Process Evaluation of California's Statewide Permanent Load Shifting Programs

Program Years 2013 to 2014

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EXECUTIVE SUMMARY

TRC Energy Services (TRC), and their subcontractor Energy + Environmental Economics ("E3", together the "TRC Team"), were selected to conduct a process evaluation of the electric California investor-owned utilities (IOU or utilities) joint Statewide Permanent Load Shifting (PLS) program. The PLS program is offered by Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE), and San Diego Gas & Electric Company (SDG&E) in their respective service territories. The PLS program is designed to help customers shift electricity use by offering a one-time, upfront incentive, based on the amount of designed kilowatt (kW) shift to the off peak hours, in order to help offset the customer's initial investments in a TES system.

PG&E managed this evaluation with oversight from a committee consisting of representatives from each of the IOUs. A broader Demand Response Measurement & Evaluation Committee (DRMEC), consisting of representatives from California's three IOUs, the California Energy Commission (CEC) and the California Public Utilities Commission (CPUC) also provided guidance.

Evaluation Objectives

The overall objectives of this process evaluation were to: 1) document the program administration and the delivery strategies, 2) assess the effectiveness of the program administration of each utility's program, 3) evaluate customer experience with the program, 4) propose a definition of mature thermal energy storage technology, 5) compare California's program to TES programs in other parts of the United States; and 6) assess the PLS-TES market opportunity in the California market and the future of TES. In addition to these evaluation objectives, the PLS program managers and the DRMEC had specific research questions that are detailed in Section 1.3, Evaluation Objectives.

Evaluation Methods

The TRC Team completed the following evaluation activities to inform this evaluation:

- Review of program materials;
- In-depth interviews with a variety of PLS stakeholders including the utility program managers in charge of each utility program, third-party implementers who support the programs, PLS program applicants, stakeholders who are associated with an active PLS project, other stakeholders and PLS market actors not directly associated with an active PLS project; and utility account executives who support customers who have submitted a PLS application. The team attempted to conduct in-depth interviews with customers who submitted a PLS application but later withdrew the application, but was not able to complete these; and
- In-depth interviews with program managers of other PLS programs in the United States.

Key Findings

Applicants and participating market actors are satisfied with this program and find it to be a winning situation for both the customer and the utility. Overall, applicants, participating market actors, and account executives are pleased with the involvement and responsiveness of the program staff and their consultants. However, many suggest that an earlier meeting or involvement of the program representatives would be beneficial to provide an opportunity to discuss requirements and the process.

Application, Eligibility Requirements, and Timeline

The majority of applicants and participating market actors do not have any issues with the application and are generally satisfied with the eligibility requirements, but feel that the program could be more lenient on some of these requirements.

Applicants and market actors, both participating and nonparticipating, do not think that the 18-month timeline is feasible for many projects, specifically entities which have extensive internal approval processes.

Feasibility Study

The feasibility study requirements and process are the most difficult portion of the program for both applicants and the market actors who develop the study, but feedback also suggests that the studies are valuable and provide ancillary benefits. Applicants and participating market actors report that the feasibility studies can be onerous and time consuming, but recognize the benefits they provide for the decision-making process and identifying project details that otherwise could become issues down the road.

Monitoring Requirements

The three months of pre-installation monitoring is troublesome for customers, whereas there is little concern over the five-year post-installation monitoring requirements. The main issues around the pre-installation monitoring appear to be the cost of monitoring equipment if the facility does not already have the required equipment; implementing the monitoring for ‘campus’ style sites containing multiple buildings, or the existing monitoring equipment or EMS/BMS were not previously setup to capture the data in the required five-minute intervals making it difficult to meet the timeline.

Incentives

Although all applicants would prefer to receive higher incentives so that their project payback periods are shorter, they responded that they find the incentive to be generous.

A separate concern is over the customer incentive cap, which can limit customers from participating at multiple sites, or underfund large projects. The upfront payment for the feasibility study is not enough to fully cover the cost of a feasibility study, so customers must pay some of the upfront costs for these studies.

Utility Rates

Although not an overwhelming sentiment from applicants, there is some concern over utility rate structures and the possibility of changes to these structures in the future. Most applicants do not expect there to be substantial rate changes that would render their system a bad investment; however, market actors list rate uncertainty as a main concern for the economic viability of TES installations.

Challenges and Barriers

The challenges and barriers identified through interviews with applicants and market actors are: high costs, the 18-month timeline, rate tariffs, potential interaction with DR programs, lack of familiarity or knowledge of TES among the market, monitoring requirements for facilities that do not have the requisite equipment, space constraints, external entity approval, and reservation towards TES due to unfavorable past experience with these systems.

Marketing

Though the PLS program marketing activities have been limited, the strategies and channels pursued by the program managers have been appropriate considering the market for TES and the complexity of the technology.

PLS-TES Market Opportunity

Based on the qualitative assessment, we identified the following applications as the most promising opportunities for TES installations: Colleges, including community level; hospitals; casinos; office complexes/campuses; and industrial facilities (pharmaceuticals, biotech, data centers).

Low-hanging fruit opportunities in the area of refurbishing/recommissioning thermal energy storage systems were identified by a few applicants, indicating the presence of lists that could point the IOUs towards actual historical installations.

We roughly estimated the overall size of the market for college, healthcare, hotel and large office sectors to range from ~ 33 MW to 330 MW. A maximum of 1250 MW could be shiftable if the entire stock within each of those applications could host a TES system.

Definition of Mature Technology

Based on our investigation, little ambiguity exists in terms of the interpretation of what technologies are mature versus emerging from a programmatic perspective; that is, participating and non-participating actors had clarity regarding which types of TES systems qualify for the PLS program vs. the SGIP program. However, the definition is interpreted by some to be ambiguous with respect to passive systems (e.g., building-integrated phase change materials), which are not covered by the PLS program. Per the objectives of the process evaluation, we proposed a definition for mature technology (indicated below) that can be used to categorize specific TES technologies on an individual basis.

Other PLS Programs

Other PLS programs share some common characteristics, but due to the varying utility territories and priorities, variances occur in program management and requirements.

Participation rates are low among other programs TES programs, except for Ice Energy projects, averaging between zero to two installations per year.

Programs all report that high costs and long payback periods are the main barriers.

None of the programs rely heavily on marketing TES installations, but aim to keep in contact with vendors, as they report the program is mostly vendor-driven.

Only two programs require feasibility studies, and one of these only requires the study when a customer expects the load shift to exceed a threshold value.

Incentives structures are not consistent among other programs; some offer the incentive in full after project completion, and others offer half of the incentive after project completion and the other half after measurement and verification. Only one program offers a TES utility rate tariff.

The majority of the identified issues do not apply to Ice Energy programs. These programs are the only ones to have high participation rates or be fully subscribed.

Recommendations

The TRC team identified the following recommendations for the PLS program:

- Continue to engage interested customers with the program early in the process;
- Adopt SCE's practice of conducing brief reviews of the project feasibility to identify good TES candidates or identify major issues;
- Develop a pre-screening tool for customers;
- The utilities should provide tool-lending services for pre-installation monitoring equipment;
- Make the recently developed statewide-consistent PLS manual available publically;
- Modify the eligibility requirements around existing or refurbished TES systems;
- Conduct marketing and outreach to promote the program and increase participation;
- Allow extensions to the program timelines for completion of certain activities;
- Consider modifying the customer incentive cap of $1.5 million from a per customer basis to a per site basis;
- Conduct further research and analysis on the feasibility of TES projects for customers with high load factor facilities such as data centers and hospitals;
- Explore feasibility of rate designs to improve economic feasibility and reduce customer risk;

- Mature thermal energy storage systems should refer to technologies that fulfill a set of criteria (i.e., technically proven, commercialized and available, deployment scenario is known, early adoption phase has been surpassed, can be deployed on mass scale);
- Explore opportunities for flexible operation of TES systems, including ways to incentivize these capabilities; this will help customers adapt to changing rate designs and provide utilities with renewables integration services;
- Conduct non-participant research to better understand the barriers to TES adoption; and
- Conduct further research and analysis on the feasibility of TES projects for customers with high load factor facilities.

1. INTRODUCTION

TRC Energy Services (TRC), and their subcontractor Energy + Environmental Economics ("E3", together the "TRC Team"), were selected to conduct a process evaluation of the electric California investor-owned utilities (IOU or utilities) joint Statewide Permanent Load Shifting (PLS) program. The PLS program is offered by Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE), and San Diego Gas & Electric Company (SDG&E) in their respective service territories.

