# LMOP Webinar

Don’t Waste the Heat!

**September 28, 2021**

LANDFILL METHANE OUTREACH PROGRAM

# Welcome and Agenda

| Agenda |
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| ***Beneficially Using Engine Exhaust for Onsite Leachate Treatment***<br>Steve Gabrielle, Partner, Energy Power Partners<br>and<br>Casey Cammann, Chief Marketing Officer, Heartland Water Technology |
| ***Sustainable and Energy-Efficient Solutions Turn Landfill Gas and Waste Heat into Profitable Power***<br>Jessie Howell, Sales Manager North America, ElectraTherm |
| **Questions and Answers** |
| **Wrap Up** |

**Mention of any company, association, or product in this presentation is for information purposes only and does not constitute a recommendation of any such company, association, or product, either express or implied, by the EPA.**


Steve Gabrielle
Energy Power Partners

Casey Cammann
Heartland Water Technology


# Beneficially Using Engine Exhaust for Onsite Leachate Treatment

# Cumberland County Improvement Authority

- Location: Cumberland County, NJ Landfill
- 275 acres permitted
- Over 6M tons of waste in place
- Receiving 540 tons solid waste per day

THE AUTHORITY
*Improving your Tomorrow.*

# Early 2018..The Situation

- Landfill generating highly concentrated Reverse Osmosis (RO) concentrate
- Hauling leachate over 40 miles to Delaware
- Over 25 truck trips per week
- Opportunity to utilize waste heat from 3 CAT 3520 landfill gas engines

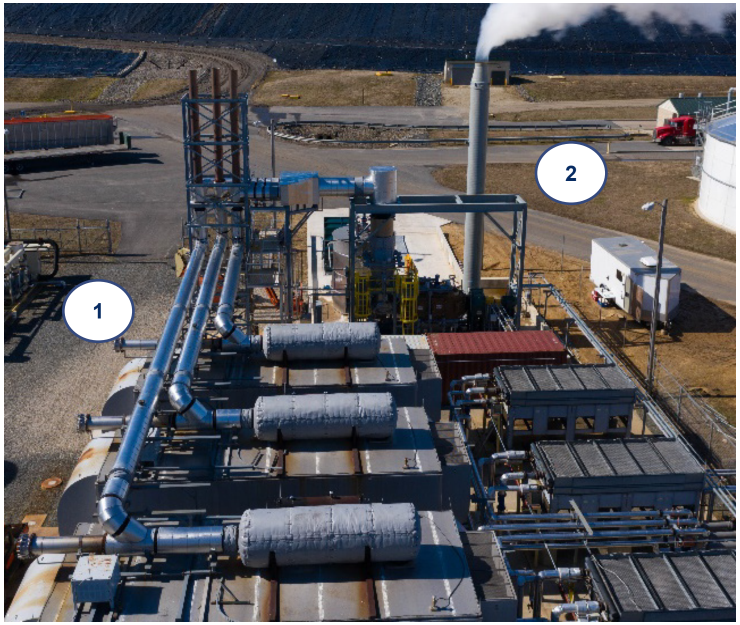
**Team worked together to optimize asset utilization**

*Concentrated Leachate from the RO Plant requires treatment*

*Waste heat available from onsite landfill gas to energy plant*

# Concept: CoVAP™
## Beneficial Use of Engine Exhaust For Onsite Leachate Treatment

- CoVAP™ = Cogeneration for industrial wastewater evaporation
- 900° F engine exhaust
- Exhaust from three engines ducted together and transferred to Heartland Concentrator
- Concentrated leachate is evaporated
- Jacket water from the engines is used to heat bio tanks that feed the evaporator
- Improve efficiency of the plant and reduced the carbon footprint for the authority




*(1) Hot generator exhaust gas is ducted together to provide thermal energy for evaporation in the Heartland Concentrator™ (2)*

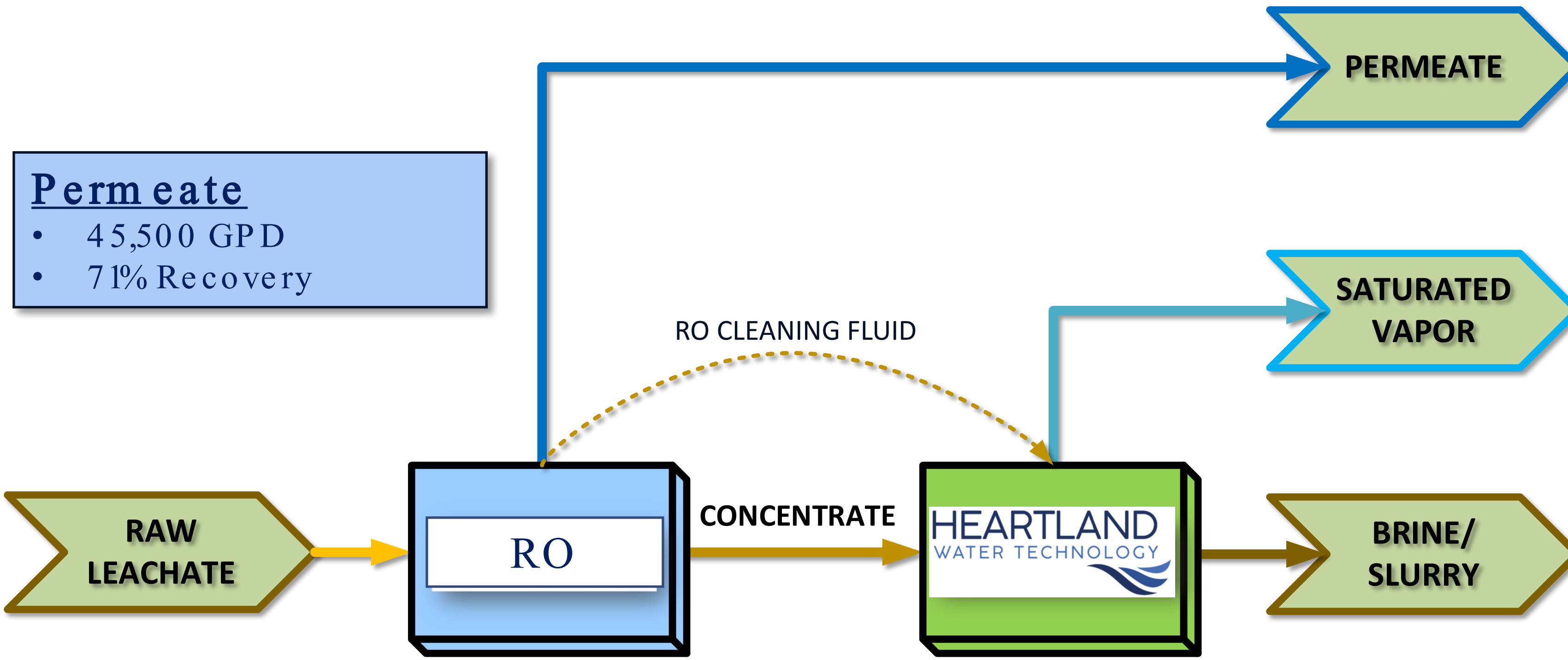
# Onsite pilot

## To prove concept the team completed a successful 5-day pilot

- Processed over 5,050 gallons of The Authority's RO Concentrate, using Heartland's 1,000 GPD pilot Concentrator.
- The trial achieved volume reduction targets, yielding 332 gallons of residual slurry
- During the trial, the Concentrator did not shutdown and required no maintenance. It was automatically self-controlling, which included overnight unattended operation.
- The concentration, precipitation, and management of solids through the Concentrator to the final residual tote were performed successfully; no degradation of performance was observed.

