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PG&E Automated Demand Response Collaborative Stakeholder Process Study

Final Report

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Executive Summary

The residential segment of PG&E's ADR program has been underway since 2017 and currently provides incentives for a limited number of manufacturers of smart thermostats. PG&E is considering expanding the list of technologies that qualify for rebates under its 2020-2022 residential ADR program. The focus is on automated control devices for the residential sector without a homeowner's manual intervention which leverages the OpenADR standard to achieve peak demand savings. To accomplish this goal, PG&E initiated a collaborative stakeholder process to identify technologies for this program, and its stakeholder group selected Opinion Dynamics, with subcontractor Extensible Energy, as a consultant (hereafter referred to as "the study team") to lead this process.

The study team first set forth a high-level framework that can govern a collaborative and transparent technology selection process where technology solution providers, utilities and other stakeholders can share and contribute. Of most importance, this framework established the technology selection criteria that guided the design of the Request for Information (RFI) and the technology assessment process, which concurrently address California's state policy goals and the key priorities of the PG&E program. The selection criteria consisted of: a) prerequisite screening based on the control technology's OpenADR certification status and residential suitability; b) policy directives of eligible end-use device types by the control technology; c) demand impact; d) demand flexibility; e) market readiness and technology validity; and f) technology cost.

Based on this framework, the study team developed the online data collection intake form and distributed the RFI to a list of over 250 stakeholders and technology providers whom the team identified as potential informants using various sources. The RFI was open to any technology providers for submissions during the month of November 2019. The study team received control technology applications from fourteen manufacturers. The study team categorized respondents into one of six control types: Air Conditioner (AC) and plug load control, AI-based energy management platform, energy management automation control system device, EV charging control, smart thermostat, and water heater control.

The team thoroughly reviewed submitted materials of each control technology based on the selection criteria and eliminated technologies that did not minimally satisfy the criteria. The team also considered two additional criteria for screening at this point: g) controls designed to affect a single end-use device; and h) exclusion of smart thermostats. For the five control technologies that passed all the selection criteria, the team contacted the utility reference contacts the applicants provided to gather their perspectives from their experiences working with the manufacturers and the technologies.

Based on the combined assessment, the team recommended PG&E adds none of the final candidate technologies to the current OpenADR program due to a lack of 1) demonstrated field testings of OpenADR communications from the utility down to the end device, and/ or 2) experience implementing controls at a utility-scale comparable to PG&E's service territory. The team further recommended that PG&E begins two technology demonstrations with water heater controls and EV chargers (four of the final candidate technologies) through the Demand Response Emerging Technologies (DRET) program.

Additionally, the study team made four recommendations for PG&E's consideration for future technology selection: 1) broadening the OpenADR compliance requirement to invite vendors with OpenADR-certified head-end systems even if their end-devices are not OpenADR certified; 2) developing methodologies to calculate per-device rebates for multi end-use controls systems; 3) broadening the device-focus eligibility by explicitly inviting vendors that provide software-based control solutions; 4) adding a market research component to future RFI development to more fully understand the technology market condition.

1. Introduction

Automated demand response (ADR), which in its residential application provides demand reduction without a homeowner intervening manually, will play an increasingly important role in meeting future energy needs. ADR solutions typically include controls for end-use technologies such as lighting, thermostats, pool pumps, and water heaters (hereafter referred to as controlled devices). As both the ADR control technologies and the controlled devices evolve, California stakeholders have been developing strategies to estimate the potential value of various automated controls in order to ultimately prioritize potential market-stimulating rebates.

The residential segment of PG&E's ADR program has been underway since 2017 and currently provides incentives for a limited number of manufacturers of smart thermostats. In Demand Response Application A.17-01-012, PG&E proposed a Settlement Agreement that set forth a framework for a collaborative stakeholder process. The objective of this process is to develop a list of residential ADR-enabled end-use devices to be considered for eligibility for an ADR incentive and criteria to determine the order in which the load impact study for the technologies should be implemented. In October of 2018 PG&E selected Opinion Dynamics[1] as a consultant to lead this process.

This report documents the collaborative stakeholder process study as implemented by Opinion Dynamics and directed by PG&E. Chapter 2 describes the framework that guided the overall technology selection process including the roles of stakeholders. Chapter 3 presents the criteria upon which the prioritization of control technologies rests. Chapter 4 outlines the process and strategies taken to solicit technologies including the development of the list of stakeholders and technology providers and intake form. Chapter 5 discusses the analysis of the submitted technologies and the results of the residential ADR technology selection and prioritization. Finally, Chapter 6 provides recommendations for future cycles of technology selections.

