Distributed Energy Resources: Case Studies

November 2022

Acknowledgements

AEMA thanks member companies for contributions to this report and the Board of Directors for its leadership. Katherine Hamilton, Executive Director of AEMA, provided content and editing.

About Advanced Energy Management Alliance

AEMA is a trade association under section 501(c)(6) of the Federal tax code whose members include national distributed energy resource companies and advanced energy management service and technology providers, including DR providers, as well as some of the nation's largest demand response and distributed energy resources. This report represents the collective consensus of AEMA as an organization, although it does not necessarily represent the individual positions of the full diversity of AEMA member companies.

For more information about AEMA, please visit our website: https://aem-alliance.org or contact Katherine Hamilton at katherine@aem-alliance.org or 202-524-8832.

Introduction

Distributed Energy Resources (DERs) include a variety of technologies and applications—rooftop and community solar, energy storage, microgrids, energy efficiency, demand response, electric vehicles, and smart thermostats. Advanced Energy Management Alliance ("AEMA") focuses on those technologies and applications that are installed behind a customer's meter. DERs have proven to lower system costs, reduce energy bills for customers with DERs, strengthen reliability and resilience, and cut emissions.

Demystifying DERs

In the course of our advocacy throughout North America, AEMA and its members have found that often utility regulators are less familiar with DER technologies and applications and are thus hesitant to promote policies and programs that incentivize customers to adopt DERs. In this paper, we provide a few case studies that describe DER deployments, their impacts, and how regulators can replicate those that would be a good fit for their own states and regions.

Our hope is that regulators—and the utilities they regulate—will begin to not only see DERs as beneficial, but to also include DER policies and programs holistically in their planning and implementation strategies. AEMA members—DER implementers and their customers—believe that increasing DERs will be a win-win-win for customers, utilities, and their communities.

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DER Case Study: Arizona Public Service Virtual Power Plant

Program names: Cool Rewards, Battery Pilot, Solar Communities

OVERVIEW

Arizona Public Service (APS) uses EnergyHub's DERMS and turnkey program services to manage a virtual power plant consisting of connected thermostats, residential batteries, and solar PV inverters. APS has launched a number of programs to help proactively manage their load curve in different ways. The Cool Rewards program targets thermostats to reduce consumption on peak load days - driven by high temperatures and HVAC load. The main driver for the Reserve and Storage Rewards programs was the need for recurring load shifting - specifically, minimizing local evening peaks while absorbing midday renewables production - leveraging energy storage and grid-interactive water heaters. The Solar Communities program will allow APS to conduct targeted management of solar in response to excess production and negative LMPs along with access to inverter settings for operational support. APS has implemented these DER programs with different deployment models, including bring-your-own (BYO) with nine thermostat brands, as well as direct install programs with grid-interactive water heaters from Rheem, residential energy storage from Sunverge, and smart solar inverters from SMA America. EnergyHub'sMercury DERMS platform has transformed these customer-constrained assets into bankable resources for APS.

USE CASE

- System-wide peak demand reduction, load shifting, renewables matching, voltage support/network management
    - Thermostats: Pre-cool, temperature offset
    - Residential batteries: Export excess capacity to the grid during peak hours
    - Water heaters/residential batteries: Daily load shifting
    - Solar inverters: Active power curtailment; seasonal inverter configuration for autonomous grid services (volt/var, frequency/watt)
- Local reliability through targeted dispatch during contingencies
- Meet CAISO Western Energy Imbalance Market (WEIM) sufficiency tests by using the residential DR portfolio to reduce the load forecast for the APS Balancing Authority Area (BAA). Eventually APS will register the DR resource as a Participating Resource in the EIM to further monetize the program in day-ahead and real-time markets

BENEFITS

APS: Emergency reliability; reduce hedges/EIM market purchases during periods of high volatility; reduce the use of costlier, dirtier, thermal capacity to meet resource adequacy requirements

Consumer: Up front enrollment incentives, ongoing participation incentives, optimized energy use in concert with a TOU or demand charge/TOU rate

Environment: Carbon emissions reduction via reduced need for thermal generation to meet supply needs