PG&E managed this evaluation with oversight from a committee consisting of representatives from each of the IOUs. A broader Demand Response Measurement & Evaluation Committee (DRMEC), consisting of representatives from California's three IOUs, the California Energy Commission (CEC) and the California Public Utilities Commission (CPUC) also provided guidance.

1.1 Program Background

As part of the 2006-2008 Demand Response Application (05-06-006), the CPUC issued Decision 06-11-049, Order Adopting Changes to 2007 Utility Demand Response Programs on November 30, 2006. This Decision, among other things, ordered the IOUs to pursue request for proposals and bilateral arrangements for PLS to promote system reliability during the summer peak demand periods. A PLS pilot was approved for all the IOUs to be pursued from 2008 to 2011. As the IOUs ran their pilots, the CPUC issued Decision 09-08-027 in 2009 directing the IOUs to work with other stakeholder parties to conduct a study examining ways of expanding the availability of PLS. The study was to consider other ways of encouraging PLS, as well as perform an evaluation of what incentive payment would be appropriate for a future standard offer. In November 2010, a statewide PLS study (2010 Statewide PLS Study), authored by E3 and StrateGen, was published that provided information to the IOUs to help them develop a PLS program offering[1].

In April of 2012, the CPUC issued Decision 12-04-045[2] which authorized IOU demand response activities and budgets for the years 2012 through 2014 and instructed the IOUs to collaboratively develop and propose a standardized, statewide PLS program. As part of the PLS program design process, the IOUs incorporated the findings from the 2010 Statewide PLS Study into the design of the 2012 to 2014 PLS program. On July 30, 2012, the IOUs submitted a joint PLS program design proposal to the CPUC Energy Division Staff (Staff). The Staff sought feedback from interested parties by facilitating a PLS Workshop that was held on September 18, 2012 at the CPUC. As a result of the PLS Workshop and the comments received from interested parties,

[1] Energy and Environmental Economics and StrateGen Consulting. Statewide Joint IOU Study of Permanent Load Shifting. December 1, 2010 with errata March 30, 2011. CALMAC Study ID SCE0292.01. See: https://www.ethree.com/public_projects/sce1.php

[2] CPUC Decision Adopting Demand Response Activities and Budgets for 2012 through 2014

the Staff provided the IOUs with program design feedback on November 13, 2012. The IOUs incorporated the Staff's feedback into the program design proposal which was submitted in a joint Tier 2 advice letter on January 14, 2013[3].

On May 9, 2013, CPUC Resolution E-4586 adopted the PLS program rules, budget, and implementation details proposed by the IOUs, with modifications. SCE launched the program in their territory and began accepting applications on July 5, 2013. SDG&E launched the program and began accepting applications on August 15, 2013. PG&E launched the program and began accepting applications on October 25, 2013.

1.2 Program Objectives

The PLS program is designed to help customers shift electricity use by offering a one-time, upfront incentive, based on the amount of designed kilowatt (kW) shift to the off peak hours, in order to help offset the customer's initial investments in a TES system. Customers are required to shift energy usage during the summer peak hours as defined by each utility. Providing an incentive to invest in a PLS TES technology helps the IOUs reduce the need for peak generation investments, reduce the likelihood of shortages during peak periods, and lower system costs overall by reducing the need for peaking generation plant.

Time-of-use (TOU) rates further encourage PLS because customers can reduce their energy bills by shifting cooling load from peak periods when rates (and demand charges) are higher to off-peak periods when they are lower. Transferring demand and energy consumption out of the most costly periods of the day can help achieve overall bill savings.

1.3 Evaluation Objectives

The overall objectives of this process evaluation were to:

1) Document the program administration and the delivery strategies;
2) Assess the effectiveness of the program administration of each utility's program;
3) Evaluate customer experience with the program;
4) Propose a definition of mature thermal energy storage technology;
5) Compare California's program to TES programs in other parts of the United States; and
6) Assess the PLS-TES market opportunity in the California market and the future of TES.

In addition to the evaluation objectives listed above, the PLS program managers and the DRMEC also had the following specific research questions:

[3] SCE Advice 2837-E, PG&E Advice 4177-E, and SDG&E Advice 2445-E were approved effective January 14, 2013 per Resolution E-4586, issued on May 13, 2013.

- Document program staff interview findings on program theories or rationale, program goals (including market transformation, peak load shift persistence, and customer commitment), implementation strategies and procedures across the IOUs.
- Evaluate the various marketing efforts and messages as well as discuss differences and similarities among the IOUs approaches to PLS.
- Identify areas of customer satisfaction, dissatisfaction or concerns related to the program, including the application submittal and review process, as well as longer-term customer participation.
- Identify and discuss the challenges faced by customers who are considering PLS such as initial investment, maintenance and operations and any building structural limitations.
- As a product of the evaluation, and to the extent possible, identify opportunities to improve the program's uptake.
- Compare the California PLS Program's characteristics and operations to other states' PLS-TES incentive program providers. Identify and recommend potential modifications to program characteristics and operations (such as either increasing persistent MW participation and/or decreasing program costs).
- Document opportunities for program changes to improve the customer and vendor experience associated with the Program. Evaluate the market and offer strategic opportunities to reach a more acceptable level of program participation.
- Document how using a PLS cooling technology can have an impact on "business as usual" for customers.
- Per each IOU, identify how customers rate the incentive level available to them; work to categorize responses by customer class, building size/type, manufacturer class, if possible.
- Identify how much of a role financing plays in getting customers to the step of applying. How frequently does the availability of financing represent the make-or-break component of deciding to enroll in the PLS program and invest in a TES system?
- Analyze price elasticity of the incentive rates and determine the range of appropriate costs for the IOUs' PLS programs.
- Review marketing costs and determine the range of appropriate costs for the IOUs' PLS programs.
- To the extent feasible, analyze existing TOU rate differentials and demand charges across the IOUs, and how this might impact adoption of the PLS-TES program in the context of payback period, benefits accruing to customers and to the IOUs, and the effectiveness of marketing messages.

It is important to recognize that, given the relatively short tenure of the PLS program and the long lead times associated with installing TES cooling technologies, the program had a limited pool of program applicants at the time of this evaluation and none had completed their TES system installation. This constrained the TRC Team's ability to address all of the research objectives and the study's depth of coverage for some of the research topics. None of the applicants' systems were installed by the time of the evaluation; therefore, TRC was not able to inquire about the TES technology's impact on business operations or on shift persistence. Because there were so few applicants, TRC was not able to categorize applicant feedback on incentives by customer segment or size, or investigate the role of project financing in a meaningful way. The TRC Team recognized the unique circumstances of the PLS Program and developed the study findings and recommendations with them in mind.

1.4 Organization of Report

The remaining sections of this report are organized around the broad evaluation objectives, as follows:

- Section 2: Evaluation Methodology – this chapter describes the evaluation methodologies used to complete this evaluation;
- Section 3: Document the Program Administration – this chapter documents the program's administration and delivery strategies;
- Section 4: Participant Experience – this chapter documents the interview feedback from applicants, participating and non-participating market actors, and program management staff;
- Section 5: Effectiveness of Program Administration – this chapter provides an assessment of the effectiveness of the utilities' administration of the PLS program. A review of the program marketing and feedback from the program staff interviews (that was not applicable to Section 3) is also included in this chapter;
- Section 6: Other TES Programs – this chapter summarizes the findings from interviews with program managers of other TES incentive programs;
- Section 7: PLS-TES Market Opportunity – this chapter defines the market opportunity for TES systems in California; and
- Section 8: Definition of Mature TES – this chapter proposes a definition for mature TES technologies.

2. Evaluation Methodology

TRC informed this evaluation through a review of program materials, secondary resources, and in-depth interviews with a variety of PLS stakeholders. This this section describes the evaluation methodology and the disposition of data collection activities.

Review of Program Materials

The TRC Team conducted a review of the program materials, including:

a) Individual utility program handbooks, the statewide program handbook, program applications and instruction packages, participation records, and other program materials;

b) Materials related to program administration, including reports of program budgets and expenditures;

c) Program marketing and outreach materials, including:

    i. Marketing plans (PG&E only);

    ii. Literature, brochures, and other materials; and

    iii. Program websites.

Secondary Research/Literature Review

The TRC Team reviewed the following secondary data sources to inform the evaluation:

- Past program-related studies, including the 2010 Statewide PLS Study and 2013 Program load impact evaluation report[4];
- California Commercial End-Use Survey data[5];
- Reports and papers from industry associations and conferences, such as:
    - Peak Load Management Association conference;
    - Energy Storage Association; and
    - California Energy Storage Alliance;
- Regulatory proceedings, filings, and orders related to the programs, including stakeholder comments.

