ElectraTherm
BY BITZER GROUP

COMPANY PROFILE

THE FUTURE IS ENERGY EFFICIENCY

HEAT TO POWER GENERATION

ELECTRATHERM

ElectraTherm, by **BITZER Group** is at the forefront in the development of practical solutions to achieve Energy Efficiency through Waste Heat to Power Generation. **ElectraTherm** was established in 2005 and after extensive research and development succeeded in bringing to market an operational proven robust designed modular heat to power generator designed for low temperature heat sources.

ElectraTherm's POWER+GENERATOR generates fuel-free, emission free power from low temperature heat sources using the Organic Rankine Cycle (ORC) and proprietary technology. The **POWER+GENERATOR** is a commercially proven technology in operation at 80+ Installations in 10 Countries on 3 Continents. Cumulative fleet runtime exceeds 1.5 Million Hours.

Since 2016 **ElectraTherm** have been part of the worldwide **BITZER Group.** The **BITZER Group** which is headquartered in Sindelfingen Germany is an internationally leading specialist for refrigeration and air conditioning technology with activities in refrigeration, air-conditioning and process cooling, heat to power generation, transport as well as services. With energy-efficient, environmentally friendly and high-quality products and services, the **BITZER Group** improves the quality of life of people worldwide.

Research & Development

BITZER and **ElectraTherm** are committed to the continued development of heat to power technologies with Research and Development facilities located in both Germany and Flowery Branch Georgia USA. **BITZER** are recognised as a leading authority in the development of refrigerants whilst the team at **ElectraTherm** have many years of accumulative knowledge in the development and application of heat to power technologies.

ElectraTherm's commitment to their clients is based on working together in partnership to provide technology based practical solutions for **Sustainable, Reliable and Affordable Renewable Energy,** through energy efficiency improvements in the operation of existing engine based generation assets and alternative opportunities for the generation of renewable power using heat from Biomass, Biogas, Waste Heat and Geothermal resources.

ElectraTherm, Inc. // 4080 Enterprise Way // Flowery Branch // Georgia 30542 // USA
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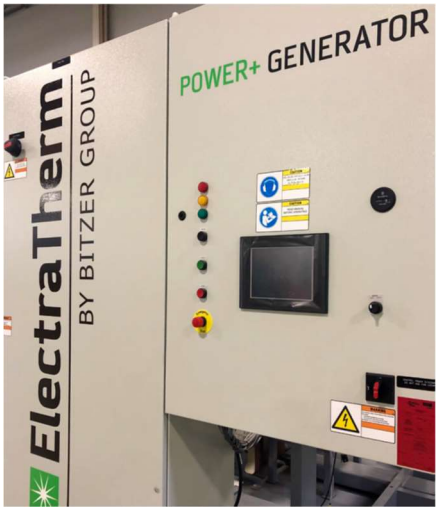
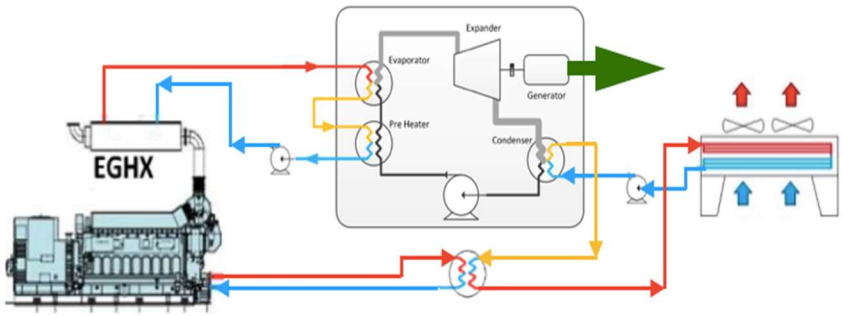
POWER+GENERATOR ENERGY EFFICIENCY

POWER+GENERATOR



ElectraTherm's POWER+GENERATOR produces fuel-free, emission free power from low grade waste heat using the Organic Rankine Cycle (ORC) and proprietary technology. With advances in technology the **POWER+GENERATOR** is the ideal solution to improve **Energy Efficiency of installed Engine Based Generation Assets.**

