CA IOUs Demand Response Emerging Technologies Program Webinar

Presented by: Mark Martinez, SCE; Jeff Barnes, SDG&E; Albert Chiu, PG&E

Moderator: Johna Roth, ETCC

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Today's Speakers

Mark Martinez
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Product Manager, Integrated Grid
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Welcome!

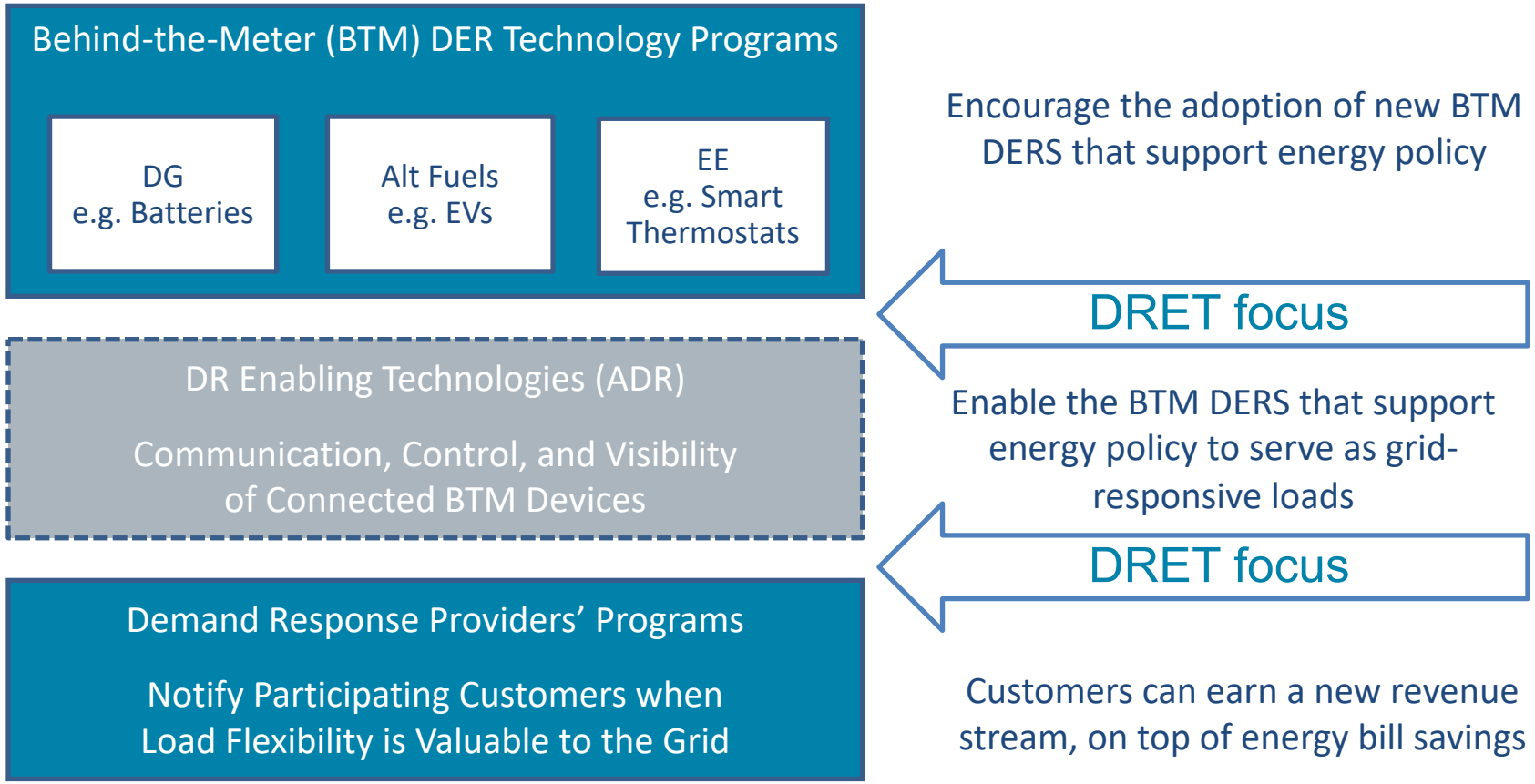
DRET HIGHLIGHTS

DRET Program Overview

- Approved in 2005 by the California Public Utilities Commission (CPUC) per Decision (D.) 05-01-056.
- Administered by California's Investor Owned Utilities SCE, PG&E, and SDG&E.
- Current funding cycle is authorized by CPUC Decision (D.) 17-12-003, *Adopting Demand Response Activities and Budgets For 2018 Through 2022.*
- The program funds research projects intended to further develop technologies and equipment, processes, and products to make demand response easier or more effective in the future.
- Currently, all three utilities are operating the DRET program from CPUC bridge funding authorization for 2023.

