DEMAND RESPONSE EMERGING TECHNOLOGIES PROGRAM

SEMI-ANNUAL REPORT 2018

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SDGE

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Summary

The Demand Response Emerging Technologies (DR-ET) Program Semi-Annual Report is being submitted pursuant to Ordering Paragraph 59 and the discussion at pages 145 – 146 of Decision (D.) 12-04-045. During Q2 and Q3 of 2018, San Diego Gas & Electric DR-ET Program completed zero projects but started two new projects and continued to manage seven ongoing projects.

I. Completed Projects in Q2 and Q3 of 2018

No Projects were completed in Q2 and Q3 of 2018.

II. Ongoing Projects in 2018

A. Electric Power Research Institute (EPRI) Smart Thermostat Collaborative

1. Overview

Define methods to translate the value proposition from multiple utilities smart thermostat pilots to utility programs of the products and services in the study. Understand all the costs and benefits from the various thermostat hardware and software offerings as well as the data streams that come from the products and services.

2. Collaboration

More than 12 utilities are participating in this study, plus 15 smart thermostat products and/or services vendors, and other stakeholders such as Environmental Protection Agency (EPA), Department of Energy (DOE), Lawrence Berkeley National Laboratory (LBNL), National Renewable Energy Laboratory (NREL), ICF International and Itron. The information from this project is also shared with the statewide DR-ET team on monthly conference calls.

3. Status

In Q2 and Q3 of 2018, many of the pilots and demonstrations associated with the Collaborative were finalized or are near completion. Results from these studies are summarized in the table below:

Table 1

Demand Response Impacts	**Summer** (Ave hourly impacts, temperature offset control strategy)	-0.7 to -1.2 kW per customer (across 4 pilots, 5 tstats)
	Winter (Ave hourly impacts, temperature offset control strategy, electric heat customers)	-1.0 to -1.2 kW per customer (across 2 pilots, 2 tstats)
Energy Efficiency Impacts	**Summer** (% of Total Summer Electricity Usage)	+2% to -7% (across 4 pilots, 5 tstats)
	Annual (% of Total Annual Electricity Usage)	+1% to -5% (across 3 pilots, 4 tstats)

During this time, effort has also been focused on technology transfer. Notable events and activities include:

- Webcast on Solutions to Help Customers Manage their Energy Demand on April 25, 2018.

- Presentation made at the Utility Energy Forum in Sonoma, CA on April 26, 2018. The presentation discussed transition of the research from connected devices such as smart thermostats to assessment of how connected devices are an integral part of connected ecosystems and Advanced Energy Communities.

- Webcast on Leveraging Voice Assistants to Enable Utility Customer Programs. The presentation discussed how connected devices such as smart thermostats can potentially be connected to other devices through voice assistant platforms.

- A Smart Thermostat and Connected Device Workshop held in Palo Alto, California on July 12th – 13th. Topics discussed during those meetings included: (1) Smart Home road-mapping; (2) Addressing Energy Affordability using connected devices; (3) Leveraging data from Connected Devices such as Smart Thermostats; (4) Voice as an enabling platform; (5) Lessons Learned from Implementing Smart Thermostat and Other Connected Device Pilots; and (6) Beyond Smart Thermostats to other Connected Devices.

- Finally, the data collected from thermostats deployed in the Kansas City Power & Light study evaluate how impact evaluations using

traditional methodologies compare with baselining implementation by national standards. US EPA moved forward with the ENERGY STAR metric on connected thermostats.

4. Next Steps

All studies under this collaborative effort were scheduled for completion by Q2 of 2018. However, the only remaining task for this project is the final analysis. Project completion date has been moved to Q4 of 2018.

B. Vehicle to Grid Integration Platform (VGIP)

1. Overview

The purpose of this project is to create requirements and use cases for a unified grid services platform that is secure, low cost, and an open platform. It will also aide in the development of architecture and functionality of the VGIP including OpenADR2.0b, SEP, and Home Area Network (HAN). Additionally, this project will assess performance of the VGIP against utility requirements through field tests and trials. BMW, Chrysler, Ford, GM, Honda, Mercedes, Mitsubishi, Nissan, and Toyota have agreed to be study participants.

