Moving the Needle on DERs and VPPs in Nevada

How Nevada Can Leverage VPPs in Resource Planning

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Executive Summary

Resource planning is becoming more complex for Nevada utilities. Load growth is putting pressure on Nevada's grid. New variable renewable energy is changing how the grid operates. Concerning extreme weather threatens electric infrastructure. In the face of these pressures, Nevada needs low-cost capacity to help manage the grid and maintain reliability.

Virtual power plants ("VPPs") made up of distributed energy resources ("DERs") in Nevada homes and businesses are an emerging grid resource that can help Nevada achieve reliability and affordability. Supporting the deployment of DERs throughout NV Energy territory and integrating VPPs into resource planning will allow Nevada to meet rising demand, while controlling ratepayer costs and achieving the state's energy goals.

VPPs are not new. As DERs such as solar, storage, smart thermostats and managed EV charging become more common, utilities across the country are taking advantage of these new customer-sited energy technologies and moving quickly to integrate VPPs into resource planning. Recent years have seen a rapid rise in VPP programs, with states including California, Oregon, Utah, and North Carolina seeing success. Nevada can learn from these states as it crafts a VPP program that is right for its unique needs.

This document, prepared by Advanced Energy United, reviews existing and proposed VPP programs in Nevada, details the impact of VPPs and distributed resources on the grid, explores some examples of VPP programs in other jurisdictions, and provides a high-level assessment of the potential for VPPs to address peak loads in Nevada. Advanced Energy United's assessment finds that based on expected DER growth, Nevada VPPs (excluding traditional commercial demand response) could feasibly clip the 100 highest demand hours on the state's grid by 2031. This paper discusses the programs proposed by NV Energy in both their 2021 and 2024 Integrated Resource Plans ("IRPs") and where the utility can improve their program. NV Energy can leverage learning from the Grid Services Grant Project, the utility's recent experience with DERMS deployment, and insights from successful VPPs in other states to inform their VPP and DER programs.

As NV Energy improves its VPP proposals, it can leverage best practices from the maturing U.S. VPP market:

- Develop integrated, multi-technology VPPs to maximize benefits to the grid
- Offer robust participation payments for VPP participants to encourage enrollment and benefit ratepayers

- Create opportunities for third-party VPP and DER technology providers in order to reduce VPP implementation costs
- Ensure that a comprehensive cost-benefit analysis that includes VPP costs, benefits, and revenue accompanies proposals that come before regulators
- Solicit input from stakeholders, ratepayers, and industry experts to create the best possible VPP program for the grid and customers

The Grid Value Pathway in NV Energy's 2024 IRP contains important proposals that would expand NV Energy's VPP programs. Though the Grid Value Pathway does not go far enough, it is a strong foundation to build from. Nevada regulators can take meaningful action to make sure the Grid Value Pathway aligns with VPP best practices while legislators can help support Nevada VPPs in reaching their full potential.

Introduction

Nevada is experiencing load growth alongside a rise in renewable energy generation. While both are beneficial to the state, managing these ongoing developments in the electricity sector requires better resource planning to ensure the electric grid remains reliable. The challenge is compounded by a rise in extreme weather events that threaten the reliability of the grid. Fortunately, residential and commercial DERs can be leveraged to meet the needs of Nevada's grid as it continues to evolve.

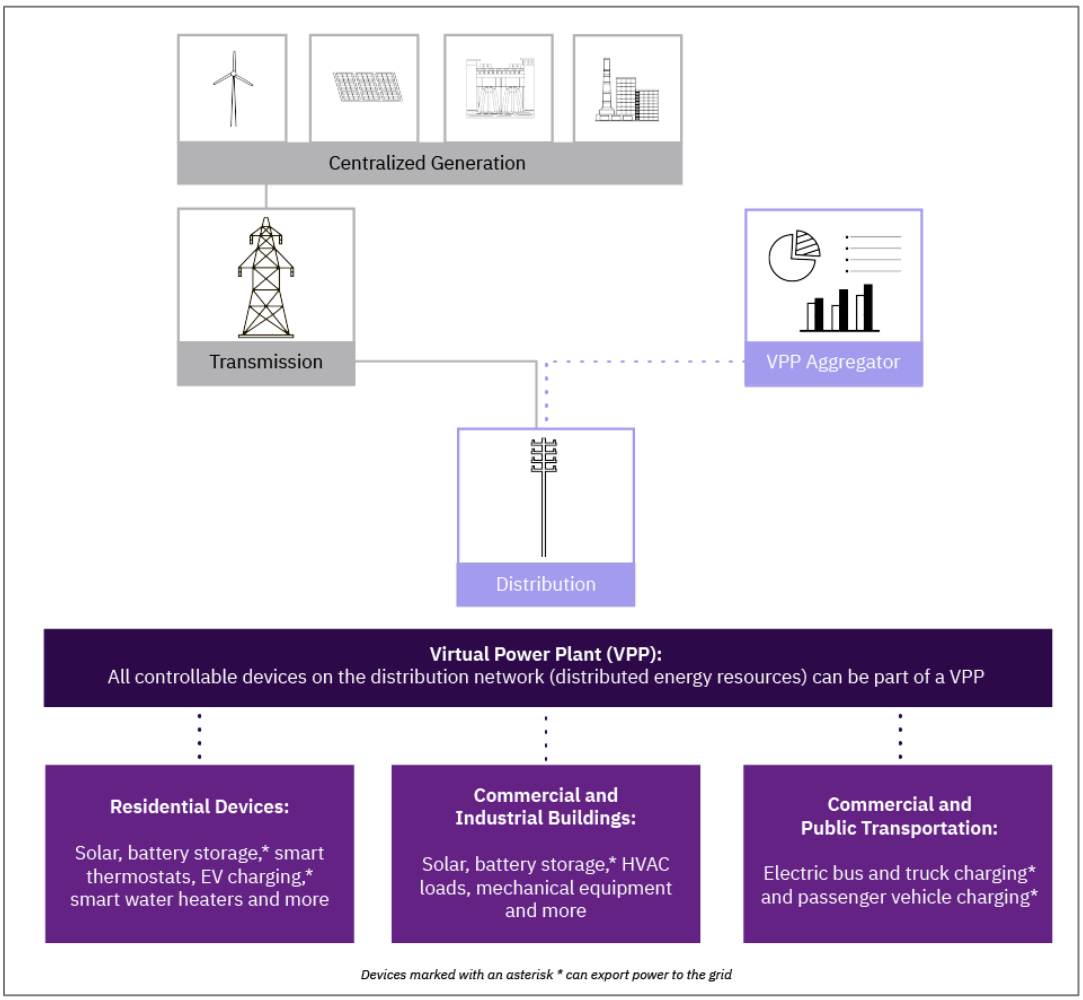
What are Distributed Energy Resources?

Distributed energy resources ("DERs") are technologies for managing energy use and generating electricity that are located on the distribution system, typically at a home or business, and can be managed remotely. Examples of DERs include rooftop solar, battery energy storage (often paired with solar), smart thermostats, smart water heaters, and managed electric vehicle ("EV") chargers. Via software that orchestrates their operation, DERs can be aggregated and actively controlled to provide demand flexibility and a range of grid services.

What is a Virtual Power Plant (VPP)?

A virtual power plant ("VPP") is an aggregation of DERs that are orchestrated via software to provide grid services, reducing or shifting customer load and even exporting power as needed. Broadly defined, VPPs include traditional demand response ("DR") from flexible commercial load, as well as DERs sited at both residential and commercial locations.[1] While DR has traditionally relied on large commercial or industrial facilities shifting their load, VPPs go further than traditional DR by allowing for more sophisticated control over a larger number of devices – including both residential and commercial loads, distributed generation, and battery storage resources. VPPs enable utilities to tap into the growing install base of DERs on the grid and use customer devices to proactively manage load and support grid operations.

[1]Department of Energy. *Pathways to Commercial Liftoff: Virtual Power Plants.* September, 2023: Available at: https://liftoff.energy.gov/vpp/.



The purpose of this paper is to explain the benefits of VPPs and recommend options for how Nevada can incorporate VPPs productively into resource planning. Although VPPs can include traditional demand response, this paper focuses on the newest wave of DERs on the grid: Battery storage (typically paired with solar), managed electric vehicle charging, smart thermostats, and smart water heaters.

The paper is divided into five sections. Section One provides a summary of Nevada-specific context for VPPs and DERs. Section Two discusses the benefits VPPs can deliver to the grid and to ratepayers. Section Three provides several examples of VPP programs from across the country that Nevada can look to as it explores VPP design. Section Four shares an analysis by Advanced Energy United of the potential for peak shaving in NV Energy territory if the utility successfully leverages its growing DER install base. Section Five focuses on key structure, software, and partnership considerations for Nevada VPP design.

Table of Contents

Part One: Background on VPPs in Nevada

From 2010 to 2020, the population of Nevada rose by 15%.[2][3] This growth is expected to continue,[4] driving up residential load. The expansion of industrial manufacturing in Nevada – including transportation and clean energy manufacturing – is expected to drive additional load growth in the coming years that may not yet be fully reflected in Nevada's load forecasts.[5] Finally, data centers, the rise of electric vehicles, and rising deployment of heat pumps and other electric appliances will all drive additional load growth. Together, this new load growth represents a potential resource adequacy challenge in Nevada, which already produces less energy than it uses.[6]

VPPs present Nevada with an opportunity to help meet load growth cost-effectively and in a timely manner. By helping meet load growth and peak demand at low cost, VPPs have the potential to bring down system costs, benefiting all ratepayers, in addition to providing value directly in the form of payments to participating customers. VPPs are highly flexible and can be scaled up or down quickly and efficiently. The expansion of VPPs and the DERs that comprise them can also create new job opportunities in the energy sector, decrease public health risks by increasing clean energy use, and help the state meet its clean energy goals.[7] Lastly, VPPs that leverage battery storage provide a source of backup power to customer homes and businesses, enhancing resilience in the face of outage threats.

Existing Nevada AMI and DERMS Investments Support Demand Flexibility

Nevada has already rolled out some of the key foundations for a successful VPP by investing in grid modernization in the form of advanced metering infrastructure ("AMI"), distribution automation tools, and distributed energy resource management software ("DERMS"). Virtual

[2]United States Census Bureau. *Nevada Continued Double-Digit Population Growth.* August, 2021. Available at: https://www.census.gov/library/stories/state-by-state/nevada-population-change-between-census-decade.html.

[3] Nevada Regional Economic Analysis Project (NV REAP), *Nevada Comparative Trends Analysis: Population Growth and Change, 1969-2022.* Available at: https://nevada.reaproject.org/analysis/comparative-trends-analysis/population/tools/92330000/320000/.

[4] University of Nevada, Las Vegas, Center for Business and Economic Research. *2022-2060 Population Forecasts, Long-Term Projections for Clark County, Nevada.* June, 2022. Available at: https://cber.unlv.edu/wp-content/uploads/2022/07/2022-CBER-Population-Forecasts.pdf.

[5] Grid Strategies. *The Era of Flat Power Demand is Over.* December 2023. At page 9. Available at: https://gridstrategiesllc.com/wp-content/uploads/2023/12/National-Load-Growth-Report-2023.pdf.