Single Heat Stream - Exhaust Gases
Option - Replacement Radiator



WASTE HEAT THE ENERGY RESOURCE YOU ALREADY HAVE

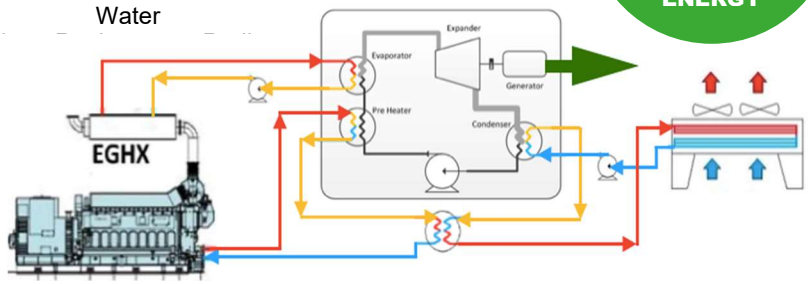
ALL FUELS

GENERATE FUEL FREE EMISSION FREE RENEWABLE ENERGY

INCREASED EFFICIENCY SAVE FUEL COSTS

SMALL FOOTPRINT

Dual Heat Stream - Exhaust/ Jacket Water



HEAT TO POWER GENERATION - A GLOBAL SOLUTION FOR 24/7 RENEWABLE

ElectraTherm ENGINE COOLER - integrated heat engine that turns heat into electricity to power the engine cooling system.

- Inlet & Return Temperatures to engine specification
- Available in 800 & 1800 kWth
- Scaleable to Multi Megawatt Heat Loads
- Contributes mitigation of engine derate at high ambient conditions up to 40^{0}C
- Multiple Cooling Circuits - Jacket Water and LT Cooling
- Standard Interface Connections for Water and Power

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INSTALLATION EXAMPLES

2012 Biogas Engine Trechwitz Germany

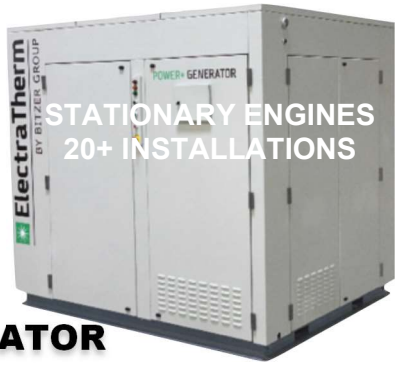
ElectraTherm installed a **Power+4400** ORC generator utilising waste heat from a biogas powered MWM Engine. The **Power+4400B** converts the waste heat from the engine jacket water system to generate additional electricity.

2014 Dutch Harbour Aleutian Islands Alaska

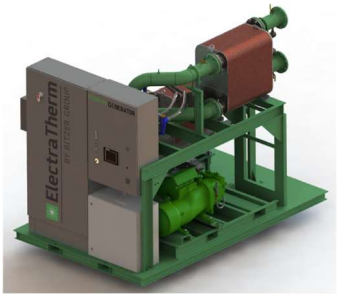
ElectraTherm installed 3 x **Power+4400** ORC generators utilising waste heat from three diesel generators at a remote site in Alaska. The **Power+4400** ORC's convert the waste heat from the jacket water systems into electricity. ORC condensing is cooled using sea water. The installation has resulted in significant fuel savings for the power station operator.

2020 Rottenburg Germany

New installation of **Power+4400B** using exhaust system waste heat to generate additional electricity



PERFORMANCE HIGHLIGHTS POWER+GENERATOR



- Waste Heat to Power Generation
- Renewable Energy and $C0_2$ Emission Saving
- Improved Fuel Efficiency - Saving Operating Costs
- Transform Waste Products to High Value Electricity
- CHP Capability - Power & Heat Outputs - Multiple Income Streams
- High Performance BITZER Semi-Hermetic Twin Screw Expander
- Flexible Controls - Remote Operation Capability
- Ease of Operation and Maintenance
- Commercially Proven Supported by BITZER GROUP Worldwide

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MICRO GEOTHERMAL
HEAT TO POWER

