

How batteries create value in Sweden's energy system

Batteries aren't just for storing electricity, they can generate revenue while keeping Sweden's power grid stable. This thesis shows where batteries are most valuable and how they support the transition to renewable energy.

Sweden's electricity system is changing fast. While the transition to renewable power is crucial for meeting climate targets, it also makes the electricity system more weather dependent with a growing share from wind and solar. To keep the system stable, flexibility is needed, and battery energy storage systems are increasingly seen as part of the solution.

This thesis investigates the revenue potential of a battery energy system in Sweden and explores what services they are actually paid for. The focus is on a battery located together with a wind farm, where they share the same grid connection. This setup allows existing infrastructure to be used more efficiently, while enabling the battery to assist the wind power and provide flexibility to the grid.

The results show that most battery earnings come not from buying and selling electricity at different prices, but from providing balancing services that help keep the grid stable in real time. In practice, this means the battery gets paid to be ready, within seconds, to either inject or absorb power when something unexpected happens in the grid. This highlights the growing importance of reserve markets as the share of variable renewable generation increases.

However, there are clear regional differences. In northern Sweden, where electricity production often exceeds local demand, battery revenues are almost entirely driven by reserve provision. In southern Sweden, where grid congestion and higher price volatility are more common, batteries benefit from a combination of reserve markets and spot market trading. This means that the same battery can have very different economic value depending on where it is installed.

An interesting finding is that co-location with wind power adds extra value. By temporarily reducing wind output at certain times, capacity is freed up in the grid, allowing the battery to operate and generate revenue without significantly reducing the wind farm's income. Instead of building new power lines, existing grid capacity can be shared more intelligently.

Overall, batteries are more than a technical add-on, they are strategic tools for a fossil-free future. They improve system efficiency, create new investment opportunities, and help bridge the gap between climate ambitions and the infrastructure needed to reach them.