

Generating Clean Power from Waste Heat

John Fox, ElectraTherm

WASTE HEAT TO POWER



Highlights

- Founded in 2005
- Patented & Patent-Pending Technology
- 70+ Operational Machines
- Acquired by BITZER in 2016

ElectraTherm's Power+ Generator®

- Commercial Release August 2011
- Up to 110 kWe Power Output
- Hot Water is the Fuel...



THIS IS SMART POWER®

BITZER INTEGRATION

BITZER is the world's largest independent manufacturer of refrigeration compressors

- BITZER 2017 Revenue: ~750M Euros
- Employees Worldwide: 3,400

June 2017: ElectraTherm headquarters relocated to the BITZER production facility in Flowery Branch, Georgia.



GLOBAL INSTALLATIONS



Austria
Czech Republic
France
Germany
Italy
Japan
Romania
Slovakia
United Kingdom
United States



DIVERSE APPLICATIONS

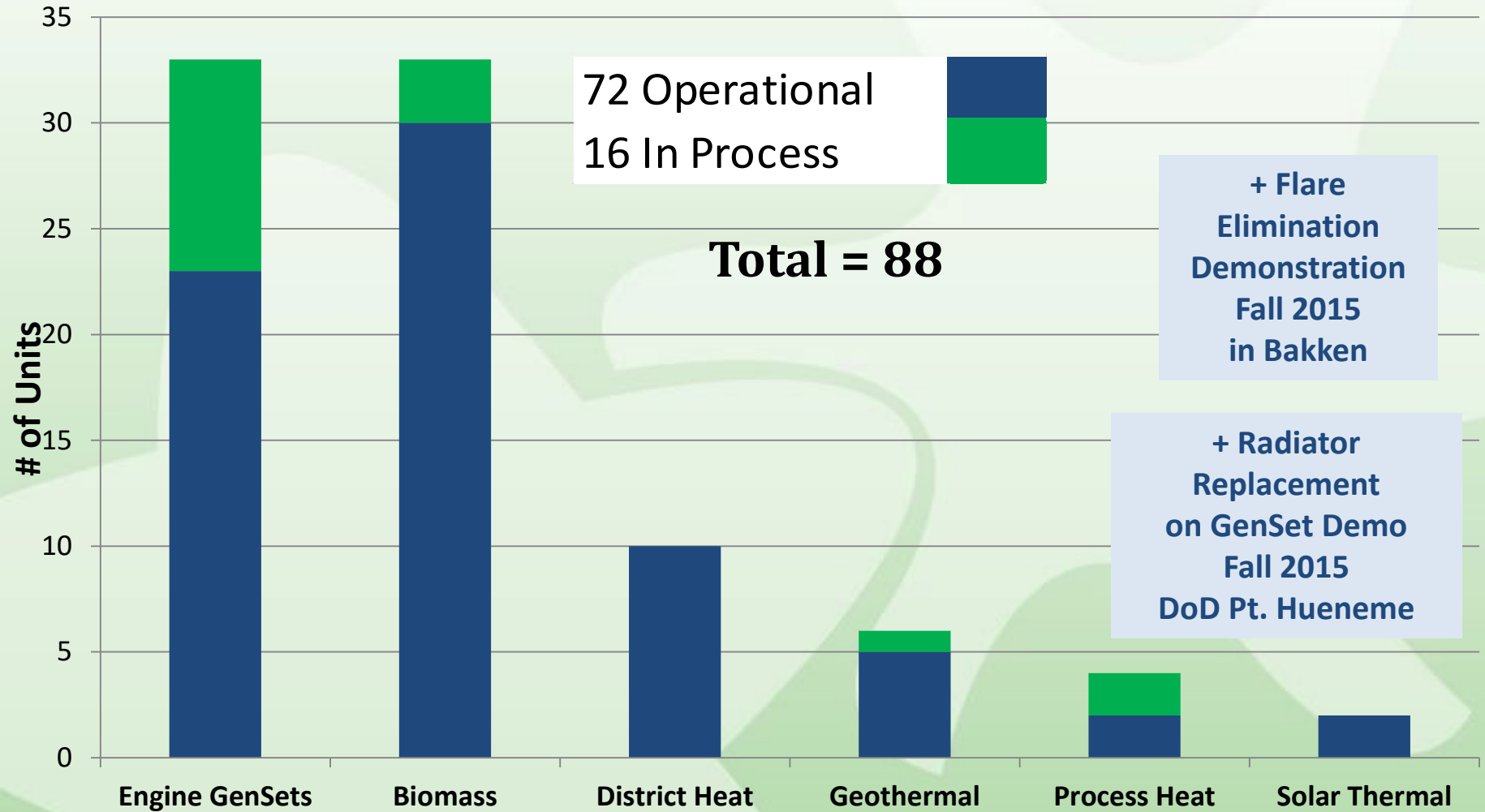
HOT WATER is the fuel (85-122°C/185-251°F)