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[4] Nexant. *2013 Load Impact Evaluation of the California Statewide Permanent Load Shifting Program*. April 1, 2014.

[5] California Energy Commission. March 2006. *California Commercial End Use Survey* (CEC-400-2006-005). Retrieved from http://energy.ca.gov/ceus/.

In–Depth Interviews

The TRC Team conducted primary data collection through in-depth interviews with a variety of market actors engaged in the delivery of TES systems.

TRC interviewed the utility PLS program managers at the outset of the evaluation (September 2014) and again as the report of findings was drafted (January 2015). TRC also interviewed staff from the third-party implementation firms supporting PG&E and SCE at the outset of the evaluation.

Thirteen PLS program applicants were identified across all utilities. Four of these projects were canceled or withdrawn during the evaluation period. TRC attempted to reach these firms to understand their barriers to TES adoption and experience with the program. However, none responded to TRC's request for an interview. Of the remaining nine applicants, TRC was able to complete interviews with six of them in November and December of 2014. Three applicant contacts interviewed were site facilities managers, one was a building property manager, and two were the project sponsors from the construction management firm handling the TES system installation. As of the interview, all of these applicants had submitted their feasibility studies, two received approval to proceed with their installations and the remaining four were under review.

TRC made call attempts to a census of identified PLS stakeholders known to operate in California. These market actors include TES equipment manufacturers, engineering firms who conduct system design, feasibility studies, and/or operate in the role of PLS project sponsors, installation contractors, and system commissioning agents. Recognized industry experts were also included. Stakeholders who are working on or have been involved with a PLS project are referred to throughout this report as ***participating***. Stakeholders who are not or have not been involved with a PLS project are referred to as ***non-participating***. These interviews took place between October and December of 2014.

TRC interviewed seven utility account managers whose assigned customers were PLS applicants. These interviews took place in November of 2014.

Lastly, TRC conducted interviews with program managers of other TES programs in the United States. Interviews were conducted from October to December 2014. The utility programs were:

- Platte River Power Authority
- Progress Energy Florida
- Southern California Public Power Authority
- ConEdison/NYSERDA
- Glendale Water and Power
- The Los Angeles Department of Water and Power

Table 1 summarizes these interviews and the final disposition. The interview guides are provided in Appendix 10.1.

Table 1. Summary of PLS In-Depth Interviews

Interviewee Type	Population[1]	Target Number of Interviews	Number of Competed Interviews	Length of Interview
Utility Program Managers	3	3	6[2]	30 min
Utility Account Executive	7 Total PG&E: 4 SCE: 2 SDG&E: 1	7	7	30 – 45 min
Third-Party Implementers	2	2	2	45 min – 1 hour
Program Applicants	9 Total PG&E: 2 SCE: 5 SDG&E: 2	9	5	45 min – 1 hour
Program Non-Participants (Canceled or Withdrawn)	4 Total PG&E: 2 SCE: 2	4	0	N/A
Participating Vendors	15	Up to 15	9	45 min – 1 hour
Non-Participating Market Actors	13	13	9	45 min – 1 hour
Other TES programs in the U.S.	15[3]	15	7	45 min – 1 hour

[1] In the context of the evaluation, TRC defined the population as the maximum number of interview candidates that were provided to or identified by TRC.

[2] TRC interviewed each utility program manager twice.

[3] Not all 15 identified utilities or entities actually had current programs. TRC was not able to reach some for interviews, but reviewed available information through their program websites.

TRC sent advance emails to targeted applicants, program non-participants, participating and non-participating market actors, and other TES programs one week in advance of the scheduled start of the interviews. TRC made at least six attempts to contact each interview candidate, including at least three calls and voicemails at different times of the day and week. For unresponsive candidates, TRC sought out additional contact information or alternative points of contact for the project of interest. TRC also interviewed the account executive for one customer who was unresponsive.

3. Document the Program Administration

This objective of this chapter is to document the program's administration and delivery strategies. The Statewide Program Handbook[6] is a comprehensive reference for the program policies and processes. This chapter highlights notable aspects of the program and the various utilities' administration, focusing on differences between the utilities.

3.1 Program Overview

The program provides an incentive of $875 per kilowatt of cooling load shifted. A customer is entitled to the lesser of the project's calculated load shift incentive, or 50 percent of the project's verified total project cost. To help defray the upfront costs of the feasibility study, the customer has the option to receive a portion of the incentive, equal to 25 percent of the feasibility study cost, to a maximum of $10,000, upon review and approval of the feasibility study and pre-installation inspection. There is also a program incentive cap of 1.5 million dollars per customer.

Customers are required to operate their TES systems for a minimum of five years. The customer is also required to monitor, record, and submit five-minute trend data of their TES system for 60 months. This is to allow the utility to conduct data analysis on cooling-load-shift performance and impact evaluation.

Table 2: PLS Program Summary

	PG&E	SCE	SDG&E
Incentive rate		$875/kW of cooling load shift	
Caps		Incentive cap: $1.5 million Project cost cap: 50%	
Date program launched	October 25, 2013	July 15, 2013	August 15, 2013
Installation Term		Minimum of 5 years	
Monitoring Period		60 months	

[6] *Statewide Program Handbook, Permanent Load Shift Thermal Energy Storage (PLS-TES) Program*. Final v8, September 17, 2014.

The program requires that the customer operate the TES system on weekdays during summer months to shift electric energy usage from on-peak hours of the day to off-peak hours. Table 3 summarizes the PLS program definitions for summer months and on-peak hours.

Table 3. PLS On-Peak Parameters

Utility	Summer Months	On-Peak Hours
PG&E	May 1 – October 31	12 pm – 6 pm
SCE	June 1 – September 30	12 pm – 6 pm
SDG&E	May 1 – October 31	11 pm – 6 pm

3.2 Program Administration

Each California electric IOU implements the program in their respective service territory. SDG&E is solely responsible for the implementation of the PLS program in their territory, while PG&E and SCE use third-party consultants in some capacity.

The PG&E PLS program contracts with an engineering firm, Integral Group, and their two subcontractors, KW Engineering and Waypoint. The Integral team is responsible for the turnkey implementation of the PG&E PLS program. Integral's specific responsibilities are general program administration duties, technical review, and managing the communications with applicants. KW Engineering provides additional technical support. Marketing and outreach is conducted by Waypoint.

SCE contracts with a third-party engineering firm, ASW Engineering, to provide technical support that includes the following activities: review applications, evaluate customer interval data, review feasibility studies, and conduct pre- and post-installation site inspections. SCE staff are responsible for the program administration and are the primary point of contact for applicants.

SDG&E has a program manager and an administrative support staff who both work on the PLS program on a part-time basis. The SDG&E program manager engages engineering and inspection staff, as needed.

All three IOUs and their consultants agree that current staff resources are sufficient to handle the current program pipeline. An estimate of the each program's staffing levels are provided in *Table 4*.

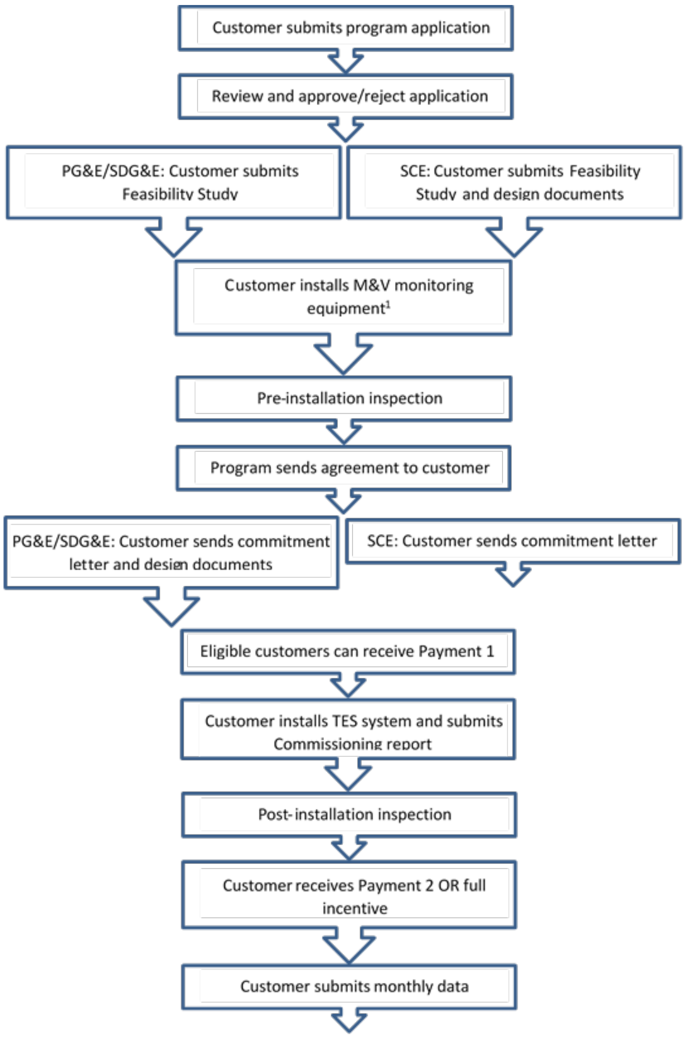
Table 4. PLS Program Staffing Resources Summary

