Smart Electric Power Alliance

Virtual Power Plant Insight Brief

Plugging In: How Customer Engagement Powers the Potential of VPPs

February 2024

This article investigates how engaging with VPPs can empower customers to become pivotal players in the clean energy transition. We will explore the crucial role of utilities, grid operators, and technology providers in fostering this engagement and unpack how their concerted efforts can help unlock the full spectrum of VPP benefits.

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Introduction

Contrasting sharply with traditional power plants, which generally operate independently of end-use electricity customers, the success of virtual power plants (VPPs) hinges on **direct customer interaction**. The foundation of VPPs lies in customer-sited energy resources; robust customer technology adoption and utility or third-party program participation are **necessary and critical** for their potential to increase and meaningfully contribute to the electric power sector's clean energy transition.

Key Takeaways

Critical Role of Information and Education:

The success of VPPs is closely tied to the ability of utilities, grid operators, and technology providers to effectively inform, educate, and motivate customers about VPP participation and its benefits.

Transition Toward Customer Engagement

A shift toward a more interactive and participatory role for customers with their electric utilities is essential for VPP adoption and success.

Inclusive and Equitable Strategies

Developing targeted programs and incentives, especially for underserved communities, is critical for creating a resilient and equitable energy ecosystem with VPPs.

Dual Benefits of VPPs

VPPs empower customers to address environmental concerns while improving their relationship and perception of their electricity providers.

Importance of Effective Communication

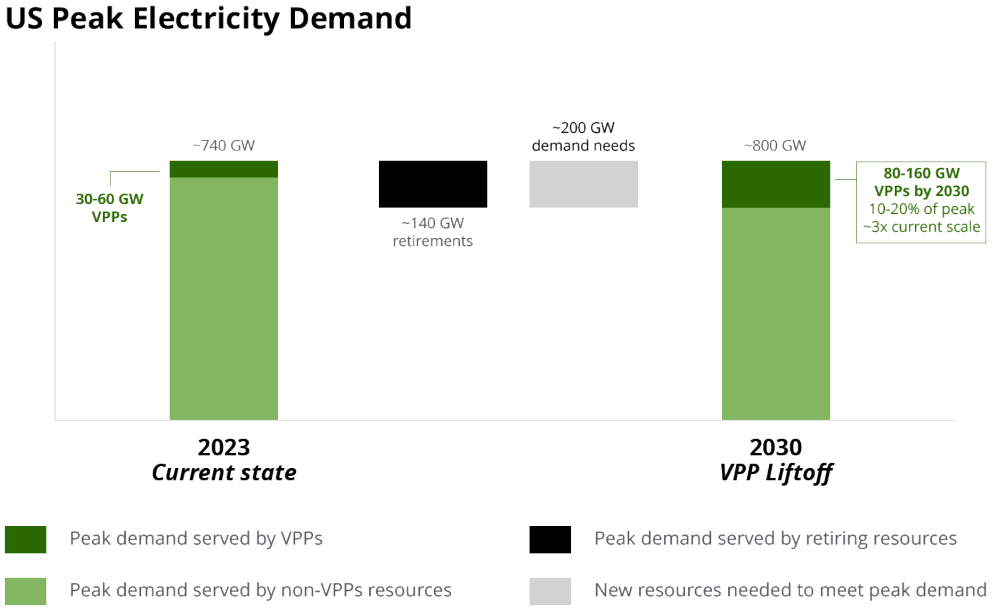
Developing tailored communication strategies for different customer segments is crucial in ensuring that customers fully understand how to participate in and benefit from VPPs.

What is a Virtual Power Plant?

The U.S. Department of Energy (DOE) recently defined Virtual Power Plants (VPPs) as **"aggregations of distributed energy resources (DERs) that can balance electrical loads and provide utility-scale and utility-grade grid services like a traditional power plant."**[1] Commonly referenced examples of DERs used in VPPs include but are not solely limited to smart thermostats, electric water heaters, electric vehicles (EV) and EV chargers, behind-the-meter battery storage, most often paired with rooftop solar PV and curtailable commercial, industrial, and agricultural loads.