2. Collaboration

The progress and results have been shared with other California Investor Own Utilities (CA IOUs) during scheduled monthly DR-ET Leadership conference calls as well as with various interested attendees at the Internal Technology Transfer meetings.

3. Status

Below are the highlights of the project from Q2 and Q3:

- Southern California Edison (SCE) Capacity Bidding - Residential Demand Response aggregation pilot has been initiated and is to operate through the end of September 2018. The project team has established the OVGIP communications interface with SCE Green Button and Demand Response Management System (DRMS). Program performance is measured using customer 10/10 baseline data from the SCE Green Button data. DR events are processed utilizing OpenADR2.0b signals.

- Continuing customer charging behavior pilots with American Electric Power and Puget Sound Energy utilities. The purpose is to obtain data for learning and determining Vehicle-Grid Integration (VGI) use cases and program strategies.

- Con Edison's Smart Charge New York Program (Customer off-peak charging incentive program) is initiated with Ford and in process of initiating participation with Honda and BMW. Original Equipment Manufacturers (OEM) provides data on customer charging behavior to verify compliance to the incentive requirements.

- New York Power Authority (NYPA), Sacramento Utility District (SMUD), and Duke Energy have signed on as members of the OVGIP EPRI Supplemental Program.

- Engaging in ongoing dialogue with Duke Energy for planning a 500 plus customer Demand Response pilot in the 2019 timeframe.

- Established a development team process for implementing OVGIP/Utility automated customer enrollment. Addressing business model process, customer authorization/registration, data privacy, security, and authentication requirements.

4. Next Steps

Below are the going forward activities and objectives for the VGIP collaborative project:

- Proceed with pilot program planning with recently joined utility participants (New York Power Authority, Sacramento Municipal Utility District, and Duke Energy).

- Continue discussions with new utilities about engagement in the OVGIP Program such as TVA, Ontario Power Generation, Excel, CMS Energy, and Exelon.

- Continue coordination with SCE, and PG&E in determination of OVGIP pilot structure and requirements for the 2019-2020 timeframe.

- Complete execution of the SCE Capacity Bidding – Residential DR aggregation pilot. The Pilot is scheduled to be completed at the end of September 2018. An analysis summary report will be prepared and distributed by EPRI.

- Ford has completed providing 6 months of implementation data. The project team is working to finalize Honda and BMW participation in the pilot. Each participant shall provide several

months of data to evaluate results and make determinations for commercial scaling of the OVGIP program, and potentially for next phase pilots for Vehicle Grid Integration (VGI) functional enhancements such as DR and dynamic pricing use cases.

- Continue dialogue with Duke Energy on the intention for a 500-vehicle data management pilot using OVGIP. Presently, Duke is preparing a filing with the North Carolina Utility Commission for review and approval of a Smart Charging pilot that will include the OVGIP.

- DTE Energy is joining the OVGIP Program and is working with Ford, Chrysler, and EPRI to develop a potential 1000 vehicle Demand Response pilot utilizing employees of the respective companies within the Detroit region. GM is expressing interest in the pilot.

- Initiate forward planning with utilities to determine requirements for scaled up 2019 commercial intent VGI programs/pilots. Establish involvement in CPUC VGI Roadmap update and VGI "use case" value assessment proceedings.

- Progress on development of the OVGIP/Utility/Original Equipment Manufacturer (OEM) interactive automated enrollment process. Honda, Ford, and Con Edison are directly involved in the process and addressing security and authentication process, software requirements and implementation.

- Final report to be completed in Q4 of 2018.

C. Battery Powered Load Shedding System – Automated Demand Response(ADR) Evaluation

1. Overview

The objective of this study is to evaluate the DR capability of the Energy Storage System (ESS). In addition to peak load shaving capability, the study will evaluate the impact of the energy storage system on the circuit and analyze customer bill/economic impacts.

2. Collaboration

The progress and results have been shared with other CA IOUs during scheduled monthly DR-ET Leadership conference calls as well as with various interested attendees at the Internal Technology Transfer meetings.

3. Status

In Q4 of 2017 and Q1 of 2018 the vendor deployed 7 ESS at one of the school districts, these are known as Group 1. In Q2 and Q3 of 2018, the vendor deployed a total of 7 additional ESS at two school districts, these systems are known as Group 2. The vendor has been working towards getting Group 2 sites fully operational, reportedly the delay has been due to a mix of communications and metering issues.