RESULTS

MW capability in 2022: 101 MW
MWh reduced during peak hours in 2022: 1200 MWh

PUBLICLY AVAILABLE REPORTS/PRESS

https://info.energyhub.com/blog/arizona-public-service-der-case-study
https://info.energyhub.com/blog/aps-100k-goal

REGULATORY ACTION

Ensure that utilities are incentivized to run cost-effective DR programs that span multiple device classes (EVs, thermostats, batteries), and use cases (peak reduction, T&D upgrade deferral, energy arbitrage, ancillary services). Potential studies illustrate that there are tremendous volumes of DR/DER resources in the field that customers have purchased and installed themselves – regulators can help utilities design programs that harness that latent value for the benefit of the grid, customers, and the environment.

DER Case Study: Eversource (CT, MA, NH) Demand Response

Program name: ConnectedSolutions

OVERVIEW

EnergyHub provides its DERMS and turnkey program services to manage Eversource's residential demand response portfolio. Virtual power plant includes EV chargers, HVAC/connected thermostats, and residential electric storage.

USE CASE

- System-wide peak demand reduction to reduce ISO-NE capacity obligations
  - Thermostats: Pre-cool, temperature offset
  - EV chargers: Curtail charging consumption down to Level 1 (1.8 kW) or full curtailment to 0 kW
  - Residential batteries: Export excess capacity to the grid during peak hours
- Local reliability through targeted dispatch during contingencies
- MA Clean Peak Standard program participation, minting and trading Clean Peak Credits

BENEFITS

Eversource: Avoided cost of generation capacity from frequent dispatch over the summer. Up to 15 events run each year for thermostats and EVSE, up to 60 events for batteries

Consumer: Up front enrollment incentives, ongoing participation incentives

Environment: Carbon emissions reduction via reducing the capacity required to serve the load in the Eversource territory

RESULTS

2019 Guidehouse ConnectedSolutions battery program evaluation:
https://fileservice.eea.comacloud.net/FileService.Api/file/FileRoom/12189610

PUBLICLY AVAILABLE REPORTS/PRESS

Eversource: https://www.utilitydive.com/news/northeastern-utilities-aim-to-crush-and-flatten-system-peaks-as-ders-boos/562944/
National Grid: https://info.energyhub.com/blog/national-grid-commercial-industrial

REGULATORY ACTION

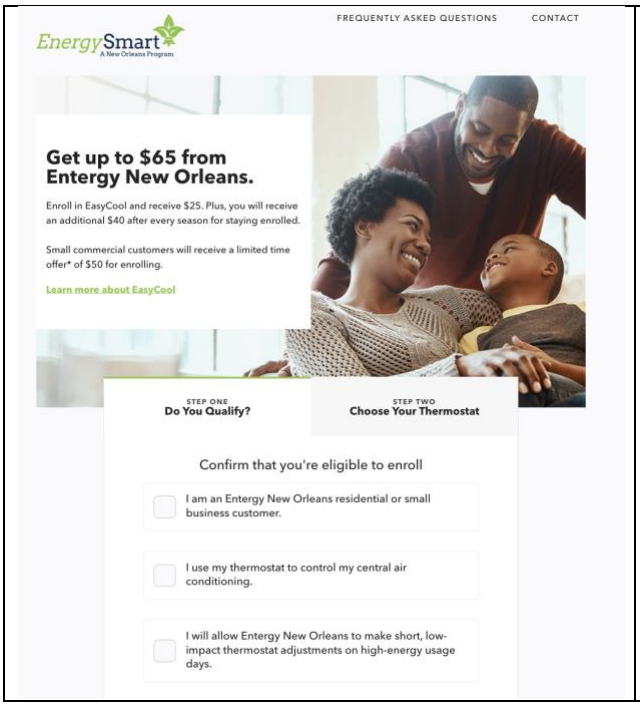
Ensure that utilities are incentivized to run cost-effective DR programs that span multiple device classes (EVs, thermostats, batteries), and use cases (peak reduction, T&D upgrade deferral, energy arbitrage, ancillary services). Potential studies illustrate that there are tremendous volumes of DR/DER resources in the field that customers have purchased and installed themselves – regulators can help utilities design programs that harness that latent value for the benefit of the grid, customers, and the environment.