While these DERs and the concept of VPPs have been part of the electric utility landscape for some time, recent technological advancements and the urgent need to replace retiring fossil fuel generation assets amidst forecasted increases in electricity demand have thrust them into a central role in the clean energy transition. Compared with utility-scale renewables like solar and wind, these resources do not require the investment and build-out of additional transmission capacity. Furthermore, DER interconnection to the distribution network is also typically less time-consuming and expensive, compared with larger, utility-scale renewable resources, all while providing proven reliability, "dispatchability", and flexibility.

Figure 1. Projected VPP Growth



Source: U.S. Department of Energy, Pathways to Commercial Liftoff: Virtual Power Plants. 2023.

For many years, utility and grid operator demand response programs have comprised the bulk of available VPP resources. More recently, customer-sited battery storage – most often paired with rooftop solar PV – and growing demand for electric vehicles and their chargers (sometimes referred to as electric vehicle service equipment - or EVSE for short) has expanded the resource list. As of 2023, VPPs delivered between 30 to 60 GW of peak demand capacity. According to a recent U.S. DOE study, by tripling this capacity by 2030, VPPs could provide a significant contribution of up to 10% to 20% of the nation's peak capacity.[2]

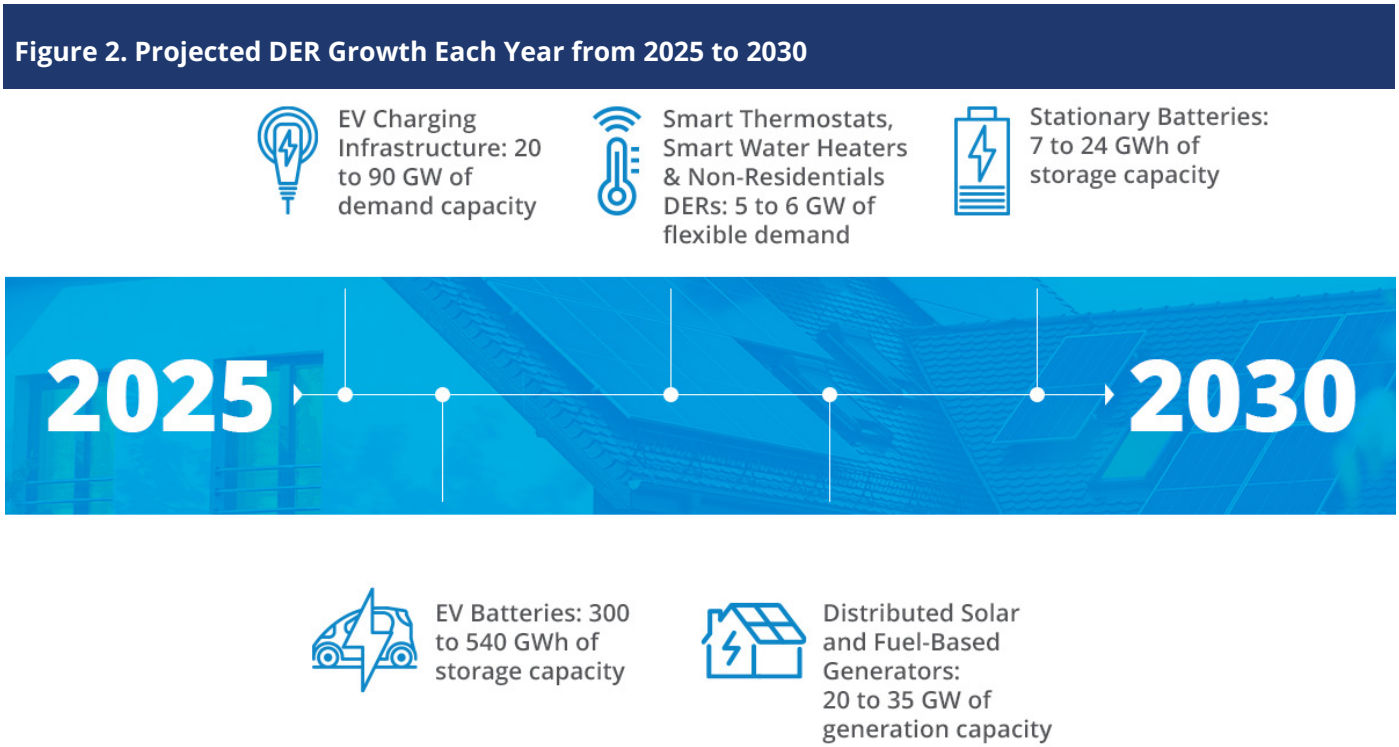
1 U.S. Department of Energy. (n.d.). Virtual Power Plants - Pathways to Commercial Liftoff. U.S. Department of Energy. Retrieved from https://liftoff.energy.gov/vpp/

2 U.S. Department of Energy. (2023, October 6). Virtual Power Plants - Pathways to Commercial Liftoff. Retrieved from https://liftoff.energy.gov/wp-content/uploads/2023/10/LIFTOFF_DOE_VVP_10062023_v4.pdf.