[6] Nevada Governor's Office of Energy. *Status of Energy Report 2023.* Available at: HYPERLINK "https://energy.nv.gov/uploadedFiles/energynvgov/content/Home/Features/2023_Status_of_Energy_Report.pdf"https://energy.nv.gov/uploadedFiles/energynvgov/content/Home/Features/2023_Status_of_Energy_Report.pdf.

[7] The legislature declared that it is the policy of Nevada to encourage and accelerate the development of new renewable energy projects; become a leading producer and consumer of clean and renewable energy; and ensure that the benefits of the increased use of portfolio energy systems and energy efficiency are received by the residents of the state. The legislature also declared a goal of achieving by 2050 an amount of energy production from zero carbon dioxide emission resources equal to the total amount of electricity sold by providers of electric service in the State. NRS 704.7820.

power plants can be considered a "function of DERMS," while DERMS helps "realize the potential of a virtual power plant."[8] Visibility into customer energy usage via AMI, combined with DERMS infrastructure for DER coordination, lays the groundwork for NV Energy to leverage demand flexibility to meet peak demand via a robust and full-scale VPP program.

NV Energy worked with AMI provider Sensus to roll out smart meters to over 1.3 million customers from 2009 and 2013, and has since continued to invest in improved visibility of customer energy usage with the FlexNet system.[9] By the end of the 2010s, Nevada had the second-highest AMI penetration in the country (after Washington, DC) at 96%.[10] Advanced metering infrastructure and distribution automation allow NV Energy to gather insight on load behavior, monitor outages, assess power quality, and ultimately optimize energy delivery as increasing volumes of DERs are added to Nevada's distribution grid. AMI integrates with distribution supervisory control and data acquisition (SCADA) systems, providing NV Energy with visibility into events on the distribution system.[11]

NV Energy has also invested in a DERMS system from Oracle. A DERMs platform can be defined as "a switchboard for DER-related protocols and information."[12] PUCN approved NV Energy's DERMs implementation in 2021 (at a cost of $15.5 million).[13] The DERMS platform is enhancing NV Energy's ability to coordinate DERs and is scheduled to replace the utility's legacy Demand Response Management System in 2024.[14] Oracle describes its DERMs offering as a customer engagement platform that can "turn DER intermittency into a dispatchable grid resource that supports reliability and efficiency goals," enabling DER scheduling and dispatch, DER modeling, network optimization, network management, and DER market management.[15] Oracle has developed a number of partnerships and integrations with other players in the DER space, including EnergyHub (an integration that facilitates bring-your-own-device programs).[16]

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[8] Smart Electric Power Alliance. DERMS Terms – Going Beyond the Buzzword. March 2021. Available at: https://sepapower.org/knowledge/derms-terms-going-beyond-the-buzzword/

[9] Sensus. NV Energy Delivers Reliable Power Distribution with Sensus. November 2018. Available at: https://sensus.com/news-events/news-releases/nv-energy-delivers-reliable-power-distribution-with-sensus/

[10] Energy Information Administration. *Nearly half of all U.S. electricity customers have smart meters.* December, 2017. Available at: https://www.eia.gov/todayinenergy/detail.php?id=34012

[11] Sensus. Case Study: NV Energy Delivers Reliable Power Distribution with Sensus. Available at: https://sensus.com/resources/case-studies/nv-energy-delivers-reliable-power-distribution-with-sensus/

[12] Smart Electric Power Alliance. DERMS Terms – Going Beyond the Buzzword. March 2021. Available at: https://sepapower.org/knowledge/derms-terms-going-beyond-the-buzzword/

[13] Docket 21-06001, Corrected Modified Final Order at page 154.

[14] DistribuTECH. *Presentation: Preparing for and Deploying Enterprise DERMS From Managing New DER Connections to Full Market Operations.* February 2023. Available at: https://cdn.asp.events/CLIENT_CL_US_323E7AA7_5056_B733_8303D39C538813E0/sites/DI-2024/media/libraries/FINAL_UU205_Presentation_Williams_20230206.pdf

[15] Oracle. *Distributed Energy Resource Management System (DERMS) from Oracle.* Available at: https://www.oracle.com/utilities/products/derms/

[16] EnergyHub. *EnergyHub and Oracle Utilities integrate distributed energy resources into the utility customer experience.* August 2019. Available at: https://www.energyhub.com/blog/partnership-with-oracle/

NV Energy's PowerShift Program

NV Energy has already taken initial steps to leverage flexible demand on the grid via its existing PowerShift program, a form of VPP focused on smart thermostats. Through this program, NV Energy provides smart thermostats for both residential and commercial customers in exchange for a five-year agreement that allows NV Energy to automatically reduce load during peak times. These FlexResponse events are most often initiated during the summer months in the evening hours, typically when customers are using air-conditioning systems. As an incentive for being a participant in the program, NV Energy covers the thermostat equipment cost, installation of the product, and any subscription costs. NV Energy also provides participants with bill credits at the end of the calendar year for their participation in demand management events. NV Energy is taking laudable steps toward expanding the Powershift program under a 'bring-your-own-device' model. This will expand the number of customers enrolled in FlexResponse, allowing the utility to control more smart thermostats during peak times to reduce demand on the grid.

VPPs in Nevada Resource Planning

Nevada requires electric utilities to file a triennial integrated resource plan (IRP), with the 2024 filing made public in June 2024.[17] As part of this IRP, NV Energy is also required to file a distributed resource plan ("DRP") and a Demand Side Management Plan ("DSM").[18] The DRP must include "recommendations for new cost-effective distributed resources, sourcing of distributed resource solutions and utility infrastructure upgrade solutions which have been determined to be the preferred solution to constraints on a utility's electric grid on the basis of the analysis in the grid needs assessment. Such recommendations must be based on the locational net benefit analysis of resource options to utility customers."[19] Within the DRP and the DSM, the state has already provided a place and process for integrating VPPs and DERs into resource planning.

NV Energy's 2021 and 2024 IRPs have made significant steps toward expanding VPP programs. However, to date, these proposals have not gone far enough. The relevant proposals are outlined below.

VPPs in NV Energy's 2021 IRP

NV Energy filed a full IRP in June 2021. Within the DRP portion of the 2021 filing, NV Energy proposed a Distributed Solar and Storage Residential Demand Management Trial ("DER

[17] The general Integrated Resource Plan requirements for electric utilities in the State are defined in NRS 704.741; NAC 704.9005 through 704.9525.
[18] NAC 704.9237; NAC 704.9215.
[19] NAC 704.9237(3)(c).

Trial").[20] This proposed trial would have deployed 5.8MW of utility-owned distributed solar and 4.1MW of distributed energy storage resources at a combination of multifamily and single-family housing (located in high growth and/or historically underserved areas) over a three-year trial period. Customers would have been compensated via a system of storage shares. The storage share system of compensating DER hosts would have been based off demand reduction and load shifting under a time-of-use rate, and would equate to a bill credit value of $92-114 per participant for multifamily customers and $214 for single-family customers (as well as the benefit of backup power). NV Energy targeted an overall capacity contribution of 5.2 MW at peak, and proposed to address distribution system needs via deployment in distribution-constrained areas. The proposed budget for the proposed DER Trial was $42.2 million.[21]

The Public Utility Commission of Nevada ("PUCN") denied NV Energy's request for $42.2 million to develop this trial, citing insufficient program detail, insufficient cost-benefit analysis, concerns about participant opt-outs, engineering risk, and overall cost to ratepayers.[22]

Within the 2021 IRP filing, NV Energy also requested approval to participate in the United States Department of Energy ('U.S. DOE') Grid Services Grant Project. NV Energy applied for and was awarded, along with the University of Nevada-Reno, the University of Nevada-Las Vegas, and the software company Evolution Networks, $3 million dollars from the DOE Solar Energy Technologies Office. The purpose of this grant from DOE is to provide NV Energy with funding "to develop and demonstrate a set of grid services provided from aggregations of DER that include customer rooftop solar, customer battery storage systems, smart thermostats, grid-interactive water heaters, and distributed storage at utility substations."[23] The PUCN approved NV Energy's participation in this program, noting that once this trial has concluded, "NV Energy will have valuable data for use in designing future DERs programs."[24] This program was targeted for completion on July 31, 2023. NV Energy now has valuable data to draw on that will inform how to best integrate DERs into the NV Energy system.

NV Energy's 2024 IRP

NV Energy filed their 2024 IRP on May 31 of this year.[25] Within their DRP and DSM filings, the company focused on programs that would have a positive impact on supply-side capacity.[26]

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[20] Docket No. 23-06001; Vol. 13 DRP & Technical Appendix at page 226 of 311 (Filed June 1, 2021).
[21] *Id.*
[22] Docket 21-06001, Corrected Modified Final Order at pages 160-178 (Filed March 8, 2022).
[23] *Id.* At page 154.
[24] *Id*. At page 159.
[25] Joint Application of Nevada Power Company D/B/A Nv Energy and Sierra Pacific Power Company D/B/A Nv Energy for Approval of their 2025-2044 Triennial Integrated Resource Plan and 2025-2027 Energy Supply Plan (Filed May 31, 2024).
[26] NV Energy 2024 IRP; Vol. 20 at page 182.

The Grid Value Pathway is the strongest choice outlined in the IRP, but still does not go far enough in making sure such VPPs are leveraged to their full potential in Nevada.

The DSM proposes two portfolios: the Grid Value Pathway (NV Energy's preferred portfolio) and the alternative Traditional Pathway. Programs introduced in both portfolios focus on reducing demand while offering incentives for customers who participate in the company's offered programs. NV Energy's energy efficiency programs and existing forms of demand response are included in the Traditional Pathway. These foundational DR programs include NV Energy's FlexResponse program, which includes some residential devices such as smart thermostats, as well as traditional commercial demand response. The Grid Value Pathway preserves these programs, but goes further by expanding demand management and DR – the provisions in this pathway best aligns with Advanced Energy United's definition of a VPP. The Grid Value Pathway introduces a new incentive structure to encourage residential demand response and explores new incentives for commercial DR. The Grid Value Pathway outlines DR programs that appear to leverage a range of different customer-sited DERs including heat pumps, thermostats, smart water heaters, battery storage, pool pumps.

Advanced Energy United supports the progress toward a more robust VPP program (termed DR in the IRP) that is represented by the Grid Value Pathway. Advanced Energy United also believes the NV Energy IRP can and should go further in its Commercial Services and Residential Services proposals to take full advantage of all DERs on the grid. Regulators can work with NV Energy to enhance the Grid Value Pathway DR proposals, ensuring NV Energy's new programs align with established VPP best practices.