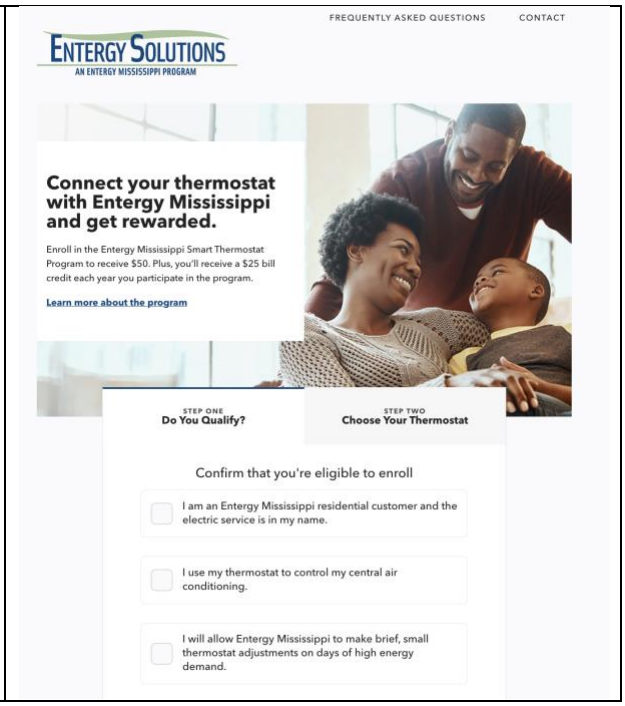
DER Case Study: Entergy (New Orleans and MS) Demand Response

Program name: Energy Smart BYOT

OVERVIEW

EnergyHub provides its DERMS and turnkey program services to manage Entergy's thermostat demand response portfolio. Entergy New Orleans runs residential and small business Bring Your Own Thermostat (BYOT) programs, while Entergy Mississippi runs both a residential BYOT program and income-qualifying direct install (IQDI) program.





USE CASE

- Meet City Council or statewide MWh/MW savings targets as set forth in the Triennial Integrated Resource Plan (IRP) and stakeholder process
- Reduce load in response to MISO-initiated contingency events (e.g., Winter Storm Uri)
- Engage hard-to-reach customers; enable new channels for customer engagement in conservation programs, resulting in additional bill savings

BENEFITS

Entergy: Local emergency reliability; customer engagement; reduce Zonal Resource Credit (ZRC) obligations in each Planning Resource Auction (PRA) by registering DR programs as a Load Modifying Resource (LMR), DRR Type I, or DRR Type II resource

Consumer: Up front enrollment incentives, ongoing participation incentives; participation in grid services to support the community

Environment: Carbon emissions reduction via reducing the capacity required to serve the load in a given LSE territory (ENO, EML)

RESULTS

2021 Entergy New Orleans Energy Smart Portfolio Evaluation: https://cdn.entergy-neworleans.com/userfiles/content/energy_smart/Program_Year_11/PY11-ENO-Energy-Smart-Portfolio-EMV-Report.pdf

PUBLICLY AVAILABLE REPORTS/PRESS

https://www.energysmartnola.info/easy-cool-program/
https://enrollmythermostat.com/entergy-mississippi/

REGULATORY ACTION

Ensure that utilities are incentivized to run cost-effective DR programs that span multiple device classes (EVs, thermostats, batteries), and use cases (peak reduction, T&D upgrade deferral, energy arbitrage, ancillary services). Potential studies illustrate that there are tremendous volumes of DR/DER resources in the field that customers have purchased and installed themselves – regulators can help utilities design programs that harness that latent value for the benefit of the grid, customers, and the environment.

Customers continue to purchase and install connected devices as costs decrease and MWh/MW savings targets should continue to scale upward to align with the growth of the DER market and take full advantage of the value that aggregations of DER can provide. Utilities should be encouraged to exploit the full value stack as well, leveraging DR programs not just for peak reduction, but for daily load shifting (T&D deferral), and meeting reserves obligations (non-spin, spinning reserves).

