Portugal energy storage for renewable energy

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The 230-tonne metal cylinder emits a roaring hum as it spins at 600 revolutions per minute, driving a pump buried underground that brings new meaning to the idea of pushing water up a hill.

Far from the analogy of an impossible task, it is the core of a Portuguese power plant aiming to show that pumping water 7km up a mountain can be an essential -- and commercially viable -- part of an energy system led by renewable power.Built by Spanish company Iberdrola at a cost of EUR1.5bn, the facility in a rocky river valley in northern Portugal is known as a pumped storage plant.

But insiders have another name for the reservoir at the top of the mountain. It is a "water battery" -- rudimentary in concept, intricately engineered and a highly effective way of storing energy.The T?mega plant takes excess electricity from the grid, mostly generated by wind and solar power, and uses it to pump water from a lower reservoir to an upper one.

Surveying its placid blue surface, Rafael Chac?n Llorente, Iberdrola"s project director at the complex, said: "When the water level is at 885 metres above sea level, the battery is fully charged."Then in peak hours, when the grid requires more power, the system is reversed on demand. A gate opens and gravity brings millions of litres of water thundering back down a tunnel every minute. The pump becomes a turbine and it spins the metal cylinder the other way, generating electricity at zero cost.

The power production is significant. The turbine has a capacity of 880 megawatts, roughly a quarter of Hinkley Point C, which is set to become the UK"s biggest nuclear plant.

Such storage is a vital complement to the growing global role of wind and solar power in producing electricity free of carbon emissions. However, the challenge for businesses is finding the right conditions to make new pumped hydro projects economically attractive.

The problem pumped hydro solves is the variability of wind and solar power. On one hand, the sun does not always shine and the wind does not always blow.

On the other, when the sun is blazing and the wind is howling, solar panels and spinning turbines produce far more electricity than can be consumed at any one time. Because power grids cannot handle any excess, the electricity has to be stored somewhere or it will be lost.

That need for storage will only grow as renewable power expands. Portugal had 61 per cent of its electricity from renewable sources in 2023 and is aiming for 85 per cent by 2030. By the same deadline, Spain wants to hit 81 per cent.

At a plant such as T?mega, surplus electricity can be used to "charge" the reservoir, often during the daytime. Then in the evening, when lights and appliances are on in homes, the pump is switched to turbine mode and generates power.

Diego D?az Pilas, Iberdrola"s global head of ventures and technology, said chemical batteries also had a role to play in grid storage: Iberdrola has plans to expand the global capacity of its battery projects to 3GWh. But their scale is smaller than pumped hydro both in terms of brute power and how long they can produce electricity at full capacity (two to four hours for lithium-ion batteries, versus roughly a whole day at T?mega).

"When you have a lot of solar, it pairs very well with batteries because solar generates in daylight hours, and batteries can be discharged when the sun is not shining," said D?az Pilas. "But when you have also a lot of wind -- and 50 per cent of electricity will be coming from wind in Europe around 2030 -- you really need to store vast amounts of energy."