# The Project

**Combined 98% Volume Reduction**




**Permeate**
- 45,500 GPD
- 71% Recovery

**Raw Infeed**
- 64,100 GPD

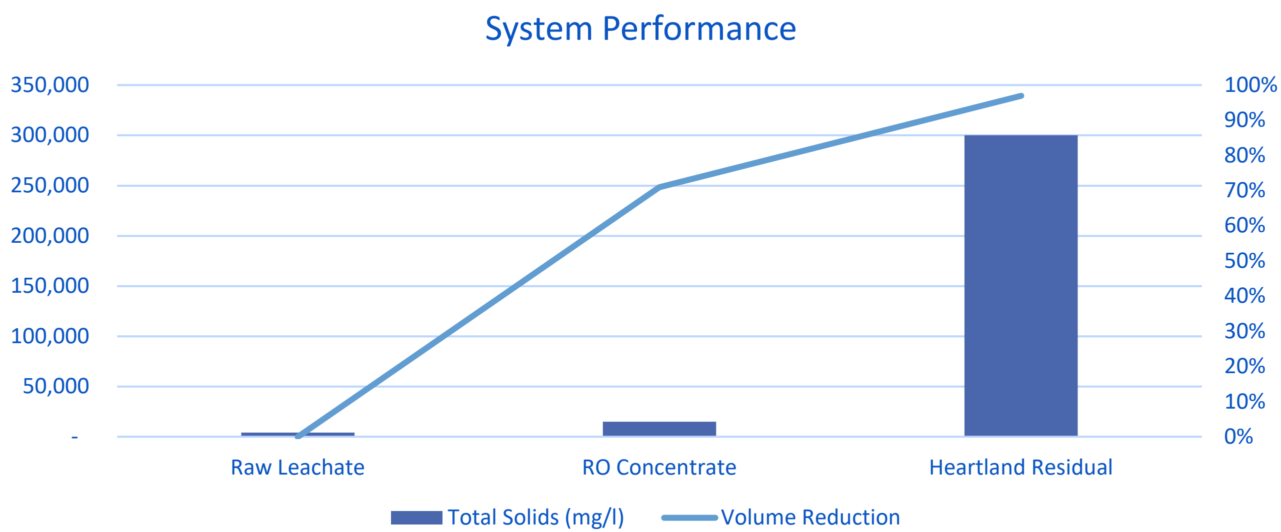
**RO Concentrate**
- 18,600 GPD

**Residual Concentrate**
- 940 GPD
- >98% Vol. Reduction

System Performance Daily Average
June to August 2021

# Integration of the Landfill Gas Engine Exhaust

# System Performance




- >98% system volume reduction
- Generates concentrated residual with over 300,000 mg/l TS
- Engine Thermal Efficiency improvement from 36% to 76%

## Engine Thermal Efficiency

| | Exhaust Loss | Jacket/Other Loss | Electric Output | Recovered Jacket | Heartland Concentrator | Thermal Efficiency |
|---|---|---|---|---|---|---|
| Prior to Project | 36% | 28% | 36% | | | **36%** |
| After Project | 0 | 24% | 36% | 4% | 36% | **76%** |

# Financial and ESG Benefits for the Authority


- Thermal efficiency increased
- Beneficial reuse of waste heat
- Removed trucks from the road
- Reduced Carbon Footprint
- Positive Community Relations
- Significant leachate volume reduction
- Annual cost savings 20-25%

# Thank you!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# SUSTAINABLE AND ENERGY EFFICIENT SOLUTIONS

# **TURN LANDFILL GAS AND WASTE HEAT INTO PROFITABLE POWER**

Engineering world-class ORC heat to power generation systems since 2005.

ElectraTherm
BY BITZER GROUP

# ABOUT ELECTRATHERM

ElectraTherm
BY BITZER GROUP

Established in 2005, we are a global leader in low temperature waste heat recovery, providing simple and effective solutions that boost efficiency while reducing energy costs and emissions.

By using utilizing an Organic Rankine Cycle (ORC) along with proprietary technologies, our heat recovery systems generate up to 125 kW of clean electricity from heat sources as low as 70°C. There are no additional emissions or fuel consumption and the power generated is ready immediately.

ElectraTherm's heat recovery solutions are modular, scalable, and robust so you can use them however, whenever, and wherever you need to.

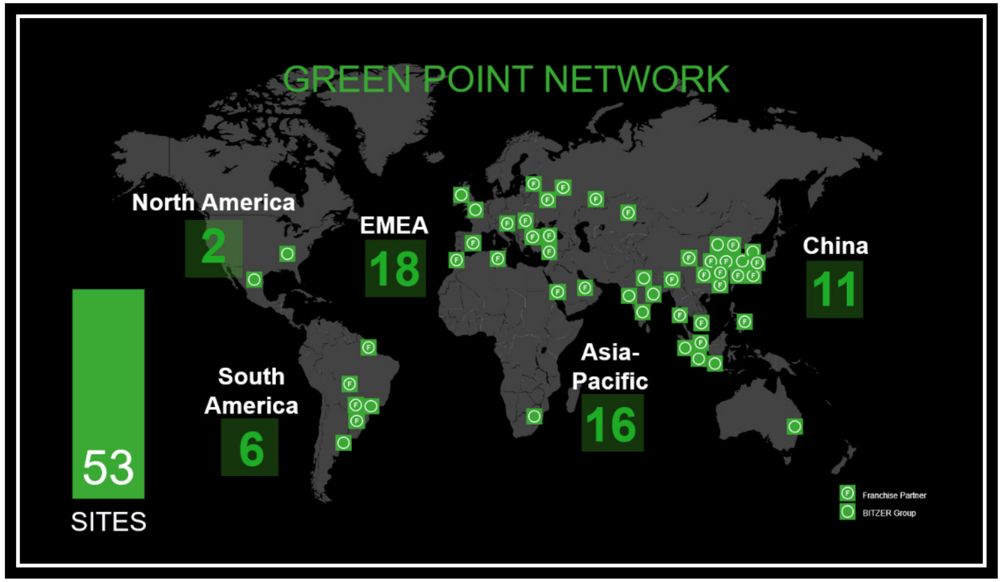
# ABOUT BITZER GROUP

In 2016 ElectraTherm was acquired by BITZER, the world’s largest manufacturer of refrigeration compressors, the centerpiece of our waste heat recovery technology.

