

Heat Recovery Options

Overview

Most natural gas-fired generators have an overall efficiency of approximately 28% to 42%. In other words, approximately 28% to 42% of the energy going into the generator in the form of natural gas comes out as electricity. System efficiency can often be increased to over 60% if the waste heat from the generator is utilized. Waste heat can be used to produce hot water, steam, or chilled water. When waste heat from the generator is utilized, it is called CHP (combined heat and power) or cogeneration.

Hot Water

Hot water is the least expensive type of heat recovery to install. A 1000 kW generator can produce the equivalent hot water of a 150 hp hot water boiler at full load. However, since most boilers have a 0.25 load factor, a 1000 kW generator utilizing heat recovery can replace a boiler up to 600 hp provided that a sufficiently sized hot water storage tank is installed.

Steam

A natural gas engine-generator can also be used to produce low-pressure steam. Steam heat recovery systems are more expensive than hot water heat recovery systems. Typically, hot water from a heat exchanger on the radiator can be flashed off the exhaust manifold of the engine to produce 15 psi steam.

If only high-pressure steam is desired, a heat recovery steam generator can produce up to 100 psi steam utilizing the exhaust gas of the engine-generator, but the amount of steam will be significantly less since much of the engine's heat is dissipated through the radiator. Natural gas turbines can produce large quantities of high-pressure steam.

Chilled Water

Hot water or steam can be recovered from a natural gas generator and can be used in an absorption chiller to produce chilled water. Chilled water temperature is limited to 44°F or warmer. Producing chilled water is significantly more expensive than producing hot water or steam due to the addition of an absorption chiller.

Since absorption chillers produce their rated capacity with a higher quality heat stream than what is available with a natural gas generator, the output capacity of a waste heat absorption chiller is often reduced below its rated capacity. A 1000 kW electric generator can produce approximately 250 tons of continuous chilled water cooling.

Waste Heat Rules of Thumb

Cooling – tons of cooling = 25% of gen-set rating in kilowatts.

Heating – boiler load displaced in hp = 15% of gen-set rating in kilowatts.

Example: a 1,000 kW generator can be used to make 250 tons of chilled water *or* 150 hp of low-pressure steam or hot water.