Utility	Utility Staff	Third-Party Consultant Staff
PG&E	2 staff: • 1 Program Manager • 1 Technical Support	~2 to 2.5 FTE • 3-5 staff, including subcontractors
SCE	2 staff: • 1 Program Manager • 1 Administrative Support	~ .75 FTE • 3 staff members,
SDG&E	2.5 to 3 staff: • 2 part–time program staff • 1/2 – 1 part-time support staff	N/A

The utilities' Program Managers have monthly conference calls to provide updates on their programs and discuss issues of program and technology eligibility. The utilities spent a lot of time and effort over the first year of the program to coordinate positions and policies on unique issues that surfaced, such as how to estimate the incentive for a site that has solar PV. The utilities believe that they have addressed the most substantive issues now and have documented the policies in the statewide program manual[7].

[7] *Statewide Program Handbook, Permanent Load Shift Thermal Energy Storage (PLS-TES) Program*. Final v8, September 17, 2014.

3.3 Program Processes



[1] SCE: No pre-monitoring required if customer submits 3 years of prior utility data

The program application process is largely the same in PG&E and SDG&E territory, while SCE has modified their process slightly. The primary difference is that SCE requires design documents to be submitted as part of the feasibility study, where PG&E and SDG&E receive design documents after the customer submits a commitment letter.

According to interviews with the utilities and third-party implementers, all of the utilities require monitoring for establishing baseline energy consumption conditions and not as part of the feasibility study. The program originally envisioned that three months of pre-monitoring of the chilled water system performance would be conducted and reported as part of the feasibility study, but applicants are reluctant to make the investment in the monitoring equipment until they receive approval of the feasibility study. The utilities allow the three months of pre-monitoring to occur after the feasibility study approval, but before the TES system installation. SCE sometimes will waive the requirement for pre-monitoring and accept the participant interval data along with the project modeling.

SCE has initiated a practice of meeting with interested applicants before they submit their application, though this isn't a format step in the application process. During this meeting, they discuss their plans for the system and how much load they think they can shift. ASW can assess whether the applicant's plans are feasible and whether they have the organizational capacity to operate a TES system. SCE/ASW, has also developed a practice of reviewing the applicant's past three years of interval data before moving to the feasibility study. Reviewing the historic data can identify existing TES equipment that has been in recent operation and assess whether the proposed magnitude of the load shift is realistic.

At the outset of the program, each utility developed their own utility-specific program handbook and made these available on their program websites. Subsequently, the utilities have collaborated on a statewide PLS handbook. The statewide PLS program managers adopted the statewide handbook in September of 2014, but as of the time of this report, it has not been made available to the public.

3.4 Program Status

Each program has seen modest activity since their respective launches. Table 5 summarizes the number of applications received, withdrawn or rejected, and the sum of on peak cooling for each utility.

Table 5. PLS Program Activity Summary as of January 2015

Overview	PG&E	SCE	SDG&E
Total applications received	5 applications	9 applications	2 applications
Applications withdrawn or canceled	1 canceled 1 withdrawn	2 withdrawn 3 canceled	n/a
Max on peak cooling* (sum of active applications)	10,519 tons	9,814 tons	2,142 tons

** Based on applicant data or feasibility studies, where available.*

For PG&E, one of the applicants (a biotech facility) accounts for (96%) of the 10,519 tons of cooling load that may be shifted off-peak. A fifth application is being cancelled by PG&E due to a lack of communication by the applicant. One of the two applicants to the SDG&E program accounts for 1,635 (76%) of the 2,142 tons of cooling load to be shifted. In SCE's territory, the eight still active applicants have estimated maximum on-peak cooling loads ranging from 540 to 3,926 tons. The smallest project, at 426 tons, withdrew their application after approval of the feasibility study and pre-inspection on site, because they chose to sign up with their local municipality for electricity service. The requirement for existing TES systems to have been inoperative for the last three years to be eligible for incentives has resulted in three applications being canceled in SCE's territory.

Budget

The utility budgets for the PLS for the time frame 2012 to 2014 are summarized below in Table 6. SDG&E did not receive authorization for marketing, education, or outreach. Program expenditures are presented in Section 5.

Table 6: 2012 to 2014 PLS Program Budgets

Utility:	**PG&E**	**SCE**	**SDG&E**
Incentive	$13,500,000	$12,690,000	$2,235,000
Administration	$1,500,000	$1,310,000	$765,000
Marketing, Education & Outreach	$200,000	$310,000	$0
Total Program Budget	$15,200,000	$14,310,000	$3,000,000

4. Participant Experience

This section summarizes the feedback received from program applicants, market actors, and utility account executives. We also include feedback from the utility program managers, where applicable. The applicant representative was typically a facility or project construction manager who did not have substantial involvement in the development of the feasibility study, but could provide feedback on project and program the process. Market actors include design engineers, manufacturers, and other TES vendors. Some market actors were directly involved with a PLS project, others were not.

Current projects are in various stages of the program, but none had been installed at the time of the report. Some project timelines and processes were integrated into other construction projects, such as overall facility upgrades or new construction. Both of these factors can affect responses to the interview questions.

TRC contacted nonparticipating customers, defined as those who submitted an application, but did not pursue the installation, either because the project was withdrawn by the applicant or cancelled by the program. However, TRC was able to talk to several market actors (including equipment manufacturers and suppliers, consulting engineers, and recognized industry experts) who have not participated on a TES project for this program. Their feedback on the program requirements and TES in the market is important to show the perception of the general industry and barriers that the program is facing.

4.1 Introduction to Program and Motivation to Participate

The applicants attribute their knowledge about TES systems and the utility incentive offerings to general industry awareness or through their relationship with their utility account executive. Design engineers (three of nine) also mention that they are generally aware of incentive offerings by the utilities, but also cite vendors and TES designers as sources of information. None mentioned being aware of any specific marketing campaigns or activities by the PLS program.

From the standpoint of both the customers and the market actors, the main driver for pursuing a TES system is economics; customers are interested in reducing demand charges and potentially avoiding the cost of additional chillers. In addition to reducing demand charges, other influencing factors include reliability, protection against potential brown- or blackouts, environmental responsibility and reducing greenhouse gas emissions, improving plant efficiency, and a means to use Proposition 39 funding.

4.2 Program Requirements

Application

The majority of applicants did not report any issues with the application and thought it was simple and straightforward. One applicant had an issue determining the proper incentive multiplier to use. This project was upgrading an air-cooled system to a water-chilled TES system, but it was not clear if they were supposed to use the incentive multiplier for the incoming or outgoing equipment. The applicant reported that they spent several weeks discussing how to interpret and apply this requirement with their utility account executive. The issue was finally resolved during an in-person meeting with the PLS program manager. The applicant attributes this delay to the newness of the program and lack of experience dealing with unique situations. Overall, the applicant was pleased with the utility's wiliness to discuss the situation and let the applicant state their case.

Eligibility Requirements

Applicants and their TES vendors and consultants were generally satisfied with the eligibility requirements for both the program and the equipment, but feel that the program could be more lenient in some aspects. Two applicants and two design engineers provided specific feedback on the eligibility requirements. They report that the requirements are straightforward, specific to the program, fair, and generally clear. They also note that for requirements that were not initially clear, applicants worked with the utility and came to an agreement. Equipment requirements are easy to deal with, feasible, and make good sense for the most part. The only issue with the equipment requirements is the five year warranty, which one market actor notes is not a typical length for manufacturers. Although generally accepting of the eligibility the requirements, both applicants and market actors identify some issues and provide suggestions for modifications, discussed below. Numeric score given for program and equipment eligibility are presented in Figure 1.