BITZER is represented across the globe, with 3,400+ employees generating sales approaching $1 Billion.

The combined advantage of ElectraTherm’s engineering along with the value of being supported by such a reputable company allows us to dedicate all our energy to the advancement of our technology in the marketplace. With BITZER’s support, we can keep the bigger picture in mind.

BITZER’s semi-hermetic twin screw expander, centerpiece of the ElectraTherm ORC system.

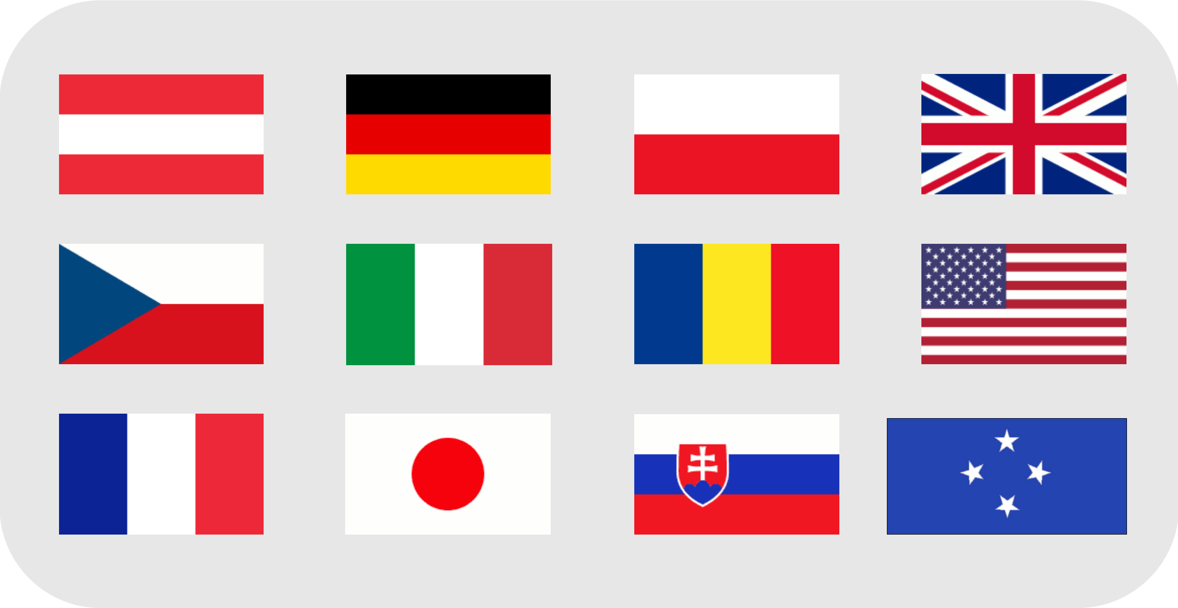


# FLEET OVERVIEW

ElectraTherm
BY BITZER GROUP

After years of research and development the Power+ Generator saw a successful commercial release in 2011.

- // **100+** applications worldwide
- // Operating in **13** countries
- // **1,700,000+** operating hours
- // Fully supported worldwide by **BITZER Greenpoint**



# METHANE OPTIMIZATION

For industries dealing with natural gases – landfill or wastewater treatment gases – integrating an ORC heat recovery system provides a reliable baseload power supply that boosts engine efficiency, decreases energy / fuel costs, and could even eliminate flaring.

## HOW IT WORKS

// Engines and boilers are extensively used to provide power to landfills and heat to wastewater treatment plants.

// Typically, the boilers only work for a small portion of the time, when the site calls for heat.

// An ORC heat recovery system, such as the Power+ or Active Cooler, produces power and consumes hot water 24/7.

// By increasing hot water production, power output can be maximized and flares can be 100% eliminated.

// This not only reduces emissions but creates a sustainable baseload power supply.

# FLARE ELIMINATION

## THE PROBLEM

Flaring is the open-air burning of natural gases – commonly occurring in biogas production, landfills, wastewater treatment, and during oil extraction.

// Flaring releases large amounts of greenhouse gases that are major contributors to global warming.

// Flaring is a waste of a natural resource. Due to the difficulty associated with storing and transporting natural gases at oil plays, the easiest choice is to burn it off.

// Recent government programs incentivize the reduction of flaring while beginning to impose fees for those in violation.

// Flaring has a negative impact on the environment and health of those nearby. Prolonged exposure can cause headaches, dizziness, weakness, nausea, and vomiting.

# FLARE ELIMINATION

## SOLUTION & RESULTS

ElectraTherm
BY BITZER GROUP

Working in tandem with a boiler, the ElectraTherm Power+ Generator is fueled by gas that would otherwise be flared. This results in the combined output of both power and heat with no additional fuel consumption or emissions.

After completing a 2,000-hour product demonstration at a HESS oil well in the Bakken, the Power+ Generator showed to have an on-stream reliability greater than 98% and showed to be effective in reducing emissions of carbon monoxide by 98%, nitrogen oxide by 48%, and VOCs by 93%.

HESS

// Reduce or eliminate flaring, lowering emissions

// Exceed air quality and EPA emission standards

// Generate power for pumpjack, controls, wellhead

// Generate heat for heater/treater and oil flow

# PORT RICHMOND
# FIRST WWTP INSTALLATION

ElectraTherm BY BITZER GROUP


PORT RICHMOND, STATEN ISLAND, NY

New boilers use a combination of biogas and natural gas, and replace equipment dating to the 1970s that ran on heating oil.

By capturing the flared biogas and using it in the plant's operations and lowering the reliance on fossil fuels, greenhouse gas emissions will be significantly reduced.

