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**Pumped-Storage is an Efficient Battery**

**Interpretation (54 words)**:

An ideal battery is able to control a high energy output based on demand, has an infinite capacity and is economically satisfactory. Pumped-storage plants are promoted as efficient batteries because they have the ability to utilize demand based on energy consumption rates, have large capacities and are an economically viable way to store energy.

**Analysis (415 words without citations):**

Pumped-storage plants conserve energy at low demand times and utilize energy output at peak demand times, which is an essential characteristic of an ideal battery. During times of high energy demand, water from an upper reservoir is released and flows through turbines which generate electricity. The water continues to flow to a lower reservoir and is transported back to the upper reservoir during a time of less demand with the excess energy produced during the high demand period (Ma, Yang, Lu. 2014:page 387). Small pumped-storage plants can generate over 100,000kWh per day (Kazempour, Moghaddam, Haghifam, Yousefi. 2009:page 2636), depending on the demand of energy. To put this into perspective, the U.S. Energy Information Administration determined the average electricity consumption of an American household in 2012 was roughly 903kWh per day (http://www.eia.gov). Based on this research, one small facility provides enough electricity for 110 homes and is still able to fully function the following day. Therefore, since pumped-storage effectively distributes mass quantities of electrical power, it is promoted as an efficient battery.

These plants are also utilized for storing mass amounts of energy; which is another primary characteristic of a battery. When water travels to the elevated reservoir, it gains gravitational potential energy which is conserved until it is necessary to meet energy demand times. Because pumped-storage facilities strictly rely on water as an energy source, the potential for capacity is extremely high. This is why 300-500 large-scale facilities currently operate worldwide, and have a combined capacity between 90–150GW (Punys, Baublys, Kasiulis, Vaisvila, Pelikan, Steller. 2013:page 191). Most small scale plants however, have a capacity of 2,000MWh (Kazempour et al. 2009:page 2636), which is still enough electricity to power nearly 2,200 homes in America (http://www.eia.gov). Therefore, not only does this method effectively distribute energy, but it also stores tremendous amounts of energy, which is why pumped-storage is considered an effective battery.

Pumped-storage plants are also an economically viable way of storing energy, which is another critical characteristic of an ideal battery. In 2009, an analysis of a pumped-storage plant was compared to a sodium-sulfur battery plant, which is currently a successful method to store energy. The researchers concluded that the pumped-storage plant’s total production cost was roughly $60,000,000 and it generated $17,265,848 for that year (Kazempour et al. 2009:page 2638). Along with generating positive revenues, pumped-storage plants also have a lifespan of over 25 years (Kucukali. 2014:page 502). Based on these statistics, pumped-storage facilities are an extremely beneficial investment in storing energy because they pay for themselves in less than four years, as well as have immense positive returns due to their lifespan. Therefore, pumped-storage plants are promoted as an efficient battery because they are economically satisfactory.

**Evaluation (15 words)**:

Some of the sources were statistical analyses from previous years, thus the values presented may have changed.

**Inference (20 words)**:

Since pumped-storage facilities are renewable systems, they are a viable option in reducing emissions globally by replacing non-renewable energy processes.

**Explanation (27 words)**:

In conclusion, pumped-storage is an efficient battery because it controls energy output based on demand, has large capacities and is an economically beneficial method of storing energy.

**Bibliography**:

"How Much Electricity Does an American Home Use?" *Independent Statistics and Analysis*.  U.S. Energy Information Administration, 10 Jan. 2014. Web. 23 Nov. 2014. http://www.eia.gov.

Kazempour, S., Moghaddam, M., Haghifam, M.R., & Yousefi, G.R. (2009). Electric energy storage systems in market-based economy: Comparison of emerging and traditional technologies. *Renewable Energy, 34* (12), 2630-2639.

Kucukali, S. (2014). Finding the most suitable existing hydropower reservoirs for the development of pumped-storage schemes: An integrated approach. *Renewable and Sustainable Energy Review, 37*, 502-508.

Ma, T., Yang, H., & Lu, L. (2014). Feasibility study and economic analysis of pumped hydro storage and battery storage for a renewable energy powered island. *Energy Conservation and Management, 79*, 387.

Punys, P., Baublys, R., Kasiulis, E., Vaisvila, A., Pelikan, B., & Steller, J. (2013). Assessment of renewable electricity generation by pumped storage power plants in EU Member States. *Renewable and Sustainable Energy Reviews, 26*, 191.