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Electricity from Waste Heat

Ener-G-Rotors' system harvests energy at lower temperatures.

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Factories, data centers, power plants--even your clothes dryer--throw off waste heat that could be a useful source of energy. But most existing heat-harvesting technologies are efficient only at temperatures above 150 °C, and much waste heat just isn't that hot. Now Ener-G-Rotors, based in Schenectady, NY, is developing technology that can use heat between 65 and 150 °C.

The company replaces the turbine in a typical electrical generator with a device called a gerotor, which it claims to have made "near frictionless." "If this works, it's so huge," says Bob Bechtold, president of Harbec Plastics, one of Ener-G-Rotors' potential customers. "I've been dreaming about the concept of using [low-temperature waste heat] ever since I first knew what it was about . . . It's all about using what we have more completely."

Ener-G-Rotors' technology is based on the Rankine cycle, in which heated fluid flowing through a tube heats a pressurized fluid in a second tube via a heat exchanger. The second tube is a closed loop; the so-called working fluid flowing through it (a refrigerant with a low boiling point, in the case of Ener-G-Rotors) vaporizes and travels into a larger space called an expander. There, as the name would imply, it expands, exerting a mechanical force that can be converted into electricity.

Instead of turning a turbine, the expanding vapor in Ener-G-Rotors' system turns the gerotor, which is really two concentric rotors. The inner rotor attaches to an axle, and the outer rotor is a kind of collar around it. The rotors have mismatched gear teeth, and when vapor passing between them forces them apart, the gears mesh, turning the rotor.

The company claims that the rotor design is far simpler than that of a turbine, making it potentially easier and cheaper to manufacture, as well as more durable. And the company says that it has invented a proprietary way of mounting the rotor on rolling bearings that makes its movement nearly frictionless.

Reducing the friction means that the rotor turns more easily, so the gas doesn't need to exert as much force to generate electricity. That's why the system can work at lower temperatures, which impart less energy to the gas.

The company expects to convert 10 to 15 percent of low-temperature waste heat into electricity, delivering a payback in two years or less in most cases, says CEO Michael Newell. Ener-G-Rotors plans to both sell systems to customers outright and operate its own systems and sell power.

Ener-G-Rotors initially plans to target industries, such as chemicals, paper, oil, and food, that use plenty of energy and also release a tremendous amount of waste heat, Newell says. Later, the company also hopes to participate in solar-thermal and geothermal projects, and to target consumers with a one-kilowatt system.

The company is installing its first beta unit, a five-kilowatt system, in a combined heat-and-power plant at Harbec Plastics. It is also installing betas at a steam plant for New York utility Consolidated Edison and at a landfill-gas-burning plant for the New York State Energy Research and Development Authority.

Edward Ecock, manager of research and development for gas and steam at ConEd,

says that Ener-G-Rotors' system is more efficient than others that he's seen. In a power plant that uses steam generators, it could have the added benefit of reducing the amount of water needed to cool the steam condensation and cutting additional sewage costs for getting rid of the extra water, he says.

Low-temperature waste-heat technologies "really are where the industry is going," says Mark Taylor, an analyst at research firm New Energy Finance. "This potentially could be applied to every coal plant, every nuclear-power, every natural-gas plant. Steel, anything that makes heat--anything."

If the betas pan out, Ener-G-Rotors plans to expand to a 50-kilowatt demonstration, which is much smaller than the scale that most of its competitors are targeting. Newell says that the company is hoping the smaller size will open up a market for smaller industrial waste-heat streams.

But first, the betas need to pan out. "If it's not economical, we won't want to go to the 50 kilowatts," Ecock says.

Ener-G-Rotors also needs money. It has raised "a few hundred thousand" in grants and angel funding and is now seeking $5 million for the first tranche of a $20 million venture-capital round.

And it will face plenty of competition as the market heats up, Taylor warns. A crop of companies, including larger players such as United Technologies, which makes aircraft, aerospace systems, and air conditioning, and smaller companies such as ElectraTherm, are also pursuing low-temperature technologies--and they already have systems installed.

Still, Newell is confident that his company can stand out.

"Our technology is more efficient and simpler than anything else out there right now," he says. "There aren't many technologies that are going to work here. And we think we have the lowest cost of any of the technologies out there."

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