The Residential DR program within the Traditional Pathway focuses on load reduction and energy savings – an efficiency focus. The Traditional Portfolio would continue to enroll smart thermostat customers in its Powershift program, which Advanced Energy United considers to be a single-device VPP, and expand opportunities for program enrollment in its bring-your-own-device model in which smart thermostats that are not installed or owned by NV Energy are eligible for bill credits for contributing to peak demand reduction.[27] The NV Energy Grid Value Pathway, which is preferred by NV Energy, would go further and expand NV Energy's residential demand response program to include residential water heaters, pool pumps, and battery storage options for peak demand management. The Grid Value Residential DR program would offer up-front incentives as well as pay-for-performance incentives in exchange for making customer-sited devices available during peak events to reduce the strain on the grid.[28]

[27] NV Energy 2024 IRP; Vol. 9 at page 223.
[28] *Id*.

[29] The Commercial DR Program also offers a different incentive structure, introduced as Levels 1 (base reliability option), 2 (economic option), and 3 (flex option).[30] This allows commercial customers to select how many DR events they will be able to participate in and select the matching incentive structure for those events. The Commercial DR Program proposal under the Grid Value Portfolio includes information on how and when the commercial customer will be informed of a DR event and includes information on whether the customer can opt out of DR events.

The NV Energy's proposed Residential DR and Commercial DR programs under the Grid Value Pathway represent meaningful progress on leveraging DERs for demand management. However, there are several areas that regulators and NV Energy must give special attention to so that valuable DER capacity is not left on the table and customers are served well by these programs. First, NV Energy must ensure that it aggregates multiple DERs at every opportunity, covering all DER types (i.e. only smart thermostats and storage) to capture the full range of available DERs that are installed on NV Energy' the system. As it stands, it is not clear from the Grid Value Pathway language if all DERs will be included in the Residential and Commercial DR programs that are proposed. Second, NV Energy must adequately reward customers for participation in DR programs, as well as communicate with all customers about DR events and compensation in a sophisticated manner to ensure safety and ongoing program participation. As it stands, the Grid Value Pathway payments to customers for participation may not be high enough to attract robust participation. Third, NV Energy must not limit the application of any of its programs to utility-owned devices, and must ensure opportunities for bring-your-own-device and third-party software partnerships. NV Energy must ensure adequate opportunities for third-party DER providers to enroll devices in Nevada's expanding demand management programs – or else risk leaving valuable DER capacity on the table. Currently, the 2024 NV Energy IRP does not contain sufficient detail on these three key issues.

Prior to this IRP, the PUCN has rejected some of the demand management programs proposed by NV Energy based on lack of clarity. As we will discuss in Part Two, VPP programs are vital for meeting Nevada's load needs and ensuring affordability into the future. We hope the PUC can direct NV Energy to expand on its latest proposals as necessary, with a particular eye to the best practices of adequate customer compensation, multi-DER aggregations, and third-party DER ecosystems.

[29] NV Energy 2024 IRP; Vol. 9 at page 260.
[30] *Id*.

Pilots Versus Programs

NV Energy is currently conducting a number of pilots and tests in order to explore how DERs can contribute to grid services. For example, in 2023 and 2024 NV Energy has been monitoring the performance of smart water heaters at two customer sites for "both traditional demand response strategies and more advanced grid services that coordinate the operation of heat pump water heaters with rooftop solar PV and electric energy storage devices."[31] The 2024 IRP also references additional pilots and tests to be explored under the Program Development Program budget.[32] NV Energy notes that its planned pilots under the Grid Value Portfolio "will lead to new measures for the Residential and Commercial Demand Response programs and improve these programs' dispatch management capabilities."[33]

Pilots can be valuable. However, Advanced Energy United would emphasize that NV Energy's DER pilots should, wherever possible, be carried out concurrently with the integration of common DERs into the DR programs proposed in the Grid Value Portfolio. If pilots are considered a prerequisite for integrating DERs in these programs, the pilots themselves can slow the embrace of residential and commercial VPPs that NV Energy seeks to achieve. Numerous operational VPPs around the US and beyond – some of which are described in this paper – have set reasonable expectations that NV Energy can look to regarding how common DERs (including battery storage, smart thermostats, EV charging, and water heaters) can contribute cost-effectively to peak demand reduction and load shifting. Delaying the integration of any of these DERs into NV Energy VPP program excludes useful peaking capacity from the programs, since the penetration of each of these DERs is growing in NV Energy territory (as affirmed by both E3's analysis for NV Energy and Advanced Energy United analysis of NV Energy VPP Potential).

Nevada Legislative Declarations of Intent Support VPPs

Finally, it is worth underscoring that recent legislative developments in Nevada support VPP development in the state. In Senate Bill 358 (2019), the Nevada Legislature included a section of legislative findings and declarations. This is notable as it is not common for the Nevada Legislature to include legislative findings and declarations in a bill. The Nevada Legislature declared: "It is the policy of this State to: (1) Encourage and accelerate the development of new renewable energy projects for the economic, health and environmental benefits provided to the people of this State; (2) Become a leading producer and consumer of clean and renewable energy, with a goal of achieving by 2050 an amount of energy production from zero carbon dioxide emission resources equal to the total amount of electricity sold by providers of

[31] NV Energy 2024 IRP; Vol. 9 at page 131.
[32] *Id*. At page 142.
[33] *Id*. At page 143.

electric service in this State; and (3) Ensure that the benefits of the increased use of portfolio energy systems and energy efficiency measures are received by the residents of this State. Such benefits include, without limitation, improved air quality, reduced water use, a more diverse portfolio of resource for generating electricity, reduced fossil fuel consumption, and more stable rates for retail customers of electric service."[34] The inclusion of VPPs and DERs in a robust electric resource planning process is consistent with this legislative declaration.

Including VPPs and DERs in planning would accelerate the development of new renewable energy projects, help the state meet its goal of achieving an amount of energy production from zero carbon dioxide emission resources equal to the total amount of electricity sold by 2050, and could increase benefits to residents of the state by improving air quality, providing a more diverse resource portfolio, reducing fossil fuel consumption, and lowering rates for customers. In other words, the inclusion of VPPs and DERs in resource planning meets each of the three goals established by the legislature.

[34] Senate Bill 358 (2019); NRS 704.7820.

Part Two: Benefits of Virtual Power Plants

Benefit 1: Resource Adequacy

Meeting growing electricity demand in Nevada is an area of concern that NV Energy has stressed in recent filings for resource planning.[35] VPP programs can reduce the need for new centralized peaking resources such as peaker plants. Dispatching VPPs to reduce and shift demand during periods where electricity usage is the highest (also called peak shaving) is a promising mechanism to help maintain a reliable grid as demand grows.

The utility can contract directly with customers or third-party VPP companies who deploy and manage DERs, leveraging those DERs to reduce and shift load when needed, such as during summer afternoons and evenings when the residential load in Nevada is greatest. If a VPP program rewards DERs export in addition to load reduction, battery and EVs are also capable of exporting power. (Through export, these resources can provide additional, more flexible capacity to the grid by contributing during peak times or grid emergencies than if they were only authorized to modulate onsite demand[36]) Studies find that resource adequacy via VPPs can be delivered at lower cost than traditional resource adequacy options.

In March of 2023, Governor Joe Lombardo issued Executive Order 2023-007 directing Nevada to pursue a diverse and balanced portfolio of energy generation resources, including renewable energy.[37] The order stated that "Nevada will develop sufficient in-state electric generation resources to ensure the needs of all Nevadans are met and ensure that Nevada has sufficient electric generation resources to mitigate the risk of energy markets not having sufficient electric energy supplies during peak usage periods."[38] One key step Nevada can take to achieve a more reliable grid is to develop a balanced portfolio of generation and demand-side management sources that includes VPPs.

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[35] NV Energy states that the Companies and stakeholders need to reevaluate established practices to ensure there is sufficient energy to meet peak demands during the summer. NV Docket No. 21-06001, Vol. 4 Summary at page 1 and 9 of 55 (Filed June 1, 2021).; NV Energy states that Nevada has experienced energy supply issues three years in a row, as well as indicating that increased summer peak and energy demand are related to native load growth and transportation electrification, Docket No. 23-08015, NV Energy and Sierra Pacific Power Company for Approval of the Fifth Amendment to its 2021 Joint Integrated Resource Plan, Vol. 1 at pages 29-30 (Filed Aug. 25, 2023).

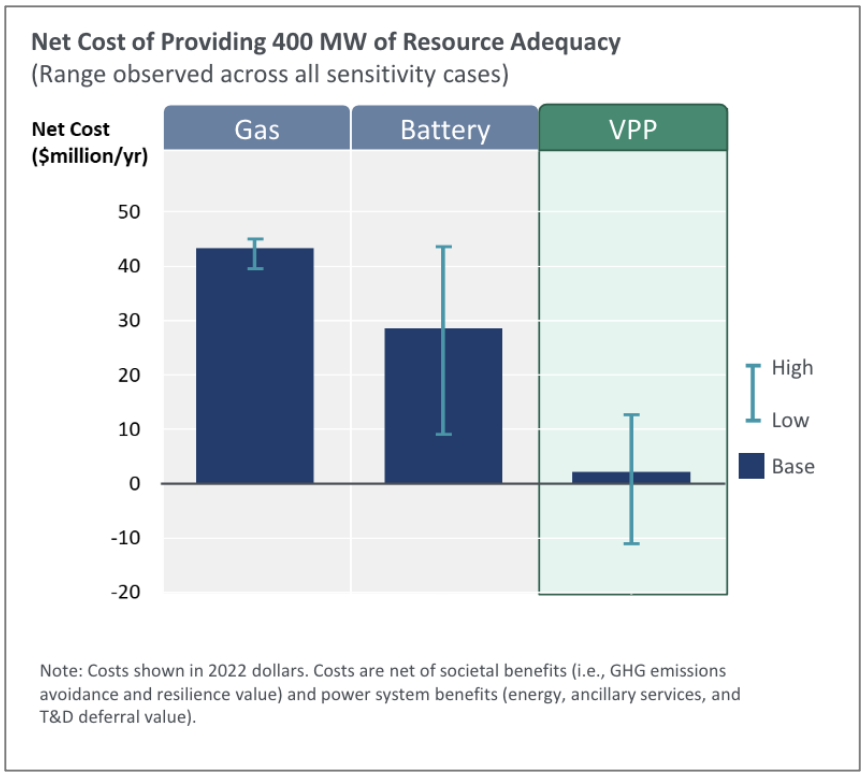
[36] Leap. *California's new Demand Side Grid Support program: A boon for batteries.* July, 2023. Available at: https://www.leap.energy/blog/california-s-new-demand-side-grid-support-program-a-boon-for-batteries

[37] Executive Order 2023-07, *Order Establishing the State of Nevada Energy Policies Objectives,* State of Nevada Executive Department, https://gov.nv.gov/Newsroom/ExecOrders/2023/Executive_Order_2023-007/#:~:text=The%20state's%20energy%20policy%20will,affordability%20and%20reliability%20for%20consumers. (Mar. 21, 2023).

[38] *Id.*

Benefit 2: Affordability

By providing benefits to the grid, VPPs and DERs also benefit ratepayers. Nevada residents face rising electricity and gas bills.[39] Rising peak demand has the potential to drive up system costs. When peak demand is met with traditional solutions, such as peaking power plants, this costly new infrastructure is only used for a handful of hours per year. VPPs can help shift demand to take better advantage of low- or no-marginal cost resources on the grid. Nationwide, the Department of Energy finds that distributed energy resources have the potential to save $22 billion per year by 2030.[40] According to the Brattle Group, procuring new peak capacity from VPPs "can be 40% lower net cost to a utility than procuring new capacity from a utility-scale battery and 60% lower net cost than a natural gas peaker plant."[41] If VPPs are left out of resource planning as load grows and fossil fuel assets retire, Nevada runs the risk of saddling ratepayers with unnecessarily expensive sources of capacity.



