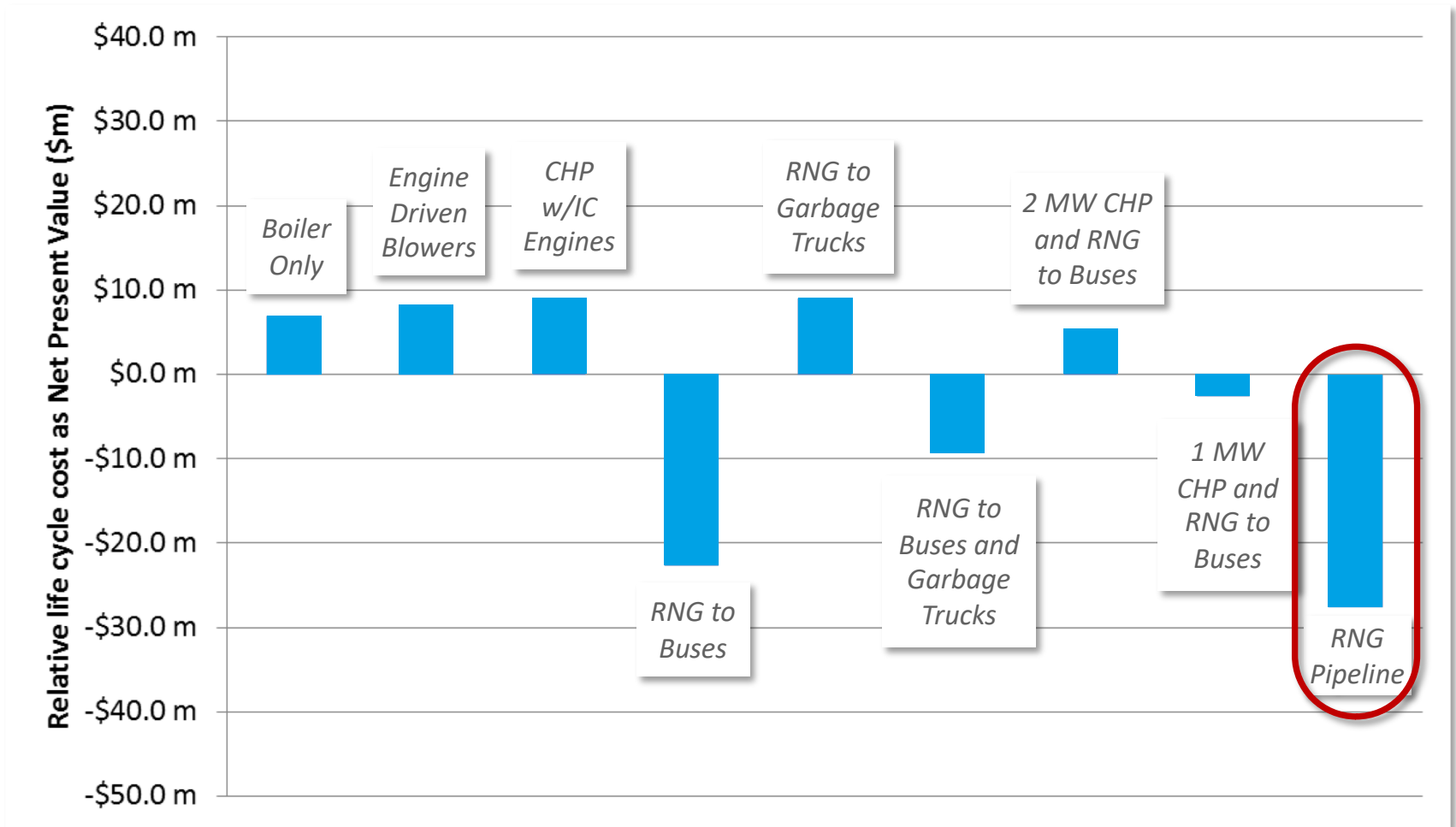
- 1: RNG to pipeline (direct sale or third party offtake)
- 2: RNG to City via third party offtake



City Buses – Cost Sensitivity to Incentives



Results – Net Present Value Comparison



D3 RINs now at \$2.50



City of Janesville, WI Digester Gas Utilization

Technology in search of Opportunity



Janesville, WI Gas Utilization:

- Microturbines replace engine generators
 - Eliminate air permit
 - Grid-connect with feed-in tariff: rates paid by utility
 - \$0.12/ kWh on-peak
 - \$0.074/kWh off-peak
 - Focus on Energy Grants
- CO₂ Removal Add-on
- CNG Fueling Station