*Location site: on rooftop, above boiler room*

ElectraTherm
BY BITZER GROUP

## WWTP/Landfill Gas Example:

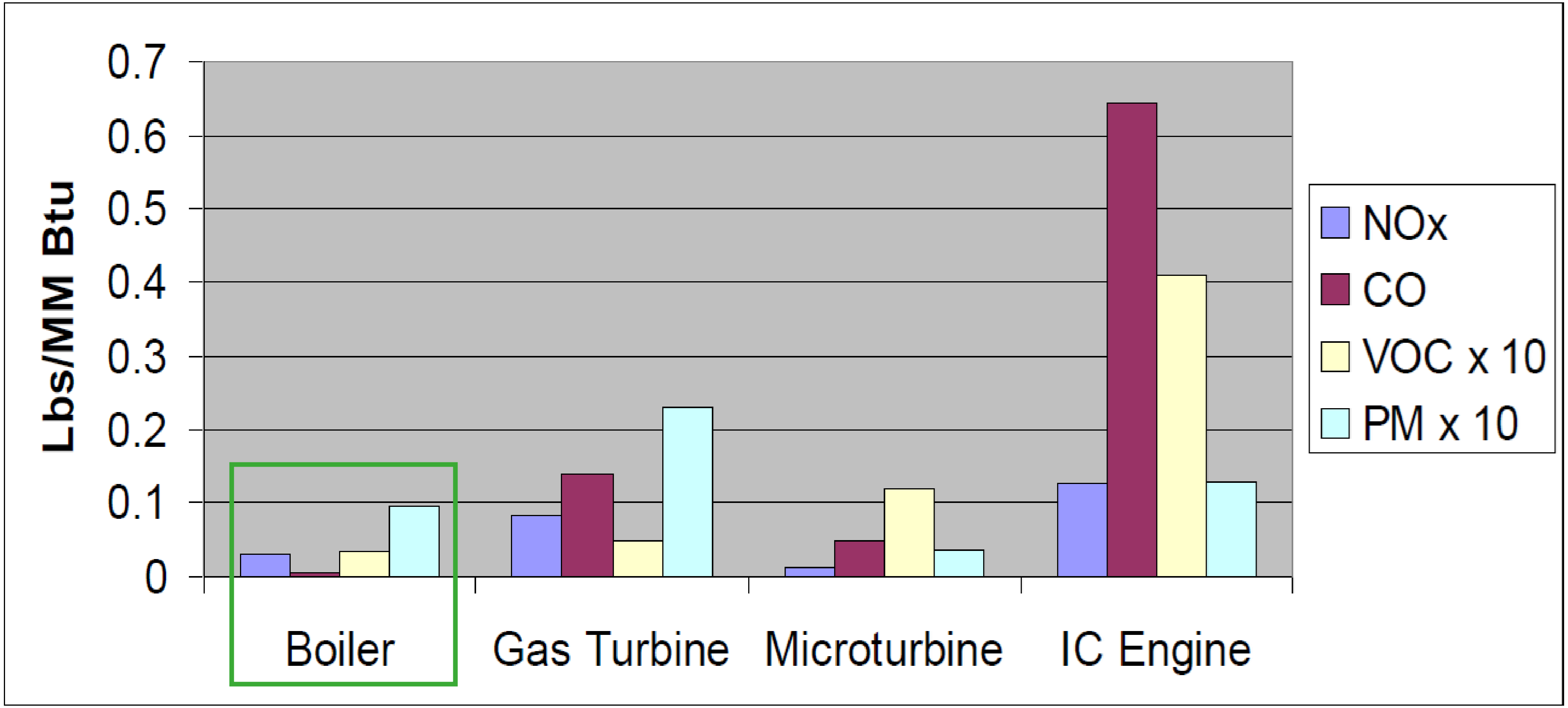
Gas Boiler

Hot Water

POWER+ 4400B


kWh Power Output

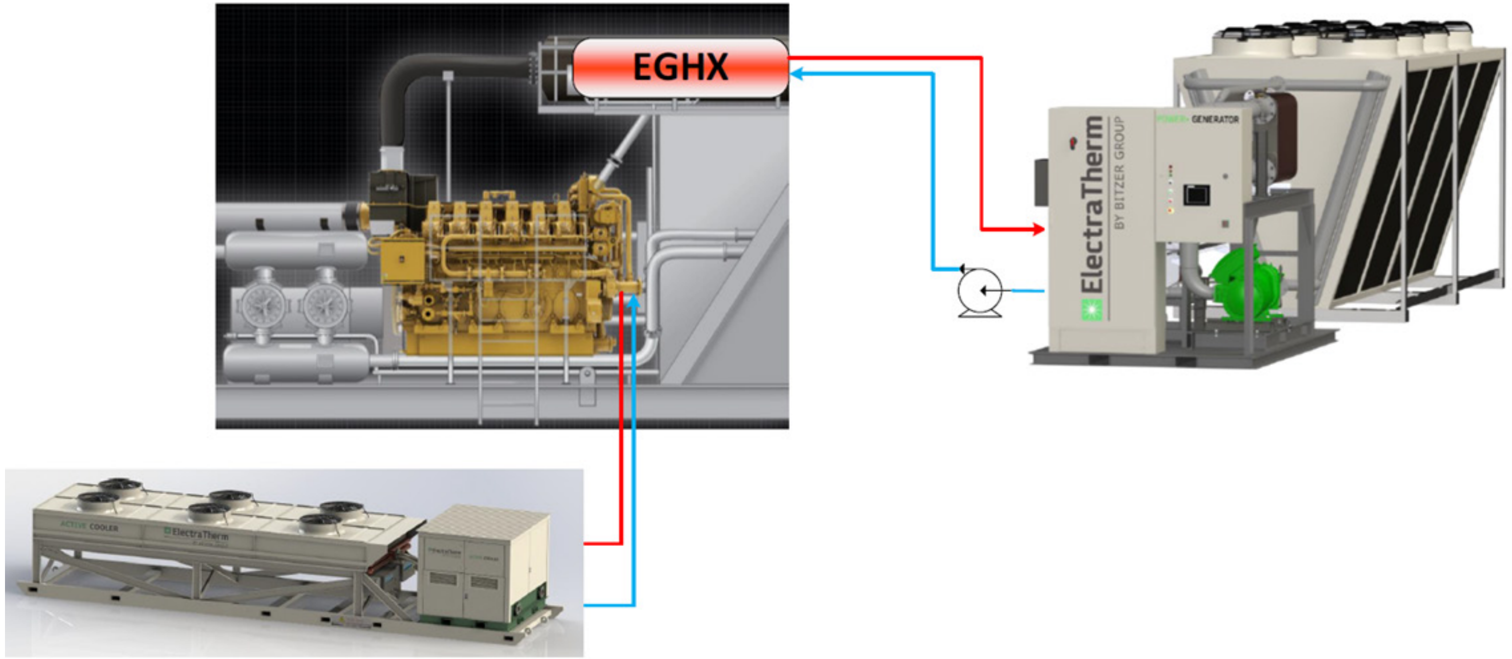
# EMISSIONS COMPARISON AMONG BIOGAS ELECTRICAL GENERATION TECHNOLOGIES




Source: http://ocacs.sites.acs.org/resources/OrellanaPresentn_BiogasEngines.pdf

ElectraTherm BY BITZER GROUP

Heat from the jacket water in reciprocating engines can be used for power production, exhaust heat from engines and turbines can act as a great heat source as well.