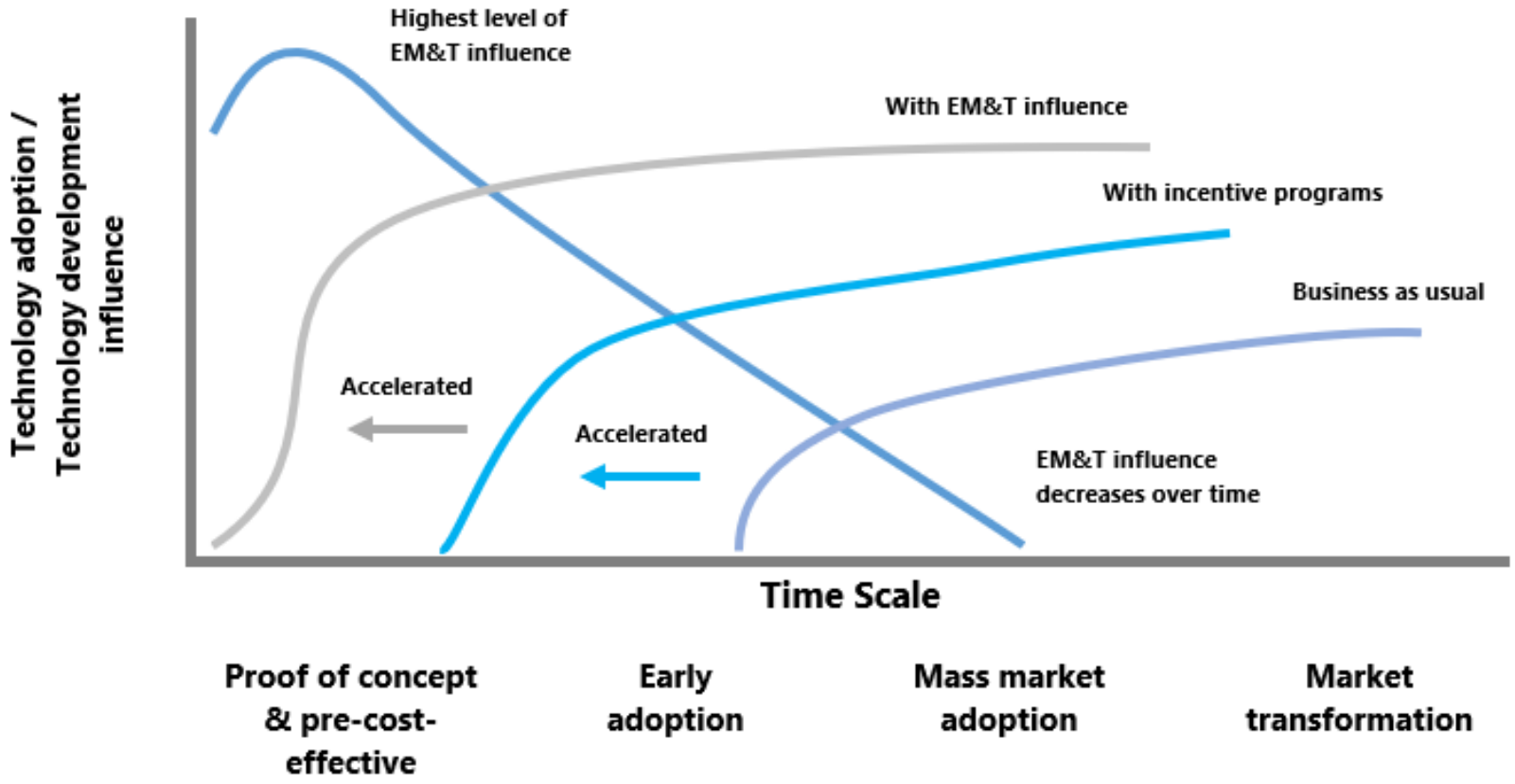
DRET Program Mission

Explore new technologies and applications with the potential to bridge the gaps between Technology Programs/ADR and ADR/DR Programs



DRET's Impact at Work

The DRET Collaborative works as a research initiative to coordinate and accelerate innovative enabling technologies to support and enhance demand response programs.



ETCC EMERGING TECHNOLOGIES COORDINATING COUNCIL

DRET DEMAND RESPONSE EMERGING TECHNOLOGIES

SCE HIGHLIGHTS:

Enabling Clean Energy in Disadvantaged Communities Project, Demand Response Technology Enhancements

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Enabling Clean Energy in Disadvantaged Communities with Integrated PV + Storage Project

This project identified scalable community models to maximize the economic benefits of solar PV energy systems for low-income multifamily populations and to evaluate how these technologies could enable grid flexibility and environmental benefits.