Source: Brattle

[39] Nevada Current. *NV households struggle to pay summer power bills, and it's getting worse.* August, 2023. Available at. https://nevadacurrent.com/2023/08/15/nv-households-struggle-to-pay-summer-power-bills-and-its-getting-worse/. See also: Larry Martino, KKLZ. *Nevada's High Electric Bills Rank In The Nation's Top 10.* March 2024. Available at: https://963kklz.com/2024/03/06/high-electric-bills-expected-in-nevada-this-year/.

[40] Department of Energy. *Pathways to Commercial Liftoff: Virtual Power Plants.* September, 2023: Available at: https://liftoff.energy.gov/vpp/.

[41] Brattle Group. *Real Reliability: The Value of Virtual Power.* May 2023. Available at: https://www.brattle.com/real-reliability/.

VPPs also promise the avoidance or deferral of transmission and distribution costs. By unlocking capacity located on the distribution network, close to load, VPPs can both reduce system-wide peaks and relieve distribution system constraints that would otherwise trigger costly upgrades. DERs and VPPs can also shape load in a manner that reduces the need for new transmission. Deferring major T&D infrastructure upgrades can create savings that are passed on to ratepayers.

Finally, VPP programs share system cost savings with VPP participants through equipment rebates, participation payments, or other means of compensation. These payments, along with the energy and bill savings that solar, smart thermostats, and other controllable devices can provide, can enhance energy affordability for Nevadans. VPPs are a key affordability solution because they are a means of procuring capacity that compensates Nevadans directly for services to the grid, while saving money on capital investments and fuel. The largest operational cost of a VPP are typically participation payments to the customers who host DERs – meaning that according to the Department of Energy "most of the money spent on VPPs flows to electricity consumers (households and businesses)."[42]

Although participation payments vary widely, payments to customers are typically one-time, periodic, per-kWh, or some combinations thereof. In one hypothetical VPP outlined by the Department of energy, behind-the-meter battery hosts receive "up-front payment of $1000 per kW of battery capacity for customers buying new systems, monthly flat payments of approximately $16 for participation based on capacity enrolled, and a $0.20 credit per kWh exported."[43] In another example cited later in this paper, Portland General Electric ("PGE") VPP pilot participants receive bill credits equivalent to $1.70 per kWh per dispatch event.[44] Finally, the Brattle Group's 2024 study on California VPP estimated that "an individual household participating in all four residential VPP options considered in this study potentially could receive participation payments of $500 to $1,000 per year."[45]

Benefit 3: Resilience

Nevada is vulnerable to extreme weather, and climate change is increasing the severity and frequency of these events.[46] The state faces a range of weather-related threats, including high

[42] U.S. Department of Energy. *Virtual Power Plants - Pathways to Commercial Liftoff.* Page 24. September, 2023. Available. at: https://liftoff.energy.gov/wp-content/uploads/2023/10/LIFTOFF_DOE_VVP_10062023_v4.pdf.
[43] *Id*. At page 27.
[44] Portland General Electric. Home Battery System & Peak Time Rebates. Available at: https://portlandgeneral.com/home-battery-system-and-peak-time-rebates.
[45] Brattle Group. *California's Virtual Power Potential: How Five Consumer Technologies Could Improve the State's Energy Affordability.* April, 2024. Available at: https://www.brattle.com/wp-content/uploads/2024/04/Californias-Virtual-Power-Potential-How-Five-Consumer-Technologies-Could-Improve-the-States-Energy-Affordability.pdf.
[46] University of Nevada, Reno. *Climate Change Impacts in Nevada.* Available at https://extension.unr.edu/publication.aspx?PubID=3957.

winds, wildfires, blizzards, and extreme heat. Each of these weather events has the potential to cause grid outages. Utilities can and should prepare for the impacts of these events and anticipate that future weather patterns may be more disruptive than weather seen in the past. VPPs can support the grid when transmission or generation is impacted by extreme weather, automatically reducing demand, or exporting power when needed. Customer-sited storage can also support Nevadans if and when power outages occur due to extreme weather. If a customer has solar and storage installed in their home with an appropriate configuration and experiences a power outage during a weather event, they can island from the grid, relying on their DERs while the utility works to restore service. EVs are also an emerging source of grid resilience, as new vehicle models are released that allow for homes to draw power from EV batteries to keep the lights on during grid outages.

Benefit 4: Decarbonization

The advanced clean energy technologies that form the basis of VPPs can help reduce carbon dioxide emissions. Using Energy Information Administration Form 930 data on NVE generation, Advanced Energy United has calculated that GHG emissions tend to peak in the hours after sundown.[47]

VPPs can reduce demand during peak evening hours when solar generation tapers off and power generation is most fossil fuel intensive.[48] Supporting the proliferation of DERs and leveraging them in VPPs will help the state to meet its clean energy goals sooner.

Benefit 5: Public Health

DERs and VPPs support public health by reducing fossil fuel power generation and providing resilience to communities in case of outages. By reducing demand and making power generation cleaner, VPPs can reduce pollution, which carries severe associated health impacts such as asthma and higher rates of cancer. In addition, severe weather tied to climate change can pose threats to public health. When outages do occur, battery storage can keep Nevadans safe by helping keep the lights on at homes, businesses, and critical facilities such as hospitals and community centers. Individuals that rely on life-sustaining medical equipment at home are a particularly vulnerable group that benefits from battery storage backup.

[47] See Hourly Electric Grid Monitor by the U.S. Energy Information Administration available at: https://www.eia.gov/electricity/gridmonitor/dashboard/custom/pending.
[48] U.S. Department of Energy, Loan Programs Office. *Sector Spotlight: Virtual Power Plants.* March, 2023. Available at: "https://www.energy.gov/lpo/articles/sector-spotlight-virtual-power-plants#:~:text=VPPs%20can%20decrease%20emissions%20and,CO2%20emissions%20per%20year"https://www.energy.gov/lpo/articles/sector-spotlight-virtual-power-plants.

Benefit 6: Economic Growth

Installation and operation of VPPs and DERs in Nevada will require the use of local labor and create opportunities to grow the in-state DER industry. According to the United States Department of Energy, "a grid managed with higher number of DERs is predicted to require significantly more full-time jobs in the energy sector than a grid that relies on utility-scale assets alone."[49] To help expand the clean energy labor force, the utility can develop apprenticeship programs with organizations such as the Expanded Solar Access Program ("ESAP"), the Nevada Department of Employment, Training and Rehabilitation ("DETR"), and the International Brotherhood of Electrical Workers ("IBEW"). As clean energy technologies proliferate in Nevada, collaboration between utilities, technology providers and local workforce programs can ensure Nevadans are equipped to take advantage of jobs in this growing sector.

[49] Department of Energy. *Pathways to Commercial Liftoff: Virtual Power Plants.* Page 36. September, 2023. Available at: https://liftoff.energy.gov/vpp/.

Part Three: Learning from Recent VPP Case Studies

NV Energy should include VPPs and DERs within a robust and transparent resource planning process. These technologies are not new to Nevada regulators: NV Energy has previously proposed DER pilot programs during its integrated resource planning filing in 2021.[50] During the upcoming IRP process, NV Energy can refer to a number of successful examples nationwide that demonstrate the possibilities of VPPs and can form the basis of a successful, well-rounded VPP program. This section focuses on VPP and DER programs that have received regulatory approval and demonstrate what is possible in Nevada.

Portland Gas and Electric's Smart Battery Pilot: bring your own device and pay-for-performance

Overview

Portland Gas and Electric ("PGE") launched a five-year solar-plus-storage pilot in 2020. The PGE Smart Battery Pilot is a 'bring-your-own-device' VPP that allows customers to enroll if they have a new or existing solar system connected to a qualifying battery. The program is compatible with batteries from a number of different manufacturers, including Generac, SolarEdge, Sonnen, Tesla, Eguana, and Duracell. The first goal of the pilot is shaving peak demand. A secondary goal is to allow the utility to test new smart-grid control devices, and the benefits they bring to distribution operations, across the distribution system. This pilot is part of a broader long-term strategy for the utility: By 2030, PGE aims to deliver a 25% reduction in peak load by shifting customer energy use.[51]

Structure and Participation

Participants' devices are dispatched during PGE 'Peak Time Events' (approximately 15 times a year, mostly during higher heat or cold days). These Peak Time Events last three to four hours and occur between 7 to 11 A.M. or 3 to 8 P.M. Participants in this pilot receive credits on their utility bill at a rate of $1.70 per kWh per Peak Time Event. Participants choose the level of capacity they are comfortable with PGE dispatching to maintain their preferred state of charge, and PGE pledges not to dispatch during an outage or when extreme weather is predicted.

[50] DER Trial; NV Docket No. 21-06001 Vol. 13 DRP & Technical Appendix at page 226 of 311 (Filed June 1, 2021).
[51] Department of Energy. *Pathways to Commercial Liftoff: Virtual Power Plants.* September, 2023. At page 50. Available at: https://liftoff.energy.gov/vpp/.

As part of its “Smart Grid Test Bed” program, PGE is targeting certain neighborhoods to achieve a density of dispatchable storage to test the locational benefits. Customers in these areas are eligible for an additional rebate (that acts as a capacity payment) of $405 per kwh of nominated capacity, in addition to the current 30% federal tax credit for solar and storage investments.

Interestingly, PGE significantly revised this compensation structure in early 2023 to move to the “pay-for-performance" framework. Previously, the company offered a flat upfront battery rebate and a flat per-month enrollment incentive. In response to lagging enrollment partially due to the pandemic and supply chain disruptions, PGE’s P4P framework offers higher compensation on a monthly basis for maximum performance, but also the option to nominate less capacity and respond less frequently for lower compensation.

Takeaways for Nevada

- Various battery models accepted: The PGE Smart Battery pilot allows a variety of different battery models to participate with a ‘bring-your-own-device' approach.
- Customer choice: The PGE pilot provides options for differing levels of participation, giving customers confidence that their devices are being dispatched appropriately.
- Incentive payments: PGE customers are compensated by event and by kilowatt-hour, ensuring a direct linkage between DER performance, benefits to the grid, and participant compensation.
- Complementary rebates: VPP participation incentives may not always drive DER adoption and participation sufficiently, which is why it is useful for PGE’s goals that the state of Oregon also offers battery storage incentives for some customers. Together, VPP incentive payments and storage rebates make it easier for PGE customers to invest in technologies that deliver flexible demand.

