



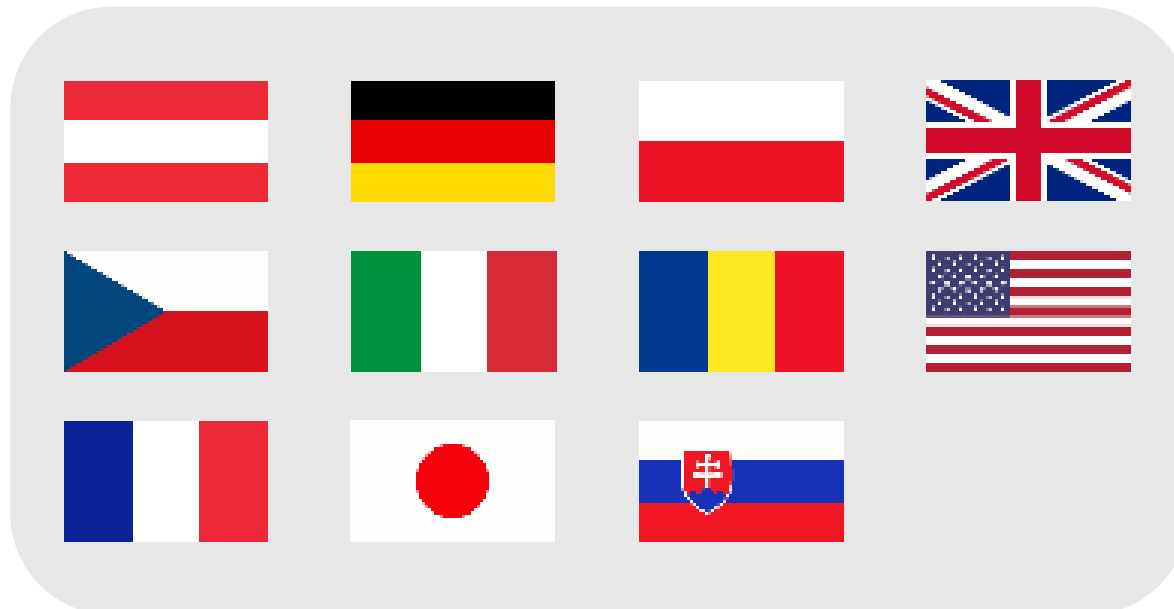
BENEFICIAL USE OF FLARED GAS,
NATURAL GAS, OR BIOGAS

ABOUT US

FLEET OVERVIEW

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

- // **100+** units sold worldwide
- // Operating in **11** countries on **3** continents
- // **1,600,000+** operating hours
- // Fully supported worldwide by **BITZER Greenpoint**



ABOUT US

WHO WE ARE

ElectraTherm by BITZER Group, established in 2005, is an industry leading clean energy company focused on the research and development of **sustainable and energy efficiency solutions** using the Organic Rankine Cycle (ORC) to convert sources of low temperature heat into **clean electricity**.



ElectraTherm and BITZER US's headquarters and manufacturing plant.

ElectraTherm's commercially-proven line of **heat to power generation** systems **increase energy efficiency** and provide **distributed heating and cooling solutions** while producing **emission-free electricity**.

ABOUT US

BITZER GROUP



BITZER, the world's largest independent manufacturer of refrigeration compressors, acquired ElectraTherm in 2016 due to their desire to develop world class energy-efficient solutions.

The combined advantage of ElectraTherm's engineering design along with the value of being backed by the BITZER Group allows us to proudly deliver world-class products.

BITZER 2019 Revenue: > 800M Euros
Global Employees: 3,800



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



ABOUT US

MANUFACTURING, RESEARCH & DEVELOPMENT

After BITZER's acquisition of ElectraTherm in 2016, a 50,000 square foot manufacturing plant and R&D test center was constructed.

This state-of-the-art facility allows for the continued development of enhanced ORC, heat to power technology.



Outside of test cell in Flowery Branch, GA.



THE PROBLEM

WASTEWATER TREATMENT / OIL & GAS WELL FLARING

Flaring is the open-air burning of natural gases – commonly occurring in biogas production, 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.





