Cool Energy

POWERING A CLEAN TOMORROW™

Introduction: As much as 40% of the energy consumed in industrial processes is ultimately lost as waste heat, and Cool Energy's products can reclaim that heat to create on-site electricity. Cool Energy has developed, demonstrated, and completed initial sales of a novel heat-to-power device, the **ThermoHeart™ Engine,** that converts low-to-medium temperature heat flows (150°C to 400°C) into clean electricity. The ThermoHeart Engine can be used to recover low grade waste heat economically, and boost the energy efficiency of a power generator or industrial process. Among the applications for the ThermoHeart Engine are waste heat recovery (WHR), solar thermal power generation, biomass power generation, and geothermal power generation. A $50 billion dollar market exists for heat to electricity conversion solutions in these lower temperature ranges for output powers under 200kW. Initial testing of the first two engines assembled has measured conversion **efficiencies of nearly 30%.**

User Benefits: Industrial processes that produce waste heat streams, remote and military generator exhaust, shipboard power generation, oil and gas production, and pollution control equipment can all benefit from using the ThermoHeart Engine for electricity production from wasted heat. Strategic partnerships are under development in all of these sectors for OEM supply. Aside from providing cost savings and reducing emissions from using less fuel and electricity, another advantage of the ThermoHeart Engine includes reducing the need for expensive transportation of fuel to remote locations. In military applications, this reduces both operational costs as well as risk to logistical support personnel. The ThermoHeart Engine can boost the output of a diesel or natural gas engine generator **by up to 10%** when recovering the waste heat in the engine exhaust, in some cases resulting in **1-2 year expected payback times**.

Cool Energy Overview

- Provide equipment to turn waste heat into clean electricity
- 1-5 year customer payback (20% to 100% IRR)
- $50B TAM for all market sectors below 200kW capacity
- 5th gen 25kW engine under test
- 10 patents issued, filings in China, India, Europe
- Go to market: license to existing channel partners
- Almost $1M in licensing revenue in 2017
- Products complement those of GE, Siemens, Mitsubishi

Cool Energy Next Steps

- Raising funding to
  - Build, test & deliver ordered 25kW units
  - Execute additional licensing agreements
  - Achieve profitability
- Channel partnerships in active development with
  - Pollution control equipment companies
  - Solar thermal power producers
  - Diesel genset re-sellers
- Established joint venture in China for manufacturing

Cool Energy provides the most efficient low-temperature power conversion devices.

The ThermoHeart™ Engine is a fully enclosed Stirling engine with a novel configuration that uses ceramics, steel, and aluminum for critical components to maximize the performance and reduce the cost of the engine. Because these engines operate at a low speed (600 rpm), have no internal combustion or firing, and are well-balanced, they are quiet and low in vibration. The metal housing and internal insulation add acoustic and thermal damping and control. There are no circulating lubricants in the ThermoHeart Engine, so performance remains high while maintenance is minimized. The conversion efficiency of the 25kW (Gen 5) engine is nearly 30% at a hot end temperature of 340°C when operated at peak-efficiency conditions, much higher than other products. Environmental benefits of using these modules for on-site power generation include avoiding emissions from centralized fossil power plants. For each engine module over its life-cycle, 2000 metric tons of CO_2 emissions are avoided, as well as 2 tons of SO_x and NO_x.

25kW (Gen 5) ThermoHeart™ Engine

- 20% to 100% customer IRR
- 20,000 hours service interval by design (3-5 years)
- Multiple engine modules can be used for WHR
- WHR on electrical gensets from 200kW to 5MW
- Genset fuel efficiency improvements up to 10%
- Also valuable for WHR from natural gas compression, pollution control oxidation, kiln exhaust, LNG re-gasification, other thermal processes
- Efficiency improvements enabled in rail and shipping applications

Diesel and NG Genset Heat Recovery

- 5% to 10% power boost
- 1 Year payback @ 6000 hrs/year in some applications
- >$2B annual market
- Live demo in 2013
- Simple exhaust hookup

Powering a Clean Tomorrow®

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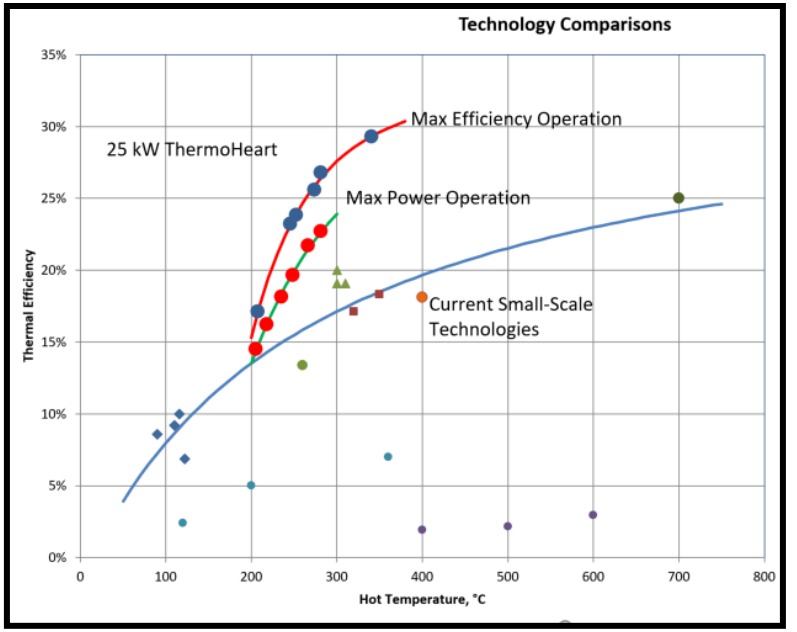

25kW ThermoHeart measured performance compared to

Patents issued to Cool Energy

- 7,617,680 - Power Generation Using Low Temp...
- 7,694,514 - Direct Contact Thermal Exchange...
- 7,805,934 - Displacer Motion Control Within...
- 7,810,330 - Power Generation Using Thermal...
- 7,877,999 - Power Generation and Space Cond...
- 8,224,495 - Control of Power Generation Sys...
- 8,539,771 - Power Generation and Space Cond...
- 9,206,900 - Assembly for Sealing a Sliding Inter…
- 9,310,135 - Configurable Heat Exchanger
- 10,100,778 - Stirling Engine and Linear-to-Rotary...

To date, Cool Energy Inc. has been funded by angel seed capital, venture capital, early adopter sales, and grants from the National Science Foundation, the Department of Energy, and the Environmental Protection Agency.