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Electrical Energy Storage and the Grid[1]

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Demand for electricity varies seasonally, daily, and on much shorter time scales. Renewable energy sources such as solar or wind power are naturally intermittent. Nuclear power plants can respond to a narrow range of fluctuating demand quickly and to larger fluctuations in hours. However, they are most efficient when operated at a constant power output. Thus implementing either nuclear power or power from renewables requires either a system for storage of electrical energy that can respond quickly to demand or a back-up power source, usually a gas turbine plant that has a quick response time. We have studied six technologies for storing electrical energy from the grid: pumped hydropower, compressed air storage, batteries, flywheels, superconducting magnetic energy storage, and electrochemical capacitors. In addition, the power conversion systems (PCS) that connect storage to the grid are both expensive and critical to the success of a storage technology. Each of these six technologies offers different benefits, is at a different stage of readiness for commercial use, and offers opportunities for research. Advantages and disadvantages for each of the technologies and PCS will be discussed.

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