

SECONDARY ARTICLE: Distributed Energy

When we think of electricity generation, we usually envision central power plants that generate electricity for large numbers of customers. These power plants are mostly coal, but also include nuclear, hydro, natural gas and wind. The electricity can be generated far from the customer and sent long distances over transmission lines, sometimes with outages due to an overly-taxed grid infrastructure or extremely inclement weather. To provide reliable electricity to customers, such as hospitals, that require an uninterrupted power supply, new emphasis is being focused on distributed energy.

Distributed energy is generated and stored near the point of use. The benefits of using distributed energy instead of central power plants includes providing greater reliability, decreasing congestion on electric transmission lines, strengthening energy security and controlling price fluctuations. By siting smaller, more flexible systems near energy consumers, distributed generation avoids transmission and distribution power losses and provides a choice of energy systems to the utility customer.

Customers likely to use distributed energy include those that are far from central power grids, those looking for less expensive power sources during peak periods or those needing dependable, high-quality power to run sensitive equipment.

Distributed energy encompasses a range of technologies, including fuel cells, photovoltaic arrays, microturbines and reciprocating engines. Typically, distributed energy technologies are fueled by natural gas, but renewable energy technologies such as solar, biomass and wind are also popular and hydrogen will likely play an expanding role in the future of distributed energy.

Gas-Fueled Technologies

Natural gas is a popular choice for distributed energy systems. It is readily available, up-front costs of natural gas systems are typically less expensive than other sources, and the generators themselves are more compact than most other systems. Gas-fueled systems include fuel cells, gas-fired reciprocating engines, industrial turbines and microturbines.

- Fuel cells are electrochemical energy conversion devices that convert hydrogen and oxygen into electricity and heat. Fuel cells often use natural gas as the source of hydrogen.
- Gas-fired reciprocating engines, also called internal combustion engines, are a wide-spread and reliable technology. Due to their small size and low capital cost, they are a popular distributed energy choice. Reciprocating engines can use a variety of fuels, including natural gas, methane from waste treatment and biofuels.
- Industrial turbines use high-temperature, high-pressure gas to move the turbine blades. The gas is produced by burning a fuel in air. They are compact, lightweight, quick starting and simple to operate. They are used by hospitals, universities and colleges, and commercial buildings to produce electricity, heat and steam.
- Microturbines are small combustion turbines that are about the size of the refrigerator. They have a small number of moving parts, lower emissions and can use waste fuels. They are designed for use on sites with limited space for power production.

Renewable Energy Technologies

Distributed power generation systems using renewable energy sources have advantages and disadvantages over traditional fossil fuel systems. Most renewable power technologies emit far less pollution and are a secure and stable source of energy. Except in the case of biomass, the fuel is also free. However, some sources provide intermittent power and the generating equipment itself is often more expensive than that of traditional fossil fuel equipment. Renewable energy technologies for power generation include biopower, solar electric, concentrating solar power and wind.

- Biopower technologies convert renewable biomass fuels into electricity and heat using boilers, gasifiers, turbines, generators and fuel cells. Biopower capitalizes on two of America's strengths—highly productive farmlands and forests. Biopower systems are designed for customers outside of central power grids with excess biomass.
- Solar electric technologies generate electricity for customers that are far from central power grids. A solar electric system consists of photovoltaic cells, batteries, battery chargers, and often a backup generator and inverter. For very remote locations, solar technologies can be the cheapest choice for electric production. For customers that are close to the electric grid, solar electric systems are usually more expensive than other fuels.
- Concentrating solar power (CSP) systems capture the sun's heat and transform it into electricity. Mirrors focus sunlight onto a receiver that houses a gas or liquid. This gas or liquid then transfers heat to a power generation system such as a steam turbine and generator. While large CSP systems are already in use, small systems are being developed for distributed energy applications.
- Wind power is versatile, adaptable and affordable. Homeowners and businesses in windy rural areas can use small wind turbines to reduce their electric bills. Zoning and land use regulations can limit installation of wind turbines. Stand-alone turbines that provide power to non-grid connected areas must have backup power systems that can significantly increase the cost of wind systems.

Hybrid Power Technologies

Hybrid power systems are combinations of two or more energy conversion devices or two or more fuels used for the same device. The combination of devices or fuels can overcome disadvantages inherent to a single system, making a more balanced power system. Examples of hybrid power systems include a wind turbine with a backup diesel generator, a photovoltaic system with battery storage, or a fuel cell combined with a microturbine. Hybrid system benefits include higher efficiency, enhanced reliability and lower emissions.

While all distributed energy systems have advantages and drawbacks, many distributed power systems produce so little noise and emissions that they can be located inside or immediately adjacent to where the power is needed. Distributed energy systems offer reliability and flexibility to electric customers that need it the most.

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