POWER+GENERATOR

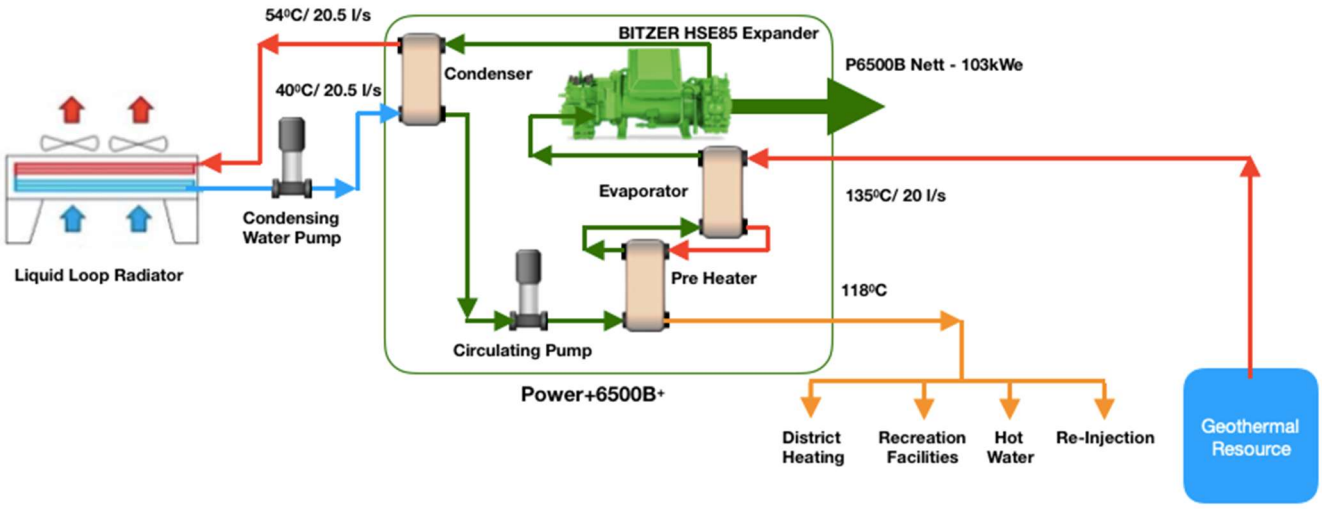
The **ElectraTherm** **Power+Generator** uses Geothermal Brine to generate 24/7 Base Load Renewable Energy using Organic Rankine Cycle (ORC) Technology.

The **Power+Generator** is a modular containerised solution for low temperature geothermal resources, difficult and sensitive sites and locations with small electrical loads not suitable for large capacity Geothermal Plants

The **Power+Generator** also provides solutions for efficiency improvements of existing geothermal power stations by converting unused heat from the primary generating units to generate additional power prior to brine re-injection.

As part of the electrical generating process the **Power+Generator** cools the geothermal brine prior to downstream use such as district heating, water recreation facilities and domestic/ industrial hot water systems.

HEAT TO POWER GENERATION - A GLOBAL SOLUTION FOR 24/7 RENEWABLE ENERGY



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GEOTHERMAL - REFERENCES

2012 Nevada USA - Mine Co-Produced Fluids

Power+Generator uses the heat from a co-produced geothermal brine to generate electricity whilst also cooling the brine prior to the mineral processing circuit.

2012 Oradea Romania - Micro Geothermal

Power+Generator uses geothermal hot water to generate electricity and at the same time provides cooling of the water prior to feeding into a district heating system

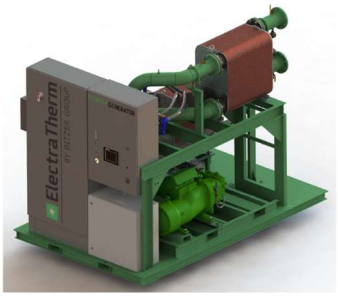
2016 Beppu Japan - Onsen Geothermal Steam

The **Power+Generator** uses geothermal heat from low temperature steam onsen to generate fuel-free emission-free electricity. The geothermal resource required cooling before being used in a district heating system. The **Power+Generator** provides cooling of the geothermal resource whilst generating electricity.

2018 Japan - Micro Geothermal

The **Power+Generator** uses heat from a low temperature geothermal resource to generate fuel-free emission-free electricity. This installation was undertaken at a difficult site with minimal access. The modular design of the **Power+Generator** made this installation possible.

