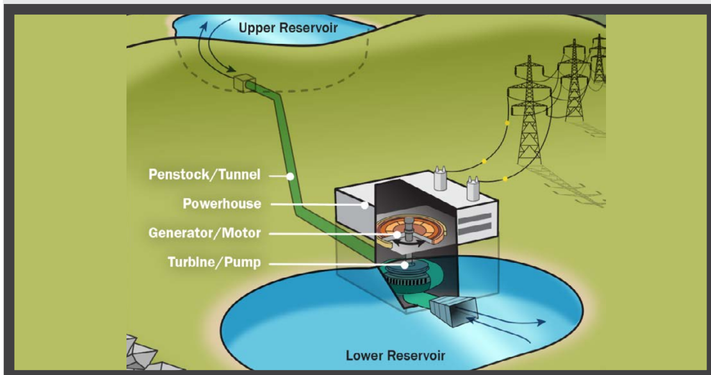
MECHANICAL ENERGY STORAGE

DEFINITION: The storage of energy by applying force to an appropriate medium to deliver acceleration, compression, or displacement (against gravity); the process can be reversed to recover the stored kinetic or potential energy.

Currently, the most widely deployed large-scale mechanical energy storage technology is pumped hydro-storage (PHS). Other well-known mechanical energy storage technologies include flywheels,compressed air energy storage (CAES), and liquid air energy storage (LAES).

TECHNOLOGY EXAMPLES

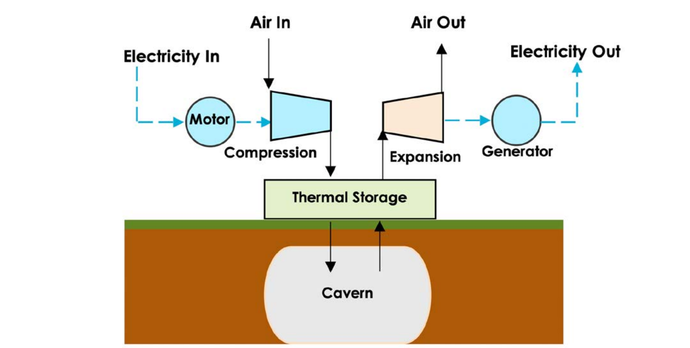


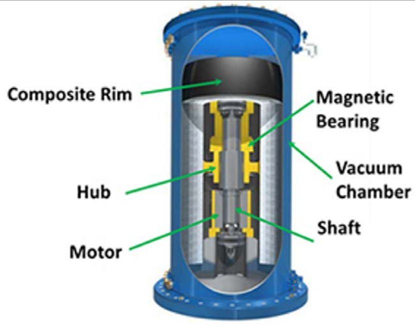
PHS

In PHS, potential energy is stored by pumping water to an up-hill reservoir. Energy is then recovered through a hydropower turbine when the water is released downwards.

CAES & LAES

CAES stores energy in the form of compressed air, and LAES stores energy in the form of liquefied air. Because large storage volumes are required in CAES, the compressed air is often stored in underground caverns. Typically, in CAES, fuel is added to the compressed air to drive a combustion turbine; however, in adiabatic CAES, heat is recuperated from the compression phase and stored using a thermal storage system. The stored heat can be transferred back to the outlet air during the expansion phase, eliminating the need for the combustion process.





Source: Beacon Power, LLC

FLYWHEEL

Flywheels store energy as rotational kinetic energy by accelerating a rotating mass around a fixed axis.

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ADDITIONAL INFORMATION

MECHANICAL ENERGY STORAGE

Technology Type	Advantages	Disadvantages And Challenges
PHS	• Large capacity • Long discharge duration • Long lifetime • Mature technology	• Can be dependent on regional topography (elevation change) • Long construction lead time • Ecological concerns
CAES	• Large capacities possible • Long discharge duration • Long lifetime	• Can be dependent on availability of underground caverns • Long construction lead time • May require combustion fuel depending on system type • Limited deployments
LAES	• High expansion ratio from liquid to gaseous air and high power density of liquid air compared to compressed air • Underground storage not required • Large capacities and long discharge durations achievable	• Requires a natural gas turbine to provide heat during the expansion process, though advanced adiabatic compressors are an area of research
Flywheel	• Modular design • Long lifetime • Short construction time • Immediately dispatchable • Wide operational experience • Low maintenance	• Short discharge duration • Small capacity • Unexpected dynamic loads or external shocks can lead to failure

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