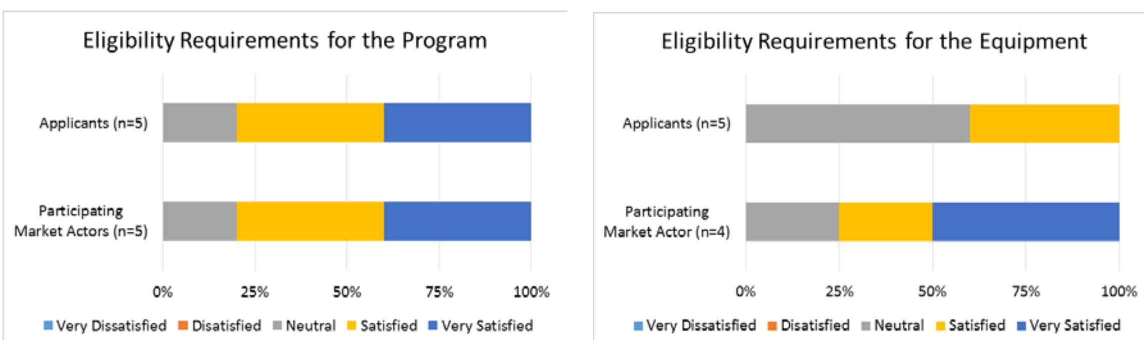


Figure 1. Satisfaction with Eligibility Requirements

Participating market actors do not think that the timeline for installation is feasible for many projects. The most common feedback from applicants and market actors is that 18-month deadline is too short to complete the entire design and construction process. TRC elaborates on this point in the program processes section below.

Market actors understand the intent of the strict requirements, but think that the program staff should evaluate each project before dismissing it and that they could be more lenient with requirements. A situation arose with a project that, due to the site construction schedule, needed to move forward with purchasing the TES equipment prior to formal approval of the feasibility study. This project moved forward with the expectation that they would receive the incentive funding. However, the program requirements are such that pre-installed equipment cannot receive incentives. The engineers understand the requirements (eliminating free ridership), but feel that the program could make as-needed exceptions based on customer needs and exceptional situations.

Two market actors reported that they do not think the requirements around eligible refurbishment projects are correct. The current language[8] states that refurbished systems must increase shift capacity AND be inoperative for at least three years. The feedback is that this language should be modified to indicate that an eligible refurbished system increase shift capacity OR be inoperative for at least three year.

Another related issue occurred when the SCE program rejected a refurbished system project. The project design engineer was left under the impression that the project was rejected because the equipment was not new. However, an SCE engineer revealed that the project was actually rejected because the engineer determined that there was a load shift within the last three years. This lack of clear information caused the applicant to go through an expensive assessment process only to find out the project would not receive program support. Unfortunately, because the customer did not qualify for the PLS incentive, the customer installed a traditional chilled water plant instead of a TES system.

Feasibility Study

The feasibility study requirements and process are the most difficult portion of the program for both applicants and the market actors who develop the study, but feedback also suggests that the studies are valuable and provide ancillary benefits. The program requires that applicants submit a feasibility study from a licensed engineer[9] that details performance data for the existing equipment, potential on-peak load shift with TES, and operation and maintenance plans, among other items. Although not all applicants and market actors had difficulty, many believe that the volume and granularity of data required may not be necessary for the purposes of showing expected load shift. As Figure 2 illustrates, applicants tend to be more dissatisfied with the feasibility study requirements than participating market actors.

[8] In the SCE and PG&E program handbooks and the state-wide handbook.

[9] PG&E and SDG&E require a mechanical engineer while SCE will allow a civil engineer to complete the study, with their approval.

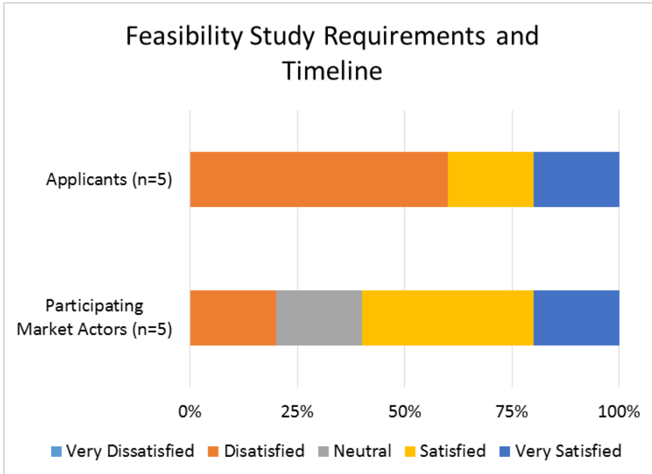


Figure 2. Satisfaction with Feasibility Study

Content Requirements

Participants were not clear on what data the study requires, and find the requirements to be onerous and time consuming, especially in regards to the performance data requirements for the existing equipment. One applicant spent several months submitting data and discussing the requirements with their account executive and the program manager before they were able to settle on the type and format of data they need to provide for the study. From the applicant's perspective, the delay and lack of clarity are due to the newness of the program.

The study requires metered data at 15-minute intervals, which is difficult for some customers to provide. Facilities that do not have equipment sub-metering or building management systems (or have their systems setup to capture 15-minute data) must invest in monitoring equipment to capture this data. Design engineers report that they spend a significant amount of time collecting data and running software models to get the load profiles in the format that is required for the study. Design engineers would prefer to use actual usage data rather than software estimates, but that is not always an option due to limitations from customers' existing monitoring systems. TRC elaborates on the feedback around monitoring requirements in the section below.

Additional feedback on the feasibility study is that the design engineers would benefit from more guidance on how to incorporate seasonal rates and various operating conditions when determining an optimal design. Finally, design engineers note that they may not be able to model the system with complete accuracy because the ultimate operation and maintenance schedule and procedures determined by the facility after installation completion; the design engineer can only provide recommendations.

Although the feasibility study portion of the program proves to be the most difficult for projects, several applicants and design engineers were ultimately satisfied with the feasibility study and felt that they received an adequate level of support from the program during the process. Performing the feasibility study provides the ancillary benefit of addressing a majority of the project details that could be barriers down the road, such as location of the system, the size and type of equipment, and the project's financing.

Timing and Process

From current applicant experience, the feasibility study takes between one and six months to develop, and the turnaround time for program review is a mix of acceptable and longer than expected wait times, which is utility-dependent.

Applicants who had feasibility studies that took longer to complete mention that started their studies during the off-peak season, but needed to wait in order to capture trend data during the peak season. Some applicants also mention that it takes a while to collect and interpret the volume of data required for the study. None of the applicants felt that the time to develop a feasibility study was too long once they understood the requirements; however, one did mention that it took longer than they initially expected because they had to secure an outside consultant to perform the study.

The majority of applicants and participating market actors feel that the turnaround time for the program review of the feasibility study is acceptable, with a few exceptions. PG&E and SCE applicants are generally pleased with the turnaround time and received a response from the program between five and eight weeks after submittal. In comparison, SDG&E applicants report that it has taken the utility longer than expected to review and respond to their submittals; one has been waiting a year for final approval.[10] These applicants note that they remain in contact with the program or their account executive during this time. Although most applicants are not displeased with the waiting time for approval or feel secure about their application status based on continued contact with the program, one market actor with an application in to SCE mentioned that their customer could not wait six to seven months for approval in order to make a decision on funding the project and eventually dropped out of the program. It is not clear how long this applicant actually waited for response from SCE or whether the long waiting time was the sole reason for dropping out of the program.

Monitoring

The program requires both pre-installation monitoring to develop a baseline for the existing performance and post-installation monitoring to track the system performance. Applicants and market actors are more neutral on monitoring than on other aspects of the program (Figure 3). Obtaining the three months of pre-installation monitoring information is troublesome for some customers, whereas there is little concern over obtaining monitoring data over five-years as required by the post-installation monitoring requirements.

[10] This interview occurred in October 2014. The status of the feasibility study may have changed since this time.

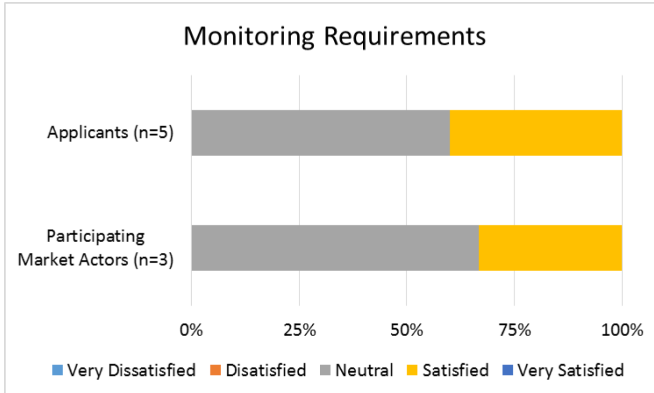


Figure 3. Satisfaction with Monitoring Requirements

The pre-installation monitoring requires that usage data be in intervals of 15-minutes and show the load profile for the facility during the highest on-peak load periods. These requirements are difficult for projects if their existing monitoring systems (building monitoring system or other monitoring devices) are not previously set up to provide this level of interval detail or if their utility meters are not in direct coordination with the buildings that the TES system will serve. We received some feedback that the cost of the pre-installation monitoring equipment can be a challenge, since the monitoring period technically begins before the project receives approval. Project engineers report that it requires significant time to determine the correct load for existing conditions and to prepare the data in 15-minute intervals. In some cases, applicants delayed submitting their feasibility study or submitted additional data later in order to capture summer peak months in their data because they either had no previous monitoring equipment or did not have the monitoring setup for 15-minute intervals. For some SCE applicants, collecting pre-installation data was not an issue because they used engineering calculations instead monitored data. Although this can avoid some of the problems, some project engineers mention that they would rather use metered data rather than simulation results if available.