- Biomass Boilers
- Reciprocating Engines
- Methane Utilization
- Geothermal/Oil & Gas Wells
- Process Heat



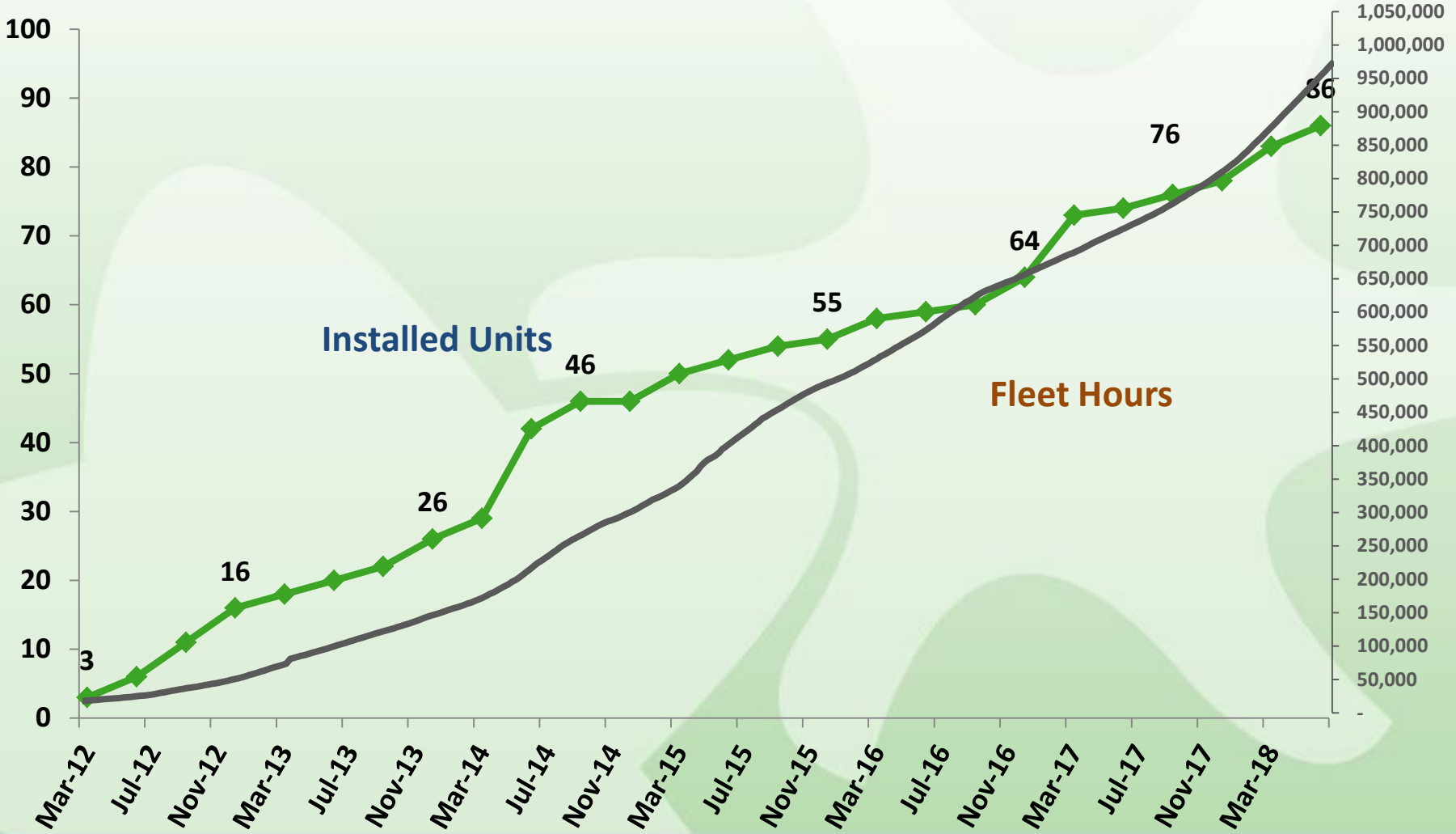
FLEET PROFILE BY APPLICATION

(Operational is the running Fleet, In Process is pending