**Simple solution for immediate action**

# ACTIVE COOLER

## COOLING TO POWER

ElectraTherm
BY BITZER GROUP

All engines produce heat. All radiators consume power. Having to cool your system results in losses of efficiency, increased energy costs, and increased emissions.

By using the excess heat produced instead of expelling it, the Active Cooler generates clean electricity while providing 100% full-load cooling capabilities for the site – with no additional energy costs. It's the radiator with a payback.

### 800 KW ENGINE APPLICATION

- 8,500 operating hours per year
- Parasitic Cooling Load (Eliminated): 8 kW (68 MWh per annum)
- Newly Available Power (Net): 43 kW (365 MWh per annum)
- Efficiency Increase: ~5.4%
- Radiator Cost: $6,800 per year at $0.10/kWh
- Active Cooler Savings: $36,500 per year at $0.10/kWh
- Total Annual Savings: $43,300

# HOW IT WORKS

ElectraTherm BY BITZER GROUP

ElectraTherm's heat recovery system uses a closed-loop Organic Rankine Cycle (ORC), taking advantage of the change in temperature in order to generate electricity.

1) Surplus heat is used to boil refrigerant in the evaporator.

2) Under pressure, the vapor is forced through a twin-screw expander, spinning an electric generator which then produces power.

3) The vapor is then cooled and condensed back into a liquid in the condenser.

4) The refrigerant is pumped to higher pressure and returned to the evaporator.

# EXPANDER ADVANTAGES

ElectraTherm
BY BITZER GROUP

Unlike most other ORC technologies, our method utilizes a twin-screw expander instead of a turbine. This leads to numerous benefits such as higher turndown rations and transient operations.

// Turbines typically have rotational speeds close to 10,000 rpm. Our twin-screw expanders have rotational speeds between 1,800 and 4,900 rpm – leading to significantly less wear and tear as well as noise reduction.

// Unlike high-speed turbo expanders, our twin-screw expander can tolerate “wet” dual phase flow. This means our system can accept disruptions in both temperature and flow, while even allowing for a turbine’s worst nightmare – *moisture*.

// Our ORC solutions are simple and compact, much less labor intensive than the leading turbine technologies. This translates to less maintenance and less down time, making for a smoother power generation experience.