Technology and Timing



CITY OF JANESVILLE, WI WWTP

PHASE 1

PHASE 2

(4) CR65-ICHP
Capstone
MicroTurbines



Gas Storage Sphere



BioCNG Add-On



November 2010

January 2012

Summer 2012

140scfm Gas
Conditioning System

July 2011

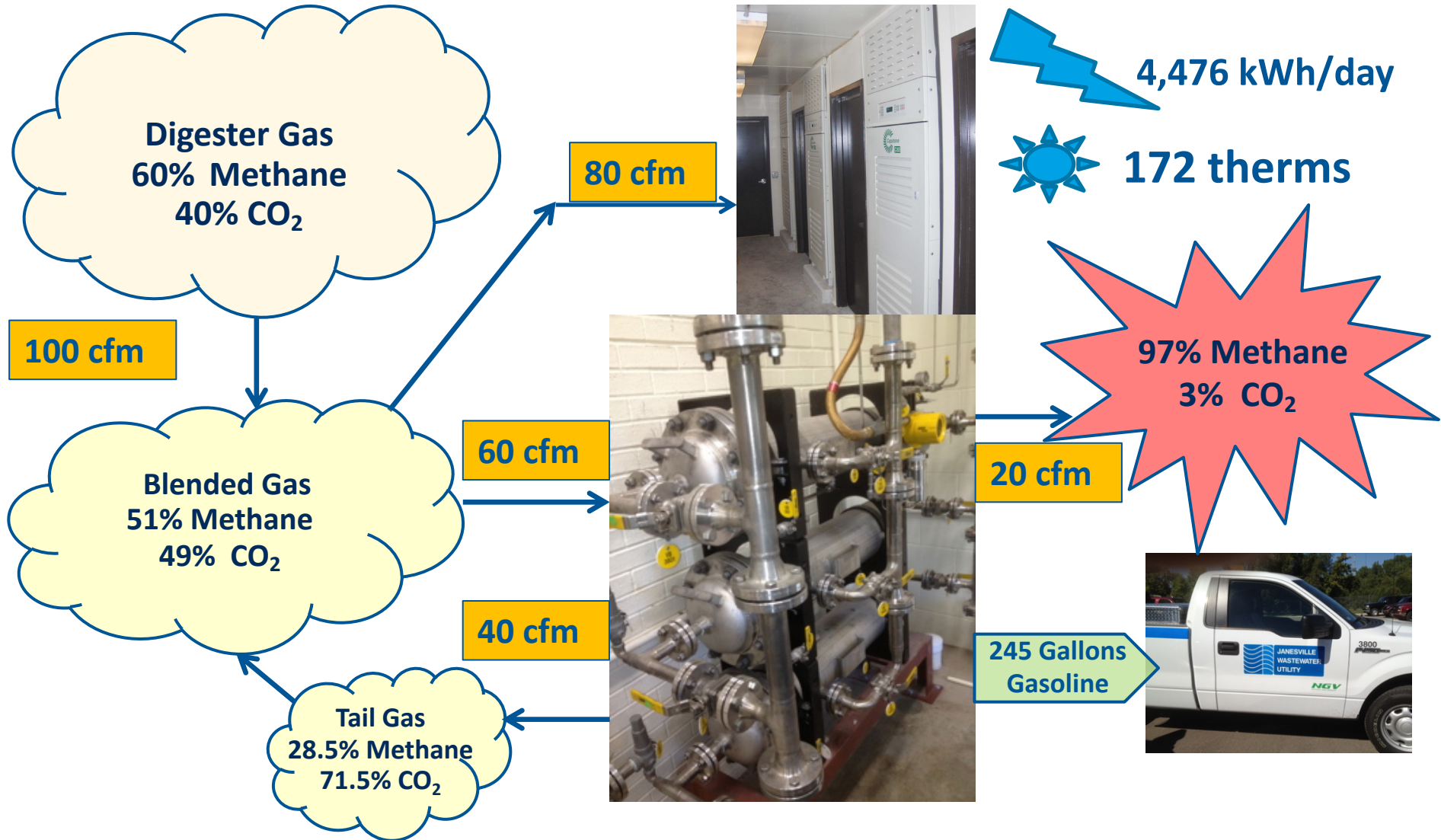
(1) CR200 Capstone
MicroTurbine

March 2012

Vehicle Fueling
Station



CITY OF JANESVILLE, WI WWTP DIGESTER GAS BALANCE- ZERO EMISSIONS- NO METHANE SLIP



Janesville – Next Steps

- Feed-in tariff expires in 2020
- Offset purchased power with CHP system
 - Required electrical mods. in design
- Look for increased vehicle fuel opportunities
 - Dane County, WI public NG injection site
 - Tube trailer to pipeline injection ?
- Monetize RINs

Technology seeks opportunity for beneficial use



Conclusions

- Significant opportunities for biogas utilization exist
- Good timing, recognizing opportunities and employing appropriate technology are essential elements in getting optimal value from digester gas



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