DER Case Study: Residential Thermostat Demand Response (California)

Program Name: Rush Hour Rewards

OVERVIEW

Google Nest has partnered with utilities, retailers, and third-party aggregators in California to enroll customers in demand response programs through Bring-Your-Own-Thermostat campaigns and at point of sale on utility marketplaces. This program included nine demand response programs throughout California. Three utility "Rush Hour Rewards" programs (Southern California Edison, San Diego Electric & Gas and PG&E), three Muni programs (LADWP, Glendale Water and Power and SMUD), two wholesale / open market programs (Leap and OhmConnect) and one CCA (Clean Power Alliance).

USE CASE

Nest thermostats are equipped with sensors, Wi-Fi capability, and smart-phone grade processing. These thermostats reduce peak demand by allowing customers to easily enroll in demand response programs, and then make adjustments to the temperature setpoint during an event. Customers have the ability to opt-out of events or override setpoint changes.

BENEFITS

Google Nest thermostats can learn occupant preferences, turn the temperature down when the house is empty, and automatically lower air conditioning ("A/C") runtime when humidity conditions permit, thereby helping people lower their energy use without sacrificing comfort. Google Nest thermostats also contribute to reducing peak demand by allowing residential customers to participate in demand response programs run by utilities or third-party aggregators. In addition, the thermostats can help customers adapt to time-of-use ("TOU") rates and prioritize power consumption during low-emissions times on the grid through the new Nest Renew offering.

RESULTS

Although Nest thermostats are used in demand response year-round, the importance of them was highlighted during the grid emergency conditions in California this Summer. During this time CAISO issues a range of Emergency notifications to customers on the three peak days where rolling blackouts were triggered (Flex Alert on 9/6, Energy Emergency Alert 3 on 9/7, Energy Emergency Alert 2 on 9/8). Nest's California partners ran 48 RHR events from 9/1 - 9/8. All 9 programs called events during this time, with 8 events on both 9/6 and 9/7.

Google estimates that on 9/6 and 9/7, Nest thermostats reduced peak load by about 75 MW each day in California.

REGULATORY ACTION

1. Develop rewarding programs that maximize participation of residential demand-side resources by ensuring funding for energy efficiency programs, expanding residential demand response programs, ensuring that customers share in the value, and streamlining customer participation.
2. Match residential incentives, programs, and rates with decarbonization objectives and household benefits by aligning the methodologies for cost-effectiveness tests with grid and carbon benefits, expanding dynamic rates, and properly valuing the entire stack of services residential households which DERs can provide.
3. Empower customers to access and share their energy data through standardized sharing processes that are minimally burdensome to customers and their chosen energy management providers and the provision of real-time pricing and emissions data accessible to customers and authorized solution providers.

DER Case Study: Demand Response in PJM (Columbus, OH)

OVERVIEW

Commercial and Industrial (C&I) customers with load curtailment capabilities.

USE CASE

The DER in this case is curtailing load.

BENEFITS

On June 14, 15 and 16 (2022), PJM, the regional transmission organization for a variety of states in the mid-Atlantic and Midwest, declared a series of emergency actions in the AEP-Marion subregion, which is in and around Columbus, Ohio.

Temperatures in the Columbus area reached 95 degrees on June 14 and 15, conditions that typically put stress on the grid. The emergency began when thunderstorms knocked out multiple 136-kV transmission lines near Columbus, and then high temperatures (and the accompanying high loads from cooling demand) caused issues with power flows.

Ultimately, PJM instructed AEP to shed load through limited-service interruptions, to prevent other transmission lines overloading and causing a cascading issue

This incident highlights the value of DERs as we see more extreme weather, as extreme weather can lead to downed transmission lines, and in populated areas that lack significant generation capacity, DERs can help keep the lights on.