Below are the highlights for this period:

- The total deployed capacity of the current fleet is rated at 5.47 MW with a 2-hour discharge time, or 10.94 MWh (Group 1 + Group 2).

- Group 2 sites are expected to be fully operational in Q3-Q4 of 2018. Data collection is currently ongoing.

- The measurement and verification (M&V) team submitted a Summary Report covering the analysis of Group 1 sites in Q1 of 2018.

- Summary Report circulated, and feedback was solicited from client in Q2 of 2018.

- Revisions based on client feedback and additional analysis was incorporated into the Summary Report in Q3 of 2018 and was submitted in July 2018.

- In Q3 of 2018 M&V team installed independent electrical sub-metering systems on 4 of the Group 2 ESS.

- Demand Response (DR) simulations on the Group 2 sites started in Q3 of 2018 and will be completed in Q4 of 2018.

The names and sizes of the ESS in each Phase are shown in the two tables below:

PHASE 1			System Size	
#	District	System Name	kW	kWh
1	District #1	Building #1	30	60
2	District #1	Building #2	250	500
3	District #1	Building #3	60	120
4	District #1	Building #4	250	500
5	District #1	Building #5	250	500
6	District #1	Building #6	250	500
7	District #1	Building #7	250	500
8	District #2	Building #1	250	500
9	District #2	Building #2	500	1000
10	District #2	Building #3	60	120
11	District #2	Building #4	250	500
12	District #2	Building #5	60	120
13	District #2	Building #6	250	500
14	District #2	Building #7	250	500
15	District #2	Building #8	250	500
16	District #2	Building #9	250	500
17	District #2	Building #10	250	500
18	District #2	Building #11	250	500
19	District #2	Building #12	250	500
20	District #2	Building #13	250	500
		Total MW / MWh	**4.46**	**8.92**

PHASE 2			System Size	
#	District	System Name	kW	kWh
1	District #1	Building #8	90	180
2	District #1	Building #9	250	500
3	District #1	Building #10	120	240
4	District #1	Building #11	120	240
5	District #1	Building #12	120	240
6	District #1	Building #13	250	500
7	District #1	Building #14	60	120
		Total MW / MWh	**1.01**	**2.02**

Total MW / MWh	
5.47	**10.94**
MW	**MWh**

4. Next Steps

In Q3 through Q4 of 2018, the M&V team will complete the 16-week data collection period at each site in Group 2 and perform all analyses per the Project Plan.

This project will be presented at the California Statewide Emerging Technology (ET) Fall Summit in October 2018, as part of the commercial battery storage panel. The link to the event site is at http://etsummit.com.

In Q1 2019, the M&V team will produce an Addendum to the Summary Report. This Addendum will cover the analysis of Group 2 and include any updates or changes to previous findings.

D. Whole Connected Home

1. Overview

Whole Home Demand Response (WHDR) is defined as a DR approach where multiple end use systems are triggered by a single DR signal delivered by the utility to either an in-home or a cloud gateway. The purpose of the project is to evaluate various emerging Internet of Things (IoT), connected device technologies, as one unified system for their capability to be developed and integrated into WHDR programs. The demonstration is done at three selected residences. The evaluation will consider both technologies and other program impact factors such as customer adoption, ease of recruitment, persistence, and data availability for M&V.

2. Collaboration

The progress and results have been shared with other CA IOUs during scheduled monthly DR-ET Leadership conference calls as well as with various interested attendees at the Internal Technology Transfer meetings.

3. Status

In Q2 and Q3 of 2018, the final commissioning of the Alexa integrated ecosystem occurred in the third home which was a learning experience. There were a range of technical issues on the other two homes that resulted in hours of troubleshooting. The project has completed the verification of the baselining methodology as well as executed a total of 15 demand response calls.

4. Next Steps

The next steps for the project are the following:

- Complete any remaining demand response events necessary per the M&V Plan.

- Complete final report which will include:
  - M&V documentation
  - Analysis of energy/power data and available thermostat data
  - Results of the 3-in-5 Baseline data
  - Demand response load reduction evaluation
  - Lessons learned from implementation
  - Identification of technology transfer opportunities that enable tech transfer to stakeholders

- Project knowledge transfer at the California ET Summit in October of 2018.