THE SOLUTION

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

In this demonstration, the flares were not eliminated due to the large amount of gas being emitted from the wells. **However, if another Power+ Generator ran in parallel with the original the flares could be extinguished.**

THE RESULTS

- // Reduce or eliminate flaring – lowering emissions.
- // Facilities can not only meet but exceed air quality and EPA emission standards.
- // Generate power for pumpjack, control/sensors, and wellhead.
- // Generate heat for heater/treater and oil flow.



ElectraTherm recently completed a 2,000-hour product demonstration at a Hess well in the Bakken.

The pilot system operated with an on-stream reliability **greater than 98%** and showed to be effective at reducing emissions of **carbon monoxide by 98%, nitrogen oxide by 48%, VOCs by 93%.**

HOW IT WORKS

WASTEWATER TREATMENT & BIOGAS

1. Boilers are extensively used along with anaerobic digestors to provide power for the production of biogas.
2. Typically, these boilers only work for a small portion of the time – when the digester calls for heat.
3. An ORC heat to power system, such as Power+ Generator, produces power and consumes hot water 24/7.
4. By increasing hot water production, potentially with existing boilers, biogas flares can be 100% eliminated.
5. This not only reduces emissions but creates a baseload power supply.



TRADITIONAL CHP PROCESS

WASTEWATER TREATMENT & BIOGAS

Existing
Equipment



Anaerobic Digester



Boiler



New
Equipment



Biogas Cleanup



Biogas Storage



Engine Genset



Cost: > \$1,000,000

ORGANIC RANKINE CYCLE CHP PROCESS

WASTEWATER TREATMENT & BIOGAS

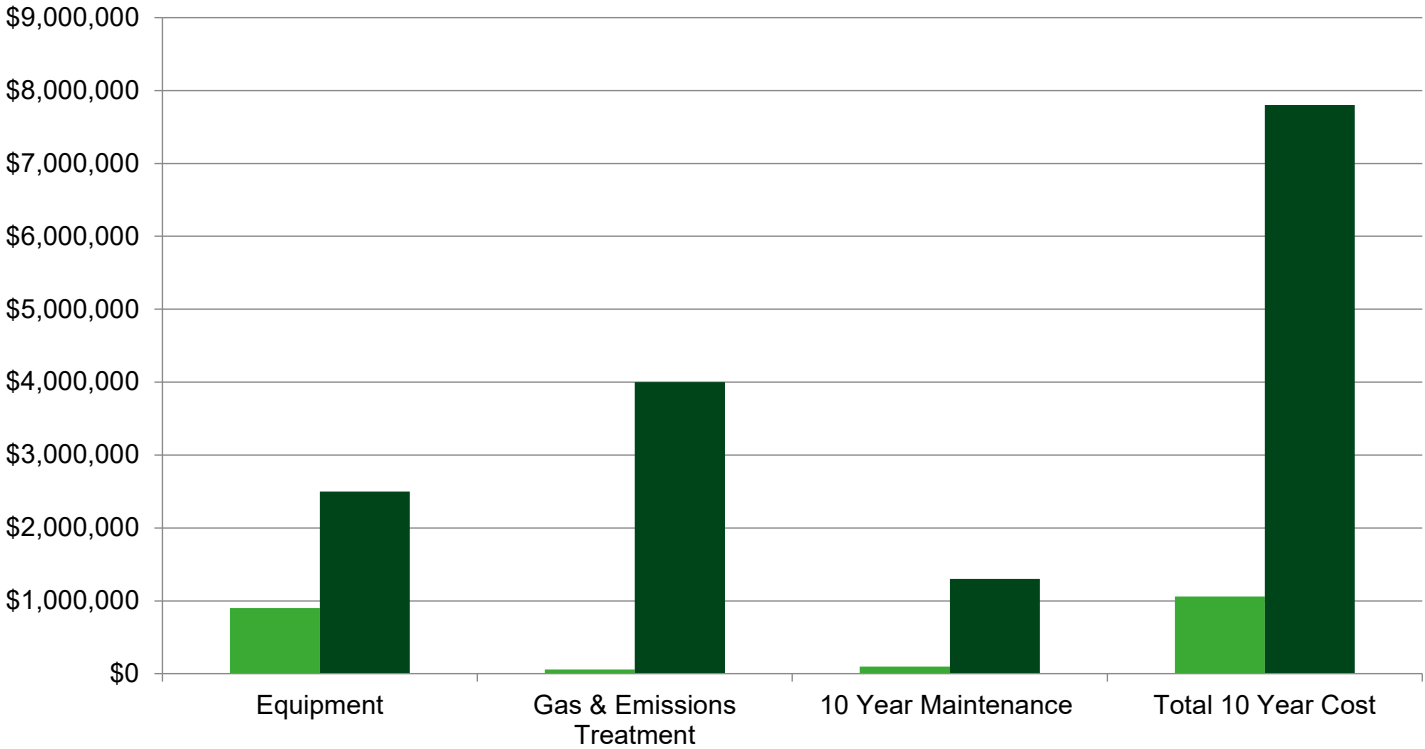


SYSTEM COMPARISON

RESULTS	Traditional CHP Process	ORC CHP Process
Produces clean power:	✓	✓
Ability to directly offset cost of electricity:	✗	✓
Reduces emissions:	✓	✓
Potential to eliminate all flaring:	✗	✓
Low capital cost:	✗	✓
Easy installation:	✗	✓
Low maintenance:	✗	✓
Small footprint:	✗	✓

ECONOMIC COMPARISON

ORC vs Engine w/ Equivalent Gas Consumption



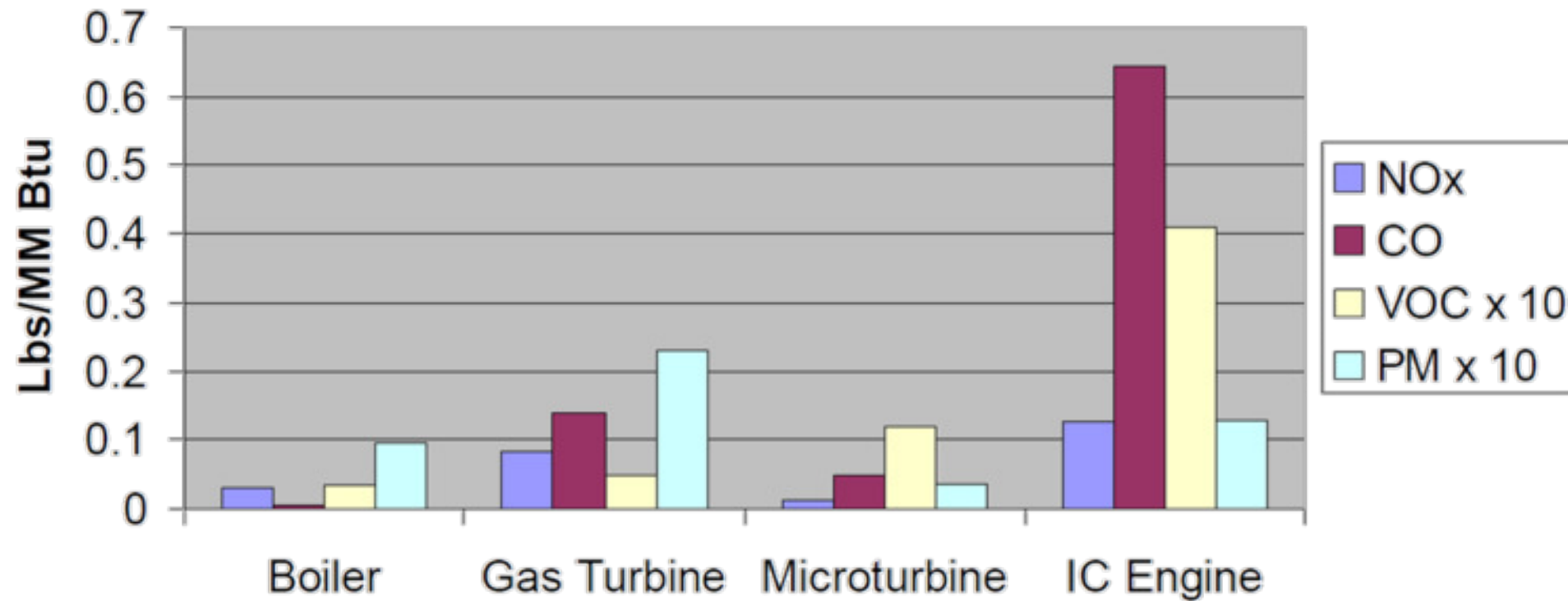
LEGEND

ORC + Boiler

Engine

ORC offers 80% lower lifecycle costs compared to an engine.