Technology Deployment:

1. DC-coupled PV and storage system
2. Local controller coordinating PV, battery, and inverter
3. Cloud-based multi-level controls integration
4. Community sharing VNEM model

Analyzed Metrics:

- Battery and PV Functionality
- Time of Use Utility Rates
- PQ Implications: studying common power quality factors
- Energy Utilization pre- vs post- treatment
- Load Shed DR Performance
- Multiple Battery Control Scenarios

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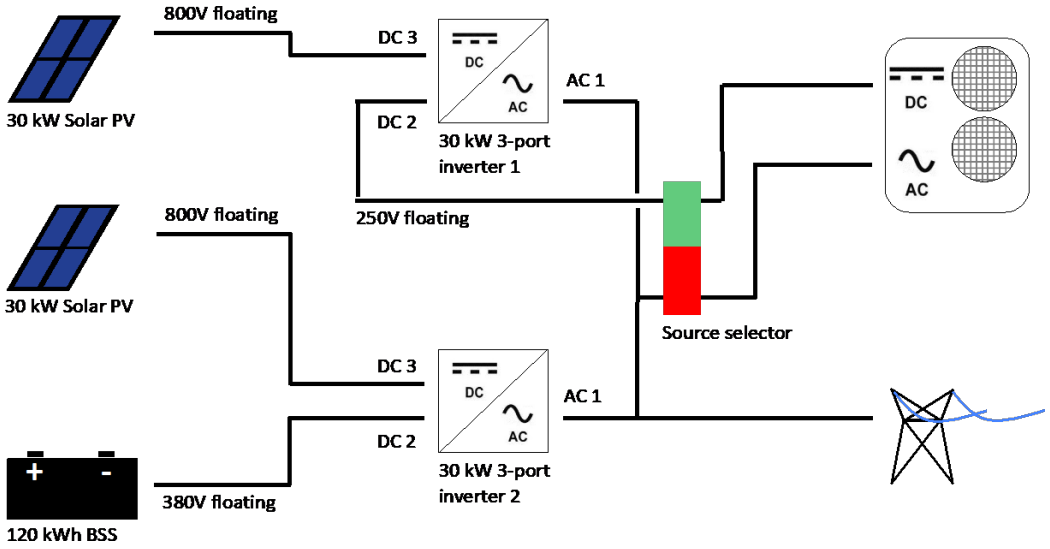
Enabling Clean Energy in Disadvantaged Communities with Integrated PV + Storage Project

This resource integration project garnered heightened attention for its energy efficiency and DR benefits, as well as being a realized demonstration of DC distribution and appliances that can be expanded with the provision of automatic transfer switch to offer low-income communities' resiliency.

The team deployed and tested the resource integration demonstration comprised of the following innovations:

- Inverter meeting CA Rule 21 Phase mandates for grid supportive functions
- DC-coupled PV and storage system, with Bi-directional inverters provided CE+T
- Multi-Level Controls Integration through a Cloud-Based Open Demand Side Resources Integration Platform (OpenDSRIP)
- Community-Sharing Virtual Net Energy Metering (VNEM) model
    - Production and operation of the PV and battery distributed/allocated across each of the residential unit meters and the Common Building meter

System Electrical Diagram



Enabling Clean Energy in Disadvantaged Communities with Integrated PV + Storage Project

Key Accomplishments:

The key finding was confirming this alternate business model would manage grid users more effectively in community-scale and support overall grid health. This will shape interconnection processes for storage systems with advanced solar systems for large multi-unit housing.

Demonstrated energy savings of 137 MWh to the grid on projected annual basis from solar generation

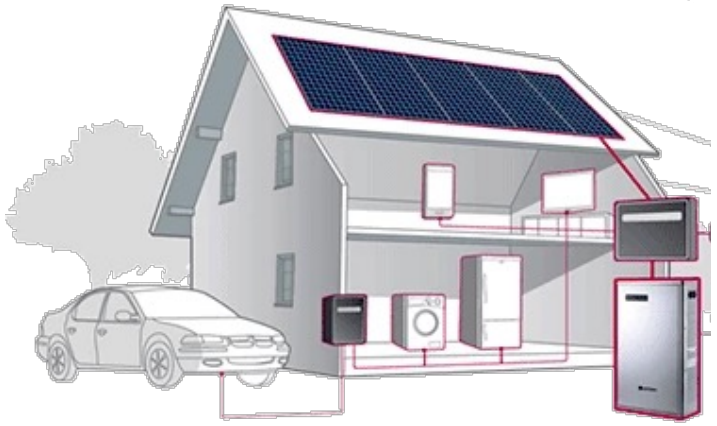
> Extending the results of this project to California's deed-restricted affordable multifamily households shows potential for a bill reduction of $253 million for California's low-income households.