# ELECTRATHERM PRODUCT LINE

ElectraTherm
BY BITZER GROUP


**POWER+ GENERATOR**

6500B / 6500 B+
Up to *150 kWe


**POWER+ GENERATOR**

4400B / 4400 B+
Up to 75 kWe


**ACTIVE COOLER**

AC-800 (800 kWth)
// Up to 75 kWe

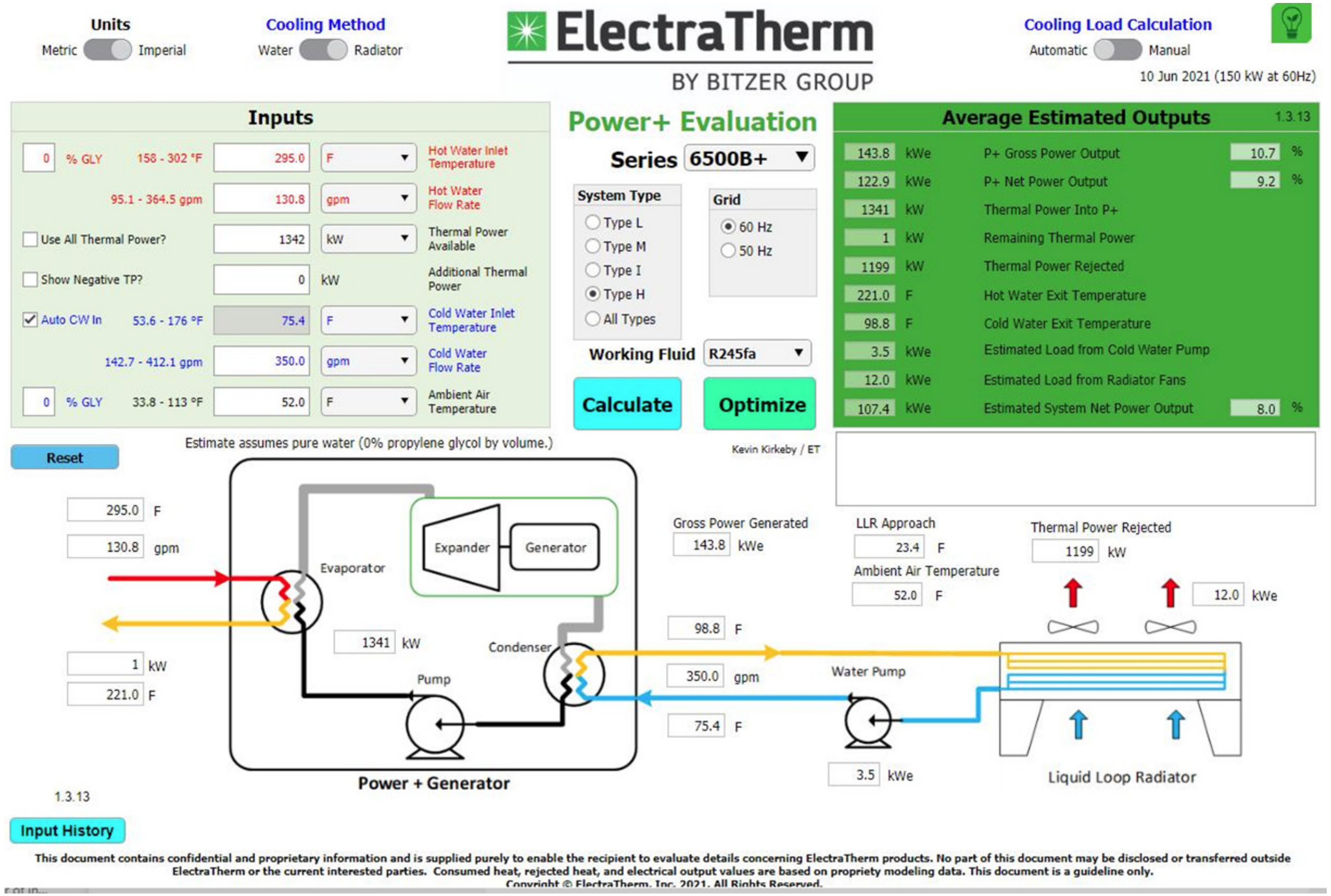
AC-1800 (1800 kWth)
// Up to 125 kWe

*60 Hz grid system only; 50 Hz is 125 kWe maximum

# LMOP data Flare Elimination examples
# Virginia Landfill

ElectraTherm
BY BITZER GROUP

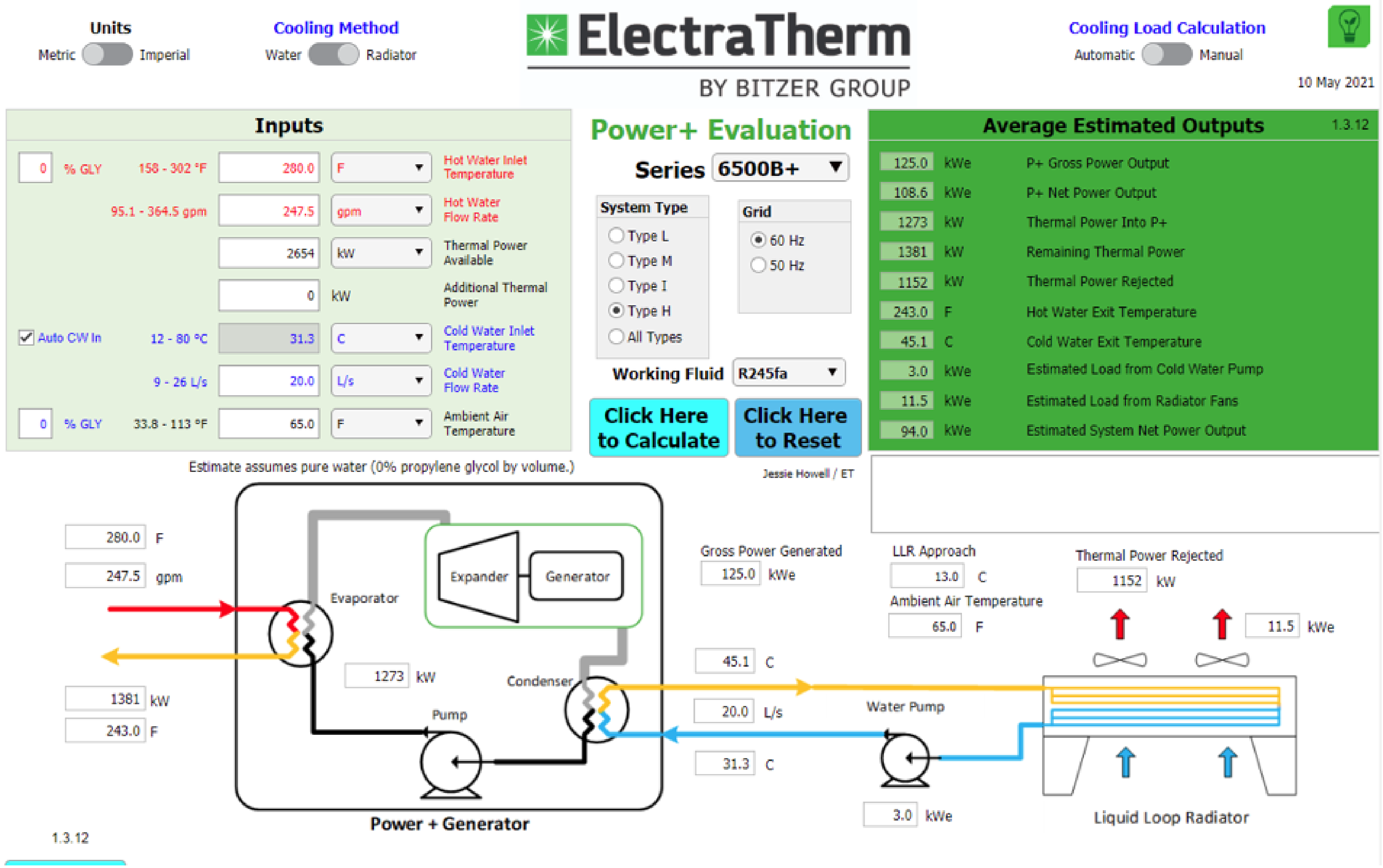
Approx. 502cfm @ 39.5% CH4= enough gas for 214kW NET= approx. 4 year ROI



