Greengineering WhitePaper

eTech Heat Recovery Systems

Waste Heat Recovery and Dependable Energy

"Blackout leaves 600 million without power."

"Record temperatures spur warning of rolling brown outs."

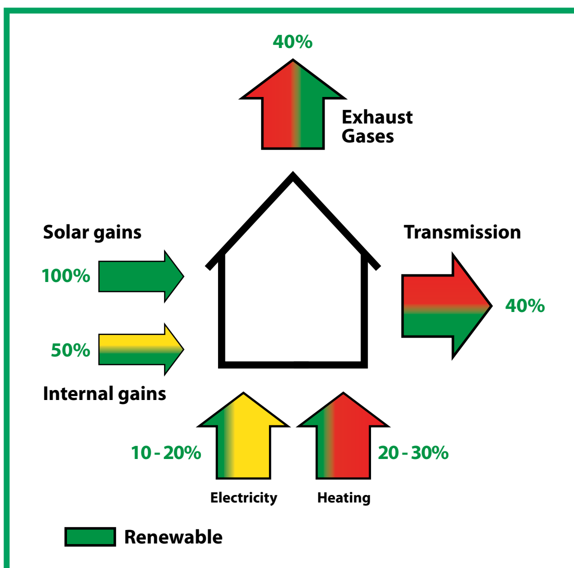
Our energy needs are ever-increasing. To meet them, we explore different options for energy creation: wind, solar, hydro, geothermal, nuclear. We also search for ways to get the greatest possible efficiency from the world's most abundant and versatile energy source, fossil fuels.

And we also develop methods for energy recovery. For the past two decades, most heat recovery work has been conducted at massive power generation facilities that distribute power to a large grid, and that are supported by substations to extend their reach.

However, commercial, light industrial and heavy industrial contractors and designers also have within their reach opportunities to convert their waste streams to useable energy, thus reducing the system load. This paper is written for these audiences.

A different approach

The energy model shown below illustrates current energy recovery concepts and technologies. Much of the discussion of local energy service has revolved around three technologies that also provide opportunities for heat recovery: exhaust gases, transmission, and solar energy gain.



However, the mindset regarding non-centralized power creation and recovery should focus not only on the heat source, but also on its application to the proper heat sink and its conversion to useable energy.

The higher the efficiency we seek, the lower grade the heat source ultimately becomes — and thus, a lower grade heat sink is required to enable recovery.

A planner will have an easier time selling a design that provides the greatest possible efficiency (without sacrificing value or reliability, of course). The owner/operator will reduce costs, as well as any negative impact on the community. And the community should experience fewer peaks and valleys in power supplies and costs.

The ORC option

The Organic Rankine Cycle is one of the least-used systems, but has one of the greatest potentials for micro energy creation. A simple explanation of the ORC is this: a heat source is used to convert organic fluids (refrigerants and hydrocarbons, for instance) to vapor. The vapor is passed through a turbine, thus generating electricity.

This is a closed loop cycle, as the operating fluid typically is not as environmentally friendly as water (i.e., steam). Nothing is. The system does provide for fluids to operate at lower temperatures as a low-grade heat source. And the results are less fuel used for heat and a source of energy creation for areas where steam is not necessarily needed.

As for heat recovery expectations, heat is still needed to raise the temperature of the working fluid. This could be geothermal or solar energy, but the heat also needs to be rejected to make the closed loop cycle work. Extended surface tubing can be used in both the vaporization and condensation phase.

The downsizing option

Natural gas is a plentiful, low-cost fuel source that is relatively clean-burning, and is also well distributed throughout the United States. It powers approximately 40 percent of all steam generation boilers and is also used for firing turbines in heat recovery steam generation combined-cycle plants. These systems are typically 70 percent to 80 percent efficient.

Over the years the trend for the units has moved from larger units to smaller ones. The components remain largely the same — but on a smaller scale. And their recovered heat may not be sufficient — either in amount or quality — to turn a secondary turbine (i.e., a high grade heat sink such as that used in HRSG) but there may be enough energy potential to preheat process water, producing additional efficiency of 3 percent to 8 percent.

The reciprocating engine option

One of the less recognized energy sources for industrial use is the reciprocating engine. This application in the U.S. is typically used as a secondary source, but could be run as the primary source, supplemented with grid energy. These engines can be powered by a variety of fuels: diesel, bio-diesel, landfill gas, natural gas — nearly any combustible carbon-based fuel.

To describe the process in the simplest of terms, if you put your hand over the exhaust pipe of your car, you can feel heat escaping and obviously being lost from the system (automotive efficiency is around 25 percent compared with industrial efficiency which ranges up to 40 percent).

Potential Waste Heat Recovery from a Reciprocating Engine

Engine Size (kWe)	Steam (pph)	Glycol (mbtu/hr)
1,000	1,425	1,721
1,500	2,140	2,582
2,500	3,565	4,303
5,000	7,135	8,605
7,500	10,700	12,908

This type of high grade source waste heat has been used by E-Tech in both heating and vaporizing high grade heat sink applications, increasing the overall efficiency of systems. The illustration shows the additional useable energy that can be recovered for a given electrical production capacity.

The law's the law

With all these applications, we still have to address the laws of physics and diminishing returns. E-Tech's first goal is to bring the system as close to 100 percent efficiency as we can. Our second goal is to measure the cost of the system against the amount of useable energy we can recover. (It is possible to build a system that can take exhaust gases/waste heat nearly to ambient temperatures, continually squeezing every last Btu into the working fluid, but the system grows exponentially — and becomes more expensive — as the approach temperature gap narrows and thus more expensive.) And finally, our third goal is to step the heat source and heat sink to determine a cost effective, practical solution to heat recovery.

"We strive to find the most economical recovery of waste heat and provide reliable uninterrupted service for the processes it works in," said long-time, certified heat transferologist, Bob Hanson, of E-Tech. "Heat recovery applications can be fire-tube, water/fluid-tube, in combination with plate and frame or shell and tube. Whichever it is, our job is to benefit both a company and the community's bottom line in cost savings and reduced pollution."