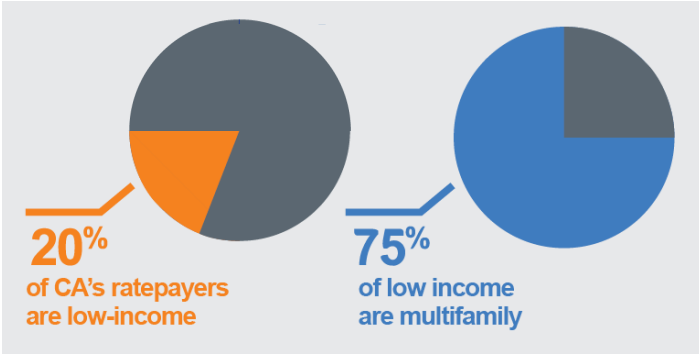
Demonstrated an integrated solar, storage, and end-use load platform in test control scenarios successfully supports greater grid reliability while supporting intermittent renewable energy resources

> Reduced evening demand by 9 percent during TOU peak periods.

Project created new jobs equivalent to eight person-years

> Can be scaled to significant job growth if similar retrofit work is conducted statewide for the target sector. The reduction in energy bills and DR participation payments also leaves tenants with greater disposable income.





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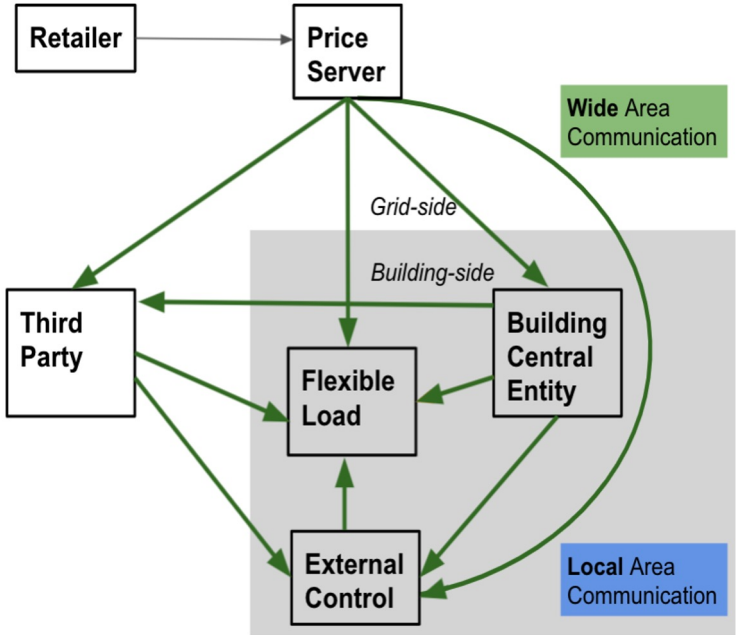
Demand Response Technology Enhancements Project

The project examines the data elements required by customer end-uses to effectively respond to new models of dynamic pricing, identifies the overall structure of tariff information relay from SCE to individual customer end-uses via digital signals, reviews communication pathways from utility grid to customer sites, and examines emerging technologies for ADR and opportunities for "shift".

Recommendations:

- An overall communication architecture, Price-Based Grid Coordination (PBGC), enables diverse communication paths, multiple locations of translating prices to functional control, and offers significant opportunities for flexibility while maximizing interoperability.
- New concept of a 'local price' of electricity facilitates maximum use of prices as the central mechanism for managing power distribution.
- Streaming prices to loads on a continuous basis to facilitate nimble use by sophisticated devices to benefit grid operators is highly practical.

