The Effect of Different Gravitational Storage-Regeneration Applications on Power Efficiency

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Gravitational energy storage offers a durable, non-chemical alternative to conventional battery systems, yet small-scale implementations remain under explored. In this project, four gravitational storage-regeneration systems were developed and compared: a dual weight elevator system, a variable counterweight system, a buoyancy-assisted gravity battery, and an electromagnetic linear gravity battery. Physics-based MATLAB simulations were created to model complete charge-discharge cycles using identical baseline parameters, including a 3 meter drop height and 50 kilogram effective mass. Key outputs such as electrical energy recovered, energy required for lifting, and mechanical and electrical losses were tracked for each system. Results show that system architecture significantly impacts performance, with the variable counterweight design achieving the highest round-trip efficiency among the four systems. These findings demonstrate that small-scale gravity batteries are feasible and specific design changes can improve efficiency.

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