RESULTS

At the Ohio Public Utility regulatory hearing in July 13 on Demand Response, Michael Bryson Sr. VP – Operations (PJM Interconnection) **testified before OH PUCO that had demand response not been utilized, PJM would have had to interrupt more customers.**

When Commissioner Friedman asked if demand response can be supplemental to consumer reduction, PJM answered that they have a service that reaches out to communities asking for demand reductions, but that, while it is a tool they can use, it is not as beneficial in a transmission emergency.

Chair French asked why demand response was only called in the Marion area and PJM responded that they drew a circle around Columbus and made it as large as possible, netting about 100 MW of demand response.

PUBLICLY AVAILABLE REPORTS/PRESS

https://www.enelx.com/n-a/en/stories/june-pjm-events-and-the-importance-of-demand-response

REGULATORY ACTION

Regulators could direct utilities to partner with DER Providers to create pay-for-performance programs that compensate DERs for the value they can provide to the grid and to consumers. Advocate with your respective ISOs to protect and improve existing DR programs where necessary and create models for new forms of DERs to participate.

DER Case Study: ERCOT Load Curtailment

OVERVIEW

This program was for commercial and industrial customers with load curtailment capabilities.

USE CASE

Curtailing load during periods of high demand.

BENEFITS

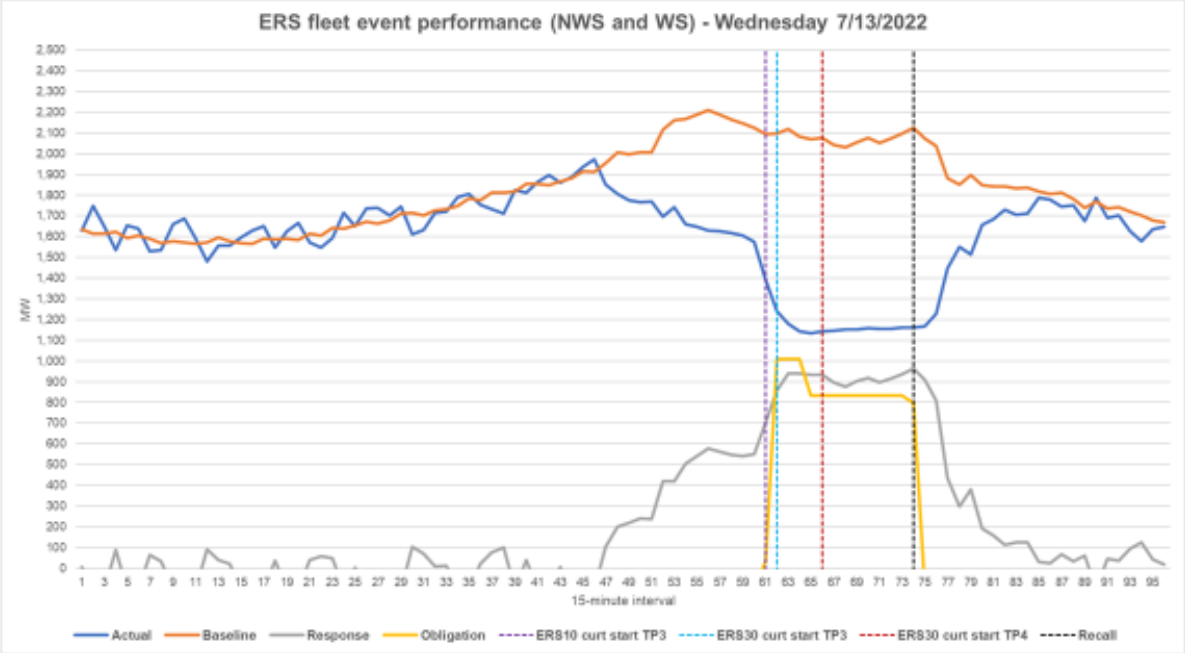
On July 13, 2022, ERCOT experienced a variety of compounding factors that led to a sustained dip in the Minimum Contingency Level (MCL) below 3,000 MW of operating reserves which triggers the deployment of Emergency Reliability Service even after a conservation appeal was sent relevant to the hours of 2-9pm CT.