EMISSIONS COMPARISON



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

UPCOMING APPLICATION

POWER+ FOR LARGE MUNICIPAL WWTP

Scheduled to be installed mid-2020, this application will be the first of its kind and could mark a major shift in how flared gases are utilized.

The installed Power+ Generator will make use of the excess gases to produce renewable energy while reducing emissions.



POWER+ GENERATOR

ElectraTherm's Power+ Generator produces clean electricity from low grade waste heat. The Power+ Generator operates between 70 - 150°C (158 - 302°F) with outputs up to 125kWe for distributed power generation.

Higher temperature heat sources can be utilized with the integration of additional heat exchanger(s).



FEATURES & BENEFITS:

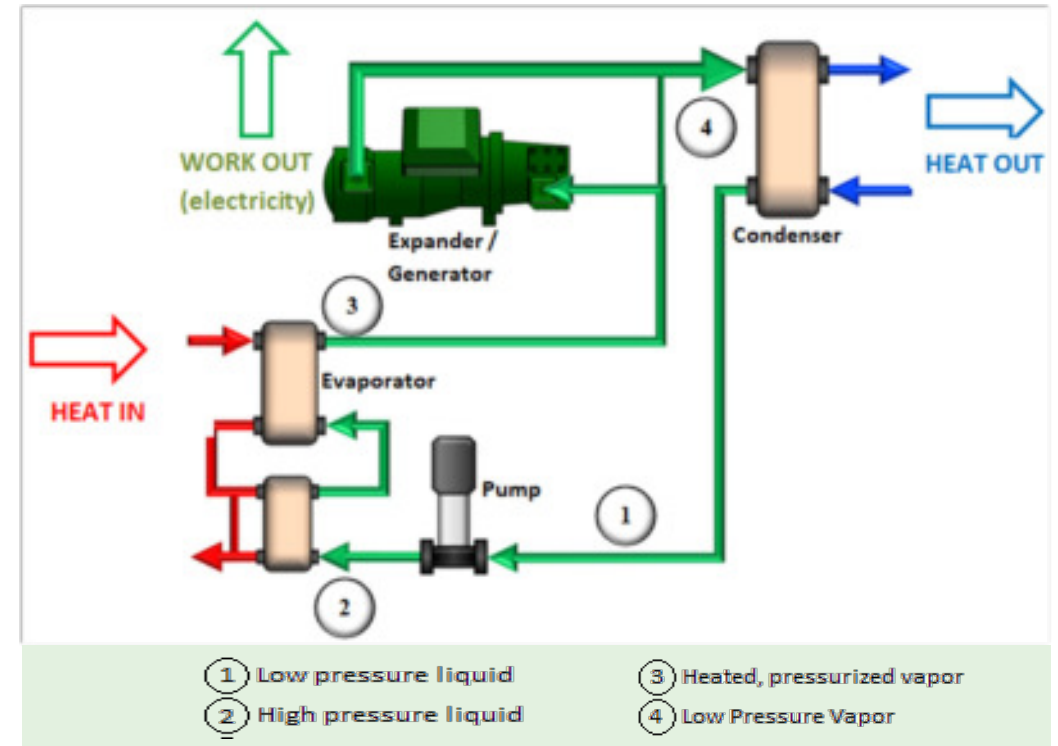
- // Zero emissions and zero fossil fuel requirements
- // Increase energy efficiency up to 10%
- // CHP capable – multiple uses and income streams
- // Ease of installation, operation, and maintenance
- // Flexible – robust, modular, and scalable design
- // Automated control system with remote monitoring
- // Attractive ROI with 20-year design life
- // May Qualify for Local Incentives
- // CE certified
- // Reduces your cooling load, increases power

THE PROCESS

ORGANIC RANKINE CYCLE

ElectraTherm's heat recovery system is a closed-loop Organic Rankine Cycle (ORC), converting thermal energy into electrical power.

- 1) Hot water is used to boil refrigerant in the evaporator.
- 2) Under pressure, the vapor is directed into 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.



