

The future of Virtual Power Plants in India - A perspective

Introduction

To meet its global commitments, India is planning to reduce fossil-fuel-based [power generation](#) by targeting 500 GW of non-fossil fuel capacity by 2030. However, the increasing adoption of renewable and distributed energy resources is creating several technical and economic challenges in the Indian power system due to intermittency and lack of infrastructure.

Virtual Power Plants: A Solution

These challenges can be addressed through virtual power plants (VPPs), which are cloud-based power plants that aggregate generators, electrical loads, and storage units to work as a single entity. Supported by information and communication technologies and the [Internet of Things](#), VPPs make sure the right amount of power is being generated at the right time. This helps to reduce the amount of power needed during peak periods, thereby saving money and avoiding the need for more power plants.

Further, by enabling the injection of [renewable energy](#) (RE) into the grid, VPPs address [power outages](#) and blackouts, frequency and voltage imbalances, and network stability issues, making the power grid more reliable and sustainable. In addition, the modular design of VPPs enables the setting up of a database almost anywhere, leading to truly sustainable power generation.

Apart from improving power generation and the efficiency of the power system, VPPs help in power trading. This allows users to generate and consume their own power, thereby making them a prosumer. For example, a residential community with a rooftop solar plus battery storage setup can remain unaffected by power outages and even supply power to other communities on demand.

VPPs Around the World

Several countries have increased the deployment of VPPs. One notable example is a VPP operated by Next Kraftwerke in Germany, with 5,000 energy-producing units and a total energy capacity of more than 4,000 MW. Successful pilots have also been set up in Australia, the United States, Denmark, and Japan, with more research being underway. India is exploring VPP development and has pilot projects underway by Tata Power Delhi Distribution Limited.

Hurdles for VPPs in India

Similar to other countries, India is facing challenges in technology, financing, and operation to bring VPPs into the power market. Another hurdle is the lack of a regulatory framework for VPPs in India. The absence of clear policy and legal guidelines and technical competence along with inadequate grid infrastructure has led to high capital expenses and limited interest from consumers, distribution companies, and the government. Further, establishing storage units within VPP systems has been particularly challenging because of the high fixed costs associated with existing communications networks.

Opportunities for VPPs in India

In India, VPPs could be a viable solution to the changing power needs due to the increase in the number of rooftop solar systems. Utilities can use a VPP, which can address these needs by optimally managing the amount of power consumed and generated.

India still has a high proportion of rural areas, and deploying VPPs can indirectly expand access to electricity in such areas. This is because increased VPP adoption will enable the deployment of more RE resources, which can generate power in remote areas with limited grid infrastructure. This will also reduce carbon emissions and dependency on fossil fuels, apart from providing new opportunities for investment in the RE sector.

Because of several government-sponsored programmes, India has seen a shift from centralised to decentralised power generation. Citizens are also aware of the additional transmission and distribution costs associated with centralised power generation. The Indian government has taken steps to promote smart grids by establishing the India Smart Grid Forum and India Smart Grid Task Force and adopting the [National Smart Grid Mission](#) programme. These developments can further strengthen VPP deployment in India.

The Way Forward

India should identify and analyse the challenges faced by other countries in VPP implementation. Focusing on technological advancements in tandem with substantial research and development will solve the issues associated with technology and high cost.

Further, India should take the necessary steps to establish a political and economic framework of policies and regulations that will best aid in a better understanding of VPPs. Because VPPs are all about a decentralised system, there should be a transition from utility-centric investment decisions to more societal-oriented ones. Moreover, prosumers can actively involve in VPP implementation by increasing their awareness of the financial, environmental, and technological benefits of VPPs.

VPP implementation also necessitates the development of trained staff, which can be accomplished through capacity building in complex elements of power generation, RE, and information technology. Therefore, the right mix of policy initiatives and technology development will ease the deployment of VPPs in India, thereby providing a comprehensive solution for the power needs of society in the future.

[This piece was written by Bidisha Banerjee. She works in the area of renewable energy and energy efficiency at the Center for Study of Science, Technology and Policy (CSTEP), a research-based think tank]