The largest contributing factors were extreme hot weather causing record high electric demand and 13 GW of forced thermal outages. With recent regulatory changes, ERCOT's ERS program is among the first line of defense for the grid to prevent declaring an Energy Emergency. With extreme weather happening more frequently, DERs will become increasingly important as we can expect more correlated outages from thermal generation like we did in ERCOT and record high demand.

PUBLICLY AVAILABLE REPORTS/PRESS

DSWG Performance Report: https://www.ercot.com/files/docs/2022/09/13/DSWG%20-%20ERS%20event%20deployment%207-13-2022.pptx

ERS deployment events 7/13/2022



Note: the ERS fleet performance depicted above is a representation of the aggregate megawatts for ERS resources and does not reflect how they will be assessed for performance during each individual ERS deployment event.

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REGULATORY ACTION

To provide grid operators an important tool in the toolbox for reliability, regulators should take steps to maximize Distributed Energy Resource participation in their jurisdictions.

DER Case Study: Ameren Missouri Demand Response

Project: Commercial and Industrial (C&I) Demand Response

OVERVIEW

Enel provides Ameren Missouri, the state's largest utility with more than 1.2 million customers, over 100 MW of demand response resources from the utility's commercial and industrial (C&I) customer base.

USE CASE

Ameren partners with Enel to dispatch the demand response resource during periods of peak demand on their grid.

BENEFITS

The demand response provides reliability value to Ameren and reduces wholesale level and retail level costs. Ameren's customers receive payments for participation that benefit their bottom line while helping keep the light on in the community.

PUBLICLY AVAILABLE REPORTS/PRESS

https://www-qual.enelx.com/n-a/en/press-releases/enel-x-signs-100mw-demand-response-agreement-ameren-missouri

https://www.ameren.com/-/media/missouri-site/files/energy-efficiency/demand-response-faqs.ashx

REGULATORY ACTION

Regulators should create frameworks for maximizing cost-effective DR and DER in their jurisdictions. In Missouri, utilities are financially incented to reduce their peak demand, which helps align their incentives with positive consumer outcomes. Regulators should also encourage their utilities to partner with DR/DER Providers that have invested millions of dollars in private capital and that have significant expertise in maximizing customer flexibility.

DER Case Study: Electric School Bus Fleet Maryland

Project: Montgomery County Public Schools Electric Vehicle School Bus Fleet

OVERVIEW

Montgomery County Public Schools (MCPS) electric vehicle school bus (EVSB) fleet, the largest EVSB fleet in the country, is now providing grid services to PJM through CPower, and is the first EVSB fleet in the country to provide synchronized reserves in a wholesale market, setting an example for other similar projects of the potential for EV fleets to provide services to the grid.

Highland Electric Fleets partnered with MCPS to upgrade 326 school buses by 2025, with 25 electric buses delivered during the 2021-22 school year and charging infrastructure installed at one of its transportation depots. During the 2022-23 school year, 61 additional buses are to be delivered and charging infrastructure to be installed at three more transportation depots.

USE CASE

Through a partnership with Highland Electric Fleets, CPower enables MCPS' EVSB fleet to manage charging and participate in PJM's capacity and ancillary services markets. The fleet's reliable operating schedule allows CPower to manage when these vehicles are charging and reduce demand on the grid when called upon during capacity emergencies as well as provide spinning reserves to help grid operators maintain system balance.

BENEFITS

MCPS' EVSB fleet's participation in PJM's market helps to maintain a reliable, resilient grid while the revenues earned from market participation help reduce the overall cost of the electrification of the county's school bus fleet. Through electrification, the EVSB fleet is helping towards decarbonization goals.

RESULTS

The EVSB fleet will begin participating in PJM's market in the 2023/24 timeframe.

PUBLICLY AVAILABLE REPORTS/PRESS

Please see CPower's press release announcing this project here: https://cpowerenergymanagement.com/who-we-are/newsandhappenings/cpower-to-turn-countrys-largest-electric-school-bus-fleet-into-grid-ready-resources/

REGULATORY ACTION

Regulators should view EVSB, as well as other EV or beneficial electrification projects as opportunities to encourage and leverage these new loads to provide grid services at both the wholesale and distribution levels to help maintain a reliable, resilient grid.

