



# **CHP for Federal Facilities Workshop**

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# **Heat Recovery**

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# Heat Recovery

- Industry and their processes utilize large quantities of fuel and electricity that ultimately produce heat and generate large amount of waste heat.
- Waste heat simply passes out the stack into the atmosphere.

# Heat Recovery

- Basic technique of waste heat recovery is to capture the waste heat streams and transfer the heat into useful energy.
- Using waste heat saves fuel or electricity that would otherwise be purchased.

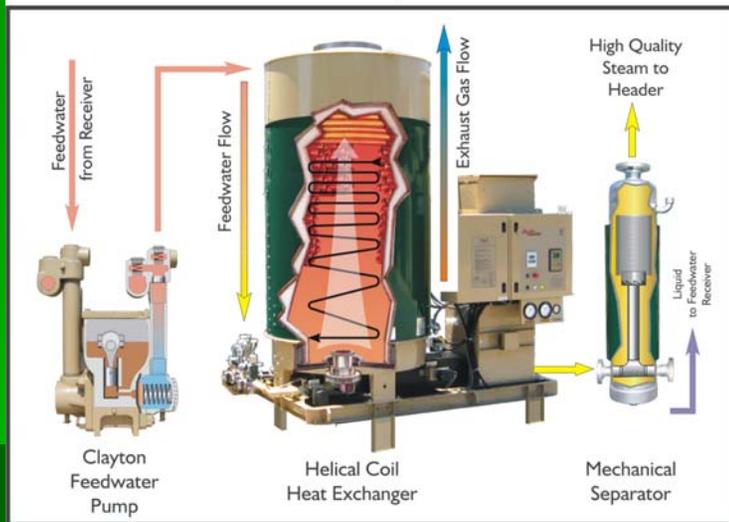
# Heat Recovery

- Simple heat exchanger to make hot water.
- Steam generator/boiler to make steam or hot water.
- Use exhaust gas directly in other devices.