PERFORMANCE HIGHLIGHTS POWER+GENERATOR



- **Heat to Power Generation delivering Renewable Energy and C02 Emission Saving**
- **Base Load Remote Power Generation**
- **CHP Capability - Power & Heat Outputs**
- **High Performance BITZER Semi-Hermetic Expander**
- **Flexible Controls - Remote Operation Capability**
- **Commercially Proven Supported by BITZER GROUP Worldwide**

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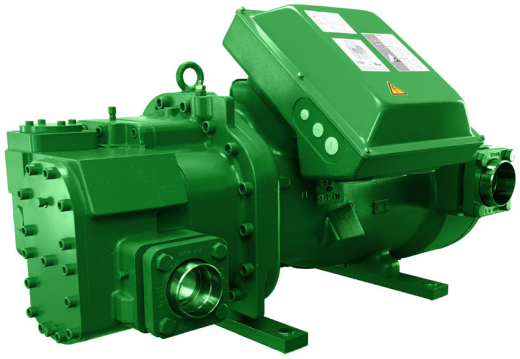
4400B+ SPECIFICATION SHEET



BITZER SEMI-HERMETIC EXPANDER/GENERATOR

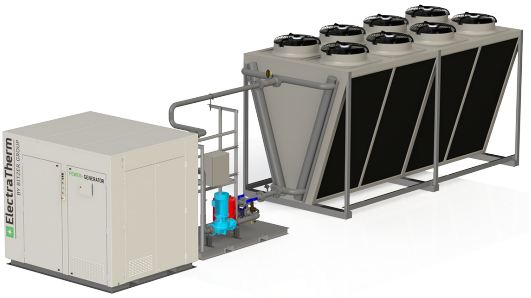
POWER+ GENERATOR

ElectraTherm's POWER+ GENERATOR produces fuel-free, emission-free power from low grade waste heat using the Organic Rankine Cycle (ORC) and proprietary technology. The company's patented BITZER semi-hermetic twin screw expander/generator combination enables the POWER+ GENERATOR to generate fuel-free and emission-free electricity from various forms of waste heat. ElectraTherm's patented ORC design represents a dramatic change from radial or axial turbine technologies, providing a more cost efficient, robust design with no shaft seal between the expander/generator combination, greatly enhancing reliability. The 4400B+ is an evolution of ElectraTherm's POWER+ and the BITZER expander offers enhanced performance across the operating range with a maximum output increased to 75kW.

4400B+ CONFIGURATIONS - UP TO 75kWe

4400B+ STAND ALONE

// Dimensions*: 2.0 x 2.4 x 2.3 m
// Weight: 3,290 kg / 7,245 lbs
// Customizable balance of plant
// Indoor or outdoor installation
// Global Price: Estimated 3 to 5 year payback depending on project details, contact us for a current review**



4400B+ SYSTEM PACKAGE

// Dimensions*: 12 x 2.4 x 2.9 m
// Weight: 6,095 kg / 13,438 lbs
// Includes: liquid loop radiator, cold water pump, integrated controls, requires minimal engineering
// Contact ElectraTherm for current pricing**

*Renderings may not be exact representations of final POWER+ product.
**Certification fees for certain countries may apply.

HEAT TO POWER APPLICATIONS

ElectraTherm generates electricity from various heat sources, including:


Stationary Engines


Biomass/Biogas


Boilers & Process Heat


Oil & Gas, Geothermal


Flare Elimination

4400B+ PERFORMANCE PARAMETERS - UP TO 75kWe

ElectraTherm's Water Cooled Condensing System Performance

HOT WATER INPUT PARAMETERS	Hot water input temp range	°F	170 - 302
		[°C]	[77 - 150]
	Thermal input range	MMBTU/hr	1.3 - 5.2
		[kWth]	[380 - 1450]
	Flow rate range	gpm	50 - 238
		[l/s]	[3.0 - 15.0]
WATER COOLED CONDENSING PARAMETERS	Cooling water input temp range	°F	40 - 150
		[°C]	[4 - 65]
	Heat rejected to cooling water range	MMBTU/hr	1.3 - 4.7
		[kWth]	[380 - 1365]
	Cooling water flow rate	gpm	95 - 285
		[l/s]	[6.0 - 18.0]
LIQUID LOOP RADIATOR (LLR)	LLR approach to ambient air temp	°F	20
		[°C]	[11]
	Heat rejected to LLR	MMBTU/hr	1.3 - 4.7
		[kWth]	[380 - 1365]