commissioning, production and backlog)



POWER+ GENERATOR CUMULATIVE FLEET

(Includes demonstration sites and R&D projects)



More than 1,000,000 Fleet Hours

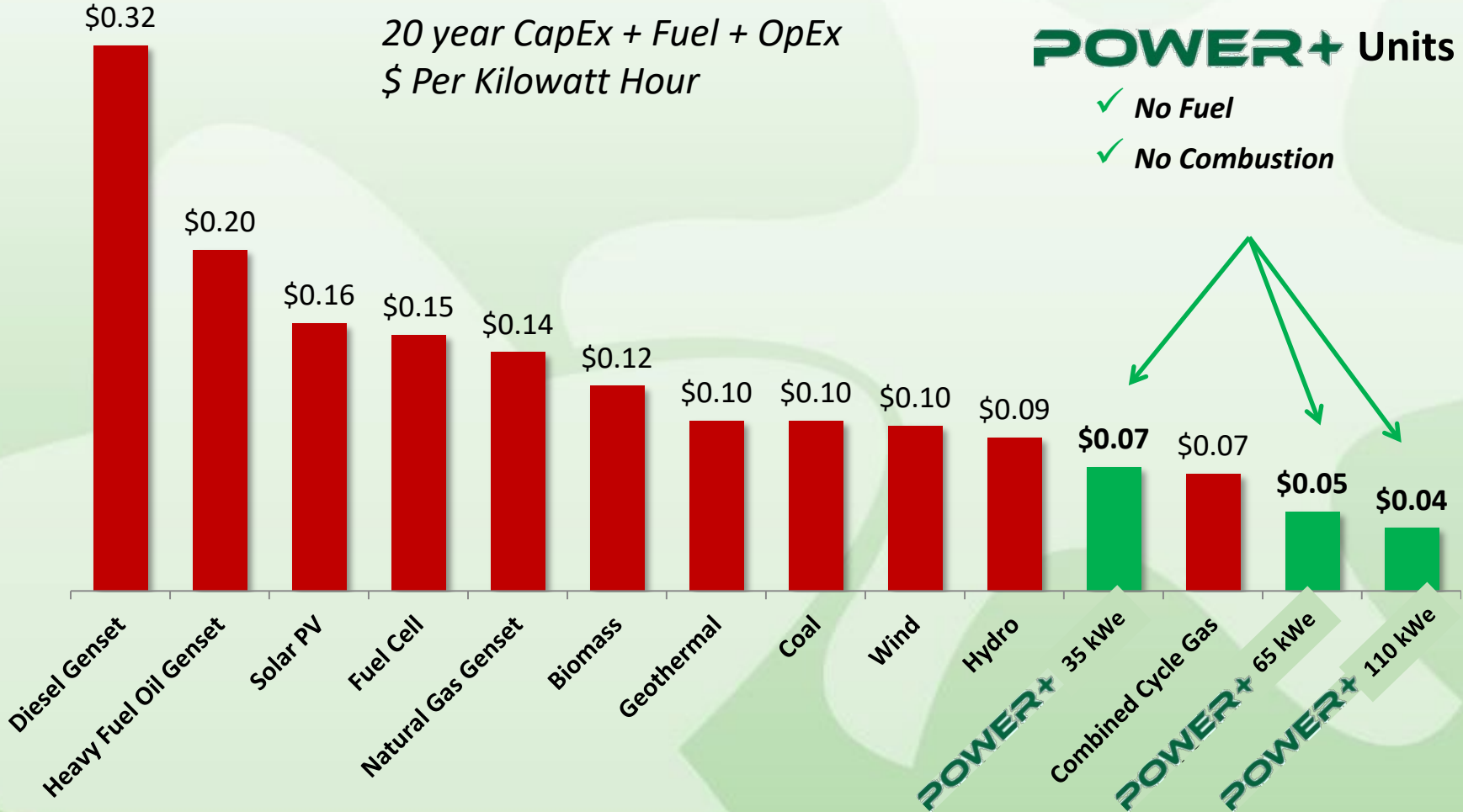
LEVELIZED COST OF ELECTRICITY GENERATION



