ELECTRA THERM®

WASTE HEAT TO POWER AT BIOGAS PLANTS

Green Machine ORC

Adding a Green Machine to a biogas engine creates a significant value and helps meet thermal requirements for various incentives.

THE GREEN MACHINE SERIES 4000

ElectraTherm's award-winning Green Machine utilizes low grade heat sources to make electricity with:

- No fuel requirement
- Minimal footprint
- Zero emissions
- 20-year design life
- Low maintenance
- Attractive payback

Standard Features and Specifications

- Fully automated controls with remote monitoring and operating capabilities
- Induction generator with power factor correction for easy grid connection
- Simple maintenance, with no gearbox or oil changes
- Closed loop air cooled condensing option results in zero water consumption
- NEMA 3R / IP 54 compliant enclosure for outdoor use
- Sound attenuated option: <72db at 1 meter
- CE certified
- Braised plate heat exchangers
- Robust, Twin Screw Expander power block
- Patented in-process lubrication

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BIOGAS PLANT ADVANTAGES

A biogas plant that uses the Green Machine converts excess engine heat into valuable electricity and reduces existing on-site electrical cooling loads for the engine. The Green Machine increases biogas plant efficiency and lowers fuel requirements for the biogas engine. **This means increased revenue for the biogas plant.**

All of this is done with zero emissions.

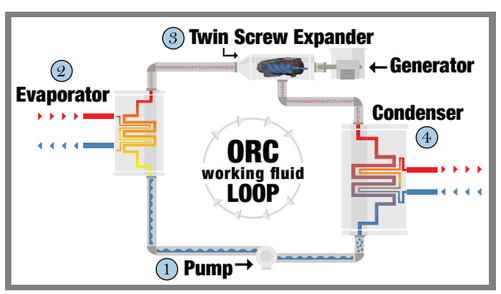
BIOGAS + ORC = BIOGAS+

An Organic Rankine Cycle that is optimized for biogas plants

Twin Screw Expander

How it Works

ElectraTherm's waste heat-to-power system uses a closed loop Organic Rankine Cycle (ORC).



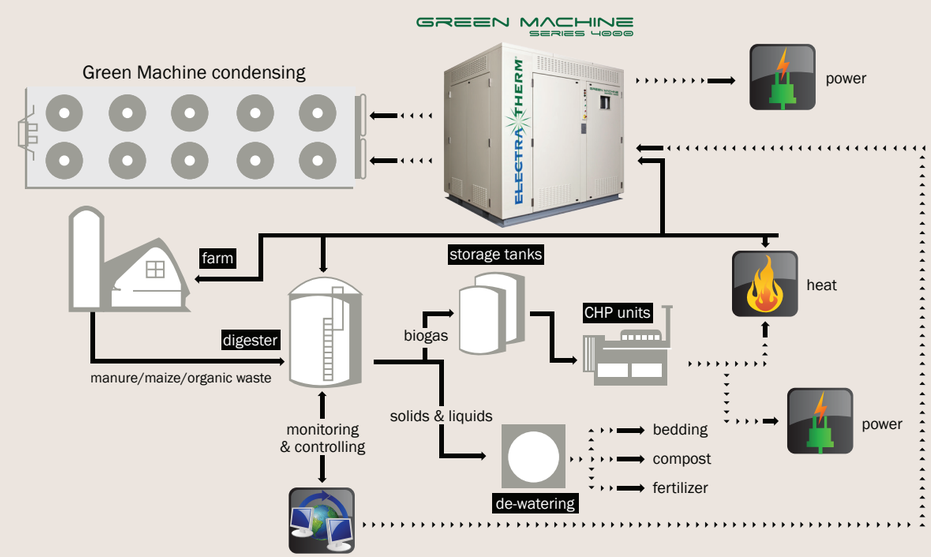
Steps in the Process

1) Working fluid is pumped to higher pressure and transferred to the evaporator.
2) Heat captured by the evaporator boils the working fluid into pressurized vapor.
3) The vapor flows through the twin screw expander, spinning an electric generator to produce power.
4) The vapor is cooled and condensed back into a liquid in the condenser to repeat the cycle.