SIMPLE CONNECTIONS



LEGEND

- 1 Cold Water In
- 2 Cold Water Out
- 3 Hot Water In
- 4 Hot Water Out

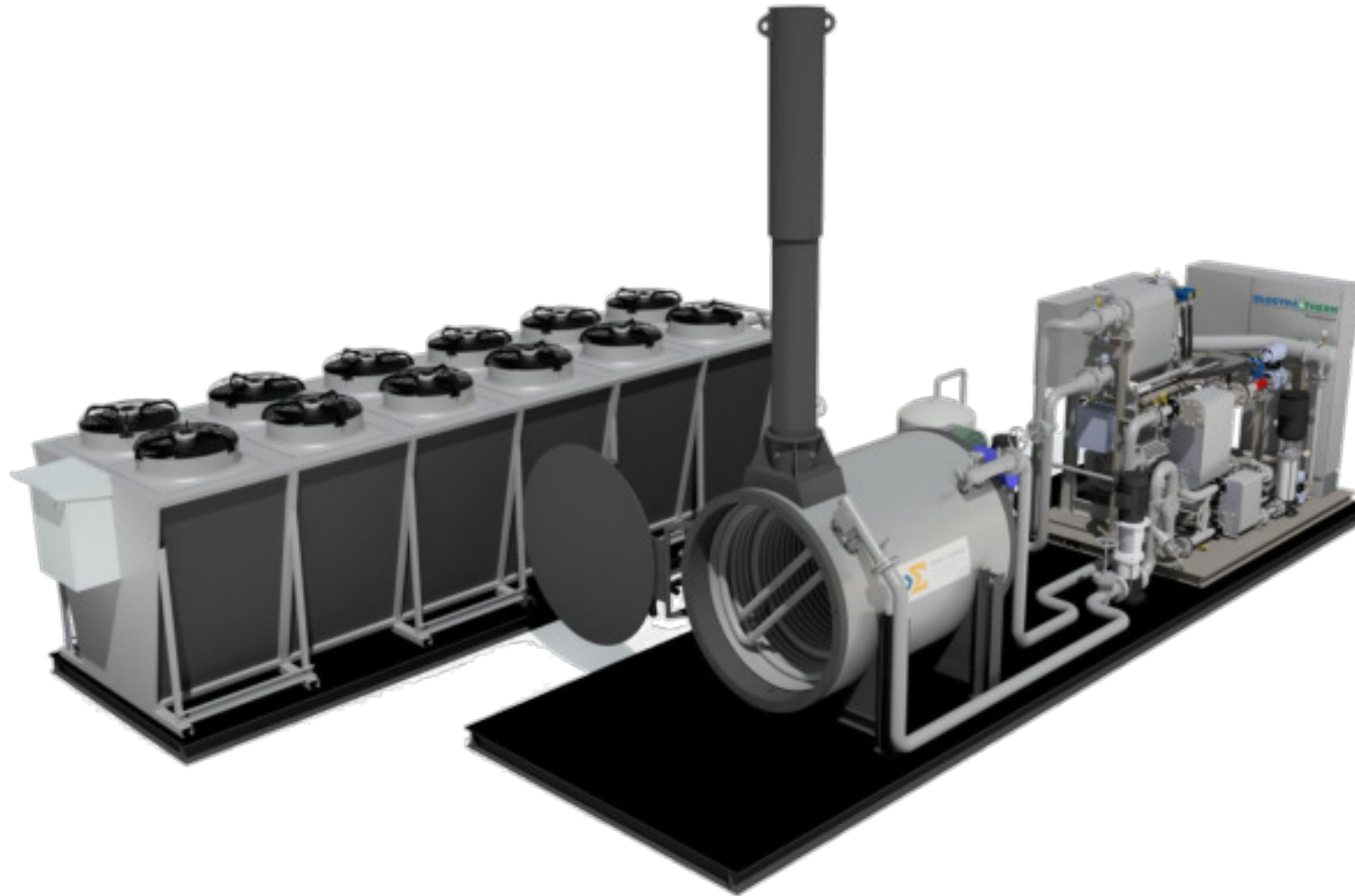
Anaerobic wastewater treatment plants make ambient clean water as their product, it can be used for the condensing side of the organic Rankine cycle – eliminating the need for a separate condenser.

PAIRED FLARING SOLUTION

INTEGRATED PROCESS HEATER - NEXT GENERATION ORC SOLUTION



S I G M A T H E R M A L



SUMMARY

- // Renewable utilization of biogas.
- // Baseload power supply capable of continuous power generation with varying conditions.
- // Ideal WWTP and Biogas applications will have an existing boiler onsite.
- // Reduced emissions, potentially leading to flare elimination.
- // Lowest capital and maintenance costs of other CHP options.
- // Easy installation with small footprint.

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