

STM POWER

THE CLEAN ENERGY CHOICE



Biogas Applications



Flare Gas



Landfill Gas Applications



Agricultural Waste

**STM
POWER**

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RENEWABLE ENERGY SOURCES

STM PRODUCTS

Leading the Way

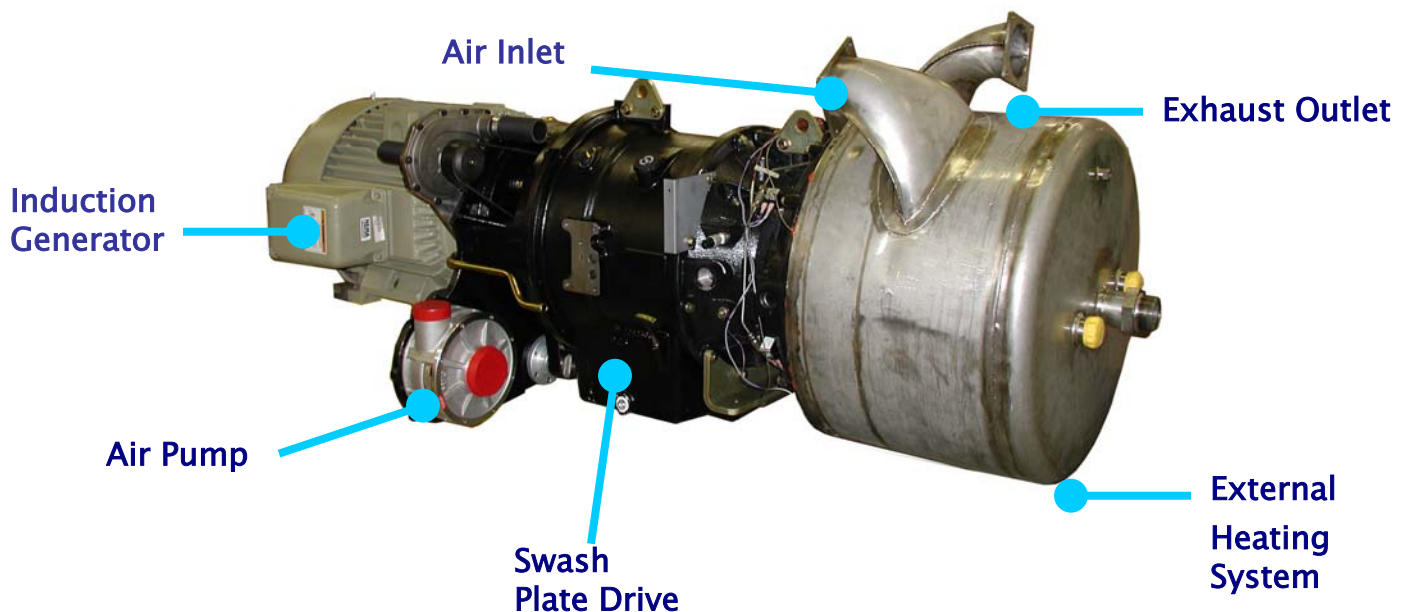
STM Power is the world's leading developer of external combustion engine technology utilizing **Stirling** Cycle Engines, which are versatile, reliable, efficient and competitively priced. STM Power has been working on commercialization of this technology for more than a decade. This technology is a breakthrough in the conversion of a wide variety of fuels into valuable electrical power and hot water for commercial, industrial and residential applications.

STM Power's solution, the PowerUnit™, provides our customers with a cost-effective, low emission and low maintenance distributed generation technology. Our integrated engine/generator unit provides 55 kilowatts (kWe) of continuous electrical power, using 50% fewer moving parts than an internal combustion engine with a fraction of the emissions and maintenance requirements. The product offering includes weather protective enclosures and options for combined heating and cooling (CHP), integral radiators or remote radiators.

Fuel Fired Units

The STM combustor (external heating system) mounted to the engine is capable of burning a wide variety of conventional fuels including natural gas, hydrogen and propane gas, resource recovery fuels such as flare gas and coal bed methane gas, or renewable biogas fuels from landfills or anaerobic digesters (sewage or agricultural waste). The fuel train is able to accept low-pressure fuel input without the need for costly fuel compressors.

In STM's external combustion engine the products of combustion never come into contact with any precision moving parts or lubricants, because the entire combustion process takes place outside the cylinders. STM PowerUnits™ are able to burn low energy content gases that are otherwise flared or vented off, while providing low maintenance requirements on the engine, long service life, and high reliability and availability. The continuous external combustion process allows precise control of emissions, making the STM PowerUnit™ not only extremely fuel-flexible, but environmentally friendly as well.