SDG&E – Shelter Valley VPP Pilot Program

Overview

In California, San Diego Gas & Electric ("SDG&E") launched the 18-month Shelter Valley Virtual Power Plant Pilot Project in 2022.[52] The goal of this pilot was to investigate how DERs function in real-world conditions and gather data to inform future VPP programs. The pilot project investigated how DERs can serve as a resource to balance supply and demand on the grid. This project explored multiple DER technologies to gather data on the performance of different DERs, providing smart thermostats, load controllers, and battery energy storage at no cost to customers who provided access to the devices for analysis. The pilot project simulated 17 demand response events during the pilot program. Contractor Alternative Energy Systems Consulting handled the recruitment of participants and the installation and testing of devices.

Structure and Participation

The pilot program focused on the Shelter Valley region of California, which is an unincorporated community in East San Diego County. Shelter Valley is a remote, rural area of the state with a small population. Both residential and commercial customers were recruited. The utility provided participants with the DER technology for free, with installation, in exchange for the utility having control over the technology to simulate DR events. After the pilot, the participants were able to keep the equipment or have the utility remove the equipment. Prior to a DR event, the utility sent notifications to participants when it would leverage customer-sited devices for demand response, and participants were given the option to opt out of events. Participants were also provided with two gift cards, one after the technology was installed and one after the pilot was finished.

Takeaways for Nevada

- DER diversity: SDG&E's choice to implement a pilot project that tests multiple technologies and brands allowed them to gather a richer dataset.
- Number of events: The technology was tested through 17 simulated demand response events, allowing them to gather data on DER performance in a variety of scenarios.
- Customer types: The pilot involved both residential and non-residential customers, adding to the value of data gathered.

- Customer experience: A pilot project that provides the DER technologies to the customers at no cost provides benefit to customers encouraging participation.
- Resilience: SD&GE implemented this pilot program in a rural area of the state that faces outages. These DER technologies helped manage demand on the grid while protecting the customers with options for resilience in case of an outage.

Duke Energy EV Complete Home Charging Plan Pilot

Overview

In North Carolina, Duke Energy launched the EV Complete Home Charging Plan Pilot Program in November 2023.[53] The pilot will run for a 12-month period. The pilot is a managed EV charging VPP as well as a pricing strategy, in which EV customers are offered access to a subscription plan for EV charging – which offers cost certainty and allows load shifting in exchange.

Structure and Participation

The pilot is in partnership with Ford, General Motors, and BMW, and only customers that own one of those vehicles are eligible for participation. The pilot operates using an 'Open Vehicle Grid Integration Platform,' software that allows the utility to manage EV charging from multiple automakers in a grid-friendly manner. The participating automakers automatically update the vehicle's preferred charging times to align with off-peak windows when the participant is charging at home.

Duke Energy notifies the EV manufacturer of a grid strain twelve hours in advance of when the manufacturer will pause charging for the participants. The paused charging events last no more than four hours at a time and occur up to three times a month.

Participants also receive notifications when their vehicle charging settings are going to be changed. Customers can override the events four times during the pilot program. If the participant overrides this update more than four times, the participant can be removed

[52] SDG&E. *Shelter Valley Virtual Power Plant Project.* . https://www.sdge.com/major-projects/shelter-valley-virtual-power-plant-pilot-project.
[53] Ford Energy Rewards. *Introducing Duke Energy's EV Complete Home Charging Pilot Program*. https://www.ford.com/grid/duke.

from the pilot program. In addition, participants agree to use no more than 800 kWh per month for charging their EV at home.
Participants are charged a flat rate for their at-home EV charging as part of this pilot program. Participants through Duke Energy Carolinas are charged $19.99, plus tax, per month for one year of at home charging. Participants through Duke Energy Progress are charged $24.99, plus tax, per month for one year of at home charging.

Takeaways for Nevada

- Timeline: With a 12-month pilot program, the shortest timeline among those programs described in this report, Duke has crafted an efficient process. The year-long timeline allows for data collection to help the utility better understand how a large-scale EV managed charging program could operate, without acting as a barrier and delaying rollout of a more robust full-scale program.
- Customer acquisition and customer experience: Partnering with third-party companies, in this case vehicle manufacturers, allows the utility to access customers who already have the required technology for the pilot. While the VPP itself may help promote the adoption of certain other DER types, such as smart thermostats and storage, the electric utility is not involved in a customer's purchase of an EV. Partnerships help Duke secure touchpoints with new EV owners, while allowing the automaker to manage elements of the customer experience.

Part Four: Estimating Nevada's VPP Potential

While the Grid Value Pathway in the NV Energy 2024 IRP DSM represents gains in demand flexibility, Advanced Energy United seeks to challenge NV Energy by suggesting that NV Energy could go further. To emphasize the untapped potential on NV Energy's grid, Advanced Energy United seeks in this section to quantify the achievable impact of a scaled-up VPP on the Nevada Grid. It would take 720 MW of demand response to clip the 100 most expensive hours of demand on Nevada's grid.[54] To achieve this as quickly as possible, every grid-enabled DER in Nevada must be leveraged for demand management.

Advanced Energy United's analysis seeks to complement the E3 DER forecast released in the recent NV Energy IRP and generate discussion about future of DERs in Nevada. For its 2024 IRP, NV Energy contracted with E3 to better understand its DER install base and forecast future DER deployment. E3's analysis results are captured in the NVE DER MPS PATHWAYS Results section[55] of the 2024 IRP. In this paper, Advanced Energy United has put forth a separate analysis, 'Addressing NV Energy Peaks with DERs,' developed internally at Advanced Energy United. This analysis overlaps somewhat with the E3 analysis, but specifically seeks to quantify peak demand management potential from grid-enabled DERs and excludes traditional commercial demand response. Comparing these two forecasts one-to-one is challenging because of incomplete information in the DSP about the assumptions that underly the E3 forecast.

Considerations When Comparing the Advanced Energy United to E3 PATHWAYS Analysis and the NV Energy IRP DSM

The E3 PATHWAYS study forecasts demand impact from the following resources: Residential demand response (device types not specified), commercial demand response (device types not specified), managed EV charging (vehicle types not specified), unmanaged EV charging (vehicle types not specified). The study also forecasts peak impact for several of these DERs. In contrast, Advanced Energy United analyzed 'Peak Impact' for all grid-enabled DERs on the NV Energy Grid (excluding commercial DR), with specific peak impact forecasts for each DER type. Advanced Energy United arrived at likely peak impact based on customer participation data and per-participant peak impact data from existing VPP programs (and estimates where real-world data was not available). This peak impact estimate is less than the nameplate capacity of the given DER, and also potentially less than the overall potential demand impact of DERs on the Nevada grid, since it estimates available DER capacity exclusively during peaks.

[54] See Load Duration Curve at NV Energy's Energy Supply Plan: Testimony, Narrative and Technical Appendix, Vol 18 of 18 at page 123. Available at: https://www.nvenergy.com/publish/content/dam/nvenergy/brochures_arch/about-nvenergy/rates-regulatory/recent-regulatory-filings/nve/irp/2021-irp-filings/NVE-21-06-IRP-VOL18.pdf

[55] NV Energy 2024 IRP; Vol. 20 at page 6.

Assumptions about how much individual devices can be expected to contribute to demand flexibility can significantly impact the peak impact projections by both the E3 and Advanced Energy United. Further visibility into the modeling behind the E3 study would be needed to explain the differences between the two analyses; differences in analysis of certain DER types, and different assumptions about likely demand flexibility participation rates and available capacity from DERs. Many factors will influence DER deployment in homes and businesses in the coming decade, and program design and customer behavior will impact the level of VPP participation that can be expected.

It is also difficult to compare the Advanced Energy United forecast to the demand impact of NV Energy programs communicated in the IRP. (All of NV Energy's 2023 DSM programs combined provided a total of 233 MW of demand savings, according to data shared in the 2024 IRP; residential and commercial DR contributed 154 MW of this total.) The Grid Value Pathway would go even further from 2025-2027, reducing demand by between 234 in 2025, 265 MW in 2026, and 300 MW in 2027. Residential and commercial DR would contribute a significant share of this demand savings (196 MW in 2025, 227 MW in 2026, and 262 MW in 2027)[56]. Advanced Energy United's analysis captures peak impact from participating DERs only, and excludes traditional commercial demand response. This likely contributes to differences between the United forecast and demand impacts captured in the 2024 NV Energy IRP.

Advanced Energy United analysis: 'Addressing NV Peak Needs with DERs'

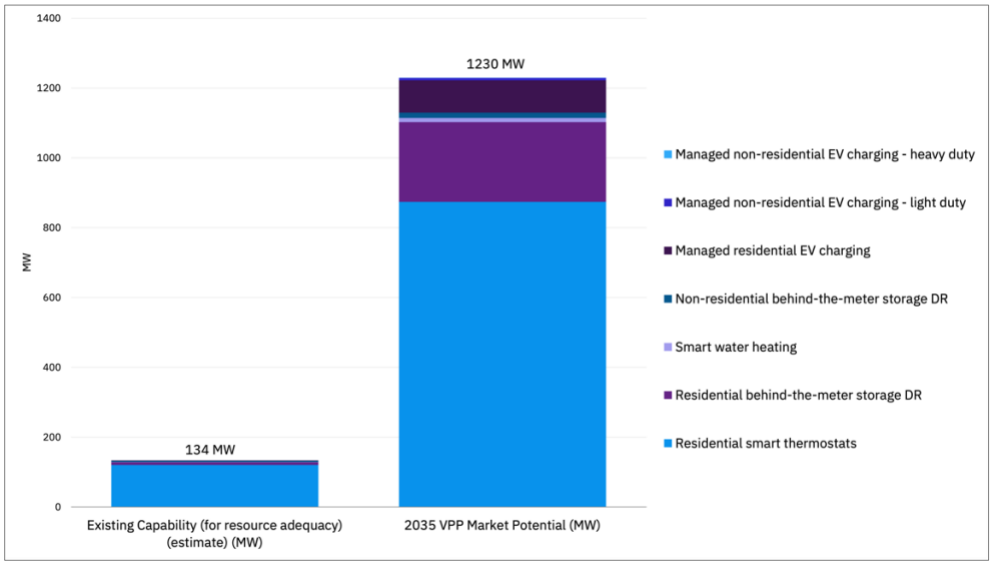
Peak demand reduction is one of the most important grid services that a VPP can provide. Advanced Energy United estimates that today, 19 of the highest value peak hours on NV Energy's system (based on 2022 NV Energy load data) could be clipped by leveraging the DERs[57] currently installed in NV Energy's service area. Additionally, based on Advanced Energy United projections of future DER growth in Nevada, the top 100 peak hours could be clipped with DERs (aggregated as a VPP) by 2031.[58] If new programs were put in place to encourage DER adoption and VPP enrollment that included upfront incentives such as rebates and/or participation incentives, NV Energy would likely reach this milestone even more quickly.
[Insert load graph from NV Energy]

[56] NV Energy 2024 IRP; Vol. 9.
[57] The distributed energy resources included in the Advanced Energy United analysis are smart thermostats, behind-the-meter storage (residential and non-residential), and residential electric vehicle charging. Solar is not included but is assumed to be paired with the great majority of behind-the-meter storage systems.
[58] Department of Energy. *Pathways to Commercial Liftoff: Virtual Power Plants.* September, 2023: Available at: https://liftoff.energy.gov/vpp/.