Price-Based Grid Coordination Architecture Overview



Identified catalogue of 16 "tariff features" relevant to dynamic price communication:

Easily Adapted	Simple Adaptation	Difficult to Address	Not relevant
TOU, CPP	Differential Buy/Sell Prices	Tiers	Direct Load Control
RTP	Voltage/Phase	Demand Charges	Rotating Outage Participation
Sub-Tariffs	Discounts	Combined Tariffs	Reactive Power
Eligibility		Bill Limiter	Fixed Charges

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Demand Response Technology Enhancements Project

Evaluations Completed:

Review of high-level capabilities of three communication protocols

OpenADR 2.0b, IEEE 2030.5, and CTA2045

Identified needs for modification to support price communication:

OpenADR and IEEE 2030.5

- Lacks some static tariff metadata
- Become less verbose
- Become less data intensive

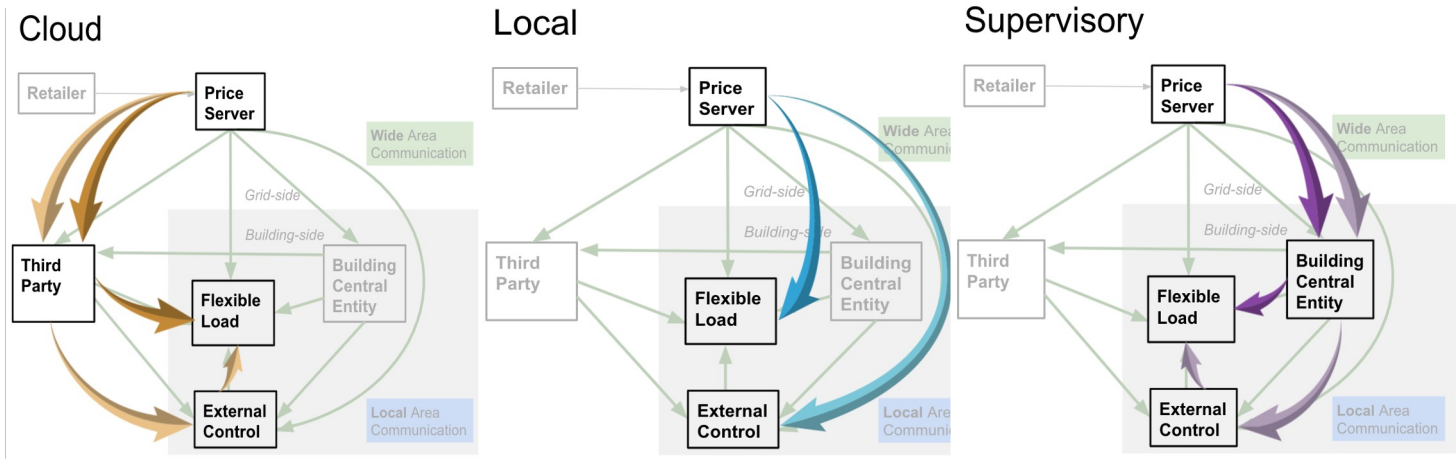
CTA2045

- Improved by identification of a standard (but optional) external interface
- Standard today only defines the internal interface between the module and the flexible load

DR Automation Pathways:

Enables three fundamental locations of DR intelligence

- Cloud - device manufacturer infrastructure or other third party
- Local - device itself, or immediately adjacent control hardware
- Supervisory - in a building energy management system or similar central device



SDG&E HIGHLIGHTS

Shelter Valley Virtual Power Plant
Signaled Grid Isolation for DR

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Shelter Valley Virtual Power Plant

The Shelter Valley Virtual Power Plant (VPP) project evaluates the control, dispatch and real-time signaling of behind-the-meter resources installed throughout a vulnerable community in SDG&E service territory.

- Seeks to help build a smart, resilient community while boosting energy reliability and emergency preparedness.
- Evaluates the impact VPPs can have during peak energy consumption periods and when load might need to be shifted or curtailed due to severe weather or other grid conditions.

Recent developments:

Q3 2022 Device installations began in customer homes and the Community Center

Q4 2022 Cloud-based VPP Platform began signaling installed devices

Q1 2023 Project extended to gather data during Demand Response season

Status:

- Continue signaling of installed devices thru Demand Response season
- Finalize provisioning of installed equipment

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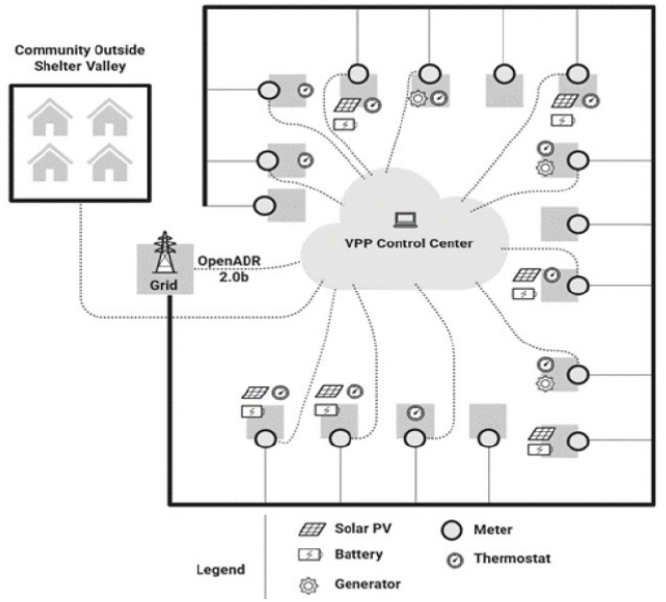
Shelter Valley Virtual Power Plant