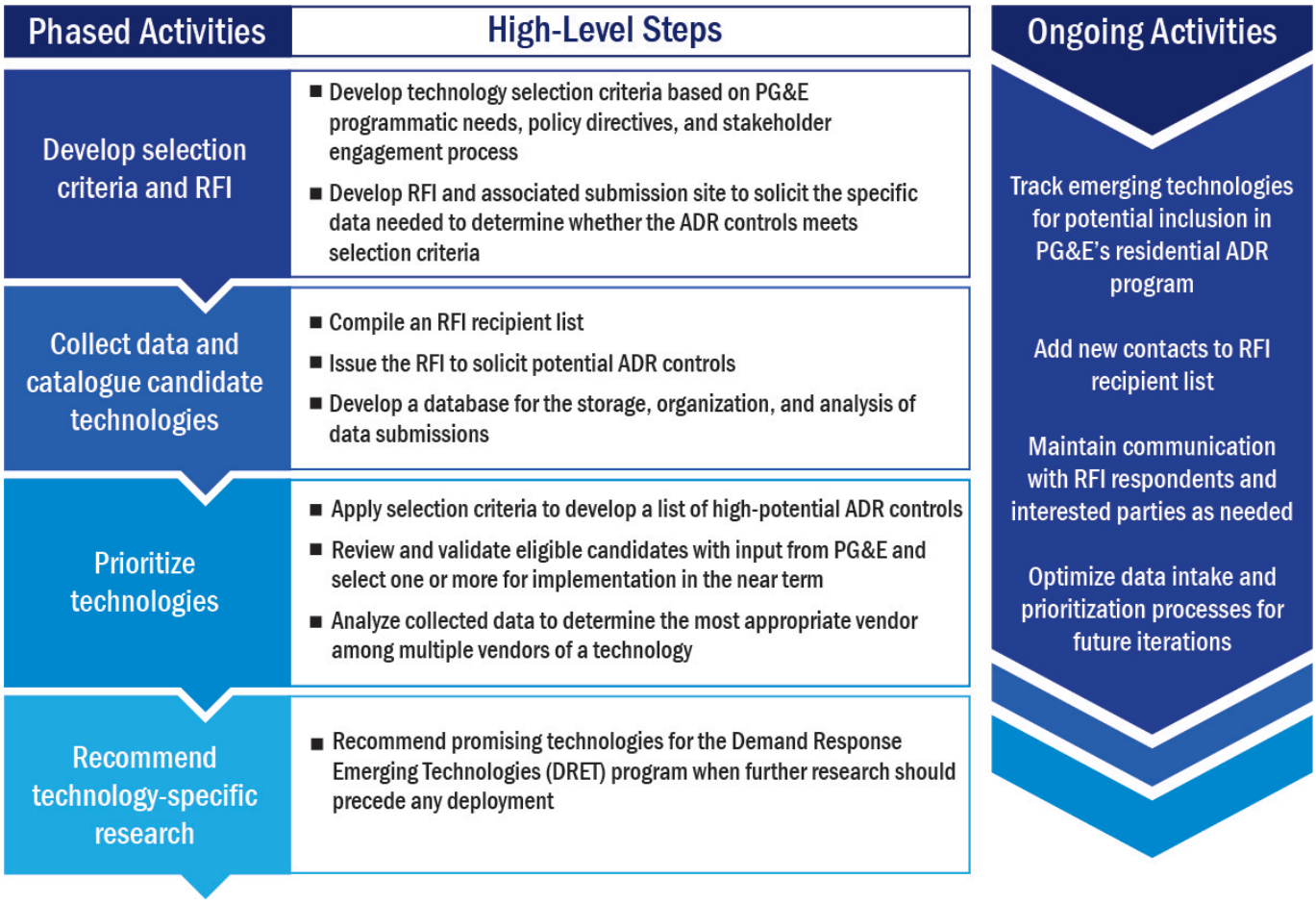
2. Technology Selection Framework

As stated above, one of the objectives for the 2018 - 2022 ADR Program is to expand the list of residential ADR enabled technologies. Given the emergence of technologies across the energy industry, PG&E comprehends that thoughtful approaches are required to govern a collaborative and open technology selection process where vendors, service providers, and other utilities can share, learn, and contribute. PG&E, therefore, sought to develop a selection framework that could possibly be leveraged in future cycles to support the ongoing inclusion of control devices within the program.

Figure 1 outlines the high-level steps of the framework which includes identifying, selecting, and recommending residential ADR controls for program inclusion. This was adopted from the U.S. Department of Energy's framework for identifying high-impact technologies (HIT), which utilizes a repeatable and streamlined method to select technologies for inclusion in the HIT Catalyst program.[2]

[1] John Powers with Extensible Energy is part of Opinion Dynamics team serving as a technical expert consultant.
[2] U.S. Department of Energy. 2017. *High-Impact Technology Catalyst – 2017 Prioritization Analysis.*

Figure 1. Emerging Technology Selection Framework



The framework also defined the roles of stakeholders involved in the technology selection process. Using the governance model known as the RACSI Model, which acknowledges the varying degrees to which parties will engage with the process ("Responsible," "Accountable," "Supportive," "Consulted," and "Informed"), the study team applied a responsibility assignment to each entity group relevant to the collaborative technology selection process (Table 1). A similar application was previously used for a California Public Utilities Commission (CPUC) Proposed Decision on Marketing, Education, and Outreach (ME&O) put forth in D.13-12-038.[3]

Table 1. Stakeholder Roles (following the RASCI Model)

Role	Description of Role	Entity
Responsible	The parties charged with delivering a successful outcome. In this case, the contracted consultants develop the selection framework, facilitate the RFI, and provide the client with recommendations for eligible controls for residential ADR application.	Opinion Dynamics Study Team

[3] CPUC. D.13-12-038. "Decision on Phase 2 Issues: Statewide Marketing, Education, and Outreach Plans for 2014 and 2015." D.13-12-038. pg. 73.

Role	Description of Role	Entity
Accountable	The authority who approves the process and receives the results. In this case, PG&E delivers feedback on the framework, weighs in on selection criteria and assessment, and receives the recommended list of controls.	PG&E, CPUC
Supportive	Those who provide resources to support the outcome of the process. In this case, the vendors via their RFI submittal are central to the selection process.	RFI Respondents
Consulted	Those whose opinions are sought for input and with whom there is two-way communication. In this case, the study team solicited feedback from the subject matter or technology experts to validate or augment information about the controls.	Interviewees (e.g., IOUs, Organizations)
Informed	Those kept up-to-date on process milestones and task completion. In this case, PG&E is sharing the framework memo, the RFI, and the results of the selection process with IOUs and other organizations. Some informed parties distributed the RFI to their networks.	Stakeholders: PG&E Service List, IOUs, Industry Organizations

The study team identified two critical points at which stakeholder engagement activities should occur to facilitate a collaborative and open selection process:

- Initiating selection study: The study team distributed emails on October 16, 2019 to the identified stakeholders and technology providers to present and explain the RFI process and finalized selection criteria described below.
- Presenting study findings: The study team hosted a webinar on February 20, 2020 to reveal the team's recommendations to PG&E for technology inclusion, detail salient lessons learned from employing the framework, and share insights on future technology inclusion.

3. Development of Selection Criteria and RFI

The first high-level step in the selection framework is the development of technology selection criteria that can guide the data collection and technology assessment. This section documents how the study team set out to perform the selection process. It is important to note that, given the actual responses and the types of technologies submitted, the process had to evolve from this original process we envisioned, which is discussed in detail in Section 5.

The study team carefully established the selection criteria to satisfy the following key considerations:

- California's state policy goals as put forth in the recent Proposed Decision;[4]
- Key priorities and needs of the PG&E program; and
- Flexibility to supporting shifting program design and goals as PG&E responds to the expansion of the existing residential ADR program, new DERs to reflect the emerging technologies on the market, and future DR needs.

[4] CPUC. D. 18-11-029. "Decision Resolving Remaining Application Issues for 2018-2022 Demand Response Portfolios and Declining to Authorize Additional Demand Response Auction Mechanism Pilot Solicitations." A.17-01-012. pp. 42-60.

The controls selection process consisted of two phases: an initial eligibility screening of the controls; and a prioritization assessment to compare and rank the eligible pool of controls.

3.1 Initial Eligibility Screening Criteria

The initial eligibility screening of the controls focused on the high-level attributes identified as crucial attributes controls must possess to receive a further assessment. The study team chose these attributes based on discussions with PG&E, a review of relevant policy goals, and previous technology prioritization frameworks.

For a control to continue into the second phase of the selection process, it had to meet a series of requirements as classified into two categories:

- **Program Requirement:** Controls meet basic program requirements as set forth by PG&E and the CPUC. Requirements include residential suitability, OpenADR 2.0 Profile A or B Certification,[5] and provision of DR control without a homeowner intervening manually.
- **Policy Directive:** CPUC stipulations deem battery storage technologies and on-site generation resources as ineligible for ADR programs.