20 year CapEx + Fuel + OpEx
\$ Per Kilowatt Hour

POWER+ Units

- ✓ No Fuel
- ✓ No Combustion



Source: US EIA's Annual Energy Outlook Data, ElectraTherm, Caterpillar

POWER+ FAMILY OF PRODUCTS

Model

Product

POWER+ 6500

Up to 110kW

40'x8'x8' / 12.2x2.4x2.4 m
Packaged Solution



POWER+ 4400

Up to 65kW



7'x7'x7' / 2.1x2.1x2.1 m
Standalone

POWER+ 4200

Up to 35kW

40'x8'x8' / 12.2x2.4x2.4 m
Packaged Solution

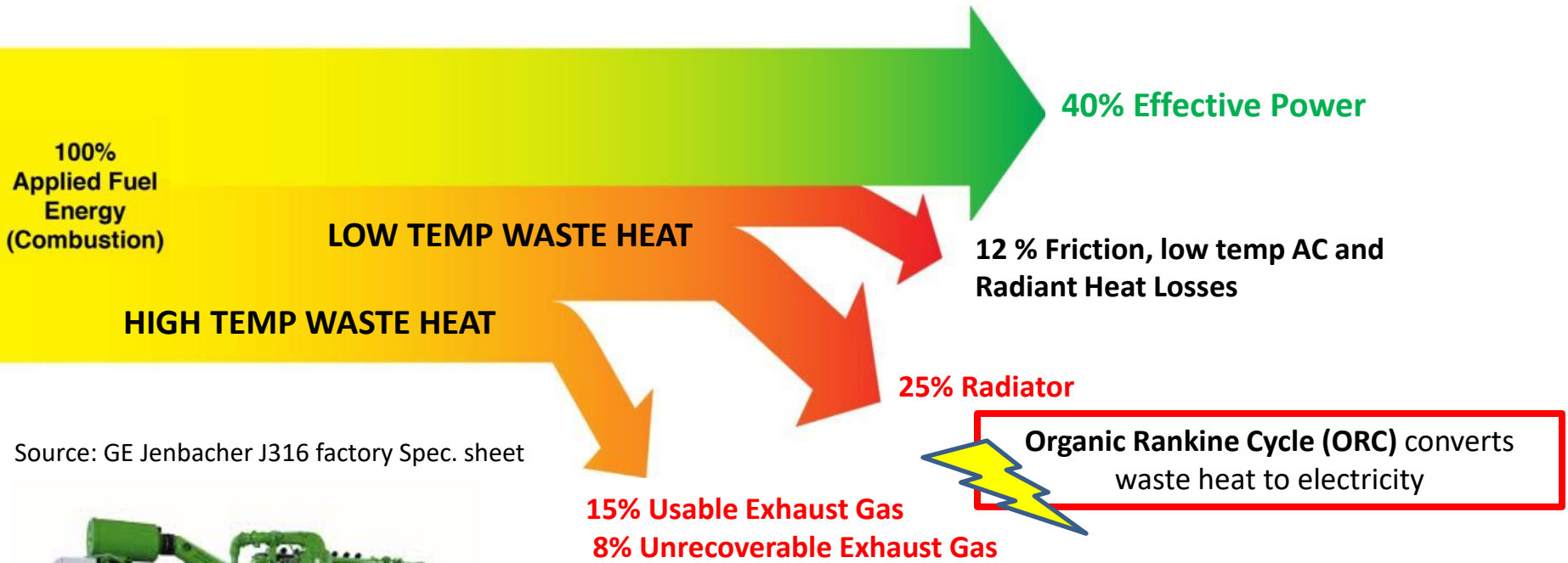


ElectraTherm offers 3 output levels packaged with cooling circuit or standalone

WASTE HEAT FROM STATIONARY ENGINES

Engines used for prime power ,landfill gas, wastewater treatment plants, CHP

Ex. Jenbacher 316 (834 kWe)



Source: GE Jenbacher J316 factory Spec. sheet



100,000+ Stationary Engines Installed Worldwide
.5-2 MW, Continuous Duty

Development of the Radiator with a Payback

Benefits:

- Complete Engine Radiator Replacement
- Engine Cooling Independent of ORC Operation
- ORC Provides Hot Ambient Cooling Benefits
- 10% - 12%+ Improved Fuel Efficiency
- Easily Transportable
- Limited Site Construction
- Payback 2-3 years (diesel)

*1.1 MW Cummins Genset and
Exhaust Gas Heat Exchanger*



“The Radiator with a Payback”

Video at <https://youtu.be/fca0faX8R84>

POWER+ ORC

*Combined Engine
and ORC Radiator*

SHOWCASE INSTALLATIONS

(Unalaska/Wisewood/Ogura)



Unalaska, Remote Diesel



Japan, Micro-Geothermal



California, Biomass

WASTE HEAT TO POWER POTENTIAL IN THE OIL & GAS INDUSTRY