Primary Uses:

1. Curtail load and dispatch storage generation during peak period
2. Community resiliency for Public Safety Power Shutoff event mitigation
3. Generac Grid Services' "Concerto" platform
4. Devices installed in single family homes and Community Center
5. Battery storage systems prioritized to customers who are on medical baseline and those with access & functional needs.



Preliminary Learnings:

- Customers very well engaged via community meetings/events, email, postal mail
    - Approximately 3-5% of customers are participating in project
- Water heaters use LTE signal, therefore typical location is not ideal for implementation
- Generac platform compatible with select thermostats, well water pump controllers, and potentially other devices

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Signaled Grid Isolation at a Meter for Demand Response

This research study is testing a grid isolation adapter that connects to a utility meter and enables whole home/facility self-consumption from solar and/or battery storage during a signaled Demand Response event or outage.

Technology Features:

- OpenADR control of solar, batteries and EV chargers for Demand Response
- Supports grid balancing and resilience to Public Safety Power Shutoff (PSPS) mitigation and extreme weather outages
- Includes worker safety interlock for safe and reliable control of Distributed Energy Resources
- Technology is UL-tested and certified UL 414 SB

Ongoing status:

- Test plan is under development and undergoing review by SDG&E teams.
- Test wall to be delivered to SDG&E facility for testing in a controlled environment.
- Testing expected to begin in Q2 2023.

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PG&E HIGHLIGHTS:
Smart Panel Lab Test

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PG&E Smart Panel Lab Test

This research evaluates electrical panel technologies integrated with add-on software controls that provide customers with additional information and capabilities beyond a traditional panel.

Lab Testing –

- Evaluates the difficulty of installation for smart panels
- Evaluates smart panel customer app functions
- Evaluates smart panel utility app functions
- Validates that the smart panel is safe to operate in field demonstrations

PG&E Smart Panel Lab Test

Laboratory Testing is built around three facets establishing the Smart Panel's safety, functionality, and communication.

Safety Testing:

- Fit all compatible breakers, apply same load to all, and monitor with IR camera.
- Misalign breaker positions by 1 in the device set up and see if it is possible to disconnect a single pole of a 2-pole breaker.

Functional Testing:

- SPAN claims +/- 0.5% energy metering accuracy. Use a calibrated meter with sufficient accuracy to measure load and compare against SPAN reported metering.
- Use the app to check load readings. Measure time it takes to update after load level change.
- Use the app to open and close circuits. Measure time it takes for control to execute.
- Use the Utility Portal to check load readings. Measure time it takes to update after load level change.
- Use the Utility Portal to open and close circuits. Measure time it takes for control to execute.
- Use the app to shed load with the 3 tier assignments.
- Use the Utility Portal to shed load with the 3 tier assignments.
- Use the app to close in a relay that was disconnected though the tiered load shed commanded by the app.
- Use the app to close in a relay that was disconnected though the tiered load shed commanded by the Utility Portal.
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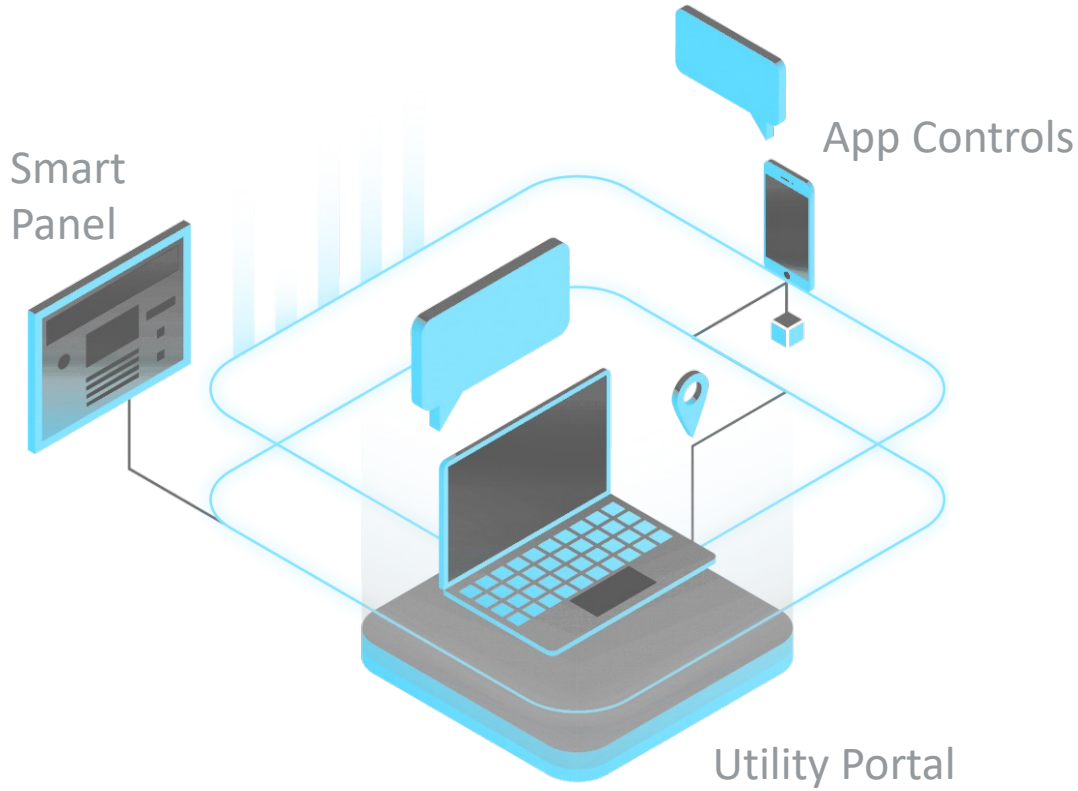
PG&E Smart Panel Lab Test