As of 2024, Advanced Energy United estimates that Nevada is currently home to an estimated 134 MW of flexible DER capacity (excluding traditional commercial DR) that can be leveraged via a VPP to reduce system peaks (see appendix). If a VPP were already in place today that fully leveraged Nevada's existing DERs, United estimates that 19 of the highest value hours of peak demand could effectively be clipped with DERs alone. As noted above, 134 MW is not the nameplate capacity of all DERs installed, but rather the *share* of DER capacity that can be expected to be available for participation in a VPP during peak times, taking expected customer behavior into account based on program data from other states. Efforts to increase customer participation in Nevada's VPP could increase the available capacity from each resource in the aggregation beyond what is estimated here. More ambitiously, the 100 highest load hours of power for the NV Energy grid (based on a 2022 NV Energy load duration curve) could be clipped with 721 MW of DER capacity (see 2022 load duration curve).[59]

It may seem daunting that NV Energy would need to achieve more than 5x today's 134 MW of DER capacity in order to clip 100 peak hours. Fortunately, however, flexible capacity is increasing in Nevada as customers seek out DERs, and the needed DER growth to clip 100 peak hours could realistically occur by 2031.[60] Advanced Energy United estimates suggest that the total flexible capacity on NV Energy's grid will increase by 5.6x from 2024-2031 under business-as-usual conditions, surpassing the 721 MW milestone. Expanding the time horizon 2024 to 2035, flexible capacity is expected to increase 9x, to over 1.2 GW.

2035 Nevada VPP Market Potential



[59] NV Energy's peak demand in 2023 was 8,135 MW in July 2023. (Las Vegas Review Journal. *'Sticker shock': NV Energy customers react to bills from record-hot July.* August, 2023. Available at: https://www.reviewjournal.com/business/energy/sticker-shock-nv-energy-customers-react-to-bills-from-record-hot-july/2891862).

[60] In the Advanced Energy United 'high case' estimate, in which DER adoption and VPP participation is accelerated, Nevada could clip the 100 highest load hours on its grid by 2028 with a VPP.

Promoting faster DER growth with rebates and VPP participation incentives

Rising demand, increasingly erratic weather, growth in variable renewable generation, and other factors require the grid to evolve quickly. Despite fairly robust DER growth expected in Nevada, an even faster growth rate could help meet emerging grid needs. Load forecasts have been rising nationally and analysts have recently signaled that grid operators should expect even greater-than-anticipated load in the coming years, with Nevada becoming a hotspot for new commercial and industrial load.[61] In this context, focused investment that incentivizes DER adoption is likely to be in the best interest of NV Energy customers.

In order to grow the installation base of DERs in Nevada and promote VPP participation, VPP programs and pilots should incentivize customers adequately. Participation incentives allow customers to keep a share of the power system investment savings provided by the VPP they participate in.[62] By paying customers per unit of capacity and per event at a rate that is meaningful to the customers, participation incentives encourage customers to adopt DERs and participate in the VPP.[63] Participation payments can also make energy more affordable for low-to-moderate income customers, helping provide equitable access to the benefits of DERs and reducing energy burden.

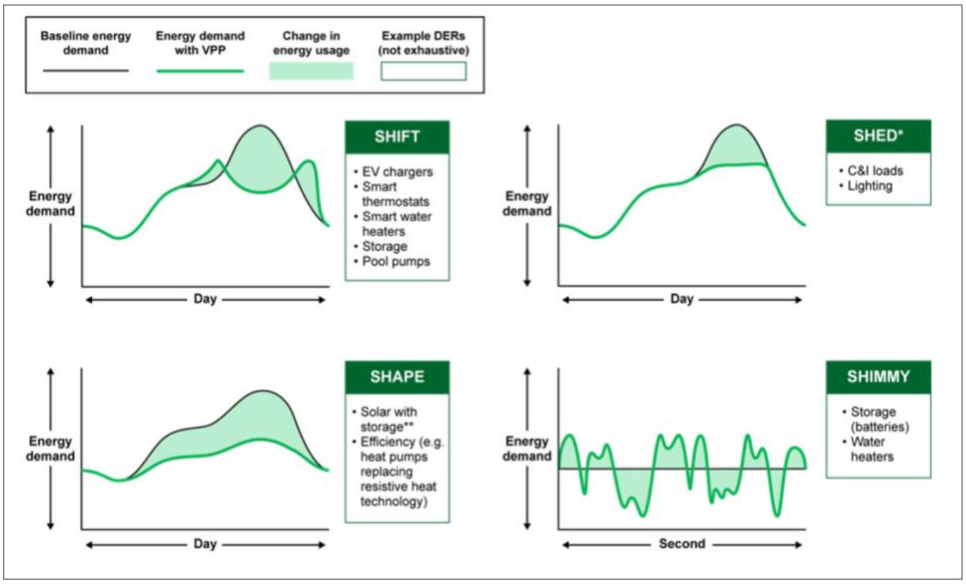
Including multiple DERs for optimized VPPs

NV Energy is already exploring investment to support DERs with PowerShift. Beginning as soon as possible, it would be valuable to expand NV Energy's VPP programs to include DERs beyond smart thermostats. VPPs can do more for the grid when they encompass multiple DER types because different DERs shape demand in different ways, based on DER size, capabilities, and customer use patterns. NV Energy would be able to fully realize its flexible demand if it pilots VPPs focused on additional DERs and builds out a robust multi-technology VPP program for the long term.

[61] Grid Strategies. *The Era of Flat Power Demand is Over.* December 2023. Available at: https://gridstrategiesllc.com/wp-content/uploads/2023/12/National-Load-Growth-Report-2023.pdf.

[62] Brattle, *California's Virtual Power Plant Potential: How Five Consumer Technologies Could Improve the State's Energy Affordability* (Apr. 2024), available at: https://www.brattle.com/wp-content/uploads/2024/04/Californias-Virtual-Power-Potential-How-Five-Consumer-Technologies-Could-Improve-the-States-Energy-Affordability.pdf.

[63] For a detailed breakdown of costs and revenues in a hypothetical smart thermostat-only DR VPP, see Ibid, 66 (Department of Energy. *Pathways to Commercial Liftoff – Virtual Power Plants.* September, 2023. Available at: https://liftoff.energy.gov/vpp).



Source: U.S. Department of Energy [Pathways to Commercial Liftoff: Virtual Power Plants]

Smart thermostats

Smart thermostats are a key source of demand flexibility for Nevada, particularly given the high impact of air conditioning on the grid during summer peaks. By providing thermostats to customers at no cost, and additionally offering bill credits for participation in FlexResponse events, PowerShift currently allows NV Energy to reduce load from customer air conditioning when the grid needs it most. Currently, the program is set to adjust thermostats by four degrees during peak events.

Going forward, collaboration with industry partners could allow NV Energy to implement more nuanced demand management strategies to control thermostats. NV Energy may seek to explore partnerships with service providers who can orchestrate devices to maximize value to the grid, and whose marketing efforts could attract more customers to the VPP. (The pros and cons of utility ownership of devices is explored further in the final section of this paper.) Smart thermostats will become an even more effective source of demand flexibility as smart HVAC proliferates (also supported by PowerShift). Their ability to support management of winter peaks will increase as electric heating becomes more widespread.

Behind-the-meter storage

As solar penetration grows on both sides of the meter, power prices in the middle of the day can dip below zero. Behind-the-meter batteries can charge during that time and shift surplus solar to the evening, limiting curtailment and edging out expensive fossil fuel generation. This makes residential behind-the-meter storage a powerful tool within a VPP. Its size adds to its value, with each residential storage system providing an estimated 7.5kW of per-participant

peak impact (versus 3kW per unit during summer peaks for smart thermostats).[64] Rebates and activation payments for storage adoption would help boost behind-the-meter storage deployment in NV Energy territory and unlock a key new source of demand flexibility on the grid.

Behind-the-meter commercial battery storage is also a small but growing market segment with demand flexibility potential. In its 2021 IRP, NV Energy projected a 634,000 MW large commercial load increase from January 2022 to December 2024; this may be an underestimate given more recent national load forecast trends.[65] Manufacturing, data centers, and other commercial facilities are increasingly adding solar and behind-the-meter storage to manage demand charges and meet sustainability goals. Industrial/manufacturing facilities in particular are a major new source of load growth in Nevada, and the impact of these new loads on the grid can be modulated if NV Energy establishes VPPs that tap into their behind-the-meter battery storage for load shifting.[66] Providing commercial and industrial customers with opportunities to bring in revenue from load flexibility can help ensure smooth grid operations as load grows in Nevada.

Residential electric vehicle charging

Electric vehicle charging is another important DER that can be harnessed as part of a VPP. Vehicle electrification is a quick-growing source of new demand on the grid. Over 12,000 new plug-in electric vehicles were sold in Nevada in 2022 and 17,000 were sold in 2023.[67] The corresponding buildout of EV chargers can lower distribution voltages and increase peak demand if not managed proactively. As Nevadans adopt EVs for the first time, the point of purchase is a key opportunity to ensure drivers opt into VPP enrollment – normalizing VPP participation as part of responsible EV ownership.

Load shifting can go a long way towards ensuring the transition to EVs is minimally disruptive and drives cost efficiencies on the grid. An analysis of data from 5,000 Southern California Edison customers found that once EVs rise to 10% of total vehicles, residential peak loads can be effectively balanced by time-shifting overnight EV charging.[68] The transmission and

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[64] Brattle, *California's Virtual Power Plant Potential: How Five Consumer Technologies Could Improve the State's Energy Affordability* (Apr. 2024), available at: https://www.brattle.com/wp-content/uploads/2024/04/Californias-Virtual-Power-Potential-How-Five-Consumer-Technologies-Could-Improve-the-States-Energy-Affordability.pdf.
[65] NV Energy 2021 Integrated Resource Plan, Vol. 5 at page 14, available at: https://www.nvenergy.com/publish/content/dam/nvenergy/brochures_arch/about-nvenergy/rates-regulatory/recent-regulatory-filings/nve/irp/2021-irp-filings/NVE-21-06-IRP-VOL5.pdf.
[66] School of Computing and Augmented Intelligence, Arizona State University. *An Energy Storage Dispatch Optimization for Demand-Side Management in Industrial Facilities.* 2022. Available at: https://www.osti.gov/servlets/purl/1977118.
[67] Las Vegas Sun, *As electric vehicles help improve Nevada's air quality, major hurdles still remain* (Dec. 2023) Available at: https://lasvegassun.com/news/2023/dec/04/as-electric-vehicles-help-improve-nevadas-air-qual/.
[68] Department of Energy. *Pathways to Commercial Liftoff: Virtual Power Plants* (Sept. 2023) Available at: https://liftoff.energy.gov/vpp/.

distribution cost deferral benefits are also potentially significant: A study of New York state found that managed charging (with load shifting) would save over $20 billion dollars in grid infrastructure upgrades versus the counterfactual. Importantly, EV batteries are the only DER that can be brought into Nevada from out of state. With a typical annual tourist population of approximately 40 million, many of whom travel by car, managing demand from an influx of electric cars could be especially important to protect Nevada's grid.[69]

Commercial electric vehicle charging

Commercial light-duty delivery and rideshare fleets, as well as heavy-duty vehicles such as trucks and buses, are electrifying. Uber and Lyft have set goals to make their fleets all electric by 2030, a goal that applies to many of the more than 40,000 rideshare drivers on the road in Nevada.[70] Bus and truck electrification is set to accelerate significantly in late 2020s and early 2030s as fleet operators adopt sustainability goals, new heavy-duty electric vehicle models are introduced, and lithium-ion battery prices decline. Nevada recently introduced an electric truck incentive which is expected to accelerate deployment.[71] And, although trucks from out of state are not included in the Advanced Energy United analysis, truck traffic from California will bring additional charging load – and VPP opportunity – as California now requires 100% electric truck sales by 2035.