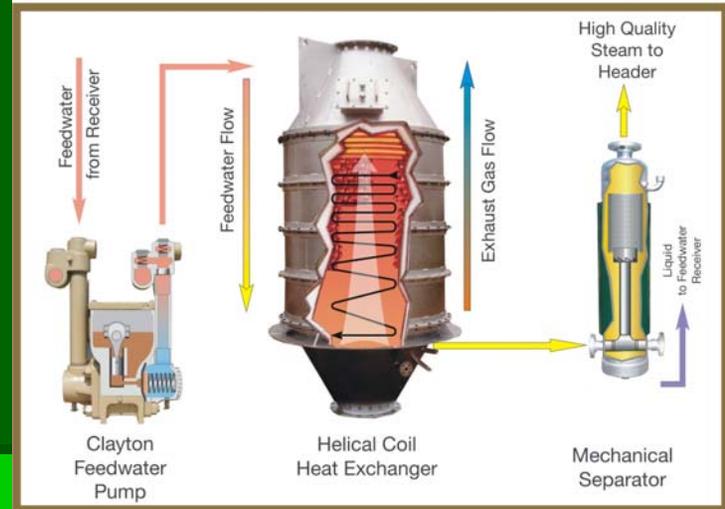
# Heat Recovery

## The Heat Recovery Steam Generator/Boiler

How Steam Is Produced In A Clayton Steam Generator

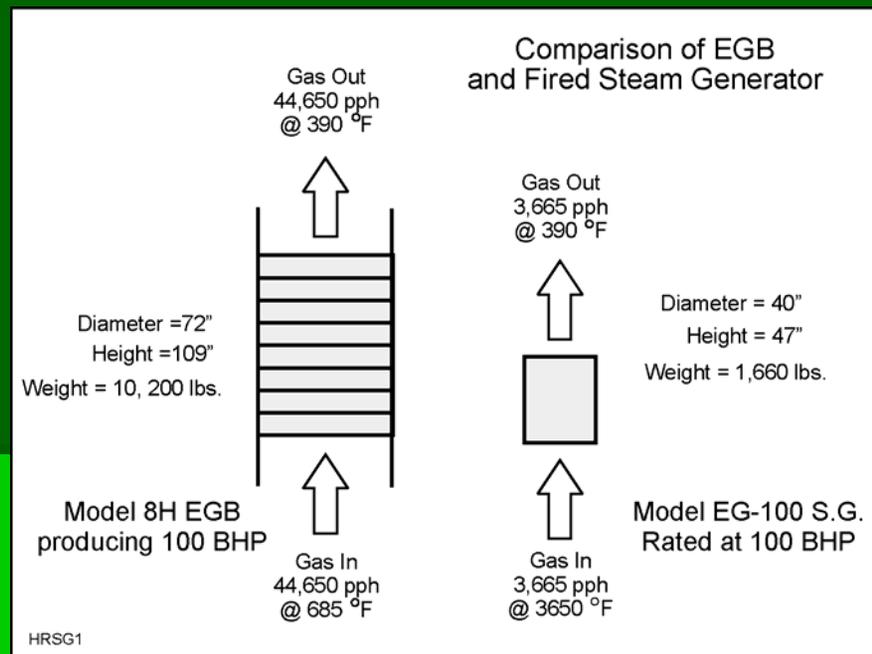


How Steam Is Produced In A Clayton Heat Recovery Boiler



# Heat Recovery

## Difference Between A Fired Boiler And The Heat Recovery Steam Generator/Boiler



# Heat Recovery

Operating The Heat Recovery Steam Generator/Boiler

- Same as a conventional boiler.
- Boiler permits.
- Operator requirements.
- Feedwater requirements.

# Heat Recovery

## Economics Of The Heat Recovery Steam Generator/Boiler

- Heat recovery boiler will not replace an existing boiler, but will supplement.
- What is the fuel saving by operating the heat recovery boiler?
- What is the acceptable payback period?

# Heat Recovery

## Applications

### Combined Heat & Power

Recover Heat From Prime Movers

Reciprocating Internal Combustion  
Engines (IC)

Combustion Turbines

Microturbines

Fuel Cells

### Industry

Recover Heat From A Process

Incinerators

Furnaces

Thermal Oxidizers

# Heat Recovery

## The CHP Heat Recovery Steam Generator/Boiler

### Example Exhaust Gas Boiler Performance Natural Gas Internal Combustion Engine

		Design Flow
Percent of Maximum Exhaust Gas Flow	100 %	100 %
Exhaust Gas Flow	14,059 Lbs./Hr.	6,377 Kgs./Hr.
Exhaust Gas Specific Heat	0.27 BTU/Lb. °F	0.27 KCAL/Kg. °C
Exhaust Gas Temperature In	885 °F	473 °C
Exhaust Gas Temperature Out	281 °F	138 °C
Exhaust Gas Pressure Dop	5 inch WC	127 mm WC
Heat Output (+/- 5%) -	69 BHP	676 kW
Heat Output (+/- 5%)	2,293,747 BTU/Hr.	577,795 KCAL/Hr.
Steam Capacity - (+/- 5%)	1,981 Lbs./Hr.	898 Kgs./Hr.
Operating Steam Pressure	125 PSIG	8.5 Bar
Design Steam Pressure	150 PSIG	10.3 Bar
Feedwater Temperature	203 °F	95 °C

# Heat Recovery

The CHP Heat Recovery Steam Generator/Boiler



# Heat Recovery

Uses Of The CHP Heat Recovery Steam Generator/Boiler

- Domestic Hot Water
- Building Heat
- High or Low Pressure Process Steam
- Absorption Chillers
- Humidification
- Steam Turbines

# Heat Recovery

Key Suppliers Of CHP Heat Recovery Steam Generators/Boilers

Clayton Industries

Vaporphase

Cannon Boilers Works

MAXIM

Cain Industries

Energy Recovery Int'l

Superior Boiler

Johnston Boilers

Aalborg Industries

# Heat Recovery

Thank You