Communication Testing:

- Remove LAN interface and verify that monitor and control from app and Utility Portal work with the cell backup.
- Compromise the cell backup (remove antenna or disrupt the signal strength is some other way) and verify monitor and control from app and Utility Portal work over LAN connection.
- Disconnect LAN from internet and compromise cell backup. See if app on same LAN can still monitor and control.
- Perform a software update over the air if one is available.



PG&E Smart Panel Lab Test

Recent Developments:

- Two smart panels installed in San Ramon location
- Panels are connected to a load simulator
- Developing test cases for the customer and utility apps

Ongoing Status:

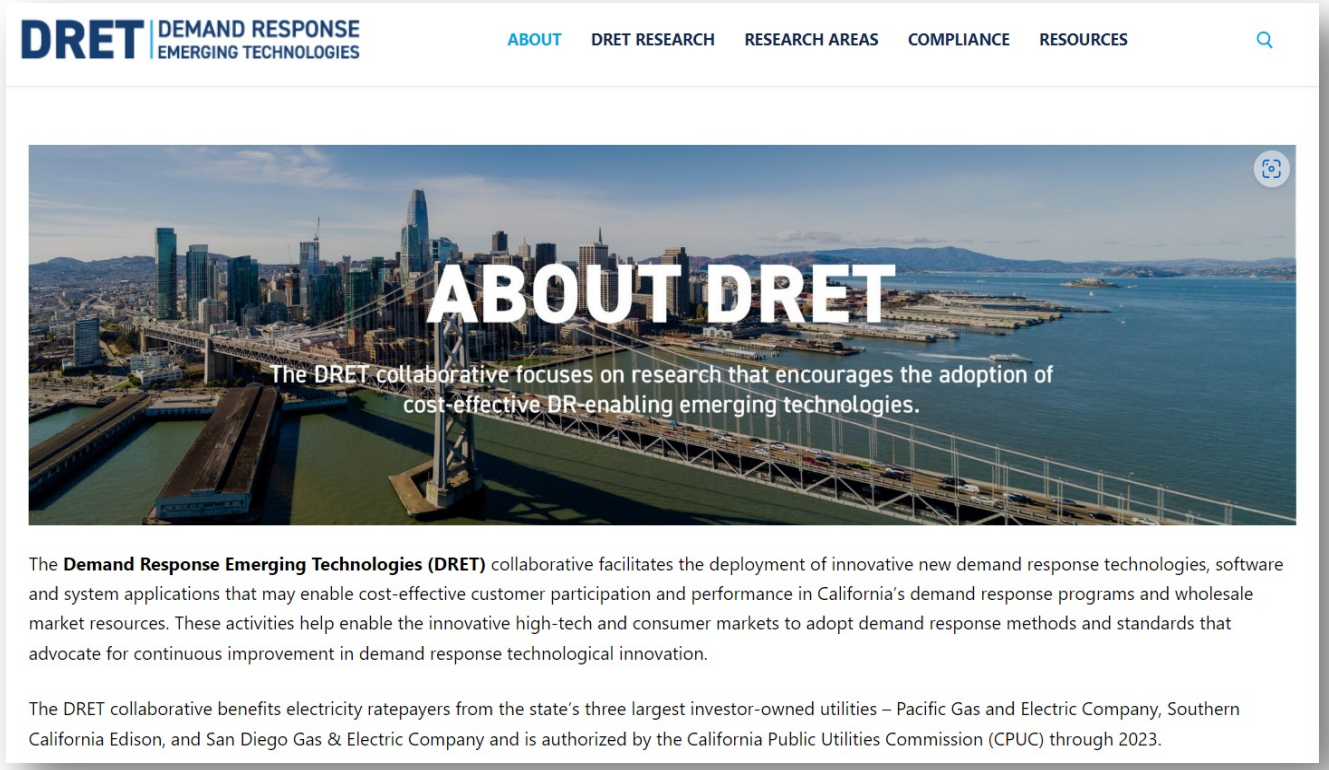
- Applied Technology Service team tested customer and utility apps from Q4 2022 through Q1 2023
- In process of reviewing draft test and lab results