Importance of Customer Engagement

At the heart of a utility's or grid operator's ability to significantly reduce peak demand through VPPs is the extensive involvement of customer-sited DERs, including smart thermostats, solar panels with battery storage, electric vehicles (EVs), and EV chargers. Customers are adopting DERs at unprecedented rates, presenting enormous opportunities for VPPs.

Figure 2. Projected DER Growth Each Year from 2025 to 2030



Source: U.S. Department of Energy, Pathways to Commercial Liftoff: Virtual Power Plants. 2023. Visualization created by SEPA.

Yet, this potential hinges on the ability of utilities, grid operators, and technology providers to effectively inform, educate, and motivate customers about the advantages of participating in a VPP and to reduce the barriers to participation.[3] This challenge is part of a broader issue: deepening customer engagement beyond traditional, transactional relationships such as bill payments and outage management. For many, this marks a shift towards a more interactive and participatory role with their electric utility, a crucial step for the widespread adoption and success of VPPs.

Key Equity Considerations

A critical focus area for utilities and grid operators in customer engagement for VPPs is the inclusion of disadvantaged communities (DACs). Historically, these communities have faced systemic inequities within the energy industry, ranging from limited access to utility program offerings to disproportionate exposure to pollution from power plants. Ensuring these communities are included and actively engaged in the clean energy transition is vital to its success.[4] This inclusion and engagement is not just a matter of equity; it is essential for the development and success of VPPs and the broader clean energy transition. Without broader adoption of DERs and load control program participation by a more diverse customer base, including DACs, VPPs may struggle to aggregate enough resources, hindering their ability to balance supply and demand and impact the clean energy transition.

Customer engagement strategies for disadvantaged communities must be thoughtfully tailored to their unique

3 Customer participation in a VPP typically involves enrolling a new or existing DER (e.g. solar plus batter storage or managed EVSE), opting devices such as smart thermostats into direct load control programs, or offering commercial or industrial end use loads for load management programs.

4 Refer to SEPA's report "Embedding Equity in Utility Transformation" for an in-depth exploration of equity components critical to facilitating an equitable clean energy transition.

5 See U.S. DOE's "Creating a Community and Stakeholder Engagement Plan" for strategies on engaging disadvantaged communities.

needs and motivations.[5] This engagement approach involves understanding and addressing the specific barriers that these communities face, such as economic constraints, lack of awareness or trust in energy programs, and historical disenfranchisement in the energy sector. A recent NREL report on VPPs and energy justice identified two primary differentiators between a baseline VPP project and a VPP project tailored towards underserved communities - (1) funding avenues and (2) project drivers.[6]

- "Funding avenues for projects targeting underserved communities could include additional subsidy programs such as loans, grants, bonds, leasing of devices, and on-bill financing."
- "While the primary driver of VPP projects overall is to provide grid services, the drivers for VPP project development in underserved communities may also include factors that mitigate historical harms, such as reducing indoor and outdoor air pollution."

By developing targeted programs and incentives, providing accessible education about the benefits of VPPs, and building trust through consistent communication, utilities, and grid operators can develop meaningful participation in VPPs from underserved communities. An approach like this not only considers historical inequities, but also builds and diversifies VPP participation, creating a more resilient and equitable energy ecosystem.[7]

VPP Participation Can Improve Customer Satisfaction

Recent JD Power studies reveal a complex relationship between electric utility customers and sustainable energy programs. While there's a notable increase in customer satisfaction when they engage in multiple utility offerings, a significant portion of customers remain disengaged from sustainable program offerings.[8] Despite this, over 50% of customers acknowledge the seriousness of climate change and the need for action.[9] This discrepancy highlights a crucial opportunity for utilities: leveraging VPPs as a means to connect customers' environmental concerns with tangible action.