- **Flared Gas** – Regulations
- **Gas Compression Engines** – Throughput
- **Co-Produced Fluids** – Sustainability/Remote Locations

REDUCE FLARING – GENERATE POWER



- ✓ Reduce or eliminate flare
- ✓ Much lower capital and maintenance than other power generation technologies
- ✓ Significantly reduced emissions



Wastewater Treatment



For WWTPs under pressure to reduce flaring and lower emissions, the Power+ pairs with boilers and anaerobic digesters for a cost-effective solution.

Oil & Gas Wells



In the fall of 2015, ElectraTherm demonstrated a Power+ paired with a boiler to reduce flaring on a Hess oil well in the Bakken.

POWER & HEAT IN THE OILFIELD

Beneficial Use of Raw or Treated Flare Gas



POWER+ORC vs. Flaring

Percent Reduction in Emissions

CO ↓	89%
NO _x ↓	48%
VOCs ↓	93%

The Problem

The Solution

The Results



Input
→
Flare Gas

POWER+



Output
→
Power & Heat

Reduce or eliminate flaring by utilizing raw/untreated gas

The Power+ and Boiler is fueled by gas that would otherwise be flared

Reduce or Eliminate Flare and Lower Emissions

Generate Power

- Power for pumpjack
- Power for controls/sensors
- Power for wellhead

Generate Heat

- Heat for heater/treater
- Heat for oil flow

ElectraTherm completed successful 2000 hour demonstration at a Hess well in the Bakken

Watch the video here: <https://youtu.be/4IJEZ1e-PRA>

NEXT GEN POWER & FLARE ELIMINATION

Sigma Thermal and ElectraTherm have teamed up to offer a complete waste gas to power packaged solution.

