SMALL SCALE COGENERATION INCLUDING AUTOMOTIVE APPLICATIONS

Introduction

Cogeneration, also known as combined heat and power (CHP), is the simultaneous production of heat and power, utilizing one fuel source. Power plants and heat engines in general, waste up to more than half its available energy. With a CHP system, excess heat that would normally be wasted can be captured and converted in to electricity. By converting this excess energy into useful power, we are able to achieve efficiencies as high as 89% (1). This in turn means there is less fuel needed, making it so there is less pollution produced. While cogeneration has been used in power plants for awhile now, we will discuss the use of it on a smaller scale such as homes, cars, offices, etc.

History of Cogeneration

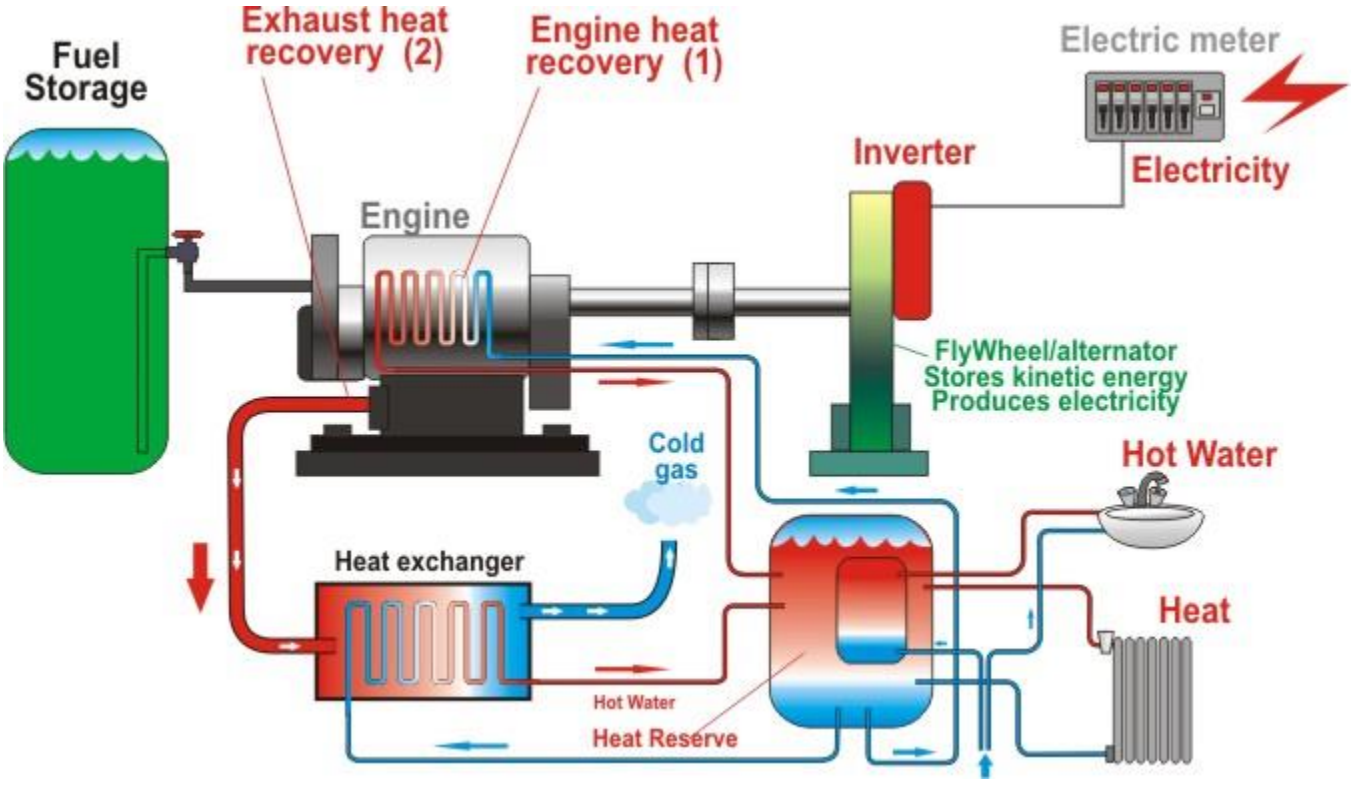
At the beginning of the twentieth century, steam was the main source of mechanical power. However, as electricity became more controllable, many small "power houses" that produced steam realized they could also produce and use electricity, and they adapted their systems to cogenerate both steam and electricity. Then from 1940 to 1970, the concept developed of a centralized electric utility that delivered power to the surrounding area. Large utility companies quickly became reliable, relatively inexpensive sources of electricity, so the small power houses stopped cogenerating and bought their electricity from the utilities.

During the late 1960s and early 1970s, interest in cogeneration began to revive, and by the late 1970s the need to conserve energy resources became clear. In the United States, legislation was passed to encourage the development of cogeneration facilities. Specifically, the Public Utilities Regulatory Policies Act (PURPA) of 1978 encouraged this technology by allowing cogenerators to connect with the utility network to purchase and sell electricity. PURPA allowed cogenerators to buy electricity from utility companies at fair prices, in times of shortfall, while also allowing them to sell their electricity based on the cost the utility would have paid to produce that power, the so-called

"avoided cost." These conditions have encouraged a rapid increase in cogeneration capacity in the United States (2).

Micro-CHP

Micro-CHP systems differ from large scale CHP systems used in power plants. Industrial CHP systems generally generate electricity, and the heat is a useful by-product. Whereas home and smaller commercial micro-CHP systems are driven by heat demand, and deliver electricity as a by-product. Micro-CHP systems will generally produce enough electricity than what is instantly being demanded, which makes them a desirable system to
have.

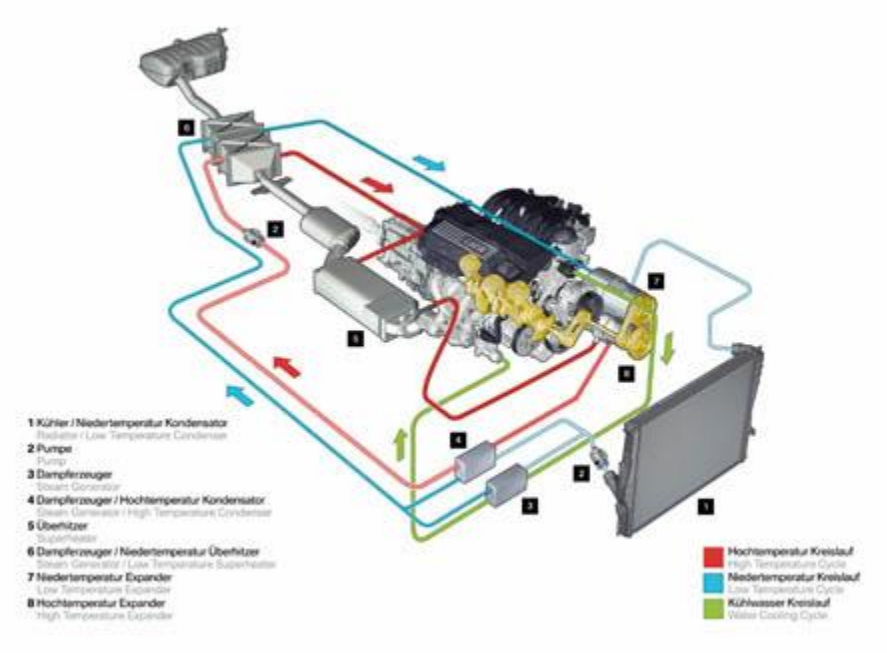


Micro-CHP Systems

Automotive Applications

Cogeneration has been used in automobiles for a long time. The heater and air conditioner in a car is operated using waste heat from the engine. BMW has come up with a cogeneration system that they call a Turbosteamer. Combining the innovative assistance drive with a 1.8 litre BMW four-cylinder engine on the test rig reduced consumption by up to 15 percent and generated 10 kilowatts more power and 20 Nm more torque (3). This increased power and efficiency comes for, well, … nothing. The energy is extracted exclusively from the heat in the exhaust gases and cooling water so it is essentially a quantum leap in efficiency.

The Turbosteamer is based on the same principle of the steam engine: liquid is heated to form steam in two circuits and this is used to power the engine. The primary energy supplier is the high-temperature circuit which uses exhaust heat from the internal combustion engine as an energy source via heat exchangers. More than 80 percent of the heat energy contained in the exhaust gases is recycled using this technology. The steam is then conducted directly into an expansion unit linked to the crankshaft of the internal combustion engine. Most of the remaining residual heat is absorbed by the cooling circuit of the engine, which acts as the second energy supply for the Turbosteamer.



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