VPP participation presents a direct avenue for customers to contribute to the clean energy transition. The data suggests that while customers are concerned about climate change, there's a substantial gap in their participation in utilities' sustainable programs. Engaging customers in VPPs not only addresses this gap but also has the potential to enhance customer satisfaction. This is especially relevant as it could help mitigate any negative sentiments toward rising electricity prices. In essence, VPPs offer a dual benefit: empowering customers to act on their environmental concerns and improving their perception of and relationship with their electricity utility provider.

Customer Benefits

Participating in a VPP provides a diverse array of benefits for customers, catering to a range of motivations and needs. For environmentally-conscious individuals, the appeal can lie in the opportunity to actively contribute to the clean energy transition, making a tangible impact on reducing carbon emissions and supporting renewable energy integration.[10] Beyond environmental stewardship, VPPs also play a critical role in enhancing local grid resilience. This benefit becomes increasingly crucial as extreme weather events, which threaten the reliability of our electric grid, become more frequent. For customers, participating in a VPP can provide resilience during such events, ensuring a stable and continuous power supply even under extreme climate conditions.

Economic incentives also play a significant role in attracting customers to VPPs. These incentives include potential bill savings through optimized energy use, direct payments for participation in demand response events, and subsidies or discounts on energy-efficient devices installed behind the meter, such as solar panels and home batteries. These financial benefits not only reduce the cost of energy consumption for the customer but also provide a direct reward for contributing to grid stability and efficiency. Additionally, customers often gain increased control and insight into their energy usage, leading to further savings and a more personalized energy management experience.

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6 NREL. (2023). Virtual Power Plants and Energy Justice. National Renewable Energy Laboratory. Retrieved from https://www.nrel.gov/docs/fy24osti/86607.pdf

7 See NREL's "Virtual Power Plants and Energy Justice" for use cases of VPPs and their relevance to the core principles of energy justice.

8 J.D. Power. (2022). 2022 Electric Utility Business Customer Satisfaction Study. Retrieved from https://www.jdpower.com/business/press-releases/2022-electric-utility-business-customer-satisfaction-study

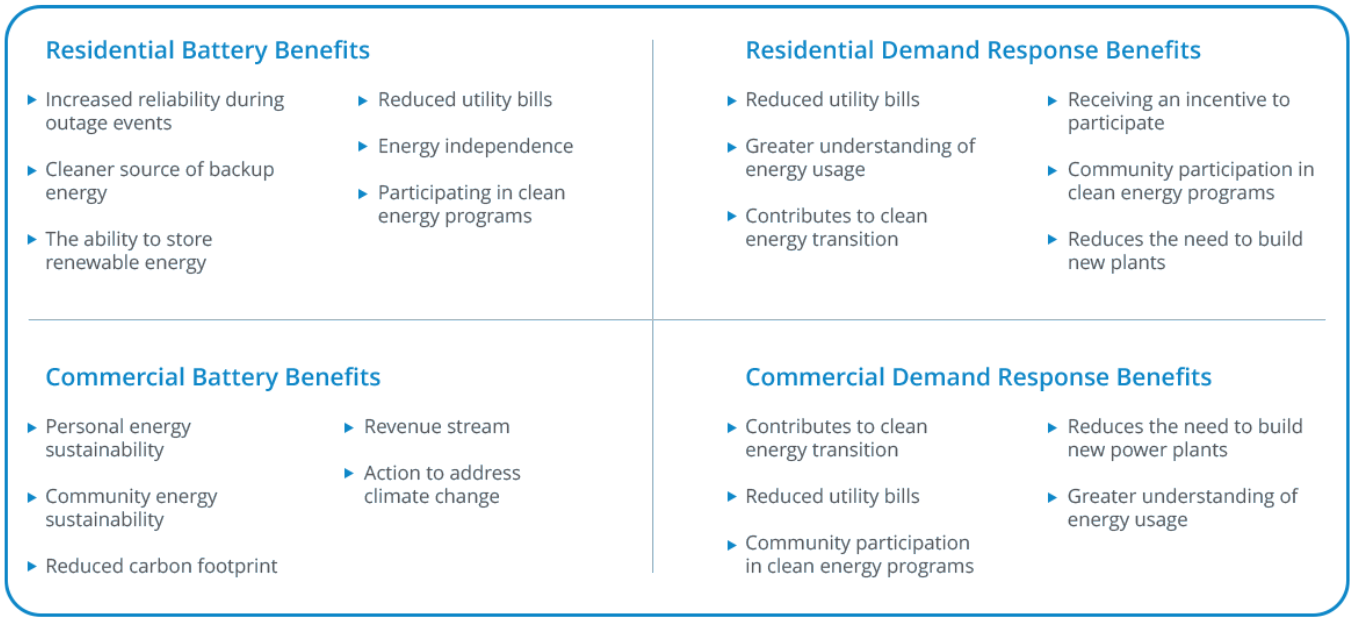
9 J.D. Power. (2022). 2022 Sustainability Index. Retrieved from https://www.jdpower.com/business/press-releases/2022-sustainability-index