Applicants and market actors generally agree that there should be more flexibility in the type of data or level of granularity required for pre-installation monitoring, perhaps based on the size of a system or selecting specific components to monitor. Design engineers agree that this level of stringency is more than they would normally implement for a TES assessment outside of this program.

The requirements to monitor systems after installation is not a problem for the majority of projects because customers typically install monitoring equipment and an energy management system (EMS)/building management system (BMS) along with TES systems if it is not already present, or plan to monitor the system through other means. The main challenge noted for post-installation monitoring is that the program specifications for monitoring equipment are more stringent than what off-the-shelf products provide, which can increase costs; standard off-the-shelf products are not usually able to report at five-minute increments, which the program requires. Applicants and design engineers, both participating and nonparticipating agree that 5-minute data may be too granular. Feedback from one design engineer is that post-installation monitoring may not be completely necessary, or at least at the five-minute interval level, because a customer who invests in this expensive system is going to operate it correctly in order to receive the cost savings from on-peak load shifting.

Overall, most applicants find monitoring a benefit because they can understand their loads and it will help with any other updates or modifications they plan in the future. Some applicants would have set up the post-installation monitoring differently if they were to have done the project without the program, such as monitoring high use areas to provide occupant feedback. Only one project felt that the requirements for post-installation monitoring were unclear and would have liked more explanation earlier. This applicant will install monitoring devices, but may not have originally planned to do so or factored in this cost. Both participating and nonparticipating project engineers say that they always encourage and default to installing monitoring equipment, but that customers sometimes omit monitoring equipment for smaller projects due to the costs.

4.3 Program Processes

After customers submit the initial application, they develop the feasibility study and then wait for program approval to move forward on the project. After program approval, projects have 18 months to complete the installation. Applicants (four out of six) feel that the 18-month timeline is too short in order for them to go through all of their internal project processes and requirements. Public or institutional customers have to secure board approval, which may require developing a proposal and convincing decision-makers to allocate budget or bond money to the project. After receiving board approval, the institution must put the project out for competitive bidding and execute a contract, which can be a lengthy process in itself. Private companies are thought of as more streamlined, but they face similar constraints. They must plan and secure financing if they are not self-funding and go through the design planning process. According to applicants, all of these customer-side requirements and the time for construction can take over 18 months.

In addition to internal processes that must take place, applicants say the timeline needs to consider the volume of data that the project engineer collects for pre-installation monitoring and the ideal time period (summer) to collect the data. Due to the 18-month timeline, at least one applicant expressed that they have limited their potential load shift because they will not be able to get as many buildings built and connected to the TES system as they would like. According to the requirements, all potential loads must be connected to the system at the time of installation completion in order to qualify for incentives.

Lastly, the timeline must be flexible in order to manage external factors that cause delays. Applicants site issues with California Environmental Quality Act (CEQA) documentation and coastal commission approval.

Applicants note that program staff from all three utilities are considerate of these delays and have been accommodating to their situations when delays arise. An applicant suggests that it would be helpful if the program had “contract networks” of service providers that have already been through a competitive solicitation process. If a public-entity applicant could leverage this resource, it would cut down on the bidding process and help the project stay within the timeline.

Besides having concerns over the project timeline, some applicants (three out of six) desire earlier contact with the program representatives and an initial site visit or in-person meetings to discuss eligibility and feasibility study requirements. Applicants suggest this would be a helpful step to reduce back-and-forth discussion when facing questions or unclear requirements. Design engineers would also benefit from more communication or earlier notification of issues on feasibility studies or calculations. Account executives support this position and think more upfront engagement between the customer and program would speed up the process and reduce confusion over requirements. Currently, SCE has introduced an offering where they will send their performance and verification engineer to meet with a customer and conduct a high-level assessment of the facility and TES opportunity. PG&E similarly offers to setup a meeting with the customer after sending out the application package to go over requirements and questions.

The majority of applicants, market actors, and account executives who volunteered comments on program staff support are satisfied with the involvement and responsiveness of program staff and their consultants (four of six applicants, two of three market actors, and four of six account executives). They feel that all utilities are accommodating when special circumstances introduce delays. Only one market actor felt that the utility needed a point of contact rather than having the consultant or program implementer be the line of communication between projects and the program.

4.4 Incentive

Incentive Level

The program currently offers $875 per kilowatt of shifted load, with a maximum of $1.5 million per customer. The incentive payment is made after the installation is verified, but the applicant can request an early payment $10,000 to offset the cost of the feasibility study. Applicants and market actors are satisfied or very satisfied with the incentive levels (Figure 4). Although all applicants would prefer to receive higher incentives so that their project payback periods are shorter, they responded that they find the incentive to be generous and that it largely influenced the decision to move forward with the project.

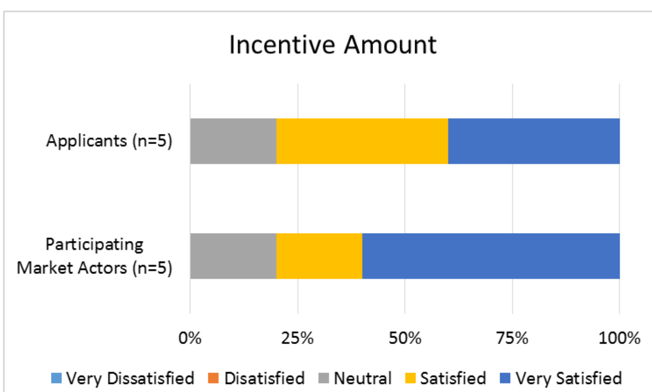


Figure 4. Satisfaction with Incentive Amount

The payback periods for current applicants are generally between 4.5 and 12 years, and one project estimates a 25-year payback period. According to applicants and project engineers, payback calculations typically only include bill savings and the incentive into the calculation. These payback periods are generally acceptable for the applicants who own their buildings. For some projects, applicants mention that the payback period might be a hard selling point when proposing the project to the decision makers. Only one applicant reports that the TES installation probably would have happened regardless of the incentive, but all other applicants say that the incentive is imperative to the project moving forward. Account executives agree that the program incentive has spurred interest in TES systems.

Both participating and nonparticipating market actors also agree that the incentive is generous and an important factor in the decision-making process. One design engineer thinks the incentive is helpful to get customers to consider more expensive and greener projects once they have committed to a TES installation, but it is not enough to mitigate the high upfront costs for the majority of customers. A participating market actor suggests including energy efficiency measures and incentives for efficiency gains from chillers running more efficiently; this would increase overall project incentives and potentially draw more customers.

The customer cap on incentives prevents some customers from participating at multiple sites, as is what happened with one customer who hit the cap, but is interested in installing TES at another site.

Design engineers report that the program requires more work than would normally be done to develop a feasibility study for this type of project. The $10,000 limit on advance incentive payment for funding the feasibility studies does not cover the customers' costs for the design engineers to complete the work.

Based on applicant feedback, the incentive calculation methodology has been problematic. The application provides a calculation to estimate the incentive, but the program bases the actual incentive amount on metered data, which caused confusion and a smaller incentive than originally estimated for at least one applicant. As described above in the application section, another applicant had trouble determining which incentive multiplier to use for their project.

Incentive Structure

Applicants and market actors are happy with the capacity-based incentive, paid after installation, rather than a performance-based incentive paid over time. However, they would still prefer a more stratified or benchmark-based payment structure. Applicants and project engineers suggest that the program pay incentives at certain milestones during the project development, which can help customers who may not be able to pay the large upfront costs and wait for the full incentive after installation. One applicant mentions that the additional requirements to select the two-installment option were too much of a challenge so they opted for the single post-installation payment.