E. Permanent Load Shifting Evaluation of a Refrigeration Battery

1. Overview

The Project will demonstrate the Refrigeration Battery's ability to maintain the desired temperature set-points of a supermarket's medium temperature refrigeration systems without running the central compressors or condensers for up to 8 hours at a time. By turning off medium temperature refrigeration compressors and condensers during "on-peak" hours, as defined by SDG&E's AL-TOU rate schedule, the Refrigeration Battery is expected to reduce the facility's monthly peak demand by up to 75 kW. If successful it would achieve a decrease in monthly peak demand of up to 25%.

2. Collaboration

The progress and results have been shared with other CA IOUs during scheduled monthly DR-ET Leadership conference calls as well as with various interested attendees at the Internal Technology Transfer meetings. This project has attracted some national media attention and strong interest from EPRI who is aiming to build on SDG&E's initial research in this space.

3. Status

Axiom Exergy began installation of the refrigeration energy storage system in March 2018 upon approval of the constructions drawings by the City of Escondido. Construction permit approval was delayed beyond the initial schedule due to delays in approval by the City of Escondido. Some of the delays were associated with requested revisions and questions

regarding utility easements overlapping the planned placement location for the energy storage tanks. Construction proceeded through Q2, with the energy storage tanks and piping installation occurring throughout April, and then the system integrator and pump skid were installed in May.

The final construction permits were approved on May 31, 2018, signaling the end of installation and the beginning of the commissioning phase of the project. Commissioning activities continued throughout Q3.

Below are some photos of the technology installation:

4. Next Steps

The refrigeration energy storage system is expected to go live in September 2018, at which time the M&V phase will begin. Preliminary results on the performance of the system are expected to be available in October 2018, and will be shared at the ET 2018 Fall Summit on the commercial battery storage panel.

F. Demand Response with Variable Capacity Commercial HVAC Systems

1. Overview

Variable Capacity systems, with their onboard instrumentation and communications capabilities, are candidates for implementing both EE and DR measures at the same time. Efficiency rebates have been in place for such equipment in certain areas, but DR capabilities can push the technology further into the mainstream market, which is dominated by rooftop units, split systems and chiller/boiler combos. Commercial HVAC systems being a coincident load (peak power draw occurs during the hottest days) is a prime candidate for DR solutions besides being an efficient technology during normal operation.

The objectives for undertaking this study are:

- Determine the extent to which variable capacity commercial HVAC systems can provide DR services by reducing (or increasing) power draw.
- Define use cases for this advanced DR capability.
- Achieve integration of candidate systems with open protocols like OpenADR as an application layer.
- Provide operational data from field installed systems with advanced DR capabilities.
- Provide data and analysis to fulfill the needs of SDG&E's Technology Incentive (TI) Program as well as traditional DR programs such as Critical Peak Pricing Default (CPP-D) and Capacity Bidding Program (CBP).

2. Collaboration

The progress and results have been shared with other CA IOUs during scheduled monthly DR-ET Leadership conference calls as well as with various interested attendees at the Internal Technology Transfer meetings.

3. Status

Coordinated extensively with field site personnel (management, legal and property owners) to review and refine the customer/utility field demonstration agreement (FDA). Modified FDA based on customer feedback. Awaiting final approval and signatures.

4. Next Steps

Below are the next steps in the project:

- Anticipate FDA final signatures by early Q4 2018. Once executed, SDG&E will process the contract modification to expand project scope and funding for the specific field site requirements.

- Contractor team will obtain an updated cost proposal for subcontractor installation of the necessary HVAC manufacturer, DR controls, and monitoring equipment. The monitoring equipment package and sensors will be assembled and tested at in a lab prior to installation at the field test site.

- Coordinate with field site personnel to schedule controls and instrumentation installation. Anticipate completion by December 2018 or January 2019.

- Complete and commission the new DR controls hardware, cloud-based software, and monitoring instrumentation. Perform initial DR tests to verify performance and resolve any issues. Prepare DR test matrix for review and approval by project participants.