10 According to a study from RMI, by 2050, VPPs could avoid 44 to 59 million metric tons of CO_2 annually.

Between September 2022 and May 2023, Puget Sound Energy (PSE) conducted a comprehensive community engagement initiative.[11] This initiative aimed to collect insights from a diverse range of voices, including customers, municipalities, community organizations, and tribal groups. The primary objective was to understand the benefits and barriers associated with the adoption of DERs and to strategize how future DER programs can be designed to minimize barriers to adoption while also maximizing benefits for the customers and communities that PSE serves.

Figure 3 summarizes the key benefits of demand response and battery storage, as identified by both residential and commercial customers of PSE. It highlights how these DERs, which are the central pillar of a VPP, bring a multitude of tangible benefits to customers.

Figure 3. Puget Sound Energy DER Customer Benefits



Source: Puget Sound Energy. (2023). Community engagement summary: Distributed energy resources (DER) - Batteries, solar, and demand response. Summarized by SEPA.

Barriers to Widespread Adoption

Customer awareness, education, and engagement affect the widespread adoption of clean energy solutions like VPPs. Alongside technological complexities and economic and regulatory challenges, the simple lack of understanding and awareness among customers presents challenges. Many customers are unaware of the potential of DERs in their home (e.g., smart thermostats, EVs, EV chargers, etc.) to participate in a VPP, and equally, they often do not realize that their utility or a third party may offer a VPP program they can join. This gap in awareness and education is a key hurdle that must be addressed to enable wider customer participation and the success of VPPs. Addressing this gap is not just about disseminating information; it is also about engaging customers in a manner that makes the value and impact of their participation clear and compelling.

In millions of households across the United States, valuable demand-side resources that can contribute to VPPs remain underutilized.[12] These range from relatively affordable smart thermostats to much more sophisticated and expensive systems like rooftop solar panels paired with battery storage. First, homeowners lack awareness or

11 Puget Sound Energy. (2023). Community engagement summary: Distributed energy resources (DER) - Batteries, solar, and demand response.

