Simple mathematics: wasted heat = wasted money

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Industries that use large quantities of fuel to produce steam and electricity, also produce substantial amounts of waste heat that can be recycled back into their processes simply by applying today's modern recovery technologies. Often, the capital cost of these improvements result in very short paybacks and long-term operating cost savings. They also could qualify for local utility energy savings programs, further reducing the initial investment required. Is your plant a candidate to take advantage of these savings?

It's a given that industrial machinery produces heat as a byproduct of the heavy-duty work it does. Ovens, furnaces, incinerators, kilns, dryers, and thermal oxidizers used for pollution control all give off residual heat.

Industries that use large amounts of fuel and electricity to produce heat for specific processes also generate large amounts of waste heat. The question, in this era of recycling to help the planet and increase efficiency and profits, is: does it make good money sense to recover and reuse waste heat to reduce ever-rising energy costs?

"As industry looks to tighten its belt in this economy, creative ways to save money and increase efficiency become more important," said John Clayton, president of Clayton Industries. "Establishing a system of waste heat recovery is one proven way to do just that."

Waste heat recovery is simple. Capture the waste heat, and, by using a heat exchanger, transfer that heat to another medium to be put back into the process. In general, recovery reduces fuel bills by recycling heat that would have otherwise had to be created using fuel or electricity. Heat recovery also reduces plant emissions and improves productivity (Figure 1).

The medium of waste heat recovery can be preheated combustion air, hot water, or steam. Hot water and steam can be used for plant services, as part of the original process heating, or to run steam turbines for mechanical work or electricity production to run absorption chillers or regenerate desiccant dehumidifiers.

Waste heat recovery is always a good idea when:

- Its temperature is hotter than required for the process.
- Fuel savings are greater than operating and maintaining heat recovery equipment.

Figure 1

Typical high-efficiency heat recovery system

Temperature, chemistry, and pressure determine waste value

When evaluating air or liquid waste heat stream values, the higher the temperature, the better. Beginning at about 500°F (260°C), waste heat is considered a viable source for recovery.

Other waste value considerations include pressure drop and the chemical makeup of the waste gases. Waste heat recovery devices can produce pressure drops that can negatively affect waste heat source operation. Also, corrosive components, and the dew-point of the gas stream, may necessitate the use of exotic metals, and the presence of materials that could foul the heat exchanger's surfaces may affect its design

Waste heat recovery choices

There are three basic types of waste heat recovery equipment:

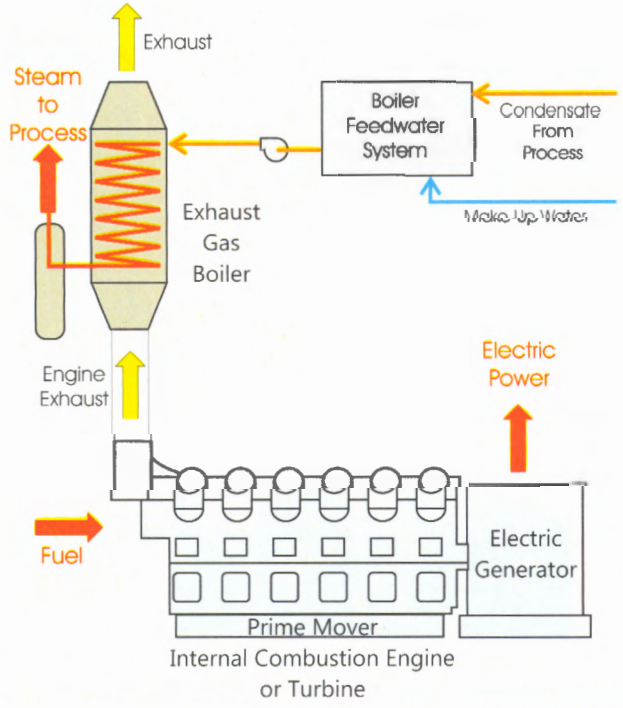
A recuperator is a gas-to-gas heat exchanger placed on the stack of an oven or on the exhaust of a prime mover in a combined heat and power installation. Recuperators transfer heat from the outgoing gas to incoming combustion air without allowing streams to mix. All recuperator designs rely on tubes or plates to transfer heat. They are the most widely used waste heat recovery devices.

Regenerators are rechargeable storage devices for heat. They can work with gas-to-gas, gas-to-liquid, or liquid-to-liquid waste heat sources and can be installed on ovens, prime movers, chemical reactors, and on steam condensate systems. A regenerator is an insulated container filled with material capable of absorbing and storing large amounts of thermal energy. The waste stream flows through the regenerator, heating the storage medium, and then an unheated stream flows through the regenerator, absorbing heat from the medium before it enters the process. The cycle then repeats itself. In continuous processes, two regenerators are required. There are many designs for regenerators, such as rotary, fixed matrix, and multilayer grates.

Waste heat and exhaust gas boilers/steam generators are similar to conventional boilers except they are heated by the waste heat stream, not their own burners. They are of most value to process industries that require large amounts of steam. They generally will not replace existing boilers but will supplement the steam they produce, reducing the energy cost to operate the direct-fired boilers. Steam is available only when the process is running, so waste heat boilers are generally designed to operate with existing boilers or with steam generators in a combination system (Figure 2).

Figure 2

Preliminary elements of an exhaust gas heat recovery system, which captures waste heat and puts it back into the process



Other waste heat recovery prospects

By recovering the waste heat from the prime mover and generating steam and/or hot water, the user reduces the amount of energy that would otherwise be purchased. This distributed generation project then becomes a combined heat and power (CHP) project. The importance of heat recovery in a CHP project is highlighted by the impact it has on the overall efficiency of the project. For example, for a total CHP efficiency of 85 percent, electrical production accounts for 35 percent and steam production accounts for 50 percent.

Examples demonstrate success

The following examples show how waste heat recovery saves money:

- A waste heat steam generator that supplements a direct-fired steam generator was installed on the furnace of a Midwest glass manufacturer, converting the 2,500°F (1,371°C) exhaust temperature into high-

pressure steam for use in process and plant services. Waste heat recovery reduced the fuel that would otherwise be purchased to operate the direct-fired boiler.

- At an East Coast building products manufacturing plant, a CHP facility provides electricity. To justify the CHP project, three exhaust gas steam generators were installed on the three reciprocating engines to generate high-pressure steam. This steam provides heat for plant processes and supplements the direct-fired steam generators during the winter. Waste heat recovery reduces the total energy costs while justifying the CHP project and providing energy independence.

There are other ways waste heat recovery saves energy costs. Versatile types of heat exchangers — for example, simple boiler economizers to preheat feedwater or more sophisticated systems recovering heat from thermal oxidizers for high-pressure process steam -- exist for nearly all applications. Partner with your heat recovery equipment supplier to reap big savings in short order. **APC**

Andy Wales *is the western Regional Sales Manager for Clayton Industries in City of Industry, CA. Andy has more than 35 years of experience with power, steam generation, and heat recovery equipment, working for manufacturers, engineering firms, and end-users. He has an aerospace engineering degree from the University of Kansas and is past president of the Los Angeles Cogeneration Society. Andy is a member of the American Boiler Manufacturers' Association. For more information about heat recovery systems, call Andy at 951-600-8946, or e-mail him at andy.wales@claytonindustries.com.*

Clayton is a leading manufacturer of steam boilers, waste and exhaust heat steam generators, and feedwater treatment systems. Visit the company website at claytonin dustries.com.