G. Expansion Study of the Statewide Expansion of Auto-DR Express Solutions

1. Overview

The DR-ET Teams of SDG&E, SCE and PG&E are engaged in discussions to develop strategies to increase adoption of Auto-DR into the Small and Medium Business (SMB) sectors (facilities with a peak demand under 499 kW). The Teams selected ASWB Engineering to study how to improve uptake on the existing “Auto-DR Express” and “FastTrack” offerings and to develop a program model that all three utilities could adopt. The Teams decided to co-fund the statewide study with SDG&E being the lead.

The main objective of this effort is to increase automated DR market penetration of SMB customers by expanding SMB eligible measures, adding additional facility types, and increasing customer and vendor awareness of the program.

This will include interviewing past program participants, proposing a streamlined model for the various IOU offerings, along with researching and addressing any barriers the customer may have with respect to program participation. A roadmap for 2018 and beyond will be developed, which focuses on the needs of SMBs.

2. Collaboration

Since this is a co-funded statewide initiative with SDG&E, SCE, and PG&E, each IOU will be updated as the project naturally progresses. SDG&E will lead all the project update conference calls. The results will also be shared with other CA IOUs during scheduled monthly DR-ET Leadership conference calls as well as with internal DR strategies team.

3. Status

Highlights for Q2 2018 include:

- Project in hiatus while Scope of Work being expanded to include $/Device incentives (Phase 2 Scope of Work).

Highlights and accomplishments for Q3 2018 include:

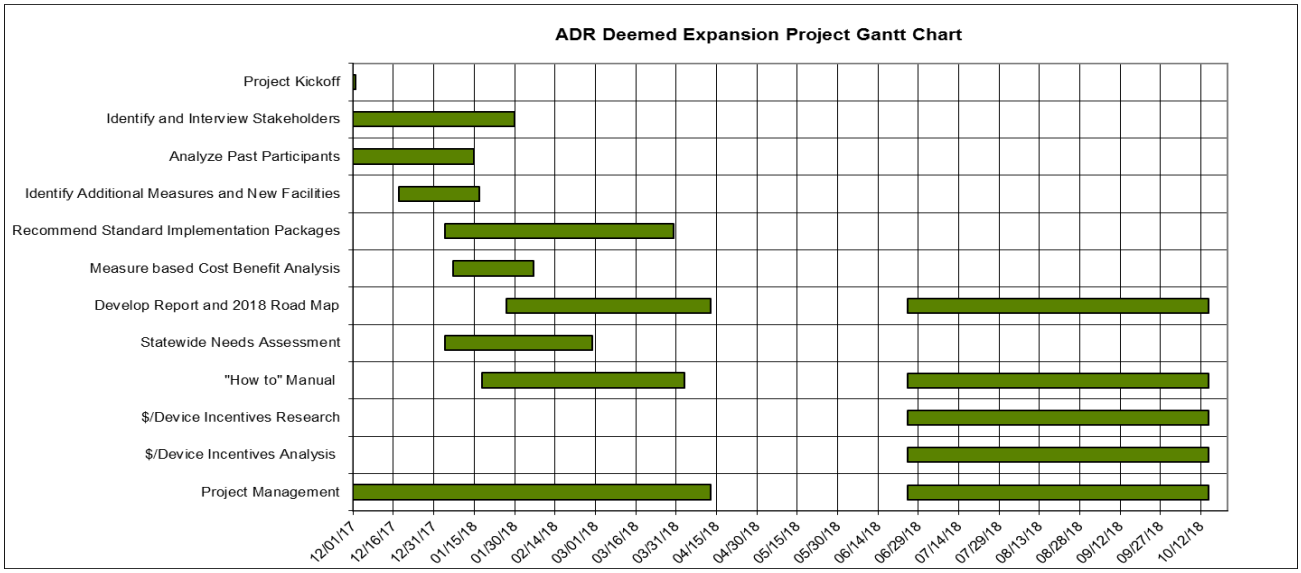
- Phase 2 Kick-off meeting on 7/3/18.
- Outreach to vendors to gain access to vendor databases on the number of devices installed and the facility and climate zones of each of the sites they have in California.
- Conduct primary and secondary research of calculated and verified kW load by installed device, facility type, and other relevant variables.
- Develop and incorporate estimated facility load shed potential and associated incentive levels on a per installed device basis.
- Developed offline reservation document for $/Device incentive to be used across all three IOUs.
- Develop roadmap for 2018 and beyond.