Applicants are also concerned over not having a guaranteed incentive amount earlier in the design and decision making phase. One applicant cites that other programs provide a conditional reservation that guarantees the customer an incentive if they build the project. Applicants would like to know the final or guaranteed incentive amount earlier in order to factor the value into their project decision-making, before they make the investment in a feasibility study or pre-monitoring data collection. The ideal time for applicants to receive the guaranteed incentive amount is when deciding upon equipment to purchase, and the next best option is to know during the program walk-through after equipment installation.

Integration with Energy Efficiency Offerings

There is no clear strategy to integrate TES installations with energy efficiency measures. Typically, chiller equipment upgrades accompany the installation in order to be compatible with the TES system. Design engineers think it would be good to implement and see the impact of energy efficiency measures during the feasibility study. It then becomes a question of how to separate the energy efficiency savings and incentives.

4.5 Utility Account Representatives

Applicants have good relationships and communication with their utility account executives; one even mentions that this relationship is what is keeping them on board with the project through a long application process. However, both account executives and applicants agree that a PLS program manager should have early contact with prospective TES applicant to explain the program requirements and provide resources. Two applicants reported delays when they tried to resolve questions with their account executives; the issues were ultimately resolved when the program staff became involved. From an account executive perspective, more engagement in the program would help them be more aware of program requirements; many seem disconnected from issues that arise with program applications after they hand the customer off to the program team; this could hinder their ability to identify and pre-assess potential customers.

4.6 Utility Rates

Although not an overwhelming sentiment from applicants, there is some mild concern over utility rate structures. Design engineers have higher concern over the impacts of changes in rates than current applicants.

Most applicants do not expect there to be substantial rate changes that would render their system a bad investment, but design engineers list rate uncertainty as a main concern for the economic viability of TES installations. A few applicants are aware of the possibility of rate changes, but they expect on-peak demand charges to continue to increase; one applicant even expects that future changes to utility rates will make the installation more advantageous.

The few applicants noted that it would be beneficial to freeze their current rate and demand structures so they can lock in their anticipated savings. Design engineers support this sentiment and one acknowledges that implementing a special rate tariff for PLS would be beneficial to the program, but would only be worth doing if they see higher levels of TES adoption. TRC was not able to speak to any non-participating customers, so although the utility rates are not a concern for current applicants, it may be a barrier for other potential TES projects.

In respect to the current rate structure, an SDG&E applicant reports that the rate differential between on-peak and off-peak demand charges is not currently enough to solely influence the project, but the incentive is helping to push their project forward. Another concern over SDG&E's utility rates is the all hours demand charge where SDG&E charges a customer a rate based on their highest demand, regardless of when it occurs. Facilities, particularly those that have 24-hour operations, might have a higher maximum demand than their on-peak demand due to adding the TES load to their existing off-peak load. An applicant feels that the current all hours demand charge penalizes them for switching load. None of the applicants from either SCE or PG&E mentioned issues or concerns with the current rate structures. All customers that are not currently on a TOU rate plan to switch after installing the TES system.

For the most part though, neither applicants nor design engineers are considering rate changes in the context of renewables or policy changes. As more renewables enter the market, most likely in the form of photovoltaic, the peak demand period may shift due to the increasing amount of generation happening during daytime hours. This could cause changes in utility on-peak demand periods, and therefore, lead to changes in the rate schedules. However, this potential circumstance does not appear to be on the radar for customers or most design engineers.

4.7 Overall Satisfaction

Applicants and market actors are satisfied to very satisfied with this program (Figure 5) and find it to be a good program overall and a wining situation for both the customer and the utility. The program representatives provide sufficient support and direct and clear feedback to projects. Applicants and market actors would recommend this program to others and encourage TES applications if it is feasible and cost-effective. All applicants and participating market actors report that they would participate again, except for a customer which has hit their incentive cap and another which will shift their entire load with this project.

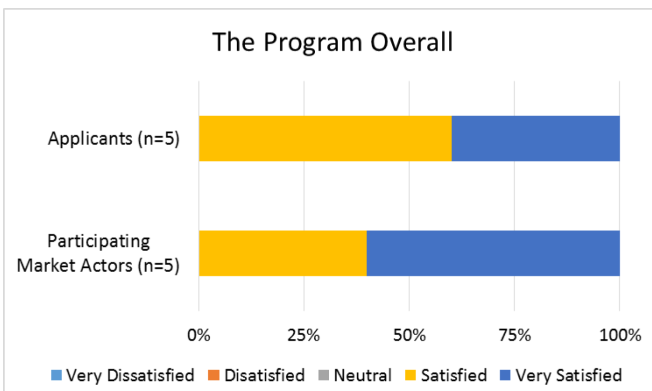


Figure 5. Overall PLS Program Satisfaction

Applicants note that having the right outside consultant really helped move their project forward and over barriers, and they suggest that the utility provide a list of consultants that specialize in TES systems.

4.8 Challenges and Barriers

There are a number of challenges and barriers to pursuing a TES system. These are described in the sections below.

Barriers

The identified barriers generally stem from the customer's circumstances or the TES technology itself, and not from the program requirements.

High Costs

All interviewees, including those participating and not participating in the program, identify several types of costs that prevent customers from pursuing a TES installation: high costs of the TES equipment, and upfront costs of the feasibility study. The costs for pre-installation monitoring can be a challenge if the requisite equipment is not already present in the facility.

Applicants and all market actors, participating and nonparticipating, agree that the high upfront cost and long payback periods are the main barrier to installing TES systems. From design engineer's experience and knowledge of the market, acceptable payback periods vary according to the customer type. Typically, installations move forward with payback periods of less than 10 years, but many building owners require payback periods of less than seven years. The majority of current applications in the program have payback periods higher than 10 years.

The cost of the feasibility study is a barrier because it requires a non-trivial outlay of funds just to fully understand the TES opportunity and savings. Although the incentive is reserved at the time of the application, the findings from the feasibility study could alter the project scope, potentially rendering it uneconomical. The program caps the progress payment for the feasibility study at $10,000, so customers must fund the remaining costs for design engineers to perform tasks that they would not perform if the project was not under the PLS program.

Engineers and market actors report that the cost for collecting the required data on existing equipment and providing it to the utility in the required format might be more than a customer would typically pay for this service if completing the installation outside of the program. Some facilities may already have the requisite monitoring equipment and data recording set up, while others may need to invest in monitoring equipment that satisfies the program requirements. The pre-installation monitoring equipment requirement can be costly since the project would no have received approval prior to the commencement of the pre-installation monitoring period.

Lack of familiarity or knowledge of TES systems

Design engineers, TES equipment vendors, and the PLS program managers report that a good candidate facility for a TES installation has engineering staff that are highly trained and operations that require engineering staff to monitor operations around the clock. Customer sites that do not have a knowledgeable operator or engineering staff to monitor the system are not good candidates for TES. Current applicants in the program are confident that they have appropriate and knowledgeable operation and maintenance staff who are familiar with TES systems, but these customers may not be representative of all eligible customers.

Similarly, market actors report that a project champion from the facility is important to the successful installation and continued operation of TES systems.

Rate Tariffs

There are concerns over the impacts of future changes in rates for all utility territories and over the demand charge differential and all-hours demand charge for SDG&E customers.

Changes to utility rate structures have the potential to adversely impact the economics of installed TES systems. Applicants do not expect future rate changes to have severe adverse effects on their installations, but market actors are more sensitive to this issue.

All parties acknowledge that the difference between on-peak and off-peak demand charges is not sufficient to justify the installation of a TES system on the merits of economics alone. Another issue in the SDG&E service territory is the all hours demand charge. The TES system could increase the customer's off-peak load beyond their on-peak load, triggering the all hour demand charge.

Space Constraints

Both participating and nonparticipating market actors agree that finding adequate space for the tanks can be a barrier for projects. The additional costs to connect a tank that is not in close proximity to the plant or placed underground is a related barrier. Customers that face space limitations are those in urban areas and those that do not have a campus style facility. Some jurisdictions have vertical rise limits. Space was not report to be an issue for any of the current applications, and this may be one reason that these projects are able to move forward.

Challenges

Program requirements present a few challenges for TES applicants, as do some external factors.

Program Timeline

Applicants, market actors, and account representatives/executives agree that 18 months is a difficult timeline to meet when one considers the steps required to complete a TES installation. Some projects indicate that they limit the shifted building loads in their applications to those that can be completed within 18 months. It is not clear whether the projects will exclude these building entirely from TES, or if they will add the building loads later without receiving an incentive.

Interaction with Demand Response Programs

Utility account executives identify potential issues for customers who are interested in or are already moving forward with participation in demand response. Customers cannot double dip incentives for demand savings, so integrating demand response and TES at a facility makes it more difficult to separate the attributable demand savings for demand response and TES. It is not impossible to participate in both PLS and demand response programs, but doing so increases the difficulty of feasibility studies and incentive calculations.