4400B+ OPTIMIZATION ALTERNATIVES

Model / Condition	INPUT VALUES				OUTPUT
	Cold Water Temp °F [°C]	Hot Water Temp °F [°C]	Hot Water Flow GPM [L/s]	Minimum Required MMBTU/ hr [kWth]	Gross kWe
B+ / High Temp / Low Flow	77 [25]	302 [150]	65 [4]	3.3 [950]	75
B+ / Low Temp / High Flow	77 [25]	270 [132]	170 [10.7]	3.3 [950]	75
B+ / High Temp / CHP*	140 [60]	302 [150]	160 [10.0]	5.2 [1100]	75

Cold water flow rate: 220 GPM [14 L/s]; *CHP 255 GPM [16 L/s]

*CHP provides up to 185°F [85°C] condesing for benificial uses

PERFORMANCE CHARACTERISTICS

Nominal Rating	Up to 75kWe* @ 380 - 500V / 3 phase / 50 & 60 Hz
Ambient Operation	32°F - 120°F (0°C - 48°C)**
Power Factor Correction	Load and Site Dependent - from 0.9 to 1
Total Harmonic Distortion	<3%
Emissions	Zero (Closed Binary Cycle)
Minimum Operating kW Output	5 kWe

DESIGN ATTRIBUTES

Refrigerant Plumbing	Built to ASME and CE Standards
Power Block	BITZER Semi-Hermetic Twin Screw Expander Generator Combination
Generator	Grid-Tied Induction (Brushless Construction, Asynchronous)
Heat Exchangers	Compact, Brazed Plate Construction
Design Life	20 Years
Lubrication	Patented Process Lubrication
Grid Protective Relay (GPR)	External Additional GPR Interface Included

SYSTEM DESCRIPTION

Working Fluid	R245fa (Pentafluoropropane)***
Heat Source	Hot Water 170°F - 302°F (77°C - 150°C)
Cooling Requirement	Water 40°F - 150°F (4°C - 65°C)
Minimum Temp Differential	Between Hot Water Input and Cooling Water Input = 80°F / 27°C
Controls	Programmable Logic Controller Based Custom Controls
Remote Monitoring	Machine accessible with included VPN router
Operation	Designed for Unattended Operation
Cabinet	NEMA 3R Outdoor Rated /IP 54 Compliant
Shipping	Ships from Flowery Branch, GA, USA
Dimensions & Weight	Various Configurations Available (see first page)
Sound Pressure	78dBA at 1 meter. Sound Attenuated Option: <70dBA at 1 meter

FEATURES INCLUDE:

// Ease Of Installation

// Low Maintenance, with No Drive Couplings, Shaft Seals, or Oil Changes

// Robust, Twin Screw Expander Power Block

// CE Certified

// Remote Monitoring

// Automated Control System

// Modular and Scalable

// Zero Emissions

// Zero Toxic By-Products

// Zero Fossil Fuel Requirements

// Dual-Heat Stream Input + Radiator Option Available

*Output depends on hot and cold resources

**Extreme environments require optional equipment

***R245fa is a non-flammable and non-ozone depleting working fluid

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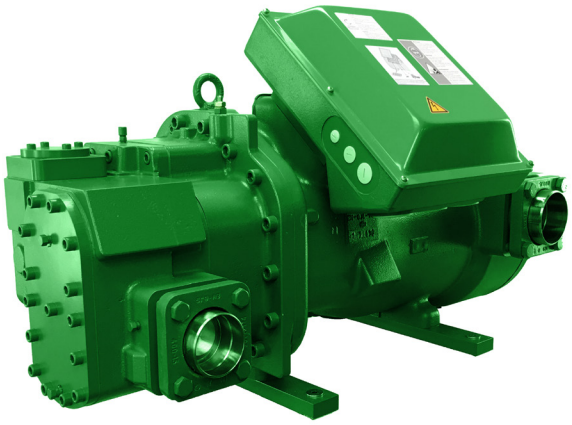
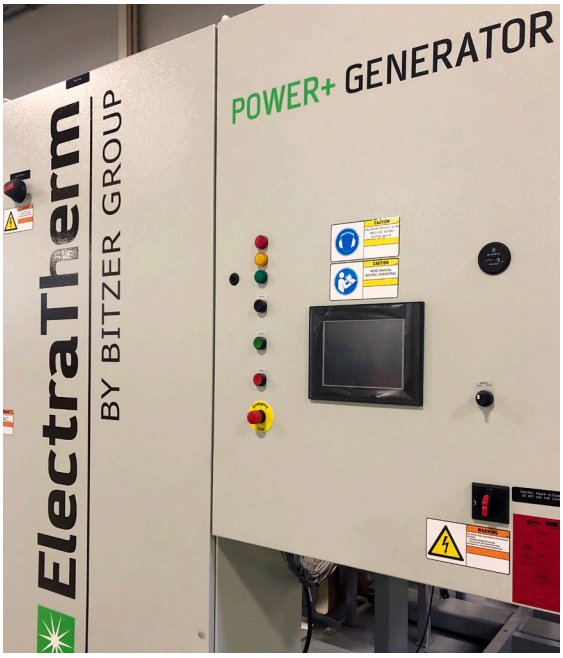
ElectraTherm
BY BITZER GROUP

6500B+ SPECIFICATION SHEET



BITZER SEMI-HERMETIC EXPANDER/GENERATOR



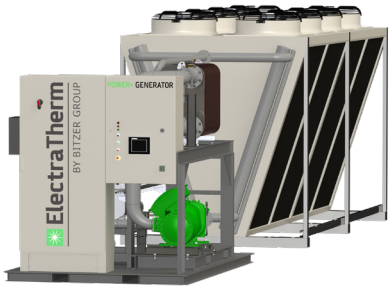
POWER+ GENERATOR

ElectraTherm's POWER+ GENERATOR produces fuel-free, emission-free power from low grade waste heat using the Organic Rankine Cycle (ORC) and proprietary technology. The POWER+ GENERATOR 6500B+ enables the unit to have beneficial higher temperature condensing water -- creating an efficient CHP (Combined Heat and Power) power system from engine waste heat, biomass, industrial processes, and more. Hot water enters the POWER+ and is transferred to the heating circuit at temperatures up to 85°C, generating up to 125kW of power for the site. Each POWER+ 6500B+ model is capable of transferring up to 2MW of heat.

6500B+ CONFIGURATIONS - UP TO 125kWe

6500B+ STAND ALONE

// Dimensions*: 3.3 x 2.0 x 2.5 m
// Weight: 4,853 kg /10,699 lbs
// Customizable balance of plant
// Indoor or outdoor installation
// Global Price: Estimated 3 to 5 year payback depending on project details, contact us for a current review**



6500B+ SYSTEM PACKAGE

// Dimensions*: 15 x 2.3 x 2.5 m
// Weight: 8,553 kg / 19,518 lbs
// Includes: liquid loop radiator, cold water pump, integrated controls, requires minimal engineering
// Contact ElectraTherm for current pricing**

* Renderings may not be exact representations of final POWER+ product.
** Certification fees for certain countries may apply.

HEAT TO POWER APPLICATIONS

ElectraTherm generates electricity from various heat sources, including:

Stationary Engines

Biomass/Biogas

Boilers & Process Heat

Oil & Gas, Geothermal

Flare Elimination

6500B+ PERFORMANCE PARAMETERS - UP TO 125kWe

ElectraTherm's Water Cooled Condensing System Performance

HOT WATER INPUT PARAMETERS	Hot water input temp range	°F	170 - 302
		[°C]	[77 - 150]
	Thermal input range	MMBTU/hr	1.35 - 7.5
		[kWth]	[400 - 2200]
	Flow rate range	gpm	95-365
		[l/s]	[6.0 - 23]
WATER COOLED CONDENSING PARAMETERS	Cooling water input temp range	°F	40 - 150
		[°C]	[4 - 65]
	Heat rejected to cooling water range	MMBTU/hr	1.35 - 6.8
		[kWth]	[400 - 2000]
	Cooling water flow rate	gpm	143 - 412
		[l/s]	[9 - 26]
LIQUID LOOP RADIATOR (LLR)	LLR approach to ambient air temp	°F	25
		[°C]	[13]
	Heat rejected to LLR (non CHP)	MMBTU/hr	1.35 - 5.4
		[kWth]	[400 - 1600]