4. Next Steps

Below are the planned actions for Q4 2018 and Q1 2019:

- Develop presentation of Standard Program Offering.
- Complete calculations based on databases given by all the vendors.
- Develop "How To" training manual for offline reservation document.

Below is an updated Gantt chart that displays estimated project milestones and timeline.



III. New Projects in 2018

H. Dehumidification & Water Purification Demand Response Project

1. Overview

This project is to evaluate the electrical load and demand response capabilities of two (2) types of dehumidification drinking water systems. Ten (10) dehumidification units from two different vendors will be installed in buildings around the SDG&E service territory. These units cool air below the dew point to produce water. The collected water is filtered, ozone is injected, then chilled or heated to use as an office "water dispenser" for drinking water.

The primary purpose of the assessment is to:

- Determine the load profile, baseline energy use and peak demand of the units.

- Determine the available peak load reduction of the units for a demand response event. Multiple reduction strategies may be analyzed, including but not limited to turning the unit off or adjusting the water delivery temperature set points.

The secondary purpose of the assessment is to:

- Understand the added load (load growth potential) to the SDG&E territory assuming a penetration rate.

- Use the micro data to theorize what impact these products could have on the embedded energy in water distribution throughout SDG&E service territory.

2. Collaboration

The progress and results will be shared with other CA IOUs during scheduled monthly DR-ET Leadership conference calls. SDG&E ET is also collaborating with our Energy Innovation Center (EIC) to place two units for comparison study.

3. Status

Vendors and independent M&V consultant were selected and contracts for this project have been executed. Equipment will be ordered upon completion of test sites selection.

SDG&E must find enough qualified sites to house 10 total units from two different manufacturers. This process is expected to be completed by Q4 2018.

Subsequently, SDG&E ET will be working with the vendor to finalize the M&V plan for this product.

4. Next Steps

Complete the site selection process and begin product installation. Install plug load monitoring equipment to track the energy draw of the units.

I. SDG&E's Energy Innovation Center (EIC) – Demonstrating DR Performance of a Variable Refrigerant Flow (VRF) – Indirect Evaporative Cooling (IEC) Hybrid System

1. Overview

Rooftop package air condition systems, or RTUs, are typical for many small to medium commercial office buildings. Replacing RTUs with more energy-efficient HVAC alternatives, such as heat humps, offers significant energy savings potential. Within the category of heat pumps, variable refrigerant flow heat pumps (VRF) offer even greater savings potential.

The selected vendor is also contracted with the California Energy Commission (CEC) to demonstrate the application of a hybrid system that combines VRF heat pump systems with Indirect Evaporative Cooling (IEC) units to possibly provide even greater energy savings. While the focus of the CEC project is to document the energy savings impact of the VRF-IEC hybrid system, the DR capability of this hybrid system is beyond the scope of CEC's direction.

However, the DR potential of the VRF-IEC hybrid system is a potentially compelling value proposition that merits demonstration. Being able to understand the DR characteristics of the hybrid system regulated by a "master controller" during all modes of operation (IEC Only, VRF Only, and simultaneous IEC and VRF) is critical to quantifying their DR impact.

2. Collaboration

This scope of work is an add-on to a larger CEC project that is focusing on the EE potential of the same combination of equipment and controls strategy. The results will also be shared with other CA IOUs during scheduled monthly DR-ET Leadership conference calls.

3. Status

The contract for this project was executed in late June 2018. The permit for this installation was received in August 2018. The HVAC installation promptly started three days after the permit was issued. Consideration has also been given to the placement and installation of the monitoring equipment.

4. Next Steps

The following are the next steps for this project:

- Hang new fan coil units.
- Run all electrical for indoor and outdoor units.
- Run all piping for indoor and outdoor units.
- Run condensate lines.
- Wire and set thermostats.
- Install data logging equipment.
- Start and commission units.

IV. Budget

Approved Budget per D.17-12-003 (dated December 14, 2017)

Program Approved Budget 2018-2022

	2018	2019	2020	2021	2022	TOTAL
ET-DR	$656,100	$675,900	$695,700	$717,300	$738,900	$3,483,900