Charging loads from commercial vehicles varies widely based on vehicle purpose and driving schedule. As with residential EVs, commercial vehicles can become a dependable VPP resource in the aggregate. Many fleets of electric vehicles, buses, and trucks are at rest and charging for long periods of time, with some trucks spending16 hours per day at their depots,[72] providing ample time for load shifting.

Water heaters

Today, approximately one in three Nevada households use electric water heaters for heat,[73] most of which are electric resistance water heaters. Recently, more efficient heat pump water heaters have emerged as a subset of the electric water heater market (and are currently being incentivized by NV Energy). A few utilities around the U.S. already tap water heaters as a

[69] Out-of-state traffic is not included in Advanced Energy United estimates of flexible capacity from EVs in Nevada.
[70] Las Vegas Review-Journal, *Uber, Lyft shortages frustrating Las Vegas visitors* (Apr. 2021), Available at: "https://www.reviewjournal.com/news/news-columns/road-warrior/uber-lyft-shortages-frustrating-las-vegas-visitors-2322130/"https://www.reviewjournal.com/news/news-columns/road-warrior/uber-lyft-shortages-frustrating-las-vegas-visitors-2322130/.
[71] Electrek, *Nevada introduces great state incentives for electric trucks and buses* (Jun. 2023), Available at: "https://electrek.co/2023/06/19/nevada-electric-trucks-buses/"https://electrek.co/2023/06/19/nevada-electric-trucks-buses/.
[72] RMI, *RMI Analysis: With Smart Policy, Truck Electrification Is Within Reach* (Nov. 2023) Available at: https://rmi.org/rmi-analysis-with-smart-policy-truck-electrification-is-within-reach/.
[73] U.S. Energy Information Administration, *Nevada State Energy Profile.* Available at: "https://www.eia.gov/state/print.php?sid=NV"https://www.eia.gov/state/print.php?sid=NV.

source of flexible demand, and in recent years there has been an uptick in pilots and programs that leverage water heaters for flexible demand.[74]

Traditional electric resistance water heaters can store hot water for hours, making these devices highly flexible.[75] New heat pump water heater models can also be tapped for demand response, although they tend to be less flexible loads because of their efficiency and design.[76] Like the rest of the United States,[77] Nevada is likely to see its share of both electric resistance water heaters and heat pumps rise in the coming years as customers gradually move away from gas heating. Although many existing water heaters in Nevada today are not equipped with grid-interactive controls, water heaters need to be replaced roughly even 10 years.[78] These new installations are an opportunity to build up the load flexibility potential from water heaters in Nevada. To ensure new installs are grid-interactive, NV Energy could require that all new water heaters incentivized by the utility are grid-interactive and make VPP enrollment a prerequisite for incentives. The utility could also incentivize heating electrification with smart water heater installations for gas customers and reward customers with VPP participation payments.

Leveling up VPP ambition

So far, this analysis has focused on demand-shaping VPPs, which leverage devices that store or save electricity produced behind the meter. However, future regulatory change in Nevada could unlock the ability to also pursue exporting VPPs, wherein battery storage systems and EVs are permitted to export energy back into the grid instead of simply modulating demand. Batteries (stationary and EV) can provide significantly more value to the grid if they are allowed to export.

This type of VPP exists in other states. One example of an exporting VPP is the Demand Side Grid Support Program, wherein Californians with solar and battery storage are paid to export

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[74] Canary Media, *Home Water Heaters: a New Ally in Making Grids Cleaner* (Apr. 11, 2022) https://www.canarymedia.com/articles/grid-edge/home-water-heaters-a-new-ally-in-making-grids-cleaner.

[75] American Council for an Energy-Efficient Economy, *Demand Flexibility of Water Heaters* (Aug. 2023) Available at: "https://www.aceee.org/sites/default/files/pdfs/demand_flexibility_of_water_heaters_-_encrypt.pdf"https://www.aceee.org/sites/default/files/pdfs/demand_flexibility_of_water_heaters_-_encrypt.pdf.

[76] Greentech Media, *Heat Pump Water Heaters Can be Demand Response Assets* (Jun. 2019) Available at: https://www.greentechmedia.com/articles/read/energyhub-shows-that-heat-pump-water-heaters-can-be-demand-response-assets.

[77] CleanTechnica, *The US Saw Record Percentages Of Heat Pump & Electric Water Heater Sales In 2023.* Available at: "https://cleantechnica.com/2024/03/04/the-us-saw-record-percentages-of-heat-pump-electric-water-heater-sales-in-2023/"https://cleantechnica.com/2024/03/04/the-us-saw-record-percentages-of-heat-pump-electric-water-heater-sales-in-2023/.

[78] EnergyStar.gov. *When Should You Replace Your Water Heater?* Available at: https://www.energystar.gov/products/ask-the-experts/when-should-you-replace-your-water-heater.

power at key times to the grid,[79] going beyond what a demand-shaping VPP can achieve. Similarly, the batteries enrolled in National Grid's ConnectedSolutions VPP would 'leave most of their value on the table' if a regulation had not been passed to allow export.[80] A VPP program that enrolls batteries today for demand flexibility could later unlock significant additional capacity from those very same batteries if Nevada regulations evolve in the future. The sooner the better: analysis on ISO-NE found New England could have saved $1 billion in costs if it had dispatched DERs during the 2014-2019 period, rather than just leveraging them for demand-shaping.[81]

Another example of an exporting VPP would be one that leverages electric vehicle-to-grid applications, rather than simply managed charging. Like home battery storage systems, electric vehicles equipped with bidirectional charging are technically capable of discharging power to the grid. Importantly, EV batteries tend to have significantly higher capacities than stationary home battery storage, meaning that tapping EV batteries for export would unlock significant capacity. Automobile manufacturers are involved in several early bidirectional charging pilots and are proving to be willing partners as utilities explore how to manage and leverage the coming wave of electric vehicles.

[79] California Energy Commission. *Demand Side Grid Support Program.* https://www.energy.ca.gov/programs-and-topics/programs/demand-side-grid-support-program.
[80] Leap, *DERs in the limelight at winter regulatory conferences* (Mar. 2024) Available at: https://www.leap.energy/blog/ders-in-the-limelight-at-winter-regulatory-conferences.
[81] *Id.*

Part Five: A Nevadan approach to VPP structure, software, and partnerships

Recommendations for VPP structure in Nevada

DER capacity needs to be proactively harnessed if it is to serve the grid effectively. NV Energy must take care ensure that customer engagement is sophisticated enough to attract and retain customers, and that VPP programs are future-proofed to handle the complexity of multi-technology, multi-grid service applications in the years to come. Partnering with third parties for execution, and/or allowing customers to join VPPs using a “bring-your-own-device" approach to participation, would allow Nevada to leverage both private sector resources and internal utility grid expertise to strengthen VPP operations.

Recommendation 1: A flexible business model

NV Energy VPP programs and proposals have not yet fully leveraged the customer engagement and DER optimization abilities of the growing DER industry. The NV Energy PowerShift program, as well as the proposed DER Trial program in NV Energy’s 2021 IRP, both position NV Energy to take the lead on customer acquisition, providing customers with equipment in exchange for incentives and engaging with them on energy use. A challenge with this utility-led approach is that the utility may have limited internal capacity and experience with this type of customer engagement, which could cause VPPs to grow and evolve more slowly and correspond to lower participation by customers. Additionally, in taking all responsibility for customer acquisition around the PowerShift program, NV Energy has left itself open to scrutiny around customer acquisition spending.[82]

Many of the successful VPPs that exist outside of Nevada rely on third parties to sell and/or manage aggregated DERs. These third parties can work in collaboration with utilities to ensure DERs deliver benefits to the grid. Private sector partners can bring valuable expertise and resources to the table, drawing on customer engagement expertise, experience in other markets (including data and software to optimize the behavior of DERs to deliver grid benefits), and integrations with other DER technology providers. These third-party providers can reduce implementation costs in Nevada by bringing in insights from VPPs in other jurisdictions. In one example, PGE’s Smart Battery Program is run in partnership with Virtual Peaker, a DER aggregator that works to integrate new battery models into the program[83] while leveraging the

[82] Las Vegas Review-Journal, *NV Energy should be more transparent on sponsorships, agency says* (Sept. 2023). Available at: https://www.reviewjournal.com/business/energy/nv-energy-should-be-more-transparent-on-sponsorships-agency-says-2903823/.

[83] Eguana, *Eguana Technologies Joins Portland General Electric’s VPP program* (Aug. 2023), Available at: https://www.globenewswire.com/en/news-release/2023/08/17/2727277/0/en/Eguana-Technologies-Joins-Portland-General-Electric-s-VPP-program.html

utility brand and enabling the utility to dispatch all DERs in the program to meet system needs.[84] This could be described as a best-of-both-worlds VPP structure in which multiple DER companies are incentivized to serve customers in the Nevada market, an experienced national DER aggregator leverages its expertise to operate the program cost-effectively, and the utility reaps the benefits of a growing controllable DER install base.

NV Energy has expressed recognition of the grid value of flexible demand in regulatory proceedings to justify expenditure on DERMS and other investments, stating: "Demand response ("DR") resources reduce peak demand, peak energy supply costs, potentially delays higher cost transmission and distribution infrastructure and provide significant economic value in the form of a physical hedge against high peak energy prices and energy emergency situations."[85] Given the value of DERs to the grid, it is vital to structure VPPs such that resources are managed efficiently, multiple DER providers are included, and new technology types are embraced as they come onto the grid.

Recommendation 2: A technology-flexible approach

NV Energy's VPP will need to grow over time to manage an increasing share of NV Energy's system peaks. In general, the more DER providers and technology partners that are welcome to participate, the more controllable capacity NV Energy will have access to. All of the technologies discussed in this paper – smart thermostats, solar and storage, vehicle charging, and smart water heating – have an important role to play in the future reliability and affordability of Nevada's grid, as they shape load differently and can be aggregated together to reduce peaks and defer transmission and distribution investment.

VPPs can ensure DERs are compatible with one another and are able to perform to utility standards by enforcing criteria that participating devices manufacturers must meet, as seen in Utah's Wattsmart program[86] and others. VPP participants can also explore standardized open communications protocols to ensure devices from different providers work well in concert with one another.

