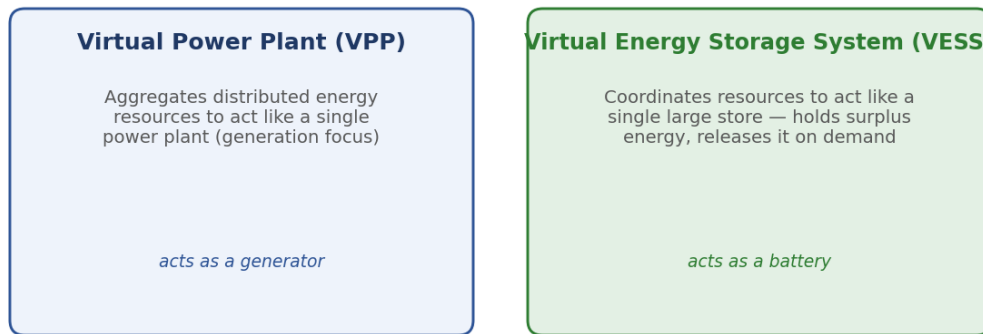


# What is a Virtual Energy Storage System, and why does Europe need one?

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## Two ways to coordinate distributed resources



FlexCHES focuses on the VESS — and can strengthen a VPP by adding storage

Europe's electricity grid was built for a world of large, predictable power stations. Today, that world is changing fast. Solar panels, wind turbines, electric vehicles and heat pumps are spreading across homes, businesses and communities- and with them comes a new challenge: variability. Renewable generation rises and falls with the weather, and demand shifts as more of our heating and transport runs on electricity. Keeping the system balanced is becoming harder, and more valuable.

This is where the idea of a Virtual Energy Storage System, or VESS, comes in: the concept at the heart of the FlexCHES project.

A VESS does not require building one enormous battery. Instead, it coordinates many smaller, distributed resources- home and vehicle batteries, flexible appliances, heat pumps and small-scale generation- so that, working together, they behave like a single large-capacity storage system. Surplus electricity can be stored when generation is high, and released when the grid needs it. In effect, flexibility that is scattered across thousands of households and businesses is pooled into something the energy system can actually use.

The benefits are significant. A VESS can provide ancillary services such as frequency response, helping to keep the grid stable. It can absorb the fluctuations of solar and wind generation, reducing the need to curtail clean energy. And it allows small participants- who could never take part in energy markets on their own- to contribute and be rewarded for the flexibility they offer.



Crucially, a VESS differs from the better-known Virtual Power Plant. While a Virtual Power Plant aggregates resources to act like a single generator, a VESS focuses on storage: holding surplus energy and releasing it according to the system's needs. The two are complementary, and a VESS can in fact strengthen a Virtual Power Plant by adding the storage capability it needs to shift energy across time.

The European Union has put this kind of active participation at the centre of its energy policy. The recast Electricity Market Directive (EU) 2019/944 explicitly recognises energy storage, demand response and the role of aggregators, and the reform of the EU's electricity market design reinforces the right of consumers and energy communities to generate, store, share and sell electricity. A VESS is, in effect, a way of turning these rights into practical capability. Quantifying a VESS's flexibility is itself a technical achievement. FlexCHES developed a Virtual State of Charge indicator to express, at any moment, how much power and energy the combined system can offer- giving operators the visibility they need to coordinate diverse resources reliably.

FlexCHES developed the open, interoperable tools that make this possible- and demonstrated them across five pilot sites in Europe. The goal is a more flexible, more resilient grid that makes better use of the renewable energy Europe is working so hard to deploy.

### References and further reading

- [FlexCHES project — CORDIS, European Commission](#)
- [Directive \(EU\) 2019/944 on the internal market for electricity — EUR-Lex](#)
- [Electricity market design — European Commission](#)
- [International Energy Agency \(IEA\)](#)



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