# LMOP data Flare Elimination examples Maryland Landfill

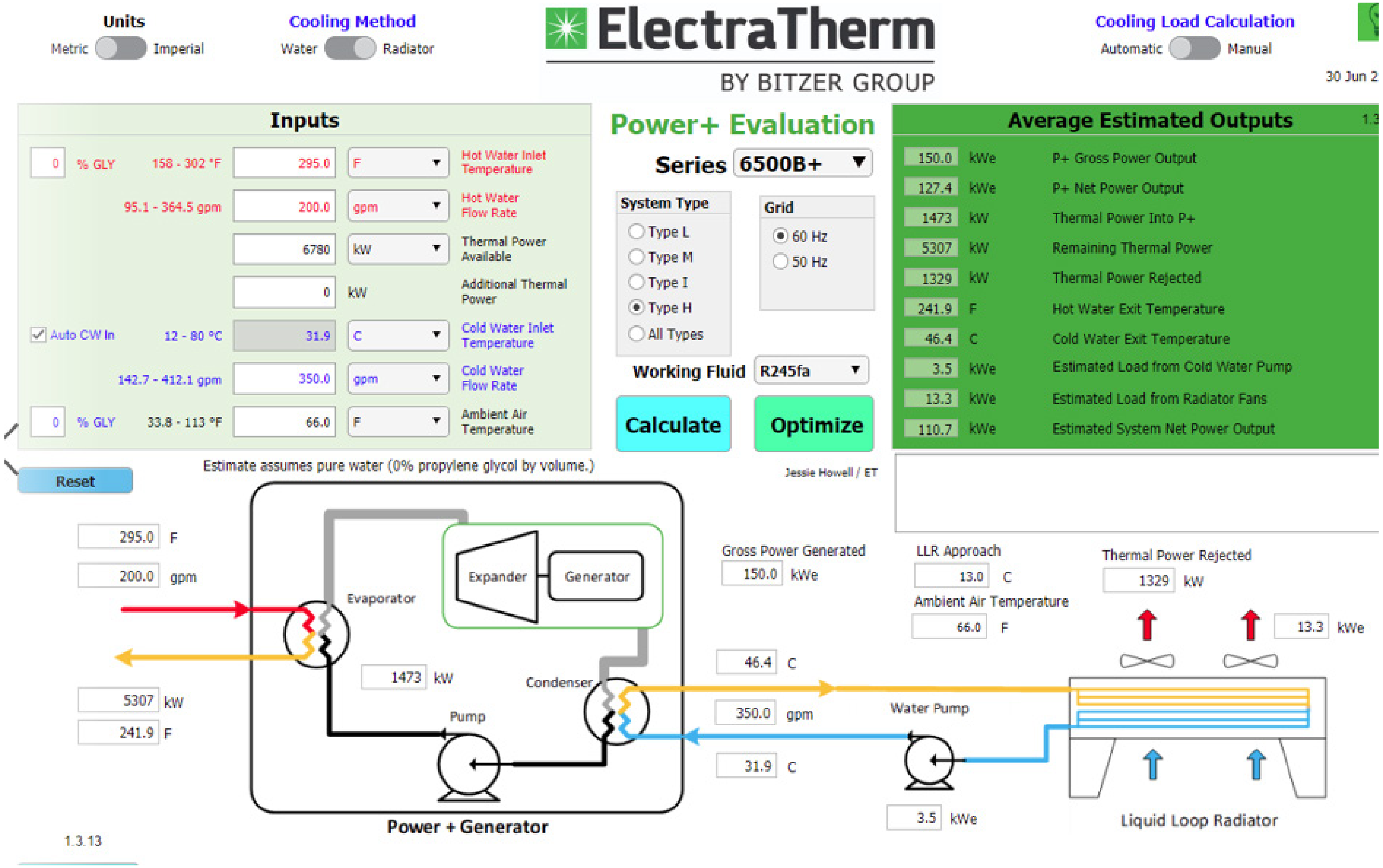


Approx. 405.9cfm @ 47.9% CH4= enough gas for 94kW NET



# LMOP data Flare Elimination examples Hawaii Landfill

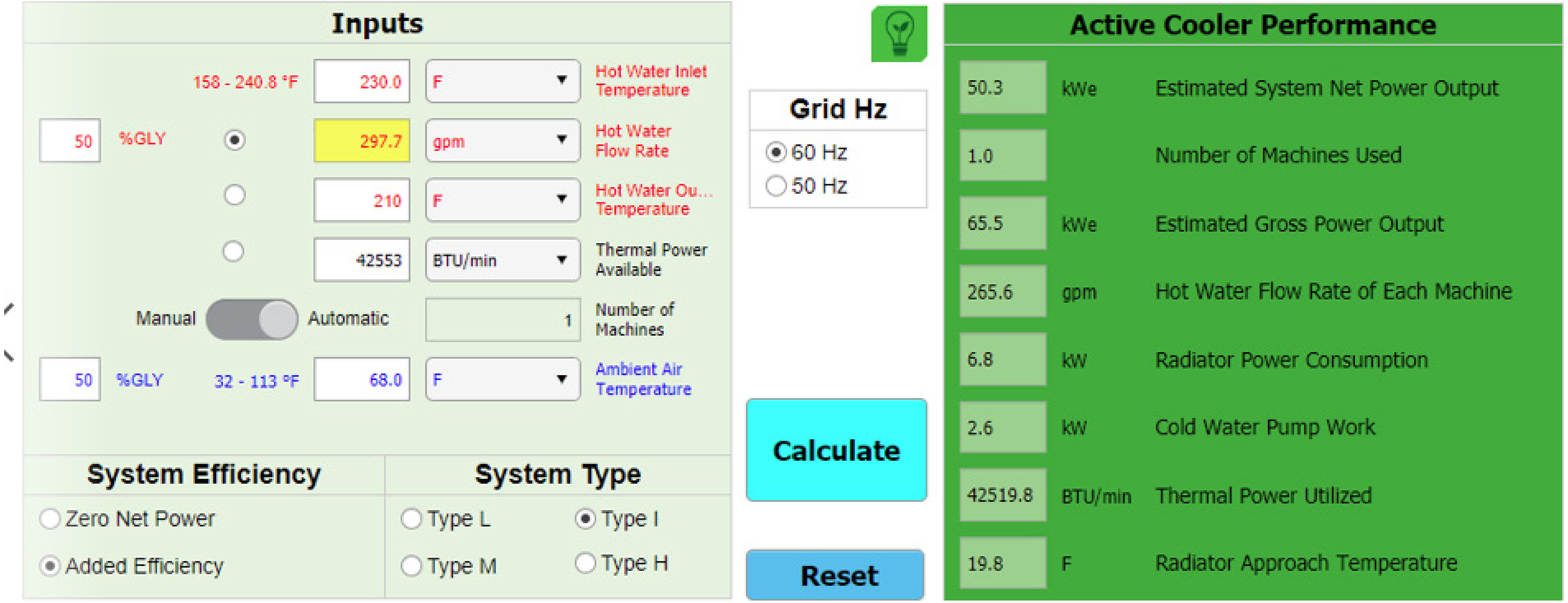
Approx. 941cfm @ 53.2% $CH_4$= enough gas for over 500kW NET