NV Energy customers will be best served if in both its VPP program design, NV Energy keeps the door open to third-party aggregators, DER providers, and multiple DER types. Oracle's DERMS "offers important capabilities that allow utility customers, aggregators and

[84] Brattle Group, *Real Reliability The Value of Virtual Power* - NARUC/NASEO Presentation (Jun. 2023) Available at: https://pubs.naruc.org/pub/20E2F9EB-9659-205E-1E81-8E40B370EACF
[85] Docket Nos 23-06007, 23-06008, testimony of Youssef AlSafi.
[86] Utility Dive, "*Tackling 3 key issues can help scale virtual power plants and spur a wave of benefits, analysts say*" (Apr. 2024) Available at: https://www.utilitydive.com/news/virtual-power-plants-vpp-der-distributed-energy-resources-derms/713282/

independent producers to enroll DER resources in demand response and reliability service."[87] By leveraging this DERMS platform to its full potential, NV Energy should be able to scale its VPP efforts to include all DER types on the grid.

Recommendation 3: Compensate customers adequately for participation

There are a range of possible approaches to customer compensation in the VPP space, but best practices are quickly becoming apparent. It is essential that customers are compensated in a predictable, meaningful fashion for VPP participation and that the level of compensation drives ongoing enrollment in the VPP. This can help prevent participant turnover,[88] ensuring DER capacity is available to serve the grid in the long term. Compensation should align somewhat with distribution system value and potentially increase over time as VPPs evolve to offer more system services.[89]

Customers increasingly adopt DERs of their own volition: solar and storage for electric bill management and backup power, EVs for an improved driving experience, and smart thermostats and water heaters for comfort in the home. Adequate compensation for customer participation through utility VPP programs helps offset the cost of DERs, making these devices more affordable for customers who want to invest in them.

Finally, Nevada's VPP potential can be enhanced by regulation and with policy that make DERs more cost-effective for customers. Regulators can advance rate design evolution that encourages DER adoption. State legislators can pass rebates for DER adoption, targets for storage and electric vehicles, and other policies that encourage the growth of the DER install base. Together, these strategies would increase the flexible demand resource potential on Nevada's grid.

Recommendation 4: Robust cost-benefit analysis

Customer benefits should correspond appropriately with utility investments. Cost-benefit analysis that is not detailed enough or that undervalues VPPs can lead to the exclusion of VPPs from utility resource plans. A lack of robust cost-benefit analysis was specifically highlighted by PUCN in its rejection of NV Energy's DER Trial in 2021.[90] Fortunately, there has been significant progress around cost-benefit analysis for DERs and VPPs since 2021.

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[87] Oracle, *Oracle Utility DERMS Solution.* Available at: https://www.oracle.com/a/ocom/docs/industries/utilities/oracle-utility-derms-solution.pdf

[88] Department of Energy, *Pathways to Commercial Liftoff: VPPs* (Sept. 2023) Available at: https://liftoff.energy.gov/wp-content/uploads/2023/10/LIFTOFF_DOE_VVP_10062023_v4.pdf

[89] Utility Dive, "*Tackling 3 key issues can help scale virtual power plants and spur a wave of benefits, analysts say*" (Apr. 2024) Available at: https://www.utilitydive.com/news/virtual-power-plants-vpp-der-distributed-energy-resources-derms/713282/

[90] Docket 21-06001, Corrected Modified Final Order at pages 160-178 (Filed March 8, 2022).

The costs and revenue drivers typically associated with a VPP are captured in the table below.[91] NV Energy should assess the likely value associated with each of these costs and revenue drivers in its VPP proposals.

VPP Costs	VPP Revenue	Additional VPP Benefits
Project implementation and administration costs: DER management system (DERMS) and associated IT and personnel costs; ongoing administrative costs. **Participant acquisition costs:** Marketing, consumer education, recruitment; potential DER subsidies; potential DER software integration fees paid to DER manufacturers. **Participant incentives:** One-time, periodic, or per-kWh payments to participants.	**Energy:** Payment per MWh delivered (e.g., avoided, shifted, exported), measured using contractually agreed-upon measurement and verification protocols that vary by DER type. **Capacity:** Payment per MW of energy option procured. (Capacity product specifications vary by market and/or off-taker.) **Ancillary services:** Payment for services such as frequency regulation, ramping, etc. **Avoided costs:** Payment proportional to avoided costs such as deferred infrastructure upgrades	**Resilience** **Greenhouse gas emissions reduction and climate benefits** **Improved air quality** **Reduced T&D congestion** **Socioeconomic benefits for communities**

Source: U.S. Department of Energy (Virtual Power Plants - Pathways to Commercial Liftoff)

Importantly, it is a best practice in DER cost-benefit analysis to estimate all benefits of DERs, even benefits beyond cost and revenue that may be more difficult to quantify[92] (such as those listed in the third column above). One 2023 study comparing VPPs to other resource adequacy

[91] US Department of Energy, *Pathways to Commercial Liftoff: Virtual Power Plants* (Sept. 2023) Available at: https://liftoff.energy.gov/wp-content/uploads/2023/10/LIFTOFF_DOE_VVP_10062023_v4.pdf

[92] National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources (Aug. 2020) Available at: https://www.nationalenergyscreeningproject.org/wp-content/uploads/2020/08/NSPM-Summary_08-24-2020.pdf.

options found that when all benefits are considered, VPPs can provide resource adequacy at net negative cost.[93]

[93] Brattle Group, *Real Reliability: The Value of Virtual Power (Technical Appendix)* (May 2023) Available at: https://www.brattle.com/wp-content/uploads/2023/04/Real-Reliability-The-Value-of-Virtual-Power-Technical-Appendix.pdf.

Conclusion: The Future for Nevada

Nevada faces load growth, extreme weather, and changes to its generation mix. To ensure reliability and efficiency in the face of these challenges, Nevada is well-positioned to embrace VPPs and DERs as a source of low-cost flexible capacity. As the analysis in this paper shows, there is ample flexible capacity on the grid today in Nevada, and the resource of customer-sited DERs will continue to grow as customers voluntarily adopt solar, storage, EVs, smart thermostats, and smart water heaters. Nevada utilities can expand VPPs to leverage the flexibility these resources offer to the grid, while making DER technologies more accessible to customers.

VPPs present an opportunity for Nevada to meet peak demand while keeping ratepayer costs low and achieving the State's energy goals. Utilities in Nevada can incorporate these technologies into resource planning through distributed resource planning. Ideally, the utility will develop an ambitious VPP that incorporates multiple DERs to maximize the benefits of these technologies, which impact load in different ways. Alternatively, the Public Utility Commission of Nevada (PUCN) can direct the utility to develop a VPP program during the integrated resource planning process. If neither the utility nor the PUCN acts on the opportunity to integrate VPPs into resource planning, the legislature can require the utility or the PUCN to act on a program and even determine parameters for a program if they wish. Other jurisdictions have seen success with implementing VPP programs into utility resource planning, and Nevada can draw on these examples while forging its own path.

Best practices Nevada can leverage in its VPP program development include:

- Develop integrated, multi-technology VPPs to maximize benefits to the grid
- Offer robust participation payments for VPP participants to encourage enrollment and benefit ratepayers
- Create opportunities for third-party VPP and DER technology providers in order to reduce VPP implementation costs
- Ensure that a comprehensive cost-benefit analysis that includes VPP costs, benefits, and revenue accompanies proposals that come before regulators
- Solicit input from stakeholders, ratepayers, and industry experts to create the best possible VPP program for the grid and customers

By incorporating these best practices into planning for its VPP programs, Nevada will be able to fully leverage DERs to benefit its grid.

Appendix: Estimating Nevada's VPP Potential

Virtual power plant (VPP) market potential can be defined as "cost-effective VPP capacity that can be developed at achievable, voluntary participation rates" by a certain year.[94] For the purposes of this analysis, Advanced Energy United sought to estimate Nevada VPP market potential each year for the period between 2024-2035.

Although under a broad definition, VPPs can include traditional commercial demand response, the VPP market potential analysis in this report is based on only the following DERs: Smart thermostats, behind-the-meter battery storage (residential and commercial), managed residential EV charging, and managed commercial/public EV charging (light and heavy duty). Furthermore, Advanced Energy United's Market Potential forecast is based on expected peak load impact from VPPs, based on assumptions around participation rates and kW impact during peak load windows.

Nevada VPP market potential for each year is captured in the table below. VPP market potential in 2024 is 134 MW. In simplified terms, this capacity can be thought of as a 134 MW power plant that is ready to be brought online today. Each year, the capacity of this unused power plant grows, reaching 1,230 MW by 2035. Each year that this capacity from DERs is not harnessed as flexible demand in a VPP represents an opportunity cost for Nevada.

Advanced Energy United analysis estimated the following VPP market potential for Nevada:

Estimated NV Energy Virtual Power Plant Market Potential (Cumulative)*

Year	'24	'25	'26	'27	'28	'29	'30	'31	'32	'33	'34	'35
NV Energy VPP Market Potential (MWs)	134	167	225	305	416	552	658	750	858	981	1,108	1,230

**Traditional commercial demand response excluded*

[94] Power Grid International, *California's virtual power plant potential is high, new report says* (Apr. 2024) Available at: https://www.power-grid.com/der-grid-edge/californias-virtual-power-plant-potential-is-high-new-report-says/#gref

What goes into the Advanced Energy United 'NV Energy VPP Market Potential' analysis?

To arrive at the estimates above, Advanced Energy United took the following steps:

- Estimated existing deployment (in units) for the following DERs in 2024: Smart thermostats, behind-the-meter battery storage (residential and commercial), managed residential EV charging, and managed commercial and public EV charging (light and heavy duty). (Lack of official public data on DER deployment on the Nevada means that estimates deployment are drawn from a combination of available data sources and/or extrapolated from national trends.)

- Estimated likely growth rates for each DER type over the course of the 2024-2035 period. (This part of the analysis draws on external industry forecasts where possible, public data sources and/or extrapolates from national trends.)

- Multiplied the forecasted units of each DER by per participant peak impact (measured in kilowatts). Per participant peak impact for smart thermostats, smart water heaters, residential managed EV charging, and BTM battery storage DR were drawn from the recent Brattle Group report 'Real Reliability: The Value of Virtual Power.'[95] Other peak impact values for this study were estimated by Advanced Energy United.

- Divided expected capacity for each DER type by expected participation, with the understanding that not all customers with DERs can be expected to participate in a VPP. Expected participation for smart thermostats, smart water heaters, residential managed EV charging, and BTM battery storage DR were drawn from the recent Brattle Group report 'Real Reliability: The Value of Virtual Power.'[96] Other expected participation values for this study were estimated by Advanced Energy United. Participation rates in a real-world VPP could feasibly rise higher than those predicated here based on participant incentives and sophisticated customer acquisition and retention efforts.

- A variety of market conditions impact DER deployment, including pricing, policy, supply chains, strategy of DER companies, and more.

[95] Further details on how Brattle Group arrived at their per participant peak impact and expected participation values can be found in the Technical Appendix of that report:. Available at: https://www.brattle.com/wp-content/uploads/2023/04/Real-Reliability-The-Value-of-Virtual-Power-Technical-Appendix.pdf.
[96] *Id.*