Pathways to Commercial Liftoff

Virtual Power Plants (VPPs)

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VPPs are aggregations of distributed energy resources (DERs) such as rooftop solar with behind-the-meter (BTM) batteries, electric vehicles (EVs) and chargers, electric water heaters, smart buildings and their controls, and flexible commercial and industrial (C&I) loads that can balance electricity demand and supply and provide utility-scale grid services like a traditional power plant.

VPPs offer a cost-effective way for utilities to integrate accelerating EV and DER growth and use it as additional flexible capacity that increases grid resilience and reduces harmful emissions. By 2030, the U.S. grid will likely need to add enough new resources to serve over 200 GW of electricity demand during peak hours. Modeling shows that procuring new peak demand capacity from a VPP can cost utilities 40-60% less than alternatives like utility-scale batteries and natural gas peaker plants. Approximately 33 GW of flexible VPP capacity operates in North America today, comprising ~20% of available DER capacity; accelerating DER deployment increases the potential capacity that can be aggregated.

By tripling VPP capacity to 80-160 GW and using it to address 10-20% of total peak demand by 2030, the U.S. can support rapid electrification while redirecting grid spending from peaker plants to DER participants and reducing overall grid costs. Managing all available flexible demand in this way could save on the order of $10B per year, largely via deferred capital expenditure for generation, transmission, and distribution infrastructure. These benefits come from managing flexible demand DERs through mechanisms such as smart thermostat demand response, commercial demand response, and managed EV charging that reshape load curves to shrink peaks and shift demand to hours when lower-cost, cleaner energy is abundant.

Market Status[1]

Metric	Value
North America VPP Capacity (% of total installed DER capacity) Source: Wood Mackenzie North America VPP Market Report 2024	33 GW (19.5%)
Distributed Solar Total Installed Nameplate Capacity[2] Source: Wood Mackenzie 2024E	70 GW
Residential and Non-Residential Flexible Demand Capacity[3] Source: Wood Mackenzie 2024E	~106 GW
EV Charging Flexible Demand Capacity[4] Source: Wood Mackenzie 2024E	18.5 GW
Distributed Storage Total Installed Power and Energy Capacity[5] Source: Wood Mackenzie 2024E	5 GW; 11.6 GWh
Distributed Fuel-based Generation Total Installed Capacity[6] Source: Wood Mackenzie 2024E	39 GW

1. No specific capacity target for the following metrics is outlined in the Liftoff analysis 2. Residential and commercial 3. Includes 29.4 GW of heat pump, 21.7 GW of smart-thermostat-enabled air conditioner, and 54.7 GW of building automation system-enabled residential and non-residential flexible demand capacity 4. Includes charging for residential, public, workplaces, buses, and all trucking. Does not account for energy export capacity of bidirectional chargers 5. Residential and commercial 6. Includes diesel and natural gas for commercial, industrial, and residential

Possible Near-term Actions

1. **Expand DER adoption with equitable benefits:** To make DERs more affordable for all Americans, utilities and other organizations could leverage on-bill financing instruments and upfront tiered rebates while partnering with community-based organizations to help consumers understand and access available rebates and tax incentives.
2. **Simplify VPP enrollment:** Enrollment at point of purchase, pre-enrollment with opt-out, and valuable incentives could help unlock 15-30% of DER capacity added to the grid by 2030, with best-in-class programs near 50%+ enrollment.
3. **Increase standardization in VPP operations:** Utilities can capture near-term value with basic VPP configurations that require little (<$5M) upfront investment, while delivering peak shaving benefits. Utilities can unlock additional value streams as VPPs mature, including voltage regulation and distribution benefits, through investments in enabling hardware and software.
4. **Integrate into utility planning and incentives:** Policymakers and regulators can continue to spur deployment by requiring utilities to include VPPs in current planning processes, creating performance incentives and cost recovery mechanisms, and requiring VPP tariff models that fairly compensate participating ratepayers.
5. **Integrate into wholesale markets:** ISO/RTOs and state policymakers and regulators can collaborate – particularly on data access, metering requirements, and governance – to learn from each other's experiences and quickly iterate on effective VPP integration into wholesale markets.