PJM's market rules were recently updated to allow for EV charging assets to participate, but do not yet allow for bi-directional EV charging assets to participate. PJM should consider changes to its market to allow EVSB and other bi-directional charging assets to export back to the grid to enable the additional flexibility these assets are capable of to provide additional grid support. CPower hopes that through policy advancements, such as implementation of FERC Order 2222, will enable the full suite of grid benefits that these assets can provide to be realized.

DER Case Study: Indoor Farming Microgrid in Pennsylvania

Project: Fifth Season Microgrid, Braddock, PA

OVERVIEW

Through a partnership with microgrid developer Scale Microgrid Solutions (Scale), CPower began optimizing the operation of several DER assets to provide Fifth Season's indoor vertical farming facility in 2021 with utility bill savings, energy resiliency, and reliable access to clean energy while generating revenue through participating in PJM's energy and ancillary services markets.

USE CASE

Scale developed a microgrid to serve Fifth Season's indoor vertical farming facility that includes solar PV panels, lithium-ion battery storage, and a natural gas generator load. CPower partnered with Scale and, through the use of CPower's EnerWise™ site optimization software solution, optimizes the operation of the component DER assets within the microgrid along with additional DR capabilities through automated load management to achieve utility demand charge savings on Fifth Season's utility bills, as well as generate additional revenues through participation in PJM's market providing energy and spinning reserves.

BENEFITS

The Scale microgrid serves the majority of the load at Fifth Season's facility with clean energy as well as provides resiliency to maintain mission-critical operations in the event power service is interrupted. CPower's EnerWise™ optimization software utilizes market-based insights and artificial intelligence to optimize the microgrids operations and DR capabilities to maximize on-bill savings and market-based revenues from participating in PJM's Economic Load Response and Synchronized Reserves programs, which helps to keep the grid in balance. Through adoption of the microgrid and optimization, Fifth Season has also been able to reduce its greenhouse gas emissions footprint by the equivalent of 39 passenger vehicles driven in a year.

PUBLICLY AVAILABLE REPORTS/PRESS

CPower's press release announcing the project: https://cpowerenergymanagement.com/who-we-are/newsandhappenings/cpower-makes-vertical-commercial-agriculture-more-cost-effective-through-distributed-energy-resource-optimization/

For further information regarding CPower's EnerWise™ Site Optimization software, see CPower's press release here: https://cpowerenergymanagement.com/who-we-are/newsandhappenings/cpower-launches-enerwise-site-optimization/

REGULATORY ACTION

Regulators should view customer adoption of DERs and microgrid solutions as resources that are capable of providing grid services to both the bulk and distribution electric systems. Removing barriers, such as enabling customer data access, streamlining interconnection requirements and processes, will help to enable increased consumer adoption of those technologies and enable them to provide grid services as well as provide benefits to customers adopting them, the grid, and all consumers.

DER Case Study: Commercial and Industrial Demand Response

Project: Commercial and Industrial (C&I) Customer Locations Nationwide

OVERVIEW

When the grid needs energy, C&I demand response (DR) pays energy users for using less energy, rather than paying a power plant to produce more energy. While many people know demand response through interruptible rates, modern demand response (DR 2.0) is so much more. Rather than just paying energy consumers to curtail once every three years (as is usually the case with an interruptible rate or a wholesale market capacity program), DR 2.0 can provide regular grid balancing through participating in the energy market and ancillary services market, as well as providing resource adequacy.