3.2 Prioritization Assessment Scoring Criteria

In the second phase of the selection process, the prioritization assessment ranks the controls using a transparent, standardized, and repeatable method. The study team set out to use five dimensions of prioritization criteria to assess each submitted control found eligible by the initial screening phase:

- **Program Demand Impact Goals:** As the primary purpose of deploying control technologies is to modify peak demand, the study team used a range of variables that could represent expected peak demand savings from various types of end-use controlled devices.
- **Demand Flexibility:** During the project, PG&E and regulators clarified that technology impact assessment should also includes the ability for a device to increase demand when appropriate.
- **Technology Market Readiness (Technology Validity):** The study team assessed the extent to which each control has a proven record of success in utility service territories, evidenced by both extent of deployment and substantiation of estimated peak demand impacts.[6]
- **Program Reach:** The study team assessed the extent to which the submitted controls are already or would be accessible to a wide range of individuals across PG&E service territory, would impact controlled devices with high incidence rates, or both.
- **Program Requirement:** The study team assessed information on the cost of the submitted controls devices to inform PG&E's assessment of their relative cost-effectiveness.

[5] OpenADR 2.0 compliance certification ensures the controls can receive and respond to signals using the protocols developed by the OpenADR Alliance. Compliant technologies become certified when they pass a series of tests which deem them with profile A or B certification, or both. The compliance profile refers to the classification of control devices: Profile A represents resource-constrained, low-end embedded devices supporting basic DR services; Profile B represents high-end embedded devices supporting most DR services and markets with flexible reporting capabilities.

[6] Technologies for which the estimated peak demand savings are based on measurement and verification (M&V) studies conducted by reputable third parties receive the highest scores, as opposed to savings estimates based on vendor tests alone or – and least valid – based on unsubstantiated vendor claims.

3.3 RFI Development

Table 2 outlines the team's data collection plan for each metric as based on the selection criteria. This guided the study team to develop a Request for Information (RFI) data collection instrument (intake form). The final RFI Intake Form is attached in Appendix A.

Table 2. Data Collection Plan

Data Collected	Criterion Category	Unit of Observation
Residential application	Screening requirement	Yes/No attribute
Automated control capability	Screening requirement	Yes/No attribute
OpenADR 2.0a or b Certification	Screening requirement	Yes/No attribute
Control type (VEN, VTN)	Screening requirement	VEN/VTN attribute
Eligible equipment (not battery storage nor on-site generation)	Screening requirement	Yes/No attribute
Product specification	Screening requirement	Document
End-use device types impacted	Program impact goals	Yes/No attribute per end-use type
Per unit peak demand savings by end-use device type	Program impact goals	Per unit kW per end-use type
Make/model of end-use device	Program impact goals	Make/model name
Availability of demand impact data	Program impact goals	Yes/No attribute
Internal reports verifying demand response impacts	Market readiness	Document
Measurement and verification reports	Market readiness	Document
Demand flexibility	Demand flexibility	Yes/No attribute re: shape, shift, shed, shimmy. Qualitative response
Opt-out, offline, failure rates	Demand flexibility	Percentages
Current incidence of controlled devices in utility service territories	Program reach	Number of controls deployed per service territory
History of deployment in utility service territories	Program reach, market readiness	Year deployment started (and ended)
Cost of control device	Program requirement	$ per unit
Rebate and incentive levels in other jurisdictions	Program requirement	$ of rebate or incentive
References that can speak to the success of previous deployment	Program reach, market readiness	Reference contacts

4. Solicitation of Technologies

In the second step of the process, the study team solicited controls information from technology providers by distributing an RFI. The tasks associated with this step were: developed a distribution list; notified stakeholders and technology providers of the opportunity to submit technologies for consideration; and distributed the RFI intake form to solicit technologies. Specifics on each one of these tasks are provided below.

4.1 Distribution List of Stakeholders and Technology Providers

In order to ensure broad outreach to create a comprehensive list of technology providers, the study team requested vendor and contact information from the following stakeholders and organizations:

- Service lists of DR and ADR proceedings
- Peak Load Management Alliance (PLMA) vendor list
- Service list of EE proceedings
- Direct inputs from California Energy Commission Codes and Standard staff
- Lawrence Berkeley National Laboratory staff
- IOUs' emerging technology program staff.

Additionally, the study team identified technology providers via the OpenADR Alliance database of OpenADR 2.0 Profile A or B Certified control technologies. According to this database, these providers serve the residential market and may meet initial eligibility selection criteria. The team obtained a number of previously unidentified contacts in response to an explicit request included in the opportunity notice (see Section 4.2) where recipients inform the team of potential additional contacts. In the end, the team compiled contacts of 92 stakeholders and 165 technology providers.

4.2 Notification of Technology Submission Opportunity

To present and explain the RFI process and finalized selection criteria, the study team distributed a "Notice of Technology Submission Opportunity for PG&E's Residential ADR Program" by email to the identified stakeholder and technology provider contacts (attached in Appendix B). This notice included an overview of PG&E's ADR residential program and the purpose of the technology solicitation; key dates in the technology solicitation and prioritization processes such as the date of RFI distribution and closure, technology assessment period, and the announcement of the completed assessment. An attached PDF file accompanied the notice that explained the eligibility and selection criteria in detail (attached in Appendix C).

4.3 RFI Intake Form Distribution

The study team programmed the RFI data collection intake form (See Section 3.3) in an online data collection platform (Qualtrics®). The study team distributed the online intake form through a standard email that was addressed from the "PG&E ADR Collaborative Research Study" to the augmented distribution list. The online intake form was open for approximately three weeks, during which time one reminder email was sent to notify recipients of the planned closure date.

The study team understands that a few trade associations, including PLMA and California Energy + Demand Management Council (CEDMC), distributed the announcement to their members during the solicitation period as well.

5. Prioritization of Technologies

As the third high-level step in the process, the study team assessed the submitted technologies. In developing the selection framework (Section 2) and scoring criteria (Section 3), the study team envisioned that submitted

data pertinent to each metric would be evaluated using ordinal scores that then would be aggregated across metrics to complete a holistic assessment of control technologies.

The limitations of such an approach quickly became evident. The submitted technologies were highly heterogeneous in terms of the types of end-use equipment affected and the extent to which these technologies impact demand. For some metrics, comparisons could be made only within a group of similar technologies. Further complicating the assessment, in many cases, the supporting documents provided by RFI respondents lacked the information necessary for the study team to confirm the validity of self-reported data, especially demand impact claims. These challenges constrained the ability to evaluate each technology solely with an ordinal scoring method.

The study team ultimately combined a pass-fail reduction method within each metric and ordinal scores for some metrics to more qualitatively synthesize our assessments than originally envisioned. During the assessment period, the team met with PG&E managers on a bi-weekly basis to share results and obtain expert opinions, which provided important technical insights that facilitated the team's assessment.

