# Use Feedwater Economizers for Waste Heat Recovery

A feedwater economizer reduces steam boiler fuel requirements by transferring heat from the flue gas to incoming feedwater. Boiler flue gases are often rejected to the stack at temperatures more than 100°F to 150°F higher than the temperature of the generated steam. Generally, boiler efficiency can be increased by 1% for every 40°F reduction in flue gas temperature. By recovering waste heat, an economizer can often reduce fuel requirements by 5% to 10% and pay for itself in less than 2 years. The table provides examples of the potential for heat recovery.

**Recoverable Heat from Boiler Flue Gases**

| Initial Stack Gas Temperature, °F | Recoverable Heat, MBtu/hr | | | |
|---|---|---|---|---|
| | Boiler Thermal Output, MBtu/hr | | | |
| | 25 | 50 | 100 | 200 |
| 400 | 1.3 | 2.6 | 5.3 | 10.6 |
| 500 | 2.3 | 4.6 | 9.2 | 18.4 |
| 600 | 3.3 | 6.5 | 13.0 | 26.1 |

Based on natural gas fuel, 15% excess air, and a final stack temperature of 250°F.

## Example

A boiler generates 45,000 lb / hr of 150 psig steam by burning natural gas. Condensate is returned to the boiler and mixed with makeup water to yield 117°F feedwater. The stack temperature is measured at 500°F. Determine the annual energy savings that will be achieved by installing an economizer given 8,400 hours per year of boiler operation at an energy cost of $4.50 / MBtu.

From the steam tables, the following enthalpy values are available:

For 150 psig saturated steam: 1,195.5 Btu / lb

For 117°F feedwater: 84.97 Btu / lb

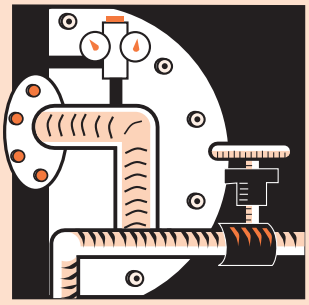
Boiler thermal output = 45,000 lb / hr x (1,195.5 – 84.97) Btu / lb = 50 million Btu / hr

The recoverable heat corresponding to a stack temperature of 500°F and a natural gas-fired boiler load of 50 MBtu / hr is read from the table (above) as 4.6 MBtu / hr.

**Annual savings = 4.6 MBtu/hr x $4.50/MBtu x 8,400 hr/yr = $173,880/yr**

## *Suggested Actions*

- Determine the stack temperature after the boiler has been tuned to manufacturer's specifications. The boiler should be operating at close-to-optimum excess air levels with all heat transfer surfaces clean.
- Determine the minimum temperature to which stack gases can be cooled subject to criteria such as dew point, cold-end corrosion, and economic heat transfer surface. (See sidebar: Exhaust Gas Temperature Limits.)
- Study the cost-effectiveness of installing a feedwater economizer or air preheater in your boiler.



## Exhaust Gas Temperature Limits

The lowest temperature to which flue gases can be cooled depends on the type of fuel used: 250°F for natural gas, 300°F for coal and low sulphur content fuel oils, and 350°F for high sulphur fuel oils. These limits are set to prevent condensation and possible corrosion of the stack.

## Potential Economizer Applications

A feedwater economizer is appropriate when insufficient heat transfer surface exists within the boiler to remove combustion heat. Boilers that exceed 100 boiler hp, operating at pressures exceeding 75 psig or above and that are significantly loaded all year long are excellent candidates for an economizer retrofit.

*Adapted from an Energy TIPS fact sheet that was originally published by the Industrial Energy Extension Service of Georgia Tech. For additional information on steam system efficiency measures, contact the Information Clearinghouse at (800) 862-2086.*

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