Multiple Meters or Multi-Buildings served by one meter

The data collection required to determine the load shift is difficult when sites do not have one meter to one building (such as in a central plant serving several buildings). These situations posed challenges for the project sponsors because they require extra effort when organizing meter data and completing the feasibility study and application, and potentially require extra controls to correctly determine load shift.

Internal and External Agency Approvals

Customers may encounter barriers to TES installations when they require approval from internal or external agencies. Applicants and market actors volunteered their feedback on potential barriers for TES installations. Facilities with architectural committees that approve facility modifications may find their project at risk if the committee finds the tanks visually unappealing. Similarly, the California Coastal Commission has line of sight requirements that may prohibit the installation of above ground tanks that block visual access. In these instances, project designers have to strategically integrate the tanks into construction, such as placing them inside buildings or parking garages, or to provide enough supporting evidence to show the benefit of these systems.

Unfavorable Experience with Prior TES Systems

Design engineers note that the early TES installations did not perform as promised and that many customers abandoned their systems. This created a bad reputation for TES systems which can be hard for the technology to overcome. Market actors recognize that TES technology has advanced since the initial introduction to the market when equipment did not function with the intended capabilities. This resulted in facilities abandoning systems after paying for the costly equipment. Design engineers and manufacturers agree that currently available systems are better and more reliable.

4.9 Other Benefits

Interviewees identified a number of other benefits TES systems provided beyond reducing demand charges and providing customers with reliability during peak demand periods. Among these identified benefits, market actors mention that TES systems lead to more efficient operation of cooling towers because they run at night when the ambient temperatures are lower. The systems provide security against brown- or blackouts because chillers are not running during peak periods when blackouts are likely to occur. This is important for facilities with sensitive products or operations that require a continued cooling supply to maintain air temperature. One project gained additional usable parking space due to advantageous placement of the tank in conjunction with a parking garage. Lastly, installation of a TES tank on adjacent land allowed for the installation of rooftop renewables at one site. The facility is removing the previous HVAC equipment which will allow the building to support the physical load (weight) of micro-turbines or photovoltaic equipment on the roof.

4.10 Decision-Making

Current projects are mostly self-funded or have received bond or Proposition 39 funding to pursue energy upgrades, so securing financing was a non-issue (five out of six applicants). Only one project claims that financing was a determining factor and that it has moved forward without completely securing project funding. For most applicants, the decision to proceed with a TES system was obvious once they were aware of the incentive and understood the benefits and long term savings. Some applicants were already interested in a TES system, but were waiting for an incentive to be available to reduce the project payback. Although financing was not an issue for the majority of current applicants, this factor could be a crucial piece for other eligible customers. TRC was not able to speak with any nonparticipating customers to investigate the importance of financing opportunities.

Feasibility studies help the decision-making process because these studies require the applicant and design engineer to investigate all of the project details in advance. The feasibility study provides the benefit of looking at any potential issues, such as location, viable load shift, and operation and maintenance suggestions. This documentation helps facility managers and operators bring complete information to the decision makers.

5. Effectiveness of Program Administration

It is difficult to thoroughly assess the effectiveness of the utilities' administration of their PLS programs because there have been very few projects enrolled in the program and none have made it very far along the process. The activities that the utilities and their implementation contractors have engaged in have been addressed thoughtfully and in a timely manner, in most cases. The main issues that remain, the complexity of the feasibility study and the incentive structure, remain in place to ensure that past issues with TES are not repeated or because of a regulatory mandate, respectively. The following sections discuss the utility performance across several key aspects of program administration.

Program Resources and Funding

For the most part, the programs have adequate financial resources to administer their programs effectively. The exceptions are SDG&E's and PG&E's marketing budgets. SDG&E was not granted any marketing funds and PG&E overspent their funding each year, despite engaging in minimal marketing and outreach.

Program managers and implementers report that they have the resources necessary to address the demands of the program and respond to inquiries from applicants and their vendors. Applicants and market actors generally report acceptable levels of responsiveness and turnaround times for application and feasibility study reviews, though SDG&E applicants report that they are still waiting for feedback or approval of their feasibility studies.

Through August of 2014, the programs have expended between 31 and 58 percent of their administration budgets (Table 7). However, there have been a very small number of projects in each program and these projects have only made it part way through the process. If the number of applications increase significantly in the future, the programs may need to bring on additional resources to meet the demand.

Table 7. PLS Administration Budgets and Expenditures

	2012-2014 Budget	2012 Expenditures	2013 Expenditures	2014 Expenditures (through August)	Total	% of Total Budget
PG&E	$1,500,000	None	$396,818.15	$466,893.30	$863,711	58%
SCE	$1,310,000	None	$185,000	$215,000	$400,000	31%
SDG&E	$765,000	$106,111	$125,066	$76,197	$307,374	40%
Total	$3,575,000	$106,111	$706,884	$758,090	$1,571,085	44%

Note: SDG&E reported expenditures in 2012 for program planning and start up. PG&E and SCE did not report expenditures in 2012.

Though the programs did not exhaust their administrative budgets, they had very few applicants and none of these projects advanced beyond the feasibility study review. In future years, the programs will be working with projects in all stages of the program cycle and the level of effort needed to complete the later stages in unclear. It is probable that the current program administration budget levels are sufficient move projects through the entire project cycle, but the level of effort and expenditure should be monitored to ensure that the programs have adequate administrative budgets.

It should also be noted that the program managers spent much time in the first year of the program resolving many unexpected situations (see below in Challenges). With these resolved, the resources required during the application and feasibility study phases will be somewhat reduced.

Program Processes

The program processes are largely the same across the utilities. As noted previously, there have only been a few project applications, and none of them have been through all of the program processes, so it is unclear how the later steps will play out in practice.

The customer interface is different for the different utilities. SDG&E and SCE manage all of the customer interactions in house. PG&E has engaged an implementation support contractor to manage both the program process and the interactions with the customer. SCE handles the communications with the applicant, but relies on a technical support consultant to handle the technical aspects, such as reviewing the feasibility study and conducting pre- and post-inspections. Recently, the SCE technical support contractor has taken on some customer-facing responsibilities, described below.

Program managers have come to realize the importance of engaging with a candidate project early to establish communications and identify and head off potential problems. SCE has taken this a step further by conducting a quick review of a candidate project before the customer or SCE invest significant resources. When a customer first expresses interesting in the program, SCE's implementation contractor meets with the customer to assess their organizational readiness to effectively operate a TES system and whether the facility is capable of hosting a TES system (for instance, if there are space constraints that would prevent the installation of a tank). They also review the customers interval data to determine if the loads are realistic or whether existing TES equipment has been in operation in the last three years.

The order of the program submittals is slightly different between the programs. All programs review and approve the project application as the first step in the process and the utilities acknowledgement of the application sets the feasibility study due date. However, SCE requires the applicant to submit the project design documents along with the feasibility study, where PG&E and SDG&E allow the design documents to be submitted after the feasibility study is approved, but before the installation commences.

All program managers noted that they have or would be willing to extend the 18 month timeframe for installation to two years, if requested by the customer.

Program Requirements

Like the program processes, the program requirements are largely the same across the utility programs with a few exceptions described in this section.

All programs require that a professional engineer, who is licensed and registered in the state of California, complete the feasibility studies. SDG&E and PG&E require a mechanical engineer, but SCE will allow a civil engineering with sufficient mechanical engineering experience, approved at their discretion.

The treatment of project pre-monitoring data is the biggest difference between the utility requirements. For all programs, the customer must capture three months of pre-installation monitoring data. Originally, the programs envisioned this occurring simultaneous to the development of the feasibility study, but the program managers relaxed this requirement when project developers complained that applicants did not want to make this investment until they were certain that the project would proceed. Now the programs allow pre-monitoring to be completed after the feasibility study, but it must occur before the system is installed. However, SCE explicitly reserves the right to waive this requirement in the statewide manual.

All utilities require five-minute monitoring data for five years. SDG&E and PG&E require the customer to submit the data monthly where SCE requires it to be submitted quarterly. It remains to be seen if this becomes an issue in practice.

Infrastructure

Because of the very low volume of projects, the utilities have not integrated program data capture and tracking into their larger database infrastructures. This is reasonable given the low volume of applications and the very technical and detailed nature of the projects. The utilities (or implementers, as appropriate) do maintain tracking spreadsheet with top-level information, such as name and contact information, and transaction dates, so they can monitor the projects' progress through the process.

As program volume increases, the programs should develop thorough and standardized tracking methods to facilitate program management and reporting.

Marketing, Education, and Outreach

The program marