March 18, 2019

Abigail Daken
U.S. Environmental Protection Agency
William Jefferson Clinton Building
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Subject: ENERGY STAR® Connected Criteria for Large Load Products Discussion Guide

Dear Ms. Daken:

This letter comprises the comments of the Pacific Gas and Electric Company (PG&E), San Diego Gas and Electric (SDG&E), and Southern California Edison (SCE) in response to the ENERGY STAR® Connected Criteria for Large Load Products Discussion Guide released on February 14, 2019.

The signatories of this letter, collectively referred to herein as the California Investor Owned Utilities (CA IOUs), represent some of the largest utility companies in the Western United States (U.S.), serving over 32 million customers. As energy companies, we understand the potential of the U.S. Environmental Protection Agency (EPA) ENERGY STAR program to cut costs and reduce consumption while maintaining or increasing consumer utility of the products. We have a responsibility to our customers to advocate for sensible test procedures, specifications, and voluntary certifications that accurately reflect the climate and conditions of our respective service areas to maximize the positive effects of these efforts.

We appreciate this opportunity to provide the following comments about the Connected Criteria for Large Load Products Discussion Guide.

General Feedback Request:

Issue #2: *What are the pros and cons of (demand response) DR application layer message translation locally in the product.*

In general, the CA IOUs support demand response (DR) application layer message translation locally in the product, but also support allowing translation at a central cloud for residential and small and medium business applications with the main requirement that both situations can communicate and demonstrate operability using the current Open Auto Demand Response (OpenADR) communication protocols and standards (currently OpenADR 2.0). The main goal is to use an open protocol to prevent stranded assets[1] and allow a customer to move between DR programs and aggregators without each time needing new equipment that can translate the new providers DR message. The CA IOUs made similar comments to the

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[1] Stranded assets occur when the automated DR load shed controls at a participating site such as a building are no longer able to communicate with the DR event initiation server and cannot automatically participate in a DR event. The DR program no longer realizes that DR load shed value unless manual DR measure initiation takes place at each event.

Smart Home Energy Management Systems Discussion Guide and appreciate that EPA continues to push for open standards within the Connected Criteria specifications.[2]

An additional focus that would result in great benefit is if the DR application layer message translation is local, it can translate multiple protocols including open protocols or standards as well as the proprietary protocols needed by the device manufacturer. Therefore, if the device is currently receiving a propriety signal and the manufacturer goes out of business then the device can switch to translating an open protocol or standard allowing the customer to still respond to DR events and pricing signals.

A major benefit of the DR application layer message translation locally in the product itself is that it greatly reduces the risk of a connected load becoming a stranded asset. It also eliminates the need for a customer to be in contract with or connected to a third party to participate in a DR program. This would increase customer choice in DR program participation. Additionally, each of these connected devices will currently, or in the future, record large amounts of data on the device operation that will be valuable to research and regulatory design. When each device uses multiple protocols, the data generated by devices can be made more accessible, rather than being locked within the manufacturers' proprietary communication pathway.

The major drawbacks of the DR application layer message translation locally in the product (as often highlighted by device or controls manufacturers) is the added upfront and ongoing cost from designing, building, and maintaining the ability of each device to have the knowledge for message translation instead of locating that feature at one central location. We also understand manufacturers have concerns regarding the complexity of some open standards or protocols that are built for such a variety of situations that are not even in use, including push/pull or telemetry, making the standard too complex for the simple actions needed for a specific device. Manufacturers have also had a desire to maintain control over their devices through a propriety control language, but we would instead want to promote the benefits of an open standard to enable customer choice and prevent stranded assets. The location of the DR application layer message translation has benefits and drawbacks described above that have led us to allow cloud level translation in certain situations to harness the benefits while still mitigating the risks.

Issue #3: *What are the pros and cons of products using a cloud connection for DR response?*

A cloud connection for DR is generally where the local device is only able to receive a proprietary signal from the cloud and minimal operational knowledge is stored or programmed at the device, but the control algorithms and computing processes are located at a central cloud. This is like Issue #2 above and common themes will be observed in both responses. With this interpretation, included below are the pros and cons of products using a cloud connection for DR response:

Pros - Products using a cloud connection for DR response have many advantages including reported lower cost of entry for intelligent systems as the primary computing capability hardware and software are not local to each device. This could be of benefit specifically to the small and medium business sector that requires cost-effective control technologies solutions. Additionally, a cloud connection is simpler and potentially decreases management burden for the utility by consolidating resource touch points. Finally, there is the potential reduction of utility resources to maintain device connectivity and instead responsibility can be moved to the manufacturer in the cloud.

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[2]https://www.energystar.gov/sites/default/files/CA%20IOU_SHEMS_Discussion%20Guide_Comments_7%2027%2018.pdf

Cons - Drawbacks to using a cloud connection for a DR response include increased potential for stranded assets, because if the manufacturer goes out of the business and the cloud no longer exists, devices cannot participate in DR or pricing events without the cloud intelligence and communication. Additionally, device and operational data is potentially only available to the cloud operator and not accessible to utilities, regulators, ENERGY STAR, or academia unless granted by the cloud operator. Finally, the customer is dependent on the cloud operator for DR participation and is limited to DR program choice based on capabilities of the cloud operator.

Issue #4: Is there a way to quantify the additional utility support that would be available for products that do have local application layer protocol translation and therefore are a less risky investment?

The CA IOUs currently implement an Auto Demand Response (ADR) program that offers incentives to customers to help offset the purchase and installation of enabling technologies that allow a customer's site to respond automatically to a DR event or price signal. As outlined in the January 24, 2019, advice letter (Advice 5472-E, Advice 3939-E, Advice 3336-E)[3] from all three CA IOUs, for commercial and industrial customers, the control must be onsite and able to communicate and demonstrate operability using the current OpenADR communication protocols and standards. For residential, and small and medium business customers, the control may be located either on site as a standalone device or part of a control system, or off site at the DR aggregator or provider cloud level. Therefore, the location of the protocol translation is already laid out in the ADR program requirements.

Issue #5: The flexible load resources these products could provide would be most useful to the grid if distribution system operators know where they sit in the grid topology. For instance, this would allow optimum use of these resources to alleviate distribution bottlenecks. What mechanisms are used currently to provide this insight (e.g. in program deployment)? Are there specification criteria that could facilitate this?

One way that California is enabling locational dispatch of resources for DR events is the California Independent System Operator (CAISO) has split up the state into 24 different sub-load aggregation points (sub-LAP). This allows for DR events to include one or more sub-LAP instead of only system-wide events and allows for different electricity prices based on location that can be used as DR triggers. To add additional granularity down to the city, feeder, or circuit level requires software that integrates information on location of devices with utility information on distribution level grid needs. This can be accomplished through a variety of software solutions, such as a demand response automation server (DRAS), a demand response management system (DRMS), or a distributed energy resource management system (DERMS) if that software with locational device information is integrated with the appropriate distribution needs software at the utility. This integration is challenging due to confidentiality and cybersecurity issues that must be addressed.

Pool Pump Feedback Request

Issue #1: Market Changes: In 2019 and 2021, ENERGY STAR requirements will reward increased availability of variable speed products. Further, Federal 2021 Standards are expected

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[3] https://cpucadviceletters.org/documents/4786/view/

to drive this market change further, which can support more advanced Demand Response. Is this anticipated to drive more pool pump DR products, interests, and programs?

Today, most major pool pump manufacturers offer variable-speed pool pumps with some level of connected-ready capabilities, and with the purchase and installation of an additional controller can become fully connected. This additional controller is typically sold as an additional piece of hardware which can be plugged in to a port or hard-wired to the variable-speed pool pump's controller/drive box. However, while there has been an ENERGY STAR "Connected Criteria" specification for pool pumps since 2015, as of March 2019 no manufacturers have certified their pool pumps to achieve ENERGY STAR's "Connected Criteria" level. The exact reasons for this are unknown, but likely include lack of pool pump specific DR programs, lack of consumer demand, and other utility incentive/ regulatory priorities for manufacturers. Fortunately, upcoming U.S. Department of Energy (DOE) standards in 2021 for dedicated-purpose pool pumps, combined with new ENERGY STAR specification levels, will increase the demand for variable-speed pool pumps nationally, many of which are connected-ready. This new product demand combined with an updated ENERGY STAR Connected Criteria specification creates a new opportunity for DR programs.

As EPA noted in the March 7, 2019, webinar, pool pumps have been used in DR and load management for many years, most prominently in Florida. Both Duke Energy[4] and Florida Power & Light[5] (FPL) have ongoing direct load control incentives for pool owners, where when called upon, a pool pump will be turned off by the utility in response to a DR event. These programs have been almost entirely focused on single-speed pool pumps, and in fact variable-speed pool pumps are not eligible in FPL's "Residential On-Call" program.

In a DR program with single-speed pool pumps, the load shed is easier to estimate/ predict, as nameplate horsepower can be used as proxy for power demand, and the load shed potential is the same for each event as the pool pump has one of two modes: on or off. A transition to variable-speed pool pumps creates new opportunities, but also challenges for DR programs. While every pool is operated differently, a commonly recommended energy efficient operation schedule will include at least 2 hours at high flow (approximately 50 gallons per minute (GPM)) to operate a pool cleaner, followed by an additional 8-10 hours per day at a lower flow (approximately 30 GPM) filtration setting depending on the size of the pool. Before variable-speed pool pumps, single-speed pumps would operate at one high speed, wasting significant amounts of energy pushing high flows of water against significant system head. Due to the pump affinity law, variable-speed pool pumps can perform much of the needed filtration pumping at a significantly lower speed and thus lower power draw. During the high-speed setting, power draw on average for medium and large self-priming dedicated-purpose pool pumps may be approximately 1.3 kilowatts (kW) whereas low speed might draw approximately 0.2 kW if set up properly. This power draw roughly represents the shipment-weighted average demand for medium (approximately 1.65 total horsepower motor) and large (approximately 3.25 total horsepower motor) self-priming dedicated purpose variable-speed pool pumps tested at the high and low flow test points in the DOE test procedure, in a California Energy Commission (Energy Commission or CEC) "Curve C" pool.[6] This standardized representative hydraulic system curve is meant to represent the total dynamic head present in a new swimming pool built to the California Building Energy Efficiency Standards (Title 24, Part 6) with 2.5-inch plumbing and a cartridge filter system.[7] Due note that actual power demand can fluctuate

[4] https://www.duke-energy.com/home/products/energywise-home
[5] https://www.fpl.com/save/programs/on-call.html
[6] https://www.regulations.gov/document?D=EERE-2015-BT-STD-0008-0105
[7] CEC also requires manufacturers to report flow and power demand data on three separate hydraulic system curves including two additional system curves: B & C. CEC Curve B is more restrictive and meant to represent a pool with a sand filter and 1.5-inch copper plumbing and CEV Curve A is meant to represent an average older pool with 2-inch plumbing and a cartridge filter.

significantly depending on pool hydraulic conditions (i.e. more or less restrictive plumbing) and flow set-points. Contractor and pool owner education in how to properly set-up and operate variable-speed pool pumps is critical to achieving energy savings.

As highlighted by EPA in the Discussion Guide, pool pumps can be a valuable flexible DR resource. Based on the definitions created by Lawrence Berkeley National Lab in the 2015 California Demand Response Potential Study,[8] connected pool pumps can be an ideal resource for three of the four types of DR: shape, shift, and shed. The ability of pool pumps to fulfill these types of DR are explained below.

Shape captures DR that reshapes customer load profiles through price response or on behavioral campaigns "load-modifying DR" with advance notice ranging from months to days.

- With many pool pumps operating 365 days per year there is significant opportunity to "shape" the load on a medium- to long-term basis using economic signals, such as time-of-use (TOU) rates as pool pumps are generally a "set-it and forget-it" type home appliance. However, connectivity offers the ability to shape the demand each week, month, or season to best meet the needs of the grid. From a utilities' perspective, just having the knowledge of when a pool pump is operating and being able to contrast that with the customer's rate schedule provides an opportunity to inform customers to shape the load and save money. More specifically, in California, a time-of-use rate will become the default rate for most residential customers starting in 2019. Therefore, there will be a near-term opportunity to help pool owners in our service territories shift load to off-peak hours and away from evening peak periods (e.g., 4 to 9 pm). ENERGY STAR Connected Criteria for pool pumps has the ability to help manufacturers, utilities, and pool owners better understand and modify pool pump operating schedules to save money on their utility bills.

Shift represents DR that encourages the movement of energy consumption from times of high demand to times of day when there is a surplus of renewable generation. Shift could smooth net load ramps associated with daily patterns of solar energy generation.

- Increasing load is likely the most unique attribute of pool pumps relative to other residential loads. Simply put, a pool cannot technically be "over-pumped" or "over-filtered." Customer bill impacts aside, pool pumps can easily be called upon to absorb load, and pools will only become cleaner with no impact to chemical levels. However, how much a pool pump can absorb is a function of the pool pump and the pool plumbing system. Often, many variable-speed pool pumps are oversized for what is needed. This is a function of there being limited sizes of products in the market and the practicality of a variable-speed pool pump being a one-size-fits-all solution. For example, a pool service contractor may keep a 3 total horsepower variable-speed pool pump on the truck or in their shop knowing it could meet the needs of any residential pool. However, just because a pool pump *can* ramp to 3,450 revolutions per minutes (RPM) and draw (absorb) approximately 2.5 kW does not mean that every pool's plumbing system *should* be subject to these higher flows. While less of a concern on newer pools built with larger 2.5-inch plumbing, to minimize the already low risk of plumbing damage, a reasonable upper limit should be implemented which will likely be less than the pool pump's full capacity. While this issue should be discussed with manufacturers, a potential good and conservative rule of thumb would be to not to operate the pump higher than the current highest speed setting set by the customer or pool service contractor, or some percentage above this highest speed setting.

Shed describes loads that can be curtailed to provide peak capacity and support the system in emergency or contingency events at the statewide level, in local areas of high load, and on the distribution system, with a range in dispatch advance notice times.

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[8] https://drrc.lbl.gov/project/2015-california-study

- In the sense of traditional DR, pool pumps can reduce or shed load. This is the only DR action pool pumps have performed at scale, as evidenced by the DR programs which have historically been operated in Florida. Because residential pool pumps are not a critical load, this can be done in numerous ways. The most obvious is to turn off the pump completely during an event. However, as the pool pump market continues to transform to variable-speed design, the magnitude (kW) of the opportunity generally decreases. Pool pumps *should* be mostly operating at a low-speed filtration mode with a load around 0.2 kW during most hours of operation. This load itself is likely not significant enough to shed alone. However, as mentioned, it is recommended that variable-speed pool pumps operate for at least a couple hours at a higher speed for to operate a pool cleaner, presenting a larger load to shed, on average of 1.3 kW. This load also can be reduced with little to no interactive effects with other equipment, aside from slightly reduced cleaning performance. On occasion this is not a significant issue, however were the cleaning mode to be reduced on a regular basis, pool cleanliness may be impacted, and customer acceptance may erode over time.

Issue #2: What are the technical barriers to pool pump DR and to creating an out-of-the-box connected product? Would industry or reference standards mitigate some of these issues?

Pool pump manufacturers are better suited to speak to the technical barriers to creating an out-of-the-box connected product, especially in the framework of an application layer translation as proposed by EPA. However, there are technical constraints regarding the pool and plumbing situation a connected pool pump will be placed into in the field. Simply put, the same pool pump in one pool may have a very different DR potential or different consideration than another pool. Two technical issues/considerations are described below.

System Effects
The pool pump is at the center of each pool's circulation system and pumps water through or to other flow dependent equipment, such as filters, heaters, solar thermal systems, auxiliary pumps (e.g., pressure cleaner booster pumps), in-ground pool cleaners, and chemical treatment systems (e.g., chlorinators, salt generators). It is important to keep in mind that when flow (or motor speed) is changed, everything in the pool system is impacted. In some pools, pump flow may be interdependent between equipment, meaning steps must be taken to ensure pump safety when recommending or implementing a DR strategy. For example, a pressure cleaner booster pump (used to power an in-ground pool floor robotic cleaner) relies on the flow from the filtration pump to operate. If the filtration pump turns completely off due to a DR event without a proper signal to the pressure cleaner booster pump, it could cause the pressure cleaner booster pump to run dry which eventually may lead to failure. It should be noted that most manufacturers are accounting for this with auxiliary connection ports, but ensuring this functionality is actually installed and connected in the field is important.

A common DR use-case often mentioned for pool pumps is the ability to absorb power, as you cannot "over-pump" a pool. However, as mentioned above in Issue #1 just because a pool pump *can* operate at full speed at 2.5 kW at 100 GPM, does not mean that it should. In other words, just because your car's speedometer goes up to 100 mph, does not mean that it is safe or sustainable to operate at that speed on a regular basis. Similarly, just because a pool pump can be turned down to 15 GPM and a does not mean that is a useful flow. The flow may be too low to properly operate a salt chlorine generator, provide flow to a pressure cleaner booster pump or to even prime the pump upon start-up. In today's market variable-speed pool pumps are essentially a "one-size fits all" such that they can be adopted to any pool's unique

needs, or hydraulic system. This is a huge asset for DR, but any program design will need proper guardrails to ensure proper long-term DR use in pools.

Providing pool owners, the assurance that their pool pump will be operated within reasonable and responsible range of flows will be critical to scaling any pool pump DR program. EPA may be able to help in the facilitation of a discussion with manufacturers and utilities relating to reasonable target upper and lower bounds for flow/RPM for DR events and other program guidelines to ensure customer acceptance.

Backyard Connectivity Issues
Pool pumps are often located at a significant distance from the house, which can make reliable connection to the Wifi network more challenging. This is a technical challenge which many manufacturers have worked to remedy through use of range extenders and other technologies. This is can be a technical challenge in certain applications and non-existent in others, but it may also impact the overall cost for connecting pool pumps.

Issue #3: *What are the current adoption barriers for pool pump DR? Stakeholders have previously mentioned: first cost, lack of equipped products, and lack of consumer interest/awareness. Will Connected Criteria lower some of these barriers?*

Pool pumps have traditionally been a "set-it and forget-it" type of appliance. Unlike thermostats or electric vehicle service equipment (EVSE) homeowners with pools are generally indifferent as to when their pool pump operates so long as the pool is clean, it is not noisy, and utility bills are not unexpectedly high. Certainly, there are homeowners who desire connectivity to remotely turn on spa jets, pool/spa lights, or adjust pool temperature, and in recent years major pool pump manufacturers have responded with more affordable connected offerings tailored for the common backyard pool. Based on conversations with manufacturers this simple connectivity market segment is growing but is still a small part of the market. An updated Connected Criteria certification from ENERGY STAR will help, but absent DR program innovation the market may not grow to a level enough to eventually enable widespread DR.

For many pool owners and pool service professionals, the driving objective through the swim season is to not have a dirty or "green" pool (i.e. algae). While chemical imbalances are often culprit for water quality issues, any modifications to daily pool pump operation will be scrutinized should water quality be negatively impacted. Most pool service professionals and manufacturers understand that so long as daily filtration is eventually completed, there is significant flexibility as to when or at what flow this daily water turnover is achieved. However, among pool owners and even some utility industry professionals there is concern about how a pool pump program would impact pool water quality, and this is a barrier for developing and participating in DR programs. There is no literature, data, or studies that can help show that pool pump DR programs would have a neutral impact on water quality. To the extent EPA can assist with overcoming this barrier, manufacturers, utilities, and program implementers will have an easier time designing and growing pool pump DR programs.

Issue #4: First cost is often considered a key driver in pool pump purchases. Does the industry anticipate the incremental costs for connected and DR equipped pool products to decrease significantly? What would help drive adoption to reach a critical mass?

The incremental cost to connect and remotely control a pool pumps flow/speed/schedule varies significantly across manufacturers, with the connected controller itself ranging from $85 to over $300[9], not including labor. Importantly, some manufacturers can add their connected controllers to most all their historic line of variable-speed products, while other manufacturers' connected offerings will only work with newer pool pumps specifically designed to be connected.

We encourage EPA to consider the ability to be able to certify or recognize a controller sold standalone (without the pool pump) as meeting "Connected Criteria" within the upcoming pool pump specification. This could enable much wider adoption of connected technology on the large installed base of energy-efficient multi/variable-speed (and likely ENERGY STAR certified) pool pump equipment. These "add-on" connected controllers include but are likely not limited to products, such as the Pentair IntelliConnect[10] and Jandy IQPUMP01[11] and are marketed as entry level products to enable easy connected control over a pool pump.

Issue #5: What data would pool pumps need to be able to send to a DR management entity (DRMS, etc.) about their state to optimize usefulness to the grid (e.g. daily filtering remaining)?

Significant work has already been completed in terms of DR protocols within existing ENERGY STAR Connected Criteria specification. However, daily filtering remaining (in gallons or time, etc.) would useful for a DRMS to know because as mentioned above, ensuring (and proving) each pool is properly circulated and cleaned will be critical to the long-term success in implementing and managing pool pump DR programs. The CA IOUs look forward to engaging with manufacturers in the revision of the Connected Criteria specification for pool pumps in the coming year. The CA IOUs encourage EPA to facilitate workshops and meetings to collaboratively work through the various issues with all necessary stakeholders.

Other General Comments

The CA IOUs would like to point out that replacement pool pump motors also have the ability to provide connectivity (such as the Century Motors VLink[12]). Currently, replacement pool pump motors do not have a federal minimum standard level, though a joint recommendation from manufacturers and efficiency advocates (including the CA IOUs) was submitted to the DOE on August 14, 2018.[13] We appreciate EPA maintaining a placeholder in the current ENERGY STAR specification version 2 for replacement pool pump motors and encourage EPA to allow replacement pool pump motors to be eligible for Connected Criteria certification when energy efficiency levels are eventually revisited.

Central Air-Conditioning/Air-Source Heat Pump Feedback Request

As previously mentioned, the CA IOUs support the use of on-premise open standards, such as OpenADR 2.0, and its potential for use in Central Air-Conditioning/Air-Source Heat Pump equipment. Specifically, SCE's emerging technology team has been involved in the development of the draft Air-Conditioning,

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[9] Incremental cost values based on conversations with manufacturers and previous online searches. Note that in 2018 some manufacturers started removing products (and thus pricing) from internet retailers, which instead means customers have to purchase through authorized professionals.
[10] https://www.pentair.com/en/applications/enjoying-water/pool-spa-equipment/pool-automation/intelliconnect.html
[11] https://www.jandy.com/en/products/pumps/variable-speed/iqpump01
[12] http://www.inyopools.com/Products/00202536082391.htm?gclid=EAIaIQobChMI856wzIb94AIVJBh9Ch2lDAHdEAQYASABEgJM6_D_BwE
[13] https://www.regulations.gov/document?D=EERE-2017-BT-STD-0048-0014

Heating, and Refrigeration Institute (AHRI) 1380p Standard and will continue to engage to ensure the final specification reflects issues of importance the CA IOUs and DR applicability broadly in California.

Water Heater Feedback Request

The CA IOUs see heat pump water heaters (HPWHs) as a significant DR resource and look forward to engaging in the development of the "Connected Criteria" specification this year (2019).

In recent years, the CA IOUs have been working to support the development of building standards in California to enable HPWHs and connected capabilities. For the 2016 Title 24, Part 6 building code cycle, the CA IOUs supported the Energy Commission in updating the compliance software to better model HPWHs. For the 2019 Title 24, Part 6 building code cycle, the CA IOUs supported the development of a prescriptive pathway for single family buildings that allows for the installation of HPHWs. One of the two prescriptive pathways that calls for the use of HPWHs requires a HPWH that meets the requirements of the NEEA Advanced Water Heater Specification Tier 3 or higher. It should be noted that NEEA Tier 2 and higher HPWHs have DR capabilities. Most recently, SCE served on the steering committee of a 2018 study led by Natural Resource Defense Council and Ecotope which evaluated the DR potential of HPWHs.[14]

The CA IOUs view HPWHs as a significant DR resource and look forward to engaging in the development of the "Connected Criteria" specification this year (2019).

EVSE Feedback Request

Issue #3: Have EVSE manufacturers adopted the ISO 15118 standard into their network-connected products or do they plan to have ISO 15118-capable EVSE in the future?

The CA IOUs recognize the value and potential role of ISO 15118, but would urge caution if EPA is considering designating ISO 15118 as an exclusive or preferred approach to implementing DR or vehicle-grid integration (VGI). For more discussion, please refer to April 2018 comments during the California Public Utilities Commission (CPUC) VGI working group by the CA electric IOUs as well as other utilities, automakers, and stakeholders.[15]

Commercially available EVSE hardware within the U.S. does not appear to currently support ISO 15118, except within specific small-scale pilots, as indicated by several manufacturers during the CPUC VGI working group process.[16] For instance, Greenlots identified that they have experimented with SEP 2.0 (with the Electric Power Research Institute (EPRI)) and precursor ISO 15118 communications (with automakers and utilities) and are involved with the Open Vehicle Grid Integration Platform.[17] The Oxygen Initiative noted that they currently operate an Energy Commission demonstration project at University of California San Diego with 26 Level 2 Alternating Current (AC) charging stations serving 80

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[14] https://aceee.org/sites/default/files/pdf/conferences/hwf/2018/2a-delforge.pdf
[15] "March 21, 2018 Opening Comments of the Joint Parties on Assigned Commissioner's Ruling Seeking Comment on Vehicle-Integration Communication Protocol Working Group Energy Division Staff Report." March 21, 2018.
[16] "March 21, 2018 Opening Comments of the Joint Parties on Assigned Commissioner's Ruling Seeking Comment on Vehicle-Integration Communication Protocol Working Group Energy Division Staff Report." March 21, 2018.
[17] "Opening Comments of Greenlots on Assigned Commissioner's ruling Seeking Comment on Vehicle-Grid Integration Communication Protocol Working Group Energy Division Staff Report." March 21, 2018.

ISO 15118 vehicles.[18] Additionally, ChargePoint commented that they are participating in an Energy Commission Electric Program Investment Charge (EPIC) Program pilot with SDG&E regarding the implementation of ISO 15118 in residential applications and in a PG&E Excess Supply Pilot focused on shifting charging patterns to align with solar generation.[19]

Issue #4: If EPA were to develop a grid response test method, what issues specific to EVSE would need to be addressed?

One challenge is to determine which capabilities and functions should be included in testing. Some basic functionality that should be included is the ability to communicate a DR response, provide a response to the entity calling for the DR event and allowing a customer over-ride to opt-out. We also note that there are many other potential services (price response, grid support, demand charge mitigation, on-site renewables integration) that could be included and reported but may be too difficult to define via a test method at this time.

Another challenge would be creating a test method that replicates an EVSE's role in the overall ecosystem of market actors. Table 1 identifies several potential communications "domains" in a Level 2 AC conductive charging multi-user environment (along with supportable protocols), such as 1) communications between the EVSE and a "Power Flow Entity" (PFE), such as a utility, and 2) between the EVSE and electric vehicle (EV). We note that other actors not listed in Table 1 may also be involved, depending on the use case (such as a third-party aggregator) similar to DR programs for other end loads.

Table 1: Domain Identified Supportable Communications Protocols to Enable VGI High Level Communications for L2/AC/Conductive Charging in Multi User Environments

Domain for Communications	Supportable Protocols (Currently Available)
PFE to EV	IEEE 2030.5 (Utilizes EVSE as a bridge/not a gateway) J2847/J2836 (Implementation of IEEE 2030.5) Telematics (for IEEE 2030.5 can support)
PFE to EVSE	IEEE 2030.5 OpenADR 2b OCPP 1.6
EVSE to EV	IEEE 2030.5 ISO/IEC 15118
Vehicle OEM to EV	Telematics (IEEE2030.5 or OEM Proprietary)

Source: http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442457079

Issue #5: What are the business models of companies currently offering grid services through EVSE?

A number of business models are being tested in pilots involving many types of use cases. (Note, the aforementioned CPUC VGI Workgroup identified a total of 77 different potential use cases.) While "[t]here is no commercial implementation/development of VGI technologies to date…",[20] we believe that some general observations are possible. First, we agree with comments during the March 7, 2019, ENERGY STAR webinar that "smart charging" is a more immediate opportunity compared to "vehicle-to-grid" or "vehicle-to-building" services that rely on two-way energy flow. While all three of these

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[18] "Comments of Oxygen Initiative on Assigned Commissioner's Ruling on Vehicle-Grid Integration Communication Protocol Working Group Energy Division Staff Report." March 21, 2018.

[19] "Chargepoint, Inc. Comments on Vehicle-Grid Integration Communication Protocol Working Group Energy Division Staff Report." No Date.

[20] Sunil Chhaya, EPRI, Vehicle Grid Integration Roadmap Update, October 30, 2018.

opportunities have tremendous potential value, smart charging is more widely deployed through CA IOUs pilots and programs, several of which are summarized in Appendix A.

Secondly, we believe that use cases can be evaluated based on several dimensions shown in **Error! Reference source not found.**.

Table 2: VGI Dimensions

User sectors	Residential, commercial (i.e., fleet, workplace, and public), and ride-share
Types	V1G and V2G, including V2B
Applications	Customer load management, distribution and transmission reliability services, wholesale energy, and resource adequacy services
Approaches	Indirect control (price signaling), direct control (dispatching)
Vehicle classes	Light duty, MDV, and HDV, including non-road classes
Charging types	AC (L1 and L2) and DC

Source: Pacific Gas and Electric Company comments on Vehicle Grid Integration Roadmap Update, PGE, 9/21/2018 and Joint Party Comments Re VGI Roadmap Webinar, Joint Parties 10/4/2018.

We also wish to provide comments on several details of the Discussion Guide related to business models and use cases. First, the Discussion Guide states that EVSE in single family homes are less likely than EVSE in multifamily housing and workplaces to contain authentication and billing features that could also be leveraged for VGI. While we agree, the also we note that 70 percent of light-duty vehicle charging today is at single family residences and should be considered, along with multifamily and workplace charging, for VGI use-cases.[21] In addition, the timing of grid impacts caused by the electricity load from residential charging are likely to coincidence with peak electric system needs.

We also note that the Discussion Guide states that EV owners would not want a load control event to prevent them from using Direct Current (DC) Fast Charging, with the possible exception that VGI may be viable for facilities seeking to integrate onsite renewables or with storage. We believe that the possible use cases for DC Fast Charging could be broader and encompass grid services. For instance, we note that in long-dwell applications (i.e., cars that are connected for an extended period, such as workplace charging) DC Fast Chargers could maximum shaping of EV charging load and/or mitigate demand charges. (We also recognizing that this is one of many possible use cases that has not yet been proven.)

Webinar Question: How can ENERGY STAR make the Qualified Product listings as useful as possible?

We recommend creating a distinction field for manufacturers to list available communications functions and protocols when listing ENERGY STAR qualified product capabilities.

The current ENERGY STAR EVSE specification contains useful suggested criteria for DR but they appear to be addressed inconsistently. For example, five products are listed with communications protocols that appear to support networking capabilities, but they are not marked as being able to support networking capabilities. Conversely, one product is listed with networking capabilities, but the listing does not contain information about the communications function that enables networking capabilities. Six

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[21] Joint Party Comments Re VGI Roadmap Webinar, Joint Parties, 10/4/2018.

products are listed as capable of "connected" functionality, along with a list of communications features that also include a description of that capability. For more information, please see Appendix B.

Low-Power Mode and Energy Efficiency Trade-Offs

The CA IOUs encourage EPA to consider and limit low-power mode consumption in upcoming Connected Criteria specifications. Although the power required to deliver connected functionality (often in low-power or standby modes) is generally significantly lower than active mode power of the loads considered in this Discussion Guide, the CA IOUs encourage EPA to require that products provide connectivity in an energy efficient manner. This is especially important for consumers who are unable to participate in utility DR programs, to ensure that the additional functionality does not waste energy or increase consumer utility bills. To ensure efficient implementation of the connected functionality, EPA should consider (1) a connected low-power mode test method and (2) power allowances for the connected function. More specifically, the CA IOUs encourage EPA to develop a connected low-power mode test method that can be applied to all large connected loads to decrease test burden and allow comparisons between product types. If EPA determines that a power allowance is needed for the connected functionality, the CA IOUs encourage EPA to use a wattage adder (e.g., connected products are allowed X watt additional power) similar to the EVSE ENERGY STAR Specification V1.0, rather than a percent increase in allowed energy use or other incentive. The allowance should be enough to allow products with efficient connected functionality to qualify for ENERGY STAR, but no larger.

In conclusion, we wish to reiterate our support to EPA for developing the ENERGY STAR Large Load Discussion Guide, and we encourage EPA to carefully consider our comments.
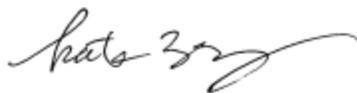
Sincerely,

Patrick Eilert
Manager, Codes & Standards
Pacific Gas and Electric Company

Michelle Thomas
Manager, Energy Codes & Standards and ZNE
Engineering Services
Southern California Edison

Kate Zeng
ETP/C&S/ZNE Manager
Customer Programs
San Diego Gas & Electric Company

Appendix A: List of Example California VGI Pilots

Los Angeles Air Force Base V2G Pilot

Electrification of non-tactical vehicle fleets represents a key efficiency and energy security objective for the U.S. Department of Defense (DoD). To achieve electrification, the DoD has targeted vehicle-to-grid services to decrease the overall cost of operating the vehicle fleet and achieve rough parity with traditional internal combustion vehicle fleets. Among other planned demonstrations, a mixed purpose 29-vehicle plug-in electrical vehicle (PEV) pilot test fleet is deployed at the Los Angeles Air Force base (LA AFB). The LA AFB fleet provided frequency regulation, a V2G service, to the California Independent System Operator (CAISO) wholesale electricity market. The project also analyzed the potential to use these electric vehicles to support critical infrastructure on the base in the event of an emergency. The vehicles (sedans, vans, pickup trucks, box trucks, and a bus) are a mix of plug-in hybrid electric vehicles and pure battery electric vehicles capable of charging and discharging via both AC level 2 and DC fast charging interfaces. The charging infrastructure is a mix of AC and DC charging, in which the AC level 2 charging is limited to 15 kW and DC fast charging is between 15 and 50 kW.

Source: EV Charging Station and Los Angeles Air Force Base V2G Pilot Technical Evaluations, Jordan Smith, Southern California Edison, Fall 2017

San Diego Gas & Electric (SDG&E) Power Your Drive (PYD) Program

The Power Your Drive pilot program is designed to increase adoption of electrical vehicles and integrate the charging of electric vehicles (EVs) with the grid through variable hourly rates. Power Your Drive seeks to satisfy this objective through the installation of up to 3,500 EV charging stations at apartments, condominiums and workplaces. As of August 31st, 2018, SDG&E has completed and energized installations at 85 sites, which includes 932 charging stations. SDG&E coordinates the design, permitting, construction, and commissioning of the charging stations. Once drivers begin charging, SDG&E handles the billing, customer support, and all maintenance for the charging equipment.

Power Your Drive is intended to encourage EV charging during periods of lower grid utilization through the implementation of a program specific hourly rate that is calculated for each circuit based on projected demand and communicated to driver participants on a day-ahead basis. Since the rate is hourly, it is designed to be more flexible than typical off-peak and on-peak Time-of-Use rate schedules.

Figure 1 below illustrates load shifting from SDG&E's peak (4:00 p.m. – 9:00 p.m.) to off-peak hours via the PYD program. The Tiered Rate covers the whole home usage of EV drivers and the EV TOU rate covers sub-metered EV usage.
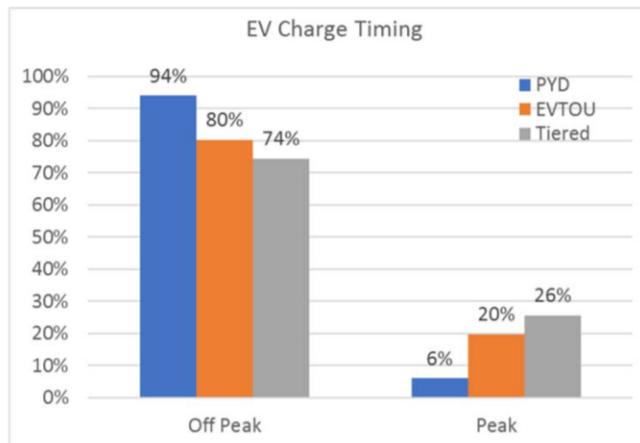
Figure 1: EV Charge Timing for Different Rate Structures

In addition, as of August 31, 2018, SDG&E has 505 employees driving EVs, and has installed more than 253 grid-integrated EV charging stations at 21 company work locations.

Source: "[Electric Vehicle Grid Integration Pilot Program ('Power Your Drive') Fifth Semi-Annual Report (Corrected) of San Diego Gas & Electric Company](#)", February 12, 2019.

Irvine Smart Grid Pilot
Southern California Edison (SCE) is conducting an end-to-end demonstration of numerous Smart Grid technologies necessary to meet state and federal policy goals for the year 2020. The Irvine Smart Grid Demonstration (ISGD) project will investigate the use of phasor measurement technology to enable deep, substation-level situational awareness. The project scope includes customer homes, where the integration, monitoring, control, and efficacy of home area network devices, such as energy management systems, smart appliances, energy storage, and photovoltaic systems will be demonstrated. The impact of device-specific DR, as well as load management capabilities involving energy storage devices and plug-in electric vehicle charging equipment will also be assessed. DR events will use the protocol standards being adopted by Advanced Metering Infrastructure programs, such as Edison SmartConnect®. The project results will also demonstrate the next generation of Substation Automation (SA-3), an automation and control design based on the open standard IEC-61850. This is expected to provide measurable engineering, operations, and maintenance benefits through improved safety, security, and reliability. Source: Southern California Edison Company. "[Irvine Smart Grid Demonstration](#)."

SCE Residential Smart Charging Pilot
The Pilot acquired and evaluated a variety of technologies, both in the lab and in the field, supporting newly developed communications standards for load management of EV charging. The goals of the Pilot were twofold:
1) Evaluate and possibly recommend a variety of residential-based smart charging technologies that utilize non-advanced metering infrastructure (AMI) communications — including the internet and standardized protocols — in order to sub-meter EV charging, provide real time demand and interval energy data, manage EV loads, and enable customer control (opt-in/opt-out functionality); and
2) Create a common set of requirements and technologies SCE can leverage for future EV or other load management pilots or programs.

Direct communications mean an architecture where SCE communicates directly to customer devices without a 3rd party. For the Pilot, SCE communicated DR signals directly to EVSEs via an internet gateway (GW) that was an Ethernet/SEP 2.0 client on the Wide Area Network (WAN) side and Wi-Fi access point/SEP 2.0 server on the Local Area Network (LAN) side. The GW was an essential part of the pilot as it allowed for separation of SCE's test network and existing customer networks.

The Pilot evaluated two possible 'paths' of over the internet communication that could be deployed for residential EV load management programs: Direct and Business to Business (B2B), represented by Figure 1 below. SCE used OpenADR 2.0 to communicate to the 3rd party and Smart Energy Profile 2.0 (SEP 2.0; also known as IEEE 2030.5) to communicate to the customer devices. Figure 2 below illustrates the architecture for each of these two paths.
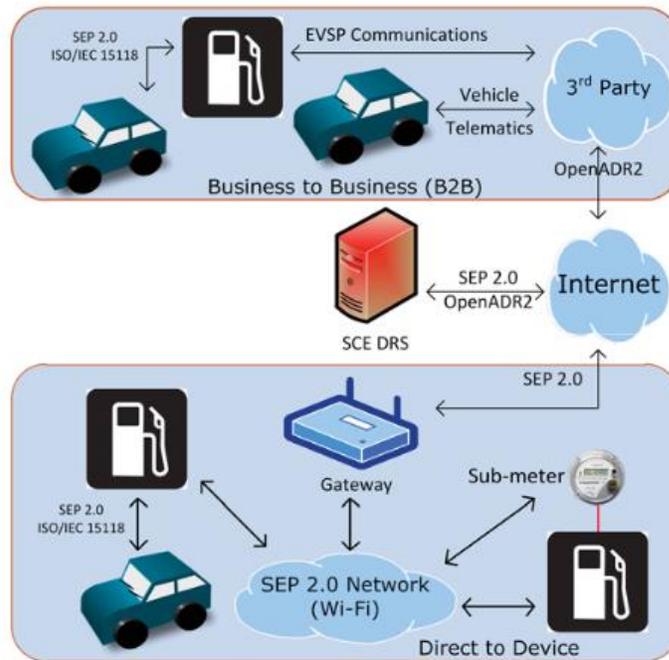
Figure 2: Smart Charging Pilot Architecture

Source: Southern California Edison Company's (U 338-E) Smart Charging Pilot Final Report, May 2016.

PG&E and BMW's i ChargeForward Pilot
The BMW i ChargeForward Project successfully tested the feasibility of using managed EV charging as a flexible grid resource. Over the course of 18 months, from July 2015 to December 2016, the i ChargeForward Project dispatched 209 DR events, totaling 19,500 kilowatt-hours using an OpenADR protocol. The Project has shown the ability for electric vehicles to provide viable grid services using the vehicle telematics system as a basis for communicating grid messages to vehicles. The grid services demonstrated in this pilot included Day Ahead and Real Time Energy, which were modeled after existing proxy demand resources from the California Independent System Operator. These grid services have the potential to result in cost savings associated with operating and maintaining the grid as well as owning an electric vehicle. For each DR event, BMW provided PG&E with 100kW of grid resources by delaying charging for approximately 100 BMW i3 vehicles in the San Francisco Bay Area and drawing from a BMW Group 2nd life stationary battery system built from reused EV batteries, for a duration of one hour. BMW is currently expanding the project to a pool of over 250 vehicles.

Source: Julia Pyper, BMW and PG&E Prove Electric Vehicles Could Be a Valuable Grid Resources, GreenTech Media, June 20, 2017; "BMW ChargeForward".

Torrance Unified School District Electric School Bus V2G Project
The project is intended to demonstrate the vehicle-to-grid (V2G) and vehicle-to-building (V2B) benefits of energy and building management to fleet services, such as school districts. This creates the opportunity for the buses' owners to participate in "ancillary service" wholesale electricity markets and help offset the capital costs of electric buses. Outbound electricity can also be retained for "behind the meter" use, i.e., by buildings and operations that are supplied by the same electric service used to charge the bus.

Source: Torrance Electric School Buses, Nuvve; February 7, 2014 Board Meeting Agenda Item No. 10, South Coast AQMD

Appendix B: Example ENERGY STAR Products Listed as Having "Communications Capabilities" or Network Functions

	Manufacturer	Model	Level	Maximum Nameplate Output	Outputs	"Network Protocol with Wake Capability"
EVSE products identified as having "connected" functionality	Aptiv Services	NA-GM-Chargecord	Level 1	120V/12A	1	Not Listed
	ChargePoint	CPH25	Level 2	240V/32A	1	Wi-Fi or Gigabit Ethernet
	ChargePoint	CPH12	Level 2	240V/16A	1	Wi-Fi or Gigabit Ethernet
	ChargePoint	CPF25	Level 2	240V/32A	1	Wi-Fi or Gigabit Ethernet
	ChargePoint	CT4000	Level 2	208V/30A	1	Wi-Fi, Gigabit Ethernet, or Cellular
	ChargePoint	CT 402X	Level 2	208V/16A or 30A	2	Wi-Fi, Gigabit Ethernet, or Cellular
	ChargePoint	CT 402X	Level 1/2	208V/24A	2	Wi-Fi, Gigabit Ethernet, or Cellular
Additional EVSE products listed with communications capabilities	Electric Electric Motor Werks, Inc.	JuiceBox Pro 40	Level 2	240V/40A	1	Wi-Fi or Gigabit Ethernet
	EVBox North America, Inc	B2320-65063	Level 2	120V/32A*	1	Cellular
	Blink Network	Blink IQ 200 Advanced: IQW2-80U-M1-R2-N-25	Level 2	240V/80A	1	Wi-Fi, Gigabit Ethernet, Other LAN (Local Area Network), or Cellular
	Blink Network	Blink IQ 200 Advanced: IQW2-80U-W1-N1-N-25	Level 2	240V/80A	1	Wi-Fi, Gigabit Ethernet, Other LAN (Local Area Network), or Cellular
	Sema Connect	Model 620	Level 2	240V/30A	1	Cellular

* According to a product listing issued by NYSERDA, this product operates at 6.6/7.4kW at 32A rated output, which equates to 208V/240V, respectively. - see "CHARGING EQUIPMENT MODEL B2320-65063-04 and B2323-65063-04" at https://www.nyserda.ny.gov/All-Programs/Programs/ChargeNY/Charge-Electric/Charging-Station-Programs/Charge-Ready-NY/Qualified-Charging-Equipment-and-Networks

Source: ENERGY STAR Product Finder March 10, 2019.