

## Fuel Cells and CHP

### What is a Combined Heat and Power Unit?

When fuel cells operate, hydrogen and oxygen are combined to produce electricity, water, and heat. In CHP systems, or Combined Heat and Power, this heat by-product is harvested to increase the efficiency of the fuel cell. This heat can be used to heat homes or buildings, and when combined with an absorption chiller, waste heat can be used for cooling.

There is massive potential for growth in this industry. Many estimates believe that CHP systems will provide up to 1 million jobs by 2030. In fact, in *Unlocking Energy Efficiency in the U.S. Economy*, by the international business consultancy McKinsey, it has been suggested that U.S. Cogeneration capacity could be profitably expanded by 50 GW by 2020. Such an expansion would cost \$56 billion and save \$77 billion annually, while reducing carbon dioxide emissions by 100 million metric tons per year. This will cut energy consumption, lower the cost of energy, and reduce our nation's carbon footprint.

### What are the Benefits of CHP Systems?

CHP Systems provide a number of benefits to users through generating efficient, flexible and clean energy.

#### Efficient

CHP systems can utilize up to 90% of the total energy in a fuel, which saves customers money and increases the environmental benefits. CHP systems far exceed the combustion systems of today in terms of efficiency. In fact, CHP systems, on average, can be about twice as efficient as central-station power plants and on-site boilers.

#### Environmental Benefits

Fuel cell CHP systems provide great environmental benefits when installed, providing great publicity to businesses and homes looking to be seen as eco-friendly. Fuel cell CHP systems are quiet and generate only a very small fraction of the amount of pollution from a combustion system, with many top experts claiming the difference is so great that they describe it in terms of pounds versus tons of emissions with combustion systems. CHP manufacturers agree that when CHP units are installed to replace central-station power generation, carbon emissions are typically reduced by 30 percent.

#### Flexible

CHP systems are extremely flexible, because of their ultra-clean aspects and quietness due to a lack of moving parts, they can be installed almost anywhere. Fuel cells have been installed very close to buildings, people and animals, allowing fuel cell heat can be captured easily and efficiently. In fact, Fuel cells give building engineers tremendous flexibility, because they can be installed right next to residents and they will hardly notice. Furthermore, CHP fuel cell systems can help engineers and building managers meet Federal energy-efficiency and emissions reduction goals.

Fuel cells are also flexible in that they decentralize power generation to the user. When CHP systems are installed, users do not have to rely on the energy grid to provide power or heat. CHP fuel cells can even be integrated into existing structures as back-up or supplemental power, and in areas that allow net metering, you can sell off excess fuel cell power back to the utility companies.

### **Refrigeration**

A remarkable aspect of CHP fuel cell systems is that they can use waste heat for refrigeration. The US EPA estimates that refrigeration constitutes nearly 40% of the energy needed by supermarkets and convenience stores. CHP systems can offset this expense when combined with a device known as an absorption chiller. These chillers use a chemical process that uses waste heat energy to provide cooling. Fuel cell CHP systems linked to absorption chillers thus offer a significant potential cost savings. Additionally, because of the ability to provide off-the-grid cooling in the case of power failure, they can eliminate the need for an expensive backup power system.

### **Savings**

Not only will CHP systems cut heating costs and reduce overall energy consumption, but there are government grants and subsidies that will help pay for installations as well. In addition, CHP systems can be financed by private-sector partners and pay for itself with the savings it reaps.

### **Renewable Power**

Fuel cell CHP systems can also become 100% renewable power devices. CHP fuel cells can be integrated with solar, wind or other renewable sources by using these means to produce renewable hydrogen which can then be used to power the fuel cell system. CHP systems can also provide renewable power by using excess heat and power to generate hydrogen themselves; this is known as Combined Heat and Hydrogen Production (CHHP). This hydrogen then has the capacity to be used to be reused by the CHP system or can even power a hydrogen fuel cell vehicle.