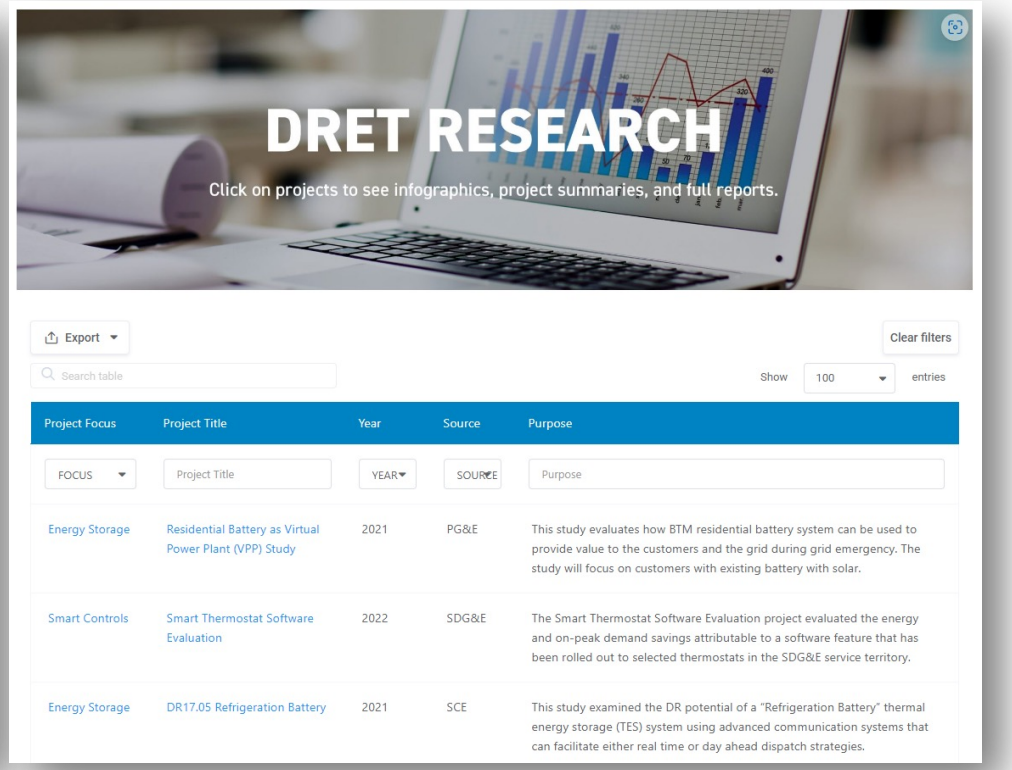
Possible Field testing in the future:

- Demonstrate the ability of smart electrical panels to deliver targeted, firm reductions in residential demand during critical tested DR events via a whole-home load limiting capability
- Demonstrate the capability for smart electrical panels to provide a platform for residential demand response that does not require direct control of end-use devices

Available Resources

- Details & Final reports can be found on the DRET website: https://www.dret-ca.com





Appendix

Previous DRET Studies

DR Program cycle	Technology focus
2004-2005	• OpenADR standard
2006-2009	• Automating CPP signals
2009-2011	• Commercial HVAC/Lighting • Industrial Process • Title 24
2012-2014	• Agricultural EMCS • Refrigerated Warehouse • Smart Thermostat • IDSM Technologies
2014-2017	• Residential EMCS • Smart Thermostat • SMB ADR Technologies
2018-2022	• DER Technologies • GHG signal • HPWH • Voice automation • EV/Battery