STIRLING ENGINE TECHNOLOGY

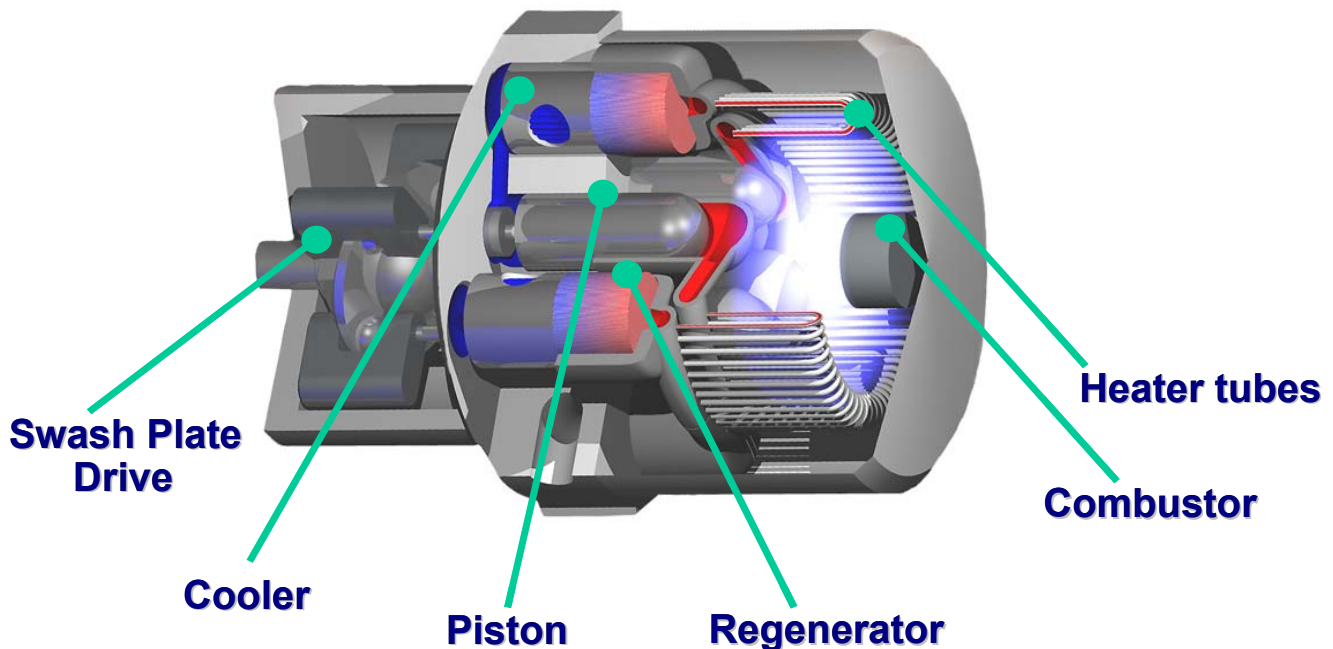
THE TECHNOLOGY

HOW STIRLING ENGINE TECHNOLOGY WORKS

The STM Stirling engine is an, “external combustion” 4-cylinder heat engine in which a fixed quantity of gaseous working medium, in this case high-pressure hydrogen, is contained and enclosed within each cylinder. A portion of the engine is maintained at a constant high temperature by burning any of a wide variety of fuels in the combustor and transferring heat to the hydrogen via the heater tubes. The other portion of the engine is maintained at a constant low temperature by circulating the hydrogen through coolers. The working gas is transferred back and forth between the hot and cold portions of the engine and alternately expanded and compressed by the movement of the engine’s pistons. The reciprocating motion of the pistons is converted to rotary motion via a swash plate drive, which powers the generator.

In each cylinder, hydrogen passing through the heater tubes absorbs heat from the combustion and expands, pushing the piston down and thereby doing work on the swash plate. As the piston comes back up, it forces the hydrogen out of the cylinder and through a regenerator, which absorbs heat from the hydrogen passing through it, and stores it temporarily. The hydrogen then passes through the tubes of a cooler and rejects heat to the coolant passing through it. The cooled hydrogen then enters the compression space below the adjacent piston, and as this piston comes down, it is compressed and pushed back up through the regenerator, where it picks up the heat previously stored there, passes through the heater tubes, and the cycle begins again.

STM 4-Piston Double Acting Stirling Cycle Engine



THE ADVANTAGES

STM Power has refined external combustion technology to become the world leader in industrial and commercial distributed generation applications of **Stirling** cycle engines. Here are some of the reasons why:

- **Scalable Solutions** Systems are scalable using competitively priced, environmentally friendly 55 kW modules, which can be equipped with low-cost integral heat exchangers for combined heat and power (CHP) applications.
- **Fuel Versatility** Fuel-fired PowerUnits™ can accept a broad range of liquid and gaseous fuels, including renewables and biogas. Minimum fuel cleanup is needed for fuels containing hydrogen sulfide or siloxanes.
- **No Fuel Compression** The STM PowerUnits™ are designed for fuel pressures as low as 2 psig (13.8 kPa), so they do not require costly fuel compressors and their associated parasitic losses and maintenance costs.
- **Ultra-low Emissions** STM PowerUnits™ are designed to meet the most stringent mandated emissions requirements, including CARB limits, without after-treatment.
- **High Fuel Efficiency** The STM PowerUnit™ provides levels of efficiency equal to or superior to other energy conversion technologies. It has a 30% electrical efficiency and an 80% total system efficiency in CHP applications delivering 330,000 Btu/hr (348,168 kJ/hr) in the form of hot water.
- **Quite and Low Vibration** The STM engine is extremely smooth and quiet and produces negligible vibration, making it possible to install the PowerUnit™ without vibration isolation devices or external sound attenuation, thereby lowering installation costs.
- **Grid interconnection** The STM Powerunits™ are easily connected to the electrical grid using a simple induction generator and are modular and scalable for larger kW projects.
- **Low Maintenance** The STM engine has less than half the number of moving parts as a reciprocating internal combustion engine, and these parts never come into contact with any products of combustion. The result is a reliable product that requires very little fuel treatment and generally requires maintenance only once a year in full-time operation. All of this means low maintenance costs.
- **Predictable, Low Power Costs** STM Power can help manage your energy costs. Fuel flexibility, high energy efficiency, easy installation with minimal fuel compression or fuel treatment expense, and low maintenance all translate into low and stable energy costs for you.

Company Profile

STM Power, Inc. is a privately held Ann Arbor, Michigan based company that designs, develops and sells ultra-low emission, external combustion (Stirling Cycle) engine products. STM Power holds 34 active patents, 57 worldwide patents and has patents pending.

STM is in the process of growing its distribution network with quality companies and partners capable of creating total power generation solutions for our customers.

Distributed by:

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