- Multiple burner options are available to meet tough emissions requirements
- Only gas and electrical interface are required to the skid edge
- Adaptable to comply with local codes and standards
- Easy to transport, install and operate

SIGMA THERMAL

Integrated system converts waste gas to hot water.

Hot Water = Power + Fuel

Integrated Controls

ElectraTherm Power+
Generator

Pre-piped and Wired Skid Mounted System

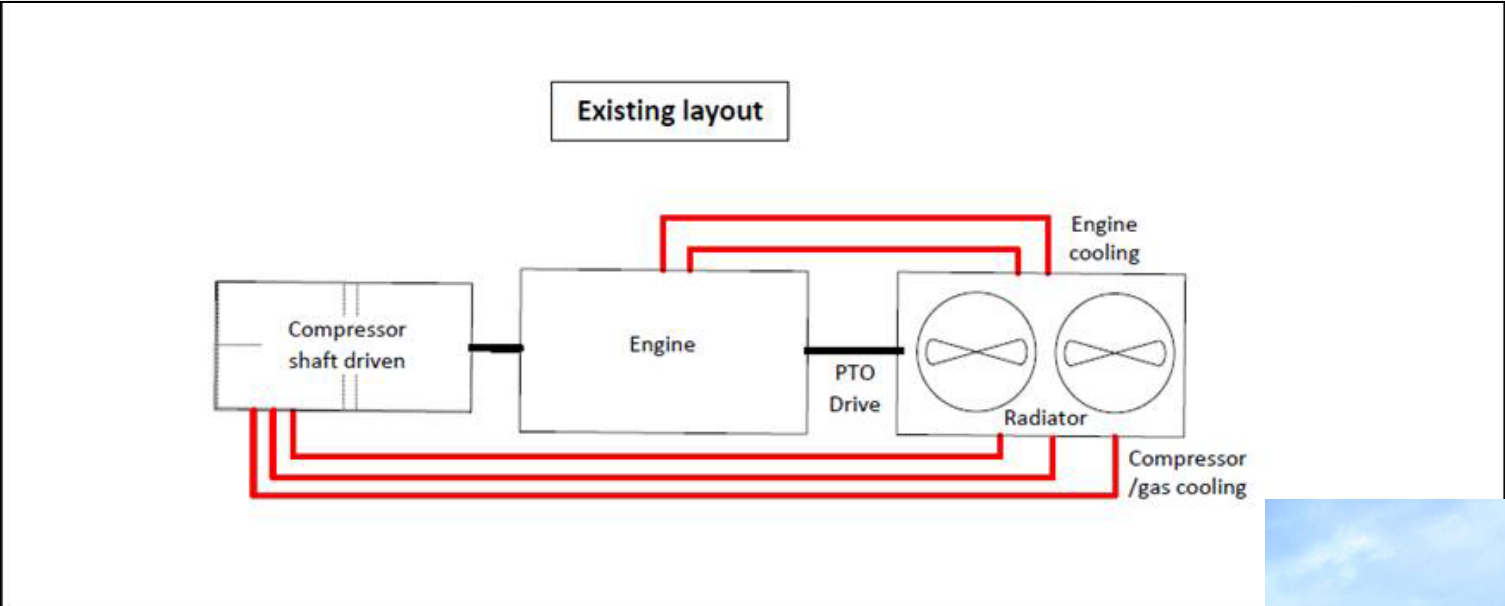
Hinged Plate for
Easy Cleaning

Robust
Helical Coil

Optional Radiator (if required)