USE CASE

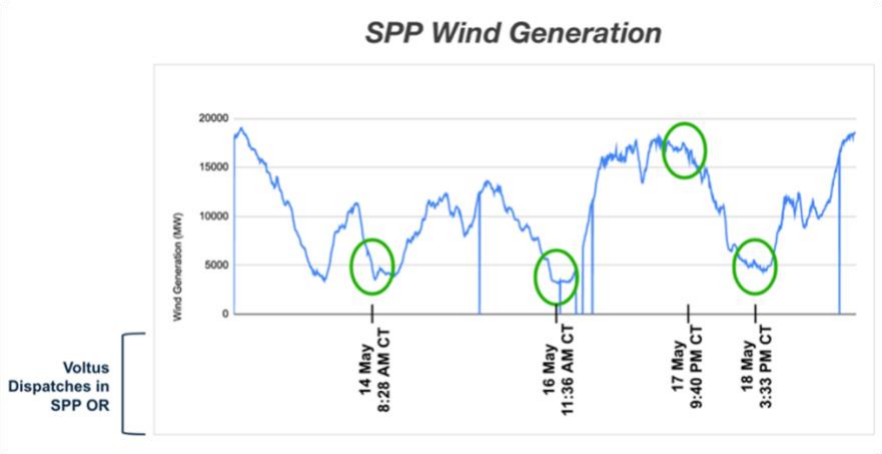
Reducing demand on system.

BENEFITS

Demand response balances the grid and helps to integrate renewables without relying on additional generation. It also creates significant value for local businesses. As Illinois Congressman Sean Casten noted in the press release for the REDUCE Act to broaden DR availability in the Midwest: "Allowing demand response reduces emissions and creates economic benefits for local businesses, an environmental and economic win-win. For example, when a business with a 5% profit margin earns $1,000 for reducing its energy consumption, this is pure profit, akin to earning $20,000 in top-line revenue."

RESULTS

The following chart shows that three of four Voltus' ancillary services dispatches during a single week in May were during lulls in wind production:



PUBLICLY AVAILABLE REPORTS/PRESS

As detailed in a Washington Post article, demand response played a huge role in keeping the lights on in California in September 2022, and August 2020.

REGULATORY ACTION

Thirteen states have banned non-utilities from doing C&I demand response. Those bans should be eliminated so that demand response providers can provide those services to customers. States should then set up narrowly tailored dual participation rules for demand response. For example, if a customer participates in its utility's interruptible program, that customer should also be allowed to participate in an aggregator's ancillary service or energy program. The customer would only ever paid once for a single MWh being dispatched, but it could be registered to participate in two different programs at two different times—like having a normal 9-5 job and weeknight or weekend side job.

SUMMARY: Steps Regulators Can Take to Maximize DERs in Their States

1. Direct utilities to partner with DER providers to **create pay-for-performance programs that compensate DERs for the value they can provide to the grid and to consumers**. Allow non-utility ownership of these resources. In regions with expected capacity or resource adequacy shortfalls, utilities should be directed to contract for DERs to provide quick to market capacity, leveraging DER provider technology solutions.

2. **Align utility incentives with customer savings and desired policy outcomes**, reforming traditional incentives for utilities to invest in generation over lower-cost demand-side alternatives. Allow utilities to share in savings or to capitalize DR investments.

3. **Encourage Independent System Operators to remove unnecessary barriers to DER participation in wholesale markets**; stay engaged in the ISO processes, especially in implementing Order 2222. Advocate at ISOs to protect and improve existing DR programs where necessary and create models for new forms of DERs to participate.

4. Identify the drivers for distribution, transmission, and wholesale costs, and **create mechanisms that allow customers to use DERs to reduce those charges on their bills and reduce overall system costs**.

5. **Encourage utilities to run DR/DER programs that serve local reliability needs and shift load on the distribution grid** to alleviate local network issues while simultaneously participating in system-wide emergency DR programs or economic DR programs offered by the ISO/RTOs.

6. **Incentivize utilities to run cost-effective DR programs that span multiple device classes and use cases**. Help utilities design programs that harness that latent value for the benefit of the grid, customers, and the environment.

7. **Scale targets to align with the growth of the DER market and take full advantage of the value that aggregations of DER can provide**. Encourage utilities to exploit the full value stack as well, leveraging DR programs not just for peak reduction, but also for daily load shifting and meeting reserves obligations.

8. States should **cease the practice of opting-out of allowing demand response aggregations in wholesale markets** and, when opening these markets, set rules that appropriately account for dual participation.