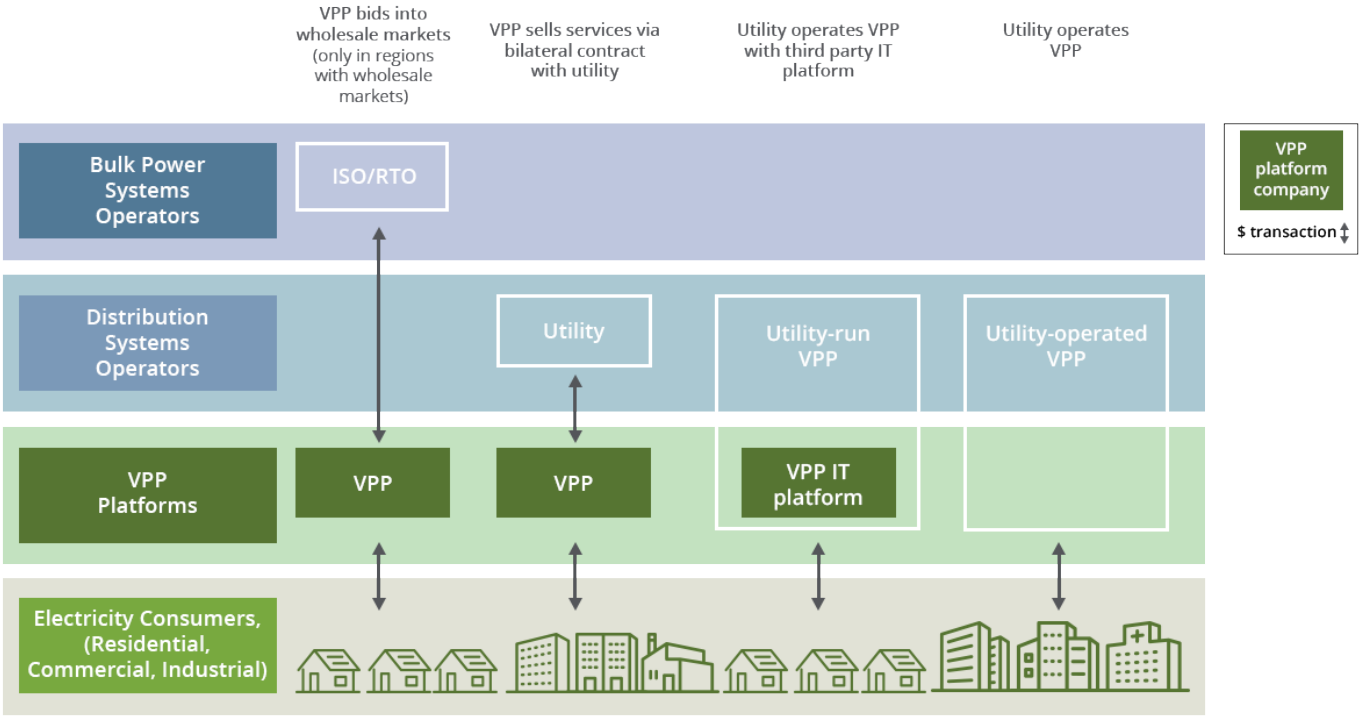
12 According to a report from Wood Mackenzie, cumulative DER capacity will reach 387 gigawatts (GW) by 2025 in the US, but the North American Electric Reliability Corporation (NERC) reports that the need for demand response will be ~35 GW in 2025.

understanding of how they can participate in a VPP and the benefits they stand to gain. Additionally, the lack of VPP or DER programs limits opportunities for participation - particularly in capacity market states within power markets like the Southwest Power Pool (SPP) and the Midcontinent Independent System Operator (MISO), where regulations do not fully support or allow for the participation of DERs in capacity markets.[13]

Just as the customers participating in them vary, VPPs are not monolithic. Several factors, including policy and regulatory frameworks, shape the participation models and structures of VPPs. In the U.S., these can be primarily categorized into four distinct types of VPP participation models:

- Direct VPP participation in the wholesale market
- Third-party operated VPP via contract with a utility
- Utility-run VPP utilizing a third-party platform
- Utility-owned and operated VPP

Figure 4. VPP Market Participation Models



Source: U.S. Department of Energy, Pathways to Commercial Liftoff: Virtual Power Plants. 2023.

The diversity of these participation models means that customer participation in a VPP can vary significantly. For example, the role of a customer in a utility-owned and operated VPP differs considerably from their role in a VPP that directly participates in the wholesale market. This variation in the participation model underscores the importance of customer education and information sharing about customer participation. Effective communication strategies tailored to each participation model are critical to ensuring that customers are well-informed about how they can participate and benefit from a VPP.

Additional Barriers

Beyond the challenges of customer awareness, education, and engagement, several other barriers impede widespread adoption and customer participation in VPPs. These barriers range from high upfront costs to regulatory hurdles related to DER aggregation.

13 Lawrence Berkeley National Laboratory. (2023). Regulation of Third-Party Aggregation in the MISO and SPP Footprints. Retrieved from https://eta-publications.lbl.gov/sites/default/files/aggregation_in_spp_and_miso_-_lbnl_report_09.27.23.pdf

The barrier of upfront cost, including the purchase, installation, and maintenance of DERs, consistently emerges as a significant challenge for the widespread adoption of and customer participation in VPPs. Given that customer DER participation is fundamental to the VPP model, the often steep upfront costs to customers pose a significant challenge. Financial support, such as incentives or rebates, can be crucial mechanisms to make DERs accessible to a broader customer base. Results from PSE's customer engagement initiative reaffirmed this, with cost being identified as the primary barrier to DER adoption.[14]