6500B+ OPTIMIZATION ALTERNATIVES

Condition	INPUT VALUES				OUTPUT
	Cold Water Temp °F [°C]	Hot Water Temp °F [°C]	Hot Water Flow GPM [L/s]	Minimum Required MMBTU/ hr [kWth]	Gross kWe
High Temp / Low Flow	77 [25]	302 [150]	110 [7]	4.3 [1250]	125
Low Temp / High Flow	77 [25]	277 [136]	365 [23]	4.3 [1250]	125
High Temp / High Flow CHP*	144 [62]	302 [150]	365 [23]	7.3 [2150]	125

Cold water flow rate: 325 GPM [20.5 L/s]
*CHP provides up to 185°F [85°C] condensing for benificial uses

PERFORMANCE CHARACTERISTICS

Nominal Rating	Up to 125kWe* @ 380 - 500V / 3 phase / 50 & 60 Hz
Ambient Operation	32°F - 120°F (0°C - 48°C)**
Power Factor Correction	Load and Site Dependent - from 0.9 to 1
Total Harmonic Distortion	<3%
Emissions	Zero (Closed Binary Cycle)
Minimum Operating kW Output	5 kWe

DESIGN ATTRIBUTES

Refrigerant Plumbing	Built to ASME and CE Standards
Power Block	Twin Screw Expander
Generator	Grid-Tied Induction (Brushless Construction, Asynchronous)
Heat Exchangers	Compact, Brazed Plate Construction
Design Life	20 Years
Lubrication	Patented Process Lubrication
Grid Protective Relay (GPR)	External Additional GPR Interface Included

SYSTEM DESCRIPTION

Working Fluid	R245fa (Pentafluoropropane)***
Heat Source	Hot Water 170°F - 302°F (77°C - 150°C)
Cooling Requirement	Water 40°F - 150°F (4°C - 65°C)
Minimum Temp Differential	Between Hot Water Input and Cooling Water Input = 80°F / 27°C
Controls	Programmable Logic Controller Based Custom Controls
Remote Monitoring	Machine accessible with included VPN router
Operation	Designed for Unattended Operation
Cabinet	NEMA 3R Outdoor Rated /IP 54 Compliant
Shipping	Ships from Flowery Branch, GA, USA
Dimensions & Weight	Various Configurations Available (see first page)
Sound Pressure	78dBA at 1 meter

FEATURES INCLUDE:

// Automated Control System
// Remote Monitoring
// Low Maintenance
// Modular and Scalable
// Robust, Twin Screw Expander Power Block
// CE Certified
// Zero Emissions
// Zero Toxic By-products
// Zero Fossil Fuel Requirements
// Dual-Heat Stream Input + Radiator Option Available

*Output depends on hot and cold resources
**Extreme environments require optional equipment
***R245fa is a non-flammable and non-ozone depleting working fluid

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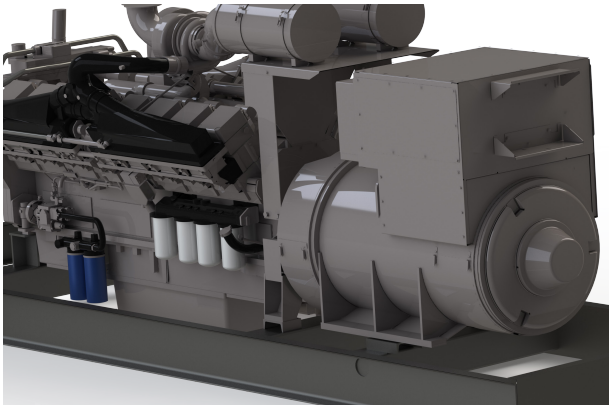
ACTIVE COOLER

COOL YOUR ENGINE AND REPLACE YOUR RADIATOR ALL WHILE GENERATING EMISSION FREE POWER



All Engines need a way to get rid of excess Heat. All Radiators consume Power. Only the ElectraTherm **Active Cooler** can remove heat from your engine while **Generating Power.**

