Distributed Energy Resources Program

Technology Overview

Distributed energy resources (DER) consist of energy generation and storage systems placed at or near the point of use. This provides the consumer with greater reliability, adequate power quality, and the possibility to participate in competitive electric power markets. DER also has the potential to mitigate transmission congestion, control price fluctuations, strengthen security, and provide greater stability to the grid. DER can lead to lower emissions and, particularly in combined heat and power (CHP) applications, to improved efficiency.

Distributed energy encompasses a range of technologies including fuel cells, microturbines, reciprocating engines, and energy storage systems. Renewable energy technologies—such as solar electricity, solar buildings, small-scale hydropower, biopower, and wind turbines—also play an important role. DER also involves power electronic interfaces, as well as communications and control devices for efficient dispatch and operation of single units, multiple system packages, and aggregated blocks of power.

The primary fuel for many distributed generation systems is natural gas, but hydrogen may well play a role in the future.

Energy storage technologies are essential for meeting the levels of power quality and reliability required by high-tech industries. Storage can provide emergency power and peak-shaving benefits. Energy storage gives other DER devices more load-following capability, and also supports renewable technologies such as wind and solar electricity by making them dispatchable.

End-use technologies include demand management techniques for reducing peak power requirements and using electrical load as a resource. CHP systems can provide electricity as well as heating, cooling, and humidity control, while achieving efficiencies as high as 70%. Advanced techniques such as absorption cooling and desiccant devices also benefit the end user.

U.S. Department of Energy Program

The mission of the U.S. Department of Energy (DOE) Distributed Energy Resources Program is to lead a national effort to develop the next generation of clean, efficient, reliable, and affordable distributed energy technologies and to support the transmission and distribution system.

The Program is establishing partnerships with manufacturers, energy service providers, and project developers. The DER Program also works with state and federal agencies, public interest groups and consumers. Research and development efforts are cost shared and involve the following main areas:

■ Technology development—developing a portfolio of technologies for advanced on-site, small-scale, and modular energy generation, storage, and delivery systems. These may be deployed in industrial, commercial, or residential applications. The scope includes advanced turbines and microturbines, reciprocating engines, fuel cells, thermally activated technologies, and energy storage devices. The program also addresses crosscutting technologies such as advanced materials, power electronics, hybrid systems, and communication and control systems.

■ End-use systems and integration—integrating distributed energy systems into customer facilities, as well as into electricity and natural gas distribution systems. Packaged, integrated systems promote reliability and allow effective demand-management techniques. Regulatory and institutional barriers to the expanded use of distributed energy systems are addressed through education, analysis, and outreach. The Program has taken the lead in developing national interconnection standards for integrating DER into the electricity grid.

Microturbine

Reciprocating Engine

Fuel Cell

Energy Storage Unit

Triple Effect Chiller

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Transmission Reliability

The Transmission Reliability (TR) Program is partnering with the electric power industry to develop advanced technologies to enhance the reliability of the power system, while enabling efficient, competitive electricity markets that integrate DER.

The TR program consists of three research and development areas.

1. Reliability-analysis tools that assist transmission system operators to manage real-time grid operations in a reliable and efficient manner. Tools under development include visualization systems that display deviations and corrections for the following parameters:

- Transmission voltages
- System frequency
- Power flow between regions
- Generator reliability performance

2. Wide Area Measurement Systems (WAMS) collect satellite-synchronized data to control the grid reliably while operating the grid closer to its capacity limits.

3. "Load as a resource" allows load to be controlled to lower the customer's energy costs, and to reduce load in system emergencies.

Market Potential

Market forces are beginning to demand small, modular energy generation and storage systems that can provide backup power during outages, hedge against energy price spikes, eliminate power quality problems, mitigate future emissions costs, and contribute to grid stability. The result is a growing market demand for smaller scale, fuel-flexible energy systems that can be deployed close to the point of use.

Estimates from a recent Electric Power Research Institute study show that losses to the U.S. due to outages amount to about $119 billion per year. An appreciable percentage of such losses could be eliminated by distributed generation and energy storage. The potential market for providing power during peak price periods is as high as 460 GW, according to a recent DOE study.

The digital economy—including telecommunication companies, internet service providers, and high-tech manufacturing facilities— faces massive financial losses from power outages and disruptions that may last only seconds. Reliability is paramount for such facilities. Distributed energy resources can provide ultrareliable power, free from voltage sags and harmonic distortions. It is expected that high-tech facilities will become a primary market for distributed generation and storage. A broad array of less digitally oriented businesses also relies on continuous power, including food retailers and hospitals.

Potential markets for distributed resources are varied, extensive, and still expanding. The Program expects that 20% of all new generation will be distributed generation by 2010.

Summary of Potential Benefits

Distributed energy resources offer advantages to the nation's energy system that large-scale, capital-intensive, central-station power plants cannot provide. By siting smaller, more fuel-flexible systems near the consumer, distributed resources avoid transmission and distribution power losses, and provide a wider choice of energy systems to the customer. Distributed energy systems offer reliability for U.S. businesses and consumers who need dependable power to run sensitive digital equipment, and can provide alternative, less-expensive power sources during peak price periods. They increase productivity by utilizing waste heat created during power generation for additional heating, cooling, and humidity control in buildings. By shifting peak loads, distributed systems offer demand relief for the already strained electric power system, and reduce transmission congestion. Distributed resources also play a crucial role in maintaining national security.

For More Information:

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