Kyrgyzstan gravity energy storage

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Renewable energy is becoming more affordable, but the unstable nature of production and reliance on the right solar and wind conditions has held back renewables in the quest to replace fossil fuels.

Taking its inspiration from hydropower, Switzerland-based start-up company Energy Vault has developed a new kind of storage method. The system essentially harnesses the power of the Earth"s gravitational pull, using concrete bricks that are raised and lowered automatically by a crane.

The storage technology incorporates basic principles of physics that have been used in the production of pumped hydropower plants for years. In pumped hydro systems, water flows down from an upper reservoir to a lower reservoir, passing through and rotating a generator or turbine. Water is then pumped back up from the lower to the upper reservoir, at some electrical cost, which again rotates the turbine and the system is repeated, thus generating and containing electricity.

In a similar vein, Energy Vault has developed a six-arm crane to lift 5,000 concrete blocks - weighing 35t in total - up and down a 33-storey building, which store gravitational potential energy when they are raised, and release it as they are lowered.

"In each gravity-based energy storage, a certain mass is moved from a lower point to an upper point - with the use of a pump, if water for example - which represents "charging" the storage, and from a higher to a lower point which creates a discharge of energy," says Energy Vault CEO and co-founder Robert Piconi.

"Increasing the height of a large mass implies storing electricity in the form of potential energy. On the other hand, in order to release the power, kinetic energy is created from the downward movement of the mass, thereby creating the electricity."

The innovation comes in its application of cloud-based automation software, which operates the six-arm crane mechanically, and manages the distribution of power to either store energy from solar and wind assets, or discharge it to the grid when needed.

Existing energy storage systems are currently very costly. Take Tesla"s 100MW/129MWh battery technology in Australia, for example, which cost the company around $66m to produce. Hydro-electric power storage plants that require man-made dams to produce energy can cost billions of dollars to construct, although they can store significantly more energy than 100MW. The largest hydro storage plant in the world is the Bath County Pumped Storage Station in Virginia, US, which cost $1.6bn in 1985 and has a storage capacity of around 24,000MWh.

In contrast, Energy Vault"s gravity storage units cost around $7m-$8m to build, and have a lower levelised

storage cost of electricity, which measures on a per kWh basis the economic break-even price to charge and discharge electricity throughout the year. It is considered by some to create a more accurate measurement of energy costs.

"Our solution is lower-cost than pumped hydro plants both on an initial capital expenditure basis and - more importantly - on a levelised cost of storage (LCOS) basis, according to the independently published Lazard banking models," says Piconi.

"The LCOS takes into account not only the initial capital expenditure but also the operating, maintenance and replacement cost. Based upon these models, pumped hydro has a LCOS of $0.17/kWh; our Energy Vault solution is below $0.05/kWh."

Equally, Energy Vault"s system is around 50% cheaper than battery storage technology, in particular lithium-ion batteries, which can have an LCOS of around $0.25/kWh-$0.35/kWh. One of the reasons for this is the cost of battery materials, which is much higher than the cost of concrete provided to Energy Vault by Mexican company Cemex.

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