Smart Grid Glossary

Overview

The integration of renewable and distributed energy sources, energy storage capability, supply-demand balancing, demand response, electric vehicle (EV) energy demand, as well as security in the grid is covered by the Renewable and Distributed Systems Integration program (RDSI). The program goal is to demonstrate a 20 percent reduction in peak load demand by 2015. Advances in grid design, planning, and operation will (1) reduce carbon emissions, (2) reduce peak load, (3) support renewable portfolio standards and efficiency, (4) enhance reliability and security, (5) improve demand management efficiency, and (6) support energy diversity to fuel electric vehicles.

Renewable and Distributed Energy Sources

Distributed energy sources are composed of smaller-scale and modular devices designed to provide electricity in locations close to consumers. They include fossil and renewable energy technologies (e.g., photovoltaic arrays, wind turbines, fuel cells); energy storage devices (e.g., batteries); and hybrid power systems. Distributed energy offers solutions to many grid problems including blackouts, energy security concerns, power quality issues, tighter emissions standards, transmission bottlenecks and the desire for greater control over energy costs.

Energy Storage Capability

Grid energy storage (or large-scale energy storage) allows energy producers to send excess power over the transmission grid to temporary electricity storage sites that become energy producers at times when demand for power is greater. Grid energy storage is particularly important in matching supply and demand over the 24-hour cycle. It increases efficiency, lowers the costs of energy production and allows the integration of alternative energy sources.

Supply and Demand Balancing (Operator)

The operators of the grid must ensure that the amounts of available and needed energy always match. The grid must respond to predictable movements in demand patterns, as well as random changes. Grid operators also have plans in place to manage major interruptions. In addition, spare capacity must be available on extremely short notice. However, this energy reserve is expensive, and produces additional carbon emission. As a result, the two-way communication in smart grid will support the demand-supply balancing process and reduce spare capacity as well as CO2 emission.

Demand Response (Consumer)

Demand response stands for mechanisms used to encourage consumers to reduce demand. Since power generation and transmission systems are designed to correspond to peak demand (plus margin for forecasting error and unforeseen events), lowering peak demand reduces overall plant and capital cost requirements. Smart grid applications improve the ability of electricity producers and consumers to communicate with one another and make decisions about how and when to produce and consume. This allows the customer to shift from event-based to price-based demand response. Customers will be able to take advantage of fluctuating prices.

Supply and Demand Balancing for Electric Vehicles

Recent advances in information and communications systems and battery technologies, in combination with substantial importance given by society to reducing greenhouse gas/carbon emissions, have resulted in dramatic thrusts towards accelerated innovations in electric vehicles (EVs) and the smart and renewable energy infrastructure necessary to fuel and support them. If 25 percent of all vehicles were EVs today, the U.S. power grid would have difficulty supporting their charging. The additional need for electrical power will require the integration of sophisticated technologies including communications, wireless, sense-and-control, internet, batteries, and so on.

Security Solutions

In response to growing concerns about the electric grid's vulnerability to cyber attack, the following requirements must be established to accomplish cyber security: (1) Confidentiality, (2) Integrity, (3) Availability and (4) Reliability.