Regulatory frameworks for DER aggregation also present a significant barrier to the full realization of VPP potential. Historically, DERs were restricted from directly participating in wholesale markets. This landscape began to shift with the emergence of FERC Order 2222 in 2020, which mandates that independent system operators (ISOs) and regional transmission organizations (RTOs) allow DER aggregation and participation in these markets.[15] This regulatory change was pivotal for VPPs, enabling their participation in wholesale markets where they were previously excluded. Despite this progress, the transition has faced challenges, particularly from RTOs/ISOs, due to operational integration complexities. For example, MISO's proposed plan for implementing FERC 2222 suggests delaying VPP participation until 2030, citing the need for substantial updates to its software systems.[16] This delay highlights ongoing challenges in adapting existing grid infrastructures to accommodate new regulatory requirements and the evolving role of DERs in the broader energy ecosystem.

Empowering Customer Participation in the Clean Energy Transition

As the impacts of the climate crisis escalate, collective motivation for bold climate action is building among the general public. Participating in a VPP allows customers to actively engage in the clean energy transition. By integrating their own energy devices – thereby allowing them to become resources – such as solar panels or smart appliances, into a VPP, individuals contribute to a more stable and efficient grid and support the shift towards integrating more clean energy sources.

In exploring the role of customer participation in VPPs, it is crucial to recognize the diversity across and within customer classes. Participation in VPPs is not a one-size-fits-all proposition; it varies significantly across different customer segments. Residential customers, for instance, contribute mainly through smaller-scale energy resources like smart thermostats, EVs, and rooftop solar paired with energy storage systems. While their involvement in VPPs has a smaller individual impact due to lower energy consumption levels compared to larger customers, the collective participation of residential customers becomes evident when these small-scale resources are aggregated, potentially significantly reducing capacity needs.

In contrast, commercial and industrial (C&I) customers can play a more substantial individual role in VPPs due to their relatively higher levels of energy usage. When C&I customers participate in a VPP, especially under load control strategies such as automated demand response, their contributions can lead to significant energy curtailment during peak demand events. This significant energy use reduction is crucial for stabilizing the grid during high-load periods and can have a more pronounced impact on overall grid stability and efficiency. However, the operational considerations for these customers are more complex, as their participation can have a direct and significant impact on their core business operations.

Understanding these distinctions and tailoring VPP participation strategies accordingly is essential. While residential customers collectively contribute to the decentralization and greening of the grid on a broad scale, the participation of commercial and industrial customers is often key to achieving substantial, immediate impacts in demand management and carbon emission reductions.[17] Through this diverse participation in VPPs, each customer segment, both large and small, plays an integral role in advancing the clean energy transition.

14 Puget Sound Energy. (2023). Community engagement summary: Distributed energy resources (DER) - Batteries, solar, and demand response.

15 Federal Energy Regulatory Commission. (2020). FERC Order No. 2222 fact sheet. Retrieved from https://www.ferc.gov/media/ferc-order-no-2222-fact-sheet

16 U.S. Department of Energy. (2023, October 6). Virtual Power Plants - Pathways to Commercial Liftoff. Retrieved January 26, 2024, from https://liftoff.energy.gov/wp-content/uploads/2023/10/LIFTOFF_DOE_VVP_10062023_v4.pdf

Utility / Customer Partnerships

A lot of DERs may be new technologies for customers, including smart thermostats, battery storage, and EVs and EVSE. Customers require education and utilities and their technology and program partners are uniquely positioned to provide education and information to increase customer awareness and knowledge and to reduce technology uncertainty, as it can often translate to skepticism.

Except for direct customer participation in wholesale market VPPs through DER aggregation, three of the four VPP participation models require at least some interaction between utilities and their customers. Redoubling customer engagement efforts to better assess and understand the need to educate and inform these customers should help build the momentum necessary for effective VPP program recruitment efforts and other various utility clean energy programs. Below, SEPA has highlighted examples of specific efforts of some of its utility members to strengthen customer engagement and highlight the role of technology providers in developing customer VPPs.