THIS IS SMART POWER™

Anaerobic Digester Balance of Plant

A small amount of the heat produced by the engine at a biogas plant is used to keep the anaerobic digester warm, and is sometimes used for district heating. The remaining, excess heat requires electricity to cool. The Green Machine can transform this heat into additional electricity, increasing plant efficiency, and reducing on-site electrical cooling loads.



INTRODUCING THE CONTAINERIZED ORC

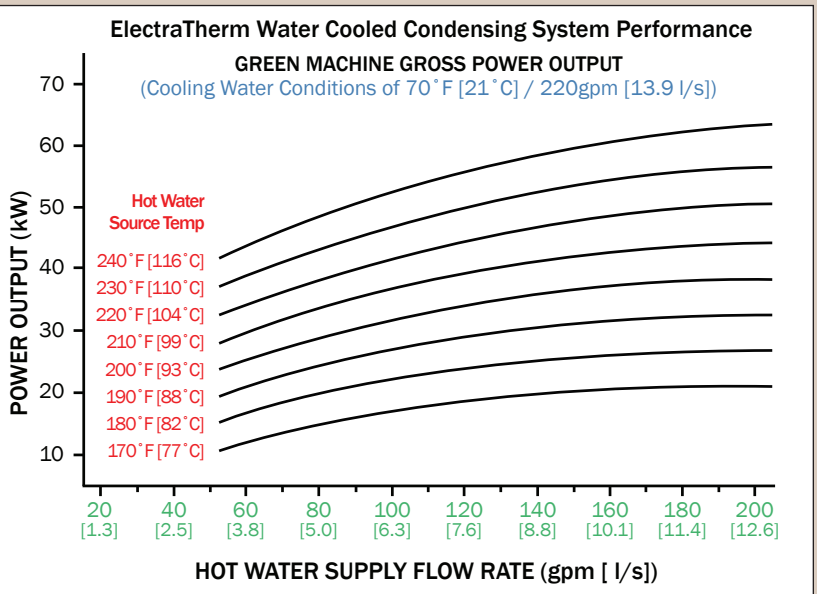
The containerized Green Machine provides added value with turnkey installation and operating features. The air cooled condenser is included and controlled by the Green Machine. There is a small footprint due to the condenser being mounted on the container. The container is easy to install and balance of plant requirements are greatly reduced.

Additional benefits include:

- 20-foot container can be placed directly on level, compacted gravel; No concrete pad is required
- Air cooled condenser plumbing is included with equipment
- Simple electrical connections
- In-out flanged connections provided at end of container for plumbing connections
- Enhanced serviceability
- Easy access to all components and control panels
- Lower installation material and labor costs
- Available in water cooled and air cooled condensing versions
- Geothermal specific models also available

PERFORMANCE

Electrical Output	Gross Electrical Output	Parameters	Up to 65 kWe
Hot Water Input Parameters	Hot water input temp range	˚F	170-240
		[˚C]	[77-116]
	Thermal input range	MMTBU/hr	1.37-2.94
		[kWth]	[400-860]
	Flow rate range	gpm	50-200
		[l/s]	[3.2-12.6]
Water Cooled Condensing Parameters	Cooling water input temp range	˚F	40-110
		[˚C]	[4-43]
	Heat rejected to cooling water range	MMTBU/hr	1.30-2.72
		[kWth]	[380-795]
	Cooling water flow rate	gpm	220
		[l/s]	[13.9]
Direct Air Condensing Conditions	Ambient air temp	˚F	<100
		[˚C]	[<38]
	Heat rejected to condenser	MMTBU/hr	1.30-2.72
		[kWth]	[380-795]



This graph displays Green Machine gross power output over different hot water temperatures and flow rates, for a given water condensing point.

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ElectraTherm, Inc. is a clean energy company headquartered in Reno, Nevada. ElectraTherm's product, the Green Machine, generates fuel-free, emission-free power from low temperature waste heat using the Organic Rankine Cycle (ORC) and patented technology. Our machines are modular, robust, low maintenance power generators.

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