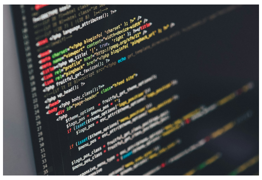
Can Virtual Power Plants Optimize Energy Distribution?

written by Nirmal Raj Joshi | October 3, 2024



Unlike traditional power plants, which are typically characterized by large physical infrastructure such as coal trains, smokestacks, and turbines, virtual power plants (VPP) rely on decentralized energy resources. These resources include rooftop solar panels, electric vehicle chargers, and smart appliances, all of which are integrated into a system that operates without a central physical facility. VPPs aggregate and manage distributed energy resources to balance supply and demand on a large scale, providing an innovative solution to the evolving energy landscape.

The rise of VPPs coincides with a global shift from conventional energy sources such as coal and gas to renewable alternatives like solar and wind. This transition has significantly altered how energy systems operate, creating a need for more flexible and responsive energy management solutions. Governments and private companies alike have recognized the potential of VPPs to lower costs and prevent grid overload, which is particularly important as renewable energy generation increases. VPPs, by coordinating energy resources in real time, can help manage peaks in electricity demand and contribute to the overall resilience of the grid.

Read also Feed In Premium (FIP)

VPPs can communicate with distributed energy sources and adjust the supply in response to the grid requirements. For instance, smart thermostats can pre-cool homes before peak demand periods, and electric vehicle chargers can either draw power from or supply power to the grid as needed. This real-time communication allows VPPs to mitigate the risk of grid overloads and reduce reliance on conventional peaking power plants.

The popularity of VPPs has grown in recent years as technological advancements in solar energy and battery storage have made it possible for VPPs to contribute electricity to the grid. In the United States, VPP capacity is estimated at between 30 and 60 gigawatts, a modest percentage of national peak demand. The U.S. Department of Energy aims to expand VPP capacity to 80 to 160 gigawatts by 2030, a development that could potentially eliminate the need for up to 160 fossil fuel power plants.

VPPs offer cost advantages, as studies suggest that using distributed energy resources during peak periods can be up to 60% more cost-effective than relying on gas plants. VPPs also engage consumers in the energy system by allowing them to both consume and supply electricity, fostering greater public involvement in the shift toward renewable energy.

While VPP technology is already in place, regulatory support and policy development remain critical to its expansion. Standardizing VPP deployment and simplifying consumer enrolment processes could help accelerate the growth of VPPs and enhance the ability of utilities to integrate distributed energy resources into the grid. As VPPs continue to evolve, their role in supporting a resilient, low-carbon energy system will likely become increasingly important.

References

- Rouzbahani, H. M., Karimipour, H., & Lei, L. (2021). A review on virtual power plant for energy management. *Sustainable Energy Technologies and Assessments*, *47*, 101370. https://doi.org/10.1016/j.seta.2021.101370
- Zhang, G., Jiang, C., & Wang, X. (2018). Comprehensive review on structure and operation of virtual power plant in electrical system. *IET Generation Transmission & Distribution*, *13*(2), 145–156. https://doi.org/10.1049/iet-gtd.2018.5880
- Kim, J. (2024, February 8). How virtual power plants are shaping tomorrow's energy system. *MIT Technology Review*. https://www.technologyreview.com/2024/02/07/1087836/how-virtual-power-plants-are-shaping-tomorrows-energy-system/