Energy storage unit

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Energy storage is the capturing and holding of energy in reserve for later use. Energy storage solutions for electricity generation include pumped-hydro storage, batteries, flywheels, compressed-air energy storage,...

Energy storage is the capture of energy produced at one time for use at a later time[1] to reduce imbalances between energy demand and energy production. A device that stores energy is generally called an accumulator or battery. Energy comes in multiple forms including radiation, chemical, gravitational potential, electrical potential, electricity, elevated temperature, latent heat and kinetic. Energy storage involves converting energy from forms that are difficult to store to more conveniently or economically storable forms.

Some technologies provide short-term energy storage, while others can endure for much longer. Bulk energy storage is currently dominated by hydroelectric dams, both conventional as well as pumped. Grid energy storage is a collection of methods used for energy storage on a large scale within an electrical power grid.

Off grid electrical use was a niche market in the 20th century, but in the 21st century, it has expanded. Portable devices are in use all over the world. Solar panels are now common in the rural settings worldwide. Access to electricity is now a question of economics and financial viability, and not solely on technical aspects. Electric vehicles are gradually replacing combustion-engine vehicles. However, powering long-distance transportation without burning fuel remains in development.

Energy can be stored in water pumped to a higher elevation using pumped storage methods or by moving solid matter to higher locations (gravity batteries). Other commercial mechanical methods include compressing air and flywheels that convert electric energy into internal energy or kinetic energy and then back again when electrical demand peaks.

Hydroelectric dams with reservoirs can be operated to provide electricity at times of peak demand. Water is stored in the reservoir during periods of low demand and released when demand is high. The net effect is similar to pumped storage, but without the pumping loss.

While a hydroelectric dam does not directly store energy from other generating units, it behaves equivalently by lowering output in periods of excess electricity from other sources. In this mode, dams are one of the most efficient forms of energy storage, because only the timing of its generation changes. Hydroelectric turbines have a start-up time on the order of a few minutes.[6]

Compressed-air energy storage (CAES) uses surplus energy to compress air for subsequent electricity generation.[12] Small-scale systems have long been used in such applications as propulsion of mine locomotives. The compressed air is stored in an underground reservoir, such as a salt dome.

Flywheel energy storage (FES) works by accelerating a rotor (a flywheel) to a very high speed, holding energy as rotational energy. When energy is added the rotational speed of the flywheel increases, and when energy is extracted, the speed declines, due to conservation of energy.

Most FES systems use electricity to accelerate and decelerate the flywheel, but devices that directly use mechanical energy are under consideration.[17]

FES systems have rotors made of high strength carbon-fiber composites, suspended by magnetic bearings and spinning at speeds from 20,000 to over 50,000 revolutions per minute (rpm) in a vacuum enclosure.[18] Such flywheels can reach maximum speed ("charge") in a matter of minutes. The flywheel system is connected to a combination electric motor/generator.

FES systems have relatively long lifetimes (lasting decades with little or no maintenance;[18] full-cycle lifetimes quoted for flywheels range from in excess of 105, up to 107, cycles of use),[19] high specific energy (100-130 W?h/kg, or 360-500 kJ/kg)[19][20] and power density.

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