WASTE HEAT RECOVERY IN GAS COMPRESSION



WASTE HEAT RECOVERY IN GAS COMPRESSION

Benefits:

- Engine cooling provided by ORC
- Eliminate shaft driven radiator horsepower
- 5-7% more work provided to compressor (*increased throughput*)
- Waste heat supplies kW's for onsite use and/or offset of generator driven cooling
- Hot ambient operational benefits provided by ORC cooler
- Useful on site hot water (CHP)



GEOHERMAL DEMONSTRATION SITE

Co-produced Fluids



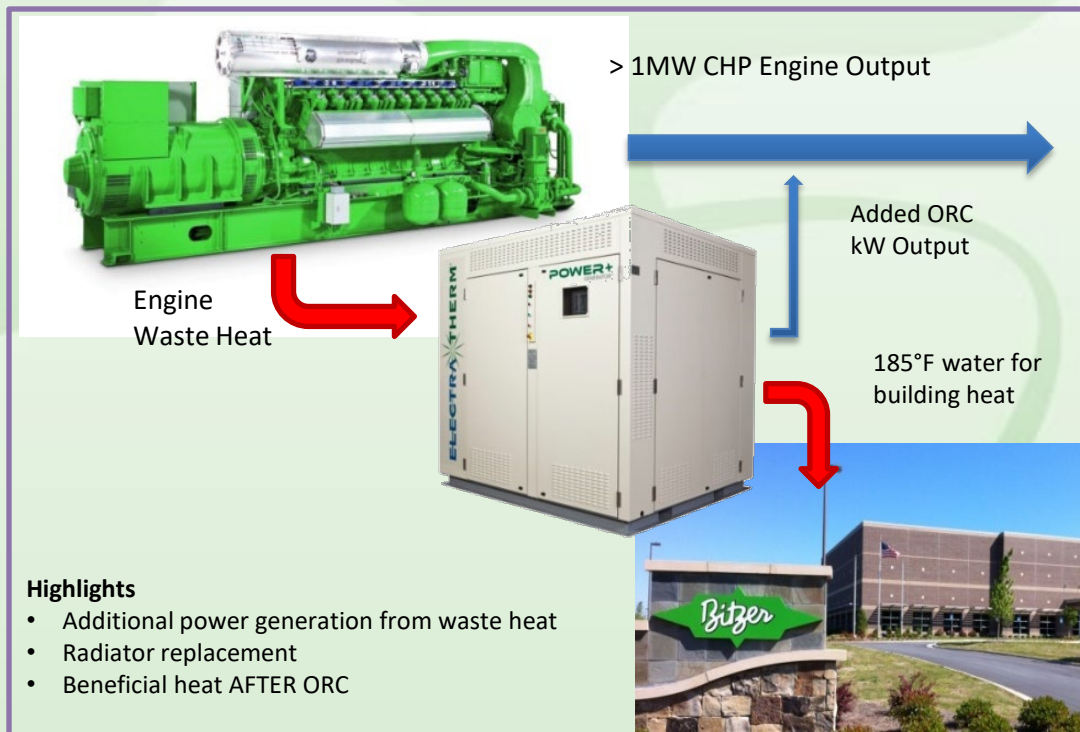
Imlay, Nevada
Deployed in 2013
Power+ Output: 60 kWe Net
Application: 230°F Geothermal Water



Florida Canyon Mine

US DEPARTMENT OF ENERGY

- Organic Rankine Cycle (ORC) Integration and Optimization for High Efficiency CHP Genset Systems
- ~3 Year Cooperative Agreement Contract



IN SUMMARY

ElectraTherm's Heat to Power Generator Delivers:

- Distributed, renewable power production
- Ease of installation, operation and maintenance
- Low operational costs with strong ROI
- Robust, reliable, off-the-shelf components
- A modular solution that can scale to the heat source
- Digital controls with remote monitoring & standard interface

Thank you!

ElectraTherm
www.electratherm.com