ElectraTherm Active Cooler

Integrated Heat Engine turns heat into electricity to power the cooling system

- Inlet and Return Temperature to Engine Specification (e.g. 90°C - 70°C)
- Available in 800 kWth and 1800 kWth Size
- Scalable to Multi Megawatt Heat loads
- No Engine Derate at High Ambient Conditions up to 40°C
- Multiple Cooling Circuits Available for Jacket Water and Low Temperature Cooling
- Standard Interface Connections for Water and Power

Powered by the Commercially Proven POWER+ Generator - Supported by BITZER GROUP Worldwide

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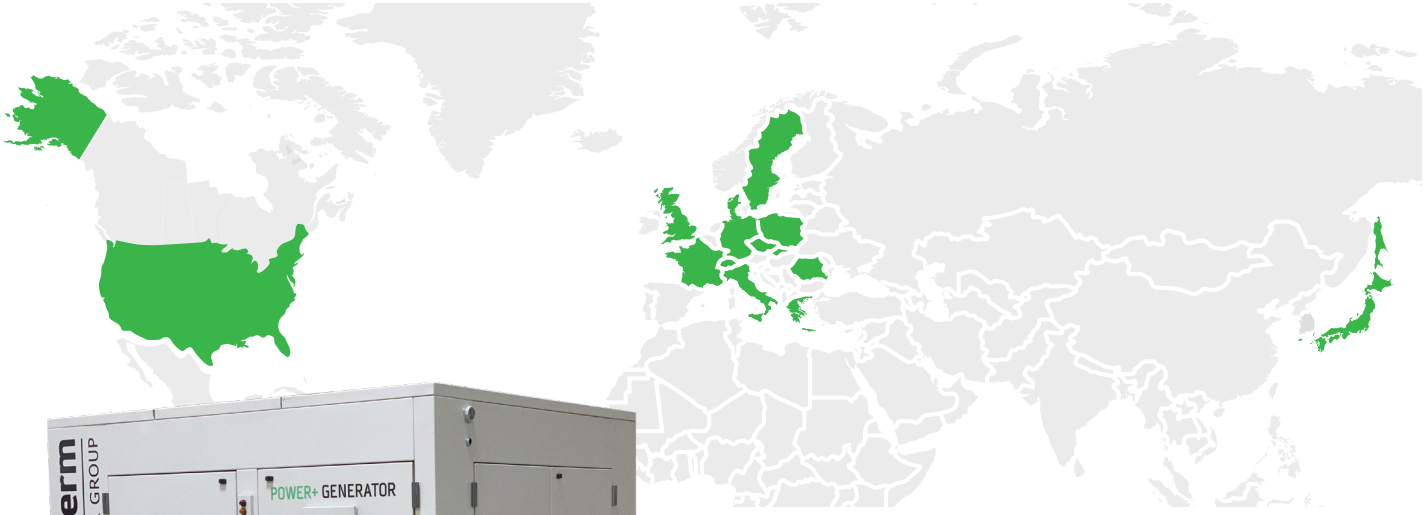
POWER+ GENERATORS IN THE FIELD

OPERATING IN 10 COUNTRIES



ELECTRATHERM'S POWER+ GENERATOR

// 80+ Operational Machines

// Robust and Proven Product Line

// 35-125kWe

// More than 1.4 Million Hours of Run Time

HEAT TO POWER APPLICATIONS

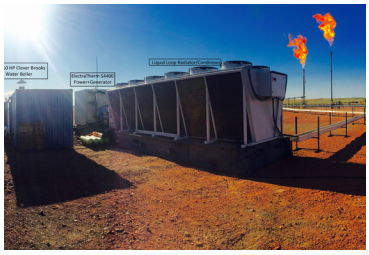
ElectraTherm generates electricity from various heat sources, including:

BIOMASS
30+ Installations

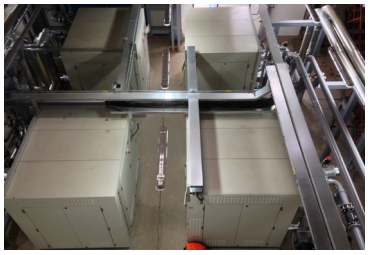
STATIONARY ENGINES
20+ Installations

MICRO-GEOTHERMAL
5 Installations

PROCESS HEAT
2 Installations



FLARING
1 Demonstration



OTHER
10+ Installations

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BY BITZER GROUP

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