# CAT 3520C Jacket Water Example
## *Pennsylvania*

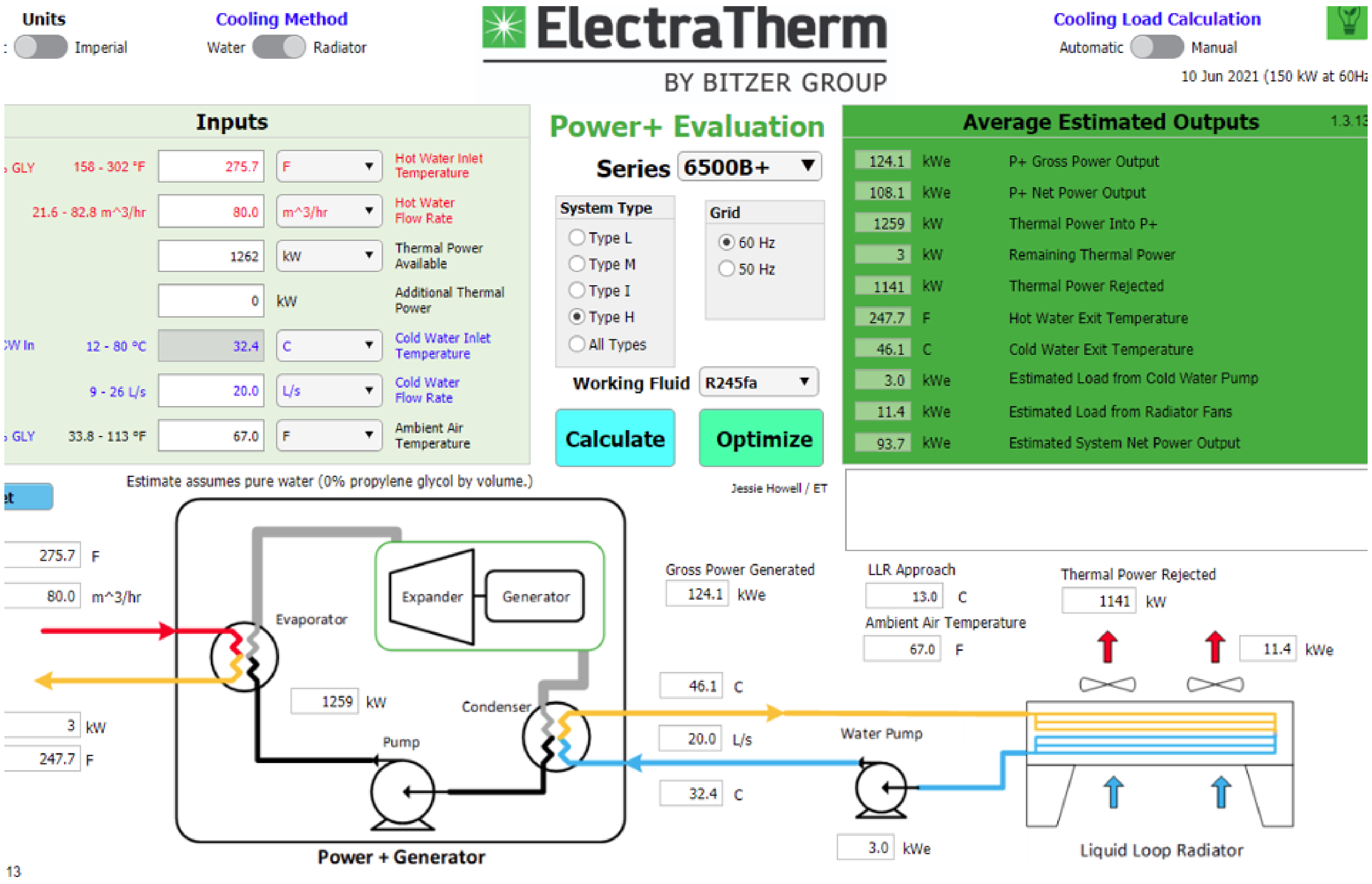
ElectraTherm
BY BITZER GROUP

Gain over 50kW NET by replacing the radiator



# CAT 3520C Exhaust Example
*Pennsylvania*

Gain over 93kW NET by replacing the radiator



ElectraTherm
BY BITZER GROUP

# Thank you!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**ElectraTherm**
**www.electratherm.com**

ElectraTherm

BY BITZER GROUP

# Questions

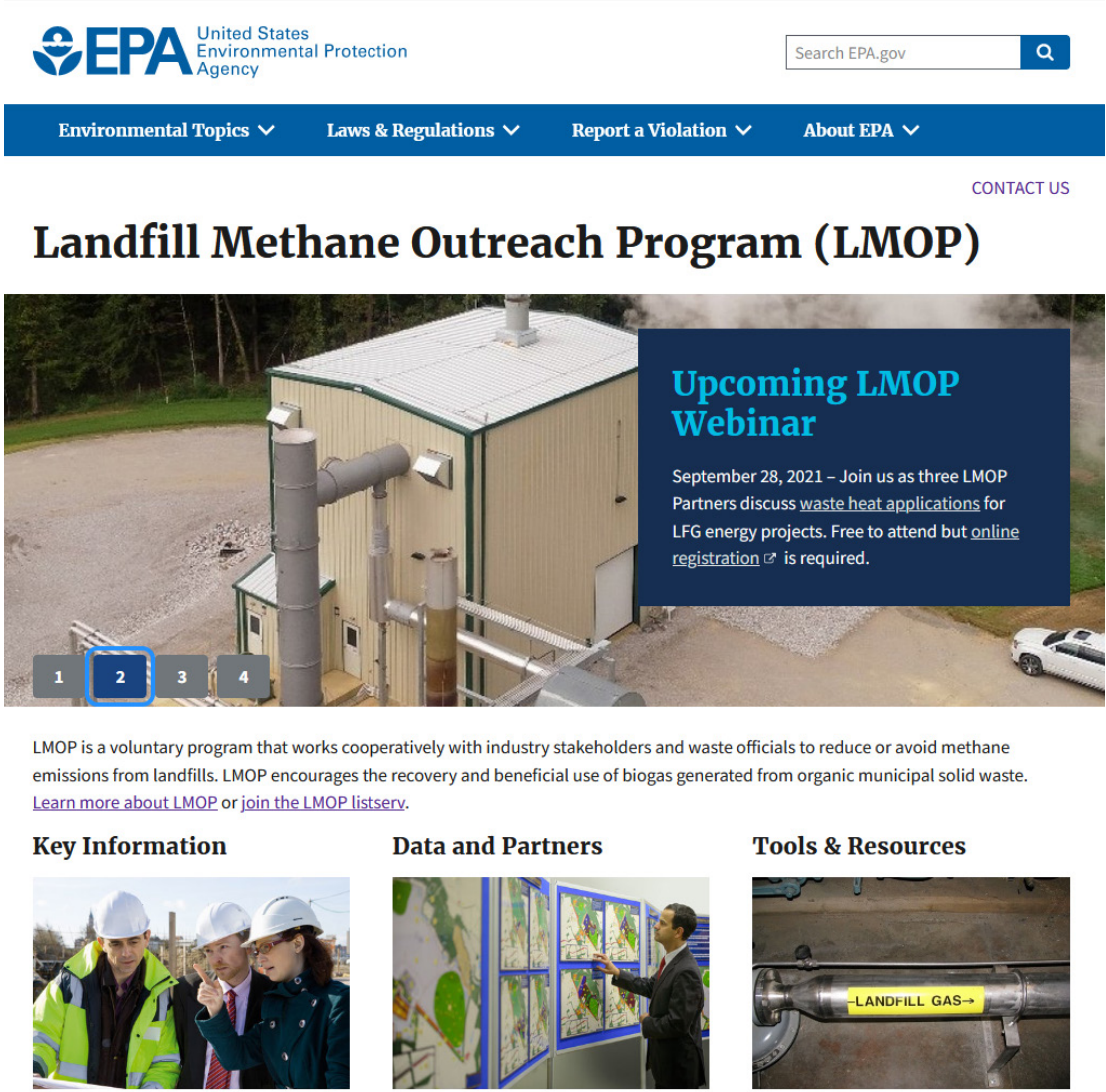
Q&A

Wrap Up

Contact Information

# Wrap Up

- The slides and recording from today's webinar will be posted on the LMOP website
- To learn more about LMOP or LFG energy, visit our website at epa.gov/lmop
- Have a webinar idea? Drop us a note with your email in the Q&A box or email lmop@epa.gov



# Thank You

Please reach out with any questions or comments

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