Puget Sound Energy[18]

Utilities are reinventing their relationship with customers to prioritize community engagement. Puget Sound Energy (PSE) provides an example of one such engagement process involving both commercial and residential customers. PSE included residential customers from black, Indigenous, and other People of Color (BIPOC) communities, named Communities as listed in the Clean Energy Implementation Plan (CEIP), limited English proficiency community members, low-income households, and rural communities as they conducted community engagement efforts. They included commercial customers from nonprofits, tribal entities, government agencies, municipalities, and small businesses.

As PSE began these community engagement efforts, their central goals included:

- Providing communities most impacted by climate change a voice in shaping the program design.
- Compensating participants for their time.
- Using community engagement information to design programs to best meet the community's needs.
- Strengthening relationships between PSE and community members.

PSE took a varied approach to engaging community members. Some of their strategies included introductory calls, interviews, focus groups, workshops, and surveys. These sessions focused on gathering customer feedback on batteries, solar, DERs, and demand response. PSE tailored efforts to the customers they were interacting with to increase participation. For instance, they held a specific solar focus group at a senior center and they offered workshops and surveys in both Spanish and English. PSE also offered all participants compensation for their time at a rate of $75/hour.

Through their engagement with the community, PSE gleaned important findings that allowed them to think about how to reshape programs in the future. Customers noted that cost was the most significant barrier to accessing DERs. For many customers, DER installation and maintenance was daunting and PSE found it needed to provide support in these areas. PSE found that customers had diverse needs and interests around DERs and that customers would benefit from flexible options. Customers were generally motivated to participate in DER; however, PSE found that a great deal of education and outreach was still needed to bring customers up to speed on the benefits and specifics of DER adoption.

Holy Cross Energy[19]

As utilities focus on community engagement to advance DER adoption, VPP technology, and solution providers can forge new customer relationships to maximize the value of new DER assets. Holy Cross Energy (HCE) has a goal to become a distribution system operator to meet its ambitious carbon reduction goals. Doing so would allow the utility to manage the grid like independent system operators allowing members to participate in its broader portfolio. As DER adoption has increased among HCE members, the utility sought out a way to simplify operational complexity

17 According to the U.S. DOE's Pathway to Commercial Liftoff: VIrtual Power Plants: As of 2023, flexible commercial and industrial customer loads have been estimated to be as high as 300 GW.

18 Puget Sound Energy. (2023). Community engagement summary: Distributed energy resources (DER) - Batteries, solar, and demand response.

19 Camus Energy. (n.d.). Holy Cross Energy: Case Study. Retrieved January 26, 2024, from https://www.camus.energy/holy-cross-energy

while simultaneously maintaining flexibility and new program offerings.

In 2021, HCE began using a Camus energy software platform to achieve these goals. The platform provides a secure, cloud-based grid orchestration enabling monitoring, analysis, and control of the Holy Cross grid on an interface overlaid with Google Maps. Among the many benefits of this new platform, it allows for member resource aggregation to help effectively manage the power supply. As Sam Whelan, HCE's power supply manager put it "Based on our cooperative principle of serving our members, we want to keep that direct relationship with members. HCE is focused on member satisfaction and making sure everyone feels a part of the co-op. We want that to continue."

What's Next?

Customer education is a critical component for increasing DER adoption to the levels required to meet the objectives laid out in the VPP liftoff report: 80 to 160 GW by 2030, representing 10% to 20% of the forecasted 2030 peak load and a tripling of 2023's estimated VPP resource base. Utilities within various jurisdictions are re-thinking and re-doubling their efforts to engage customers on these technologies.

Utilities should consider these recommendations:

- Engaging their communities across customer classes to understand barriers and perceived benefits
- Employing diverse strategies to engage these communities, including introductory calls, interviews, focus groups, workshops, and surveys
- Partnering with community-based organizations to identify hard-to-reach customers
- Offering options to increase DER adoption, including customer leasing of utility-owned
- Providing education and outreach to explain the benefits and specifics of DER adoption
- Providing education and outreach to explain the benefits and specifics of VPP participation
- Partnering with technology providers and vendors to deploy solutions to reduce customer barriers to VPP program participation.

We need creative strategies to increase DER adoption and triple 2023's VPP resource base by 2030. These steps can strengthen utility/customer relationships, increase adoption of DERs and VPP resource base, and help ensure that the benefits of the clean energy transition accrue to customers across all classes and locations within a utility's service area.

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