The study team first cataloged all the submitted data and supporting materials provided for each of the candidate technologies. Thoroughly reviewing these sources, the team organized the data by selection criterion. The team reviewed the submitted supporting materials in an attempt to validate self-reported data. The team reviewed each of the selection criteria in the order of importance and eliminated technologies that did not minimally meet the criteria. For technologies not eliminated, the team made follow-up phone calls to gather missing information from the submittals as well as to gather opinions from the reference contacts the providers identified that could confirm the claimed characteristics. By combining the team's assessment with the opinions of the reference contacts provided, the team made the final recommendations to PG&E.

The rest of this chapter describes the assessment details by selection criterion. To protect manufacturers' confidentiality and trade secrets, submitted manufacturers and technologies are anonymized.

5.1 Submitted Technologies and Eligibility Assessment

Fourteen manufacturers submitted control technologies which the team categorized into one of six control types: AC and plug load control, AI-based energy management platform, energy management automation control system device, EV charging control, smart thermostat, and water heater control (Table 3).

The study team determined three submitted (Manufacturers 4, 8, and 12) had not attained OpenADR 2.0 Profile A or B Certification and thus were not eligible for further consideration. In consultation with PG&E program managers, the team also eliminated for further consideration in the current study smart thermostat technologies (Manufacturers 11 and 12) because PG&E already rebates smart thermostats in its Energy Efficiency and DR portfolios and the current effort is aimed at selecting other effective ADR technologies.

The study team determined ten manufacturers' technologies were eligible for further assessment.

Table 3. Submitted Technologies and Eligibility per Initial Screening

Manufactures	Control Types	Residential application	Automated end-use control capability	OpenADR2.0 Profile A	OpenADR2.0 Profile B	Assessment
Manufacturer 1	AC and plug load control	✓	✓	✓		Eligible
Manufacturer 2	AI-based energy management platform	✓	✓	✓		Eligible
Manufacturer 3		✓	✓	✓	✓	Eligible
Manufacturer 4		✓	✓			Ineligible
Manufacturer 5	Energy management automation control	✓	✓	✓	✓	Eligible
Manufacturer 6		✓	✓		✓	Eligible
Manufacturer 7		✓	✓		✓	Eligible
Manufacturer 8		✓	✓			Ineligible
Manufacturer 9	EV charging control	✓	✓		✓	Eligible
Manufacturer 10		✓	✓		✓	Eligible
Manufacturer 11	Smart thermostat	✓	✓		✓	Ineligible
Manufacturer 12		✓	✓			Ineligible
Manufacturer 13	Water heater control	✓	✓		✓	Eligible
Manufacturer 14		✓	✓		✓	Eligible

5.2 Assessment of Demand Impacts

The RFI Intake Form asked submitters to identify the end-use equipment types controlled by their technologies and, if available, to report, for each affected end-use type, the estimated per-unit average demand savings – potential kW savings for a control event during a peak period.[7] The RFI also asked submitters to provide internal or third-party reports such as case studies, pilot program documentation, and measurement and verification (M&V) report in support of the self-reported demand response impacts.

Table 4 shows the demand impact information the team received from the ten eligible manufacturers. Table cells highlighted light blue indicate the end-use types manufacturers reported their controls can impact. The single cell highlighted dark blue indicates the study team was able to validate the manufacturer's reported demand savings. Numerals in cells provide the reported demand savings (in kW), only one of which could the team validate due to a lack of adequate documentation available from the manufacturers. Light blue cells lacking numerals indicate the manufacture identified the end-use type as affected by its controls but did not provide a savings estimate.

[7] For completeness, the RFI intake form included battery storage as well as on-site generation as end-use equipment types. All of the manufacturers of an energy management automation control reported their system impacts both of these end-use types. Storage and generation are excluded from this assessment due to CPUC stipulations that they are ineligible applications of ADR.

Table 4. Demand Impact kW by End-Use Controlled Device Type (n=10)

Manufactures	Control Types	HVAC	Water heaters	Pool pumps	Lighting	Plug load	EV	Assessment
Manufacturer 1	AC and plug load control	<5				<5		Eligible
Manufacturer 2	AI-based energy management platform							Ineligible
Manufacturer 3		<5				<5		Ineligible
Manufacturer 5	Energy management automation control							Ineligible
Manufacturer 6		<5	<5	<5	<5		>10	Ineligible
Manufacturer 7			<5				>10	Ineligible
Manufacturer 9	EV charging control						>10	Eligible
Manufacturer 10							>10	Eligible
Manufacturer 13	Water heater control		<5					Eligible
Manufacturer 14			<5					Eligible

The study team notes an emerging trend in the market toward systems that manage the energy of multiple end-use types, such as those of manufacturers 2 through 7. Many of these technologies have a system component that is OpenADR Certified through a cloud interface, a hardware gateway or both with no single end-use device being certified.

While single end-use devices can provide reliable estimates of the expected control impacts and be incorporated into the current program with minimal changes in program design, multi end-use home energy management systems could offer the advantage of aggregating demand impacts in a consumer-friendly manner with less need for PG&E to evaluate each end-use technology.

PG&E program managers guided the study team to eliminate those multi end-use controls from the current technology assessment because its current DR program is equipped to incorporate only control systems that work solely with single end-use equipment. This directive left five manufacturers (1, 9, 10, 13, and 14) for further assessment.

5.3 Assessment of Market Readiness and Validity

The RFI Intake Form collected information about the controls' deployment status (history and extent of deployment) in PG&E and other utility service areas to assess the validity of the manufacturers' claims and to determine whether the technology has both market penetration and a proven record of success.

Manufacturers 1, 9, 10 reported large-scale deployments in multiple utility areas; manufacturers 13 and 14 reported multiple-utility deployment but lacked large-scale deployment (Table 5). Using a 5-point ordinal scale (1 = "very limited," 2 = "somewhat limited," 3 = "fair," 4 = "adequate," and 5 = "expansive") the team assessed the market readiness "adequate" or "expansive" for all five manufacturers' technologies. None were eliminated based on this selection criterion.

Table 5. Deployment History in PG&E and other Utility Areas (n=5)

Manufactures	Control Types	Deployment in PG&E area	Deployment in other jurisdictions	Assessment
Manufacturer 1	AC and plug load control	None	>5,000 deployments in 5 utility areas	Expansive
Manufacturer 9	EV charging control	>100 devices sold	>500 deployments in one utility area	Expansive
Manufacturer 10		>5,000 device-enabled EV charging stations	>5,000 stations installed in >10 utility areas	Expansive
Manufacturer 13	Water heater control	None	>300 deployments in 7 utility areas	Adequate
Manufacturer 14		>20 device pilot	>300 deployments in 4 utility areas	Adequate

5.4 Assessment of Demand Flexibility

Submitters reported information about the control technologies' dispatch capabilities so that the study team might understand the demand flexibility the technologies provide. The requested information included the types of grid demand needs the controls can impact (shape, shift, shed, and shimmy),[8] and customer opt-out and offline/failure rates.[9]

Most manufacturers reported their controls' ability to provide a high level of demand flexibility (Table 6). All manufacturers' control technologies can provide *shape* and *shed* resources, which are more traditional and critical DR production; four provide *shift* and three provide *shimmy* which are more advanced resources. Manufacturers reported comparable opt-out and offline/failure rates, ranging up to 30%, although some manufacturers did not report these data.

Using a 5-point ordinal scale (1 = "very limited," 2 = "somewhat limited," 3 = "fair," 4 = "adequate," and 5 = "expansive"), the team determined that the combined level of demand flexibilities of all of these manufacturers' controls to be "adequate" or "expansive." No manufacturer was eliminated based on this selection criterion.

Table 6. Demand Flexibility (n=5)

Manufactures	Control Types	Shape	Shift	Shed	Simmy	Opt-out rate	Offline/ failure rate	Assessment
Manufacturer 1	AC and plug load control	✓		✓		<15%	<30%	Adequate
Manufacturer 9	EV charging control	✓	✓	✓		<30%	<5%	Adequate
Manufacturer 10		✓	✓	✓	✓	<10%	<10%	Expansive

[8] *Shape* resources help reshape customer load profiles. *Shift* resources encourages the movement of energy consumption from times of high demand to times of day when there is an energy surplus due to renewable generation. *Shed* resources help curtail peak capacity. *Shimmy* resources dynamically adjust demand to alleviate short-run ramps and disturbances. The intake form asked whether the controls enable each of these four resources and provided an open-ended field to elaborate how the controls enables demand flexibility. 2025 California Demand Response Potential Study – Charting California's Demand Response Future, Lawrence Berkeley National Laboratory (2017).

[9] *Opt-out rate* is the percentage of customers that override participation in ADR events when they are called and do not come under control. *Offline/failure rate* is the percentage of control devices reportedly breaking, not operating correctly, or otherwise failing in the field.

Manufactures	Control Types	Shape	Shift	Shed	Simmy	Opt-out rate	Offline/ failure rate	Assessment
Manufacturer 13	Water heater control	✓	✓	✓	✓	NA	<1%	Expansive
Manufacturer 14		✓	✓	✓	✓	NA	NA	Expansive

5.5 Assessment of Cost

The RFI Intake Form captured information about the control technology's retail costs and any rebates offered by utility partners so that the study might contribute to PG&E's assessment of technology cost-effectiveness. The reported controls' costs typically ranged widely depending on the scale of purchase. Effective rebate levels are largely dependent on the utility's program and its target market. Therefore, the team determined that the cost and rebate data obtained did not make a useful contribution to this study's selection of control technologies.

5.6 Interviews with Reference Contacts of Selected Technologies

For the five manufacturers that were not eliminated through the review of the submitted data, the study team interviewed the reference contacts these manufacturers provided to gather opinions that could confirm the claimed characteristics. Each of the manufacturers submitted at least one utility reference as part of their RFI response. The team conducted a total of 8 interviews with these utility references (some manufacturers submitted multiple references; at least one interview with a utility reference was conducted for each manufacturer) (Table 7).

Table 7. Reference Contacts

Manufactures	Control Types	Number of reference contacts provided	Number of interviews completed
Manufacturer 1	AC and plug load control	5	1
Manufacturer 9	EV charging control	1	1
Manufacturer 10		3	2
Manufacturer 13	Water heater control	1	1
Manufacturer 14		7	3

The interviews centered around a few specific questions about the manufacturer and the specific technology or product identified by the manufacturer in their RFI response. Specifically, the team asked:

- Did the technology work?
- Did the manufacturer perform their part of the work well?
- Is the proposed technology scalable and ready for large deployments, or is it better suited for a pilot project?
- Did the product/technology deliver the expected per-device impacts?
- What was the failure rate? The opt-out rate for events?
- Are there any M&V reports or pilot test results that we can access?
- Are there any other issues we should be aware of?

Several trends became clear during these discussions. First, while manufacturers submitted information about controls that were OpenADR certified, none (zero) of the references reported using the OpenADR features of the end-use technologies. Several used OpenADR to communicate from the utility to the "head-end" of the manufacturer's control technology, but relied on another protocol (usually vendor-specific) for communication between the manufacturer's server or cloud and the end devices. This finding validates some of the industry discussion at conferences and other meetings, i.e., that OpenADR communication to end devices in the residential sector is not important to many utilities today. At least two references volunteered that they planned to test such communication in future pilots or technology evaluation projects, but none had done so to date.

Second, the most mature and widely deployed of the technologies evaluated here (Manufacturer 1) was viewed by the utility reference as useful technology, but not likely to be pursued in future programs. Manufacturer 1's reference suggested that their technology worked well, but that the most likely path forward for the utility was to work with wifi-enabled air conditioners now coming onto the market from AC manufacturers especially considering their implementation challenge of managing the distribution and proper use of the control device.

Third, the remaining manufacturers (Manufacturers 9, 10, 13, and 14) all submitted technologies that had solid, positive references – but the references generally agreed that the controls were more relevant to large pilots or small deployments than full-scale rollouts at this time. The study team agrees with this assessment – the EV charging market is still relatively new and volatile, while the water heater control manufacturers who submitted RFI responses have a history with field trials in the hundreds of sites, not the tens of thousands that PG&E would prefer.

5.7 Recommended Control Technologies for Program Inclusion

Based on the review of all RFI responses, the screening criteria discussed above, and the interviews conducted with all references of the screened candidates, the study team recommends that PG&E adds none of the devices from the reviewed candidates to the current OpenADR program. This recommendation is based on the following considerations:

- Of the screened candidates with positive references and significant potential per-device impacts (Manufacturers 9, 10, 13, and 14), none have been implemented in utility programs at scale – pilots have included hundreds, but not thousands of devices.
- The only screened candidate with tens of thousands of devices in the field in a utility program (Manufacturer 1) may have low impacts due to a relatively low room AC load in PG&E's service territory, and has an implementation strategy that may not be fully compatible with PG&E's current program design.
- None of the screened candidates have a utility reference that conducted field testings of OpenADR communications from the utility down to the end device.

The study team further recommends that PG&E begin two technology demonstrations through the Demand Response Emerging Technologies (DRET) program in the future. The team suggests a Water Heater study with Manufacturers 13 and 14, and an Electric Vehicle study with Manufacturers 9 and 10. This recommendation is based on the following considerations:

- All four manufacturers have excellent utility references from ongoing utility pilots.
- All four have the potential to deliver significant demand impacts in PG&E's service territory.

- All four target technologies are projected to grow significantly under California's (and PG&E's) electrification plans.

6. Recommendations for Future Technology Selection

Despite the best effort put forward in the development of the selection framework, the study team encountered several unanticipated circumstances during the actual implementation of the selection process. This section summarizes these lessons learned as recommendations for PG&E's consideration for its future technology selection.

Recommendation 1: Consider broadening the OpenADR compliance requirement for head-end systems, rather than end-use control only.

During the RFI process, the team learned that most manufacturers perceive the idea of OpenADR at the device level in the residential sector unnecessary because the industry is increasingly using manufacturer-specific protocols to control end-devices, instead of the OpenADR features. Some manufacturers are using the OpenADR protocol for communication between utilities and their control technology, but relied on a manufacturer's proprietary protocol for communication between the manufacturer's server or cloud and the end devices. The study team is aware of at least one manufacturer that did not apply because their end devices are not OpenADR certified. Therefore, PG&E could consider a future RFI with explicit invitations to vendors with OpenADR-certified head-end systems even if their end-devices are not OpenADR certified. Nevertheless, PG&E has a good reason to prefer OpenADR-certified devices over non-OpenADR devices because OpenADR features are risk-mitigating solutions for PG&E in case of a number of unforeseeable changes in the device supplier's circumstances such as a business closure or acquisition, abandonment of or a shift of focus from the device, etc. As a result, a head-end system requirement would mitigate PG&E's risk by providing confidence that PG&E can continue operating the device while broadening the number of vendors eligible for the program.

Recommendation 2: Consider developing methodologies to calculate per-device rebates for multiple end-use control systems to incorporate them in the program.

The study team received more submissions from manufacturers of systems that manage multiple end-use types than anticipated (such as Manufacturers 5, 6, 7). This is an emerging trend in the market that offers greater advantages of aggregating demand impacts in a consumer-friendly manner, but they were excluded because the current PG&E ADR program's incentive calculation methodology assumes control technologies for single end-use equipment only. While single end-use controls can provide reliable estimates of the expected control impacts, multi end-use controls may open the market up to more types of devices with less need for PG&E to evaluate each end-use technologies. However, incorporating multiple end-use control systems will require program redesign, most notably incentive calculation methodologies for multiple end-use systems.

Recommendation 3: Consider broadening the eligibility requirement by explicitly inviting vendors that provide platform- or software-based control solutions as well.

Even though the RFI suggested the project's "device-focus" preference, a few manufacturers that provide platform-based control solutions (Manufacturers 2, 3, 4) made entries and the team eventually took them into consideration as long as the system is OpenADR-certified. Further, CPUC Decisions only stipulate a control system to be automated control without a need for manual interventions using an OpenADR protocol. Therefore, the team recommends PG&E considering broadening the eligibility requirement by explicitly inviting platform solution providers as well.

Recommendation 4: Consider adding a market research component as a part of the RFI development in the future selection cycles.

ADR control technology solutions are constantly evolving at a fast pace, upon which utilities' DR program successes depend. As a result, policy directives on utilities' ADR programs at a given time may not be adequately consistent with the state or trend of technologies in the market. An example of this is the diverse and varying perspectives the study team observed on the role of the OpenADR protocol between the vendors and the CPUC. Therefore, the study team recommends PG&E add a market research activity to more fully understand the technology market conditions in developing an RFI in future technology selection cycles.

Appendix A. Data Collection Intake Form

Pacific Gas and Electric Company: Residential Automated Demand Response Program
Request for Information Data Collection Tool
Final – October 21, 2019

Email Invitation (along with logos of PG&E and Opinion Dynamics)

From: PG&E ADR Collaborative Research Study
Subject: RFI Intake Form for PG&E's Residential ADR Program
Attachment: Eligibility Screening and Prioritization Process of Control Technology (pdf)

Opinion Dynamics

Pacific Gas and Electric Company®

Dear PG&E ADR Program Stakeholders,

As notified on October 16, 2019, working on behalf of Pacific Gas and Electric Company (PG&E), Opinion Dynamics hereby distributes the Request for Information (RFI) Intake Form to facilitate the submission of residential automated control technologies for rebate eligibility consideration in PG&E's Automated Demand Response (ADR) 2020-2022 program.

The selection process is comprised of two phases; eligibility screening and technology prioritization. The data collected through this Intake Form will allow PG&E to assess which control technologies are eligible under the Guidelines of PG&E's residential ADR program, have demonstrated performance in attaining peak demand or flexible load impacts, and support various program and policy goals. This is a device-focused project, and software platform is out of scope. For information about the eligibility screening and prioritization process of control technologies, please read the attached PDF document.

For technologies that are eligible, respondents may be asked to provide additional materials in support of the second phase of the technology selection process. Opinion Dynamics is facilitating the selection under contract with PG&E and will contact respondents directly for any needed follow-up materials.

This data collection tool will take approximately 15 to 20 minutes to complete. The submission deadline is COB on November 15, 2019. You have the option to save and return if you cannot complete the form in one visit. You can continue and complete your submission by clicking the link below. PG&E will be using the information received from these surveys for its internal business purposes only. The information will not be shared or produced unless mandated by law or required by request from the California Public Utilities Commission.

Please click on the link below to begin filling out the Intake Form:

Click this link to start your submission: http://tiny.cc/PGEADRRFIintakeform

If you have any questions about the Intake Form, please feel free to contact Jun Suzuki with Opinion Dynamics at jsuzuki@opiniondynamics.com or (503) 943-2132.

Kind regards, ADR Collaborative Research Study Team

Survey Instrument

Basic Information

B1. Does your technology serve residential customers?

1. Yes
2. No **[THANK AND TERMINATE]**
8. Don't know **[THANK AND TERMINATE]**

B2. Which residential customer types does your technology serve?

1. Single family
2. Multifamily
3. Both
8. Don't know

B3. Does your technology provide automated control of an electric end use? [**HOVER OVER NOTE**: ADR control technologies are capable of receiving a demand response signal and automatically changing electric usage without any manual customer intervention.]

1. Yes
2. No
8. Don't know

B4. Please provide a short sales pitch for your control technology, as if you were selling it to a residential customer. **[OPEN END]**

Technology Specifications

T1. Is your technology OpenADR Certified?

OpenADR is an open and interoperable information exchange model and emerging Smart Grid standard. Open ADR standardizes the message format used for Auto-DR so that dynamic price and reliability signals can be delivered in a uniform and interoperable fashion among utilities, ISOs, and energy management and controls systems.

1. Yes
2. No
8. Don't know

[ASK IF T1=1]

T2. Which OpenADR profile is your certification?

1. Profile A
2. Profile B
3. Both
8. Don't know

T3. Does your technology operate using Virtual End Node (VEN) or Virtual Top Node (VTN) software client?

1. VTN
2. VEN
8. Don't know

T4. Is your ADR control technology located in the cloud or within the hardware in a customer home?

1. Cloud
2. Home
3. Don't know

Control Technology Impacts

Technologies that meet PG&E's core eligibility requirements for deployment in the residential ADR program will be prioritized based on their attributes, including their demand response kW impact potential.

I1. Which end-use equipment types can your technology control? Please select all that apply. **[MULTIPLE RESPONSE]**

1. Heating equipment
2. Cooling equipment
3. Ventilation equipment
4. Water heater
5. Pool pump
6. Lighting
7. EV charger
8. Battery storage
9. On-site generation
10. Kitchen appliances
11. Plug load control (e.g. smart plugs, advanced power strips, etc.)
0. Other (Please specify)

I2. For each end-use type from the previous question:

a. Please provide the average per unit demand savings, if available. Per unit demand savings is an estimate of the potential kW savings for a control event during a peak period. Providing ranges is acceptable. **[OPEN END, DON'T KNOW=9998, REFUSED=9999, REPEAT QUESTION FOR EACH ANSWER IN I1]**

b. If your technology is compatible with specific makes and/or models of the equipment type that it controls, please list the names below (up to four) for each end-use technology. If there is no specific make or model with which the control is compatible, select N/A. **[OPEN END, DON'T KNOW=98, REFUSED=99, N/A=97]**

End-use technology	a. Per unit demand impact (kW)	b. Make and/or model of the end-use technology (up to four)
Heating equipment [SHOW IF I1=1]		
Cooling equipment [SHOW IF I1=2]		

End-use technology	a. Per unit demand impact (kW)	b. Make and/or model of the end-use technology (up to four)
Ventilation equipment [SHOW IF I1=3]		
Water heater [SHOW IF I1=4]		
Pool pump [SHOW IF I1=5]		
Lighting [SHOW IF I1=6]		
EV charger [SHOW IF I1=7]		
Battery storage [SHOW IF I1=8]		
On-site generation [SHOW IF I1=9]		
Kitchen appliances [SHOW IF I1=10]		
Plug load control [SHOW IF I1=11]		
<READ-IN I1 OTHER RESPONSE> [SHOW IF I1=0]		

I3. Does your control technology have any of the following demand response impact data available? Select all that apply.

1. Yes, we have third party-verified demand impact data
2. Yes, we have internally-verified demand impact data
3. No
8. Don't know

Dispatch Capabilities

DC1. Which of the following demand response service types does your control technology provide? Please select all that apply. **[MULTIPLE RESPONSE]**

1. Shape [Note*: reshapes customer load profiles through price response or on behavioral campaigns—"load-modifying DR"—with advance notice of months to day.*]

2. Shift [Note: *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.*]

3. Shed [Note: *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.*]

4. Shimmy [Note: *using loads to dynamically adjust demand on the system to alleviate short-run ramps and disturbances at timescales ranging from seconds up to an hour.*]

5. Don't know

DC1a. Does your control technology enable demand flexibility? If so, how? [Note: Flexible demand includes resources that can 1) sustain upward or downward ramp; respond for a defined period of time; change ramp directions quickly; store energy or modify use; react quickly and meet expected operating levels; start with short notice from a zero or low-electricity operating level; start and stop multiple times per day; and accurately forecast operating capability] **[OPEN END]**

DC2. What are the customer opt-out, offline/failure rates for your control technology? [**HOVER OVER NOTE OPT-OUT**: The percentage of customers that override participation in ADR events when they are called and are offline/fail to come under control; **HOVER OVER NOTE FAILURE RATE**: The percentage of control devices reportedly breaking, not operating correctly, or otherwise failing in the field]

[VALID=0-100, DON'T KNOW=998, REFUSED=999]

a. Opt-out Rate (%)	b. Offline/Failure Rate (%)

Market Readiness

M1. Is your control technology currently deployed in PG&E service territory?

1. Yes
2. No
8. Don't know

[ASK IF M1 = 1]

M1a. Approximately how many control devices have been sold in PG&E service territory for use by residential customers through September 30, 2019? **[OPEN END, DON'T KNOW=9998, REFUSED=9999]**

M1b. Approximately how many control devices currently participate in demand response events in PG&E service territory? **[OPEN END, DON'T KNOW=9998, REFUSED=9999]**

M2. Have other utilities or entities deployed your control technology?

1. Yes
2. No
8. Don't know

[ASK IF M2 =1, ELSE SKIP TO C1]

M3. Which utilities or entities have deployed your residential control technology? **[OPEN END]**

M4. In what year were the control devices introduced for this utility (these utilities)? **[OPEN END]**

M5. How many control devices have been deployed at these other utilities or entities through September 30, 2019? **[OPEN END, DON'T KNOW=9998, REFUSED=9999]**

M6. Please provide contact information for the key individual(s) at utilities and/or entities with whom you have partnered. **[OPEN END]**

Technology Cost, Purchase & Rebate

C1. What is the retail cost of your control device? Please provide as much detail as you can, including price in bulk quantities. **[OPEN END, DON'T KNOW=998, REFUSED=999]**

C2. Where is your control device available for purchase? Please provide web links where possible. **[OPEN END]**

9. None

C3. If other utilities offer rebates/incentives on your control device, what are some of those values? If offered by multiple utilities, please provide a value for each utility. **[OPEN END]**

C4. If other utilities offer the device, how is it promoted? Check all that apply.

1. CO-MARKETED WITH UTILITY
2. UTILITY MARKETPLACE
3. IN STORE DISPLAY
4. NO UTILITY SUPPORT
5. Other (please state)

C5. Please provide web links to utility or demand response provider sites with programs where your control technology is promoted or supported. **[OPEN END]**

C6. What do you think is an ideal rebate/incentive level that would support robust adoption rates in PG&E territory? **[OPEN END]**

Supporting Data

S1. Selected technologies must be market ready and have data verifying their efficacy. While we welcome information about technologies still in pilot deployment, please be aware that technology's market readiness is one of the top selection criteria *for deployment in this round of residential ADR program expansion.* Please attach supporting documentation in each of the following categories, where available:

a. Product specification **[PDF FILE UPLOAD]**
b. Reports from case studies or pilot programs that can verify demand response impacts, or internal or third-party reports on these deployments **[PDF FILE UPLOAD]**
c. Measurement and verification reports that can verify demand response impacts **[PDF FILE UPLOAD]**
d. Other synthesized data from lab trials and/or field studies that can verify demand response impacts **[PDF FILE UPLOAD]**
e. References that can speak to the success of this control technology **[OPEN END]**

S2. Please provide a brief description of other supporting data that you may possess, which we can use to verify the demand impacts achieved by your control technology. We may follow up to collect these data at a later date. **[OPEN END]**

S3. Please provide a copy of your certificate proving OpenADR certification, if available. **[PDF FILE UPLOAD]**

Conclusion

E1. Are there any additional details about your control technology that you feel should be considered in the technology selection process? **[OPEN END]**

Thank you for taking the time to submit your control technology in response to PG&E's Residential ADR RFI. Additional materials may be requested from you, based on the data provided.

If you have any questions or concerns about the survey, please contact Jun Suzuki (503.943.2132 or jsuzuki@opiniondynamics.com).

Appendix B. Notification of Technology Submission Opportunity

From name: PG&E Residential ADR Collaborative Research Study
Subject line: Notice of Technology Submission Opportunity for PG&E's Residential ADR Program

Opinion Dynamics

Pacific Gas and Electric Company®

Dear PG&E ADR Program Stakeholders,

Working on behalf of Pacific Gas & Electric Company (PG&E), Opinion Dynamics would like to inform you of an upcoming opportunity to submit control technology information to be considered for PG&E's residential Automated Demand Response (ADR) program.

Overview

PG&E is considering expanding the list of technologies which qualify for rebates under its 2020-2022 residential ADR program. The focus is on automated control technologies for the residential sector which leverage the standard of OpenADR to achieve peak demand savings. ADR, which in its residential application provides demand reduction without a homeowner intervening manually, will play an increasingly important role in meeting future energy needs. Residential ADR solutions typically include controls for end-use technologies such as plug-load, lighting, thermostats, pool pumps, and electric water heaters (hereafter referred to as controlled devices).

A key aspect of this technology selection process is engagement with industry stakeholders to ensure a collaborative and open process where vendors, service providers and other utilities can share, learn and contribute. In order to select control technologies to serve this program, PG&E has contracted a third party, Opinion Dynamics, to facilitate a two-stage technology selection process which includes a Request for Information (RFI) and a selection and prioritization stage.

Below is an overview of the selection process, and other key dates in the selection process.

Key Dates (Estimated)

October 24, 2019 **Distribution of RFI**

Opinion Dynamics will distribute an online RFI Intake Form to the same email list used for this notification. The Intake Form is intended to collect information about control technologies from solution providers. This data collection tool will take approximately 15-20 minutes to complete.

To broaden the reach of the RFI, please feel free to share this opportunity with other solution providers. Interested parties should notify our team if they would like to be included in the distribution list. Please inform our team of the most appropriate email address for contact prior to October 23, 2019. Notice of intention to submit your control technology information is not required.

November 15, 2019 **Closure of RFI**

Nov. – Dec. 2019 **Selection and Prioritization of Control Technologies**

For technologies that are deemed eligible, submitting solution providers may be asked to provide additional materials in support of the second phase of the technology selection process. Opinion Dynamics will contact submitters directly for any needed follow-up materials.

Mid-January 2020 **Webinar to present the results of the selection**

For information about the eligibility screening and prioritization process of control technologies, please read the attached PDF document.

Please feel free to circulate this notice to any interested parties. Should you have any questions or would like to be added to the distribution list for the upcoming RFI distribution email, please contact the Project Manager at Opinion Dynamics, Jun Suzuki (503-943-2132, jun.suzuki@opiniondynamics.com).

Sincerely,

Opinion Dynamics

Appendix C. Eligibility Screening and Prioritization Process of Control Technologies

Eligibility Screening and Prioritization Process of Control Technologies

October 16, 2019

The control selection criteria process will consist of two phases: an initial screening of the control technology submissions to assess eligibility, and a prioritization assessment scoring to compare and rank the eligible pool of controls.

Phase 1: Initial Eligibility Screening Criteria

The initial eligibility screening of the control technologies submissions will focus on high-level attributes of which the study team identified as crucial components that controls must possess to receive further assessment of their potential. The study team determined these attributes based on discussions with PG&E, a review of the policy goals for the program, and previous prioritization frameworks. For a control to continue into the second phase of the selection process, it will be evaluated under the following three categories:

Program Requirement: The controls must meet basic program requirements as set forth by PG&E and the California Public Utilities Commission (CPUC). Requirements include that control technologies must be OpenADR-compliant 2.0 a or b certified,[10] and they must have a residential application.

Technology Market Readiness (Technology Validity): The respondent must also prove that the control is tested and market ready by providing documentation which may include, but is not limited to, technology use cases, program evaluations, and references from program partners (e.g., utilities who have used the technology in a DR program or large-scale pilot).

CPUC Policy Directive: The CPUC stipulations deem battery storage technologies and on-site generation resources as ineligible applications of ADR controls.

Phase 2: Prioritization Assessment Scoring Criteria

In the second phase of the selection process, the study team will use a series of prioritization criteria to assess those control technologies that were selected in the Phase 1. The prioritization assessment utilizes comparative attributes to rank the controls using a transparent, standardized, and repeatable method. The potential of each control is based on a set of metrics which the study team has organized into five categories. In order to complete a holistic assessment, the study team will base the results on multiple scores from each of the following five categories.

Peak Demand Impact Goals: Peak demand impact goals, or control's ability that can contribute to the load flexibility goals, comprise a critical aspect of ADR controls selection, as the primary purpose of deploying such control technologies is to reduce peak demand, potentially to increase off-peak usage, and more broadly, to

[10] OpenADR 2.0 compliance means the controls can receive and respond to signals using the protocols developed by the OpenADR Alliance. Compliant technologies become certified when they pass a series of tests which deem them with profile A or B certification, or both. The compliance profile refers to the classification of control devices: Profile A represents resource-constrained, low-end embedded devices supporting basic DR services; Profile B represents high-end embedded devices supporting most DR services and markets with flexible reporting capabilities.

react flexibly to signals based on grid conditions. In this respect, PG&E is interested in reviewing controls that can shed load, as well as promote flexible loads.

Technology Market Readiness (Technology Validity): The study team will assess the validity of each vendor's claims to determine whether the control technology has a proven record of success in other jurisdictions. For example, a technology that claims peak demand savings based on a measurement and verification (M&V) study by a reputable third party will receive higher scores in this category than a technology with similar claims based on vendor tests alone.

Program Reach: PG&E aims to provide value to its ratepayers, and as such, the selected control technologies should be accessible to a wide range of individuals, should impact controlled devices with high incidence rates, or both, across PG&E service territory. Examples include technology's penetration rates in California markets, opt-out and failure rates.

Cost Information: In accordance with PG&E's residential portfolio strategy, the study team will capture information about the cost of the control technologies to inform PG&E's assessment of the relative cost-effectiveness of each control. Ancillary equipment to support the control technology will be factored in as well, i.e.., gateways. This metric will serve as a comparative tool for the eligible control technologies, just as PG&E would require for another residential program.

Policy Directive: As in the initial screening phase, the control technologies will be prioritized based on their ability to meet policy goals put forth by the CPUC. During this phase, the team will solicit PG&E's advice in scoring each control's potential to meet Energy Division policy goals.

We anticipate prioritizing peak load management, data availability and technology validity as the key criterion. Notably, eligible technologies that the study team does not recommend in the first selection process may be considered for review in subsequent iterations.

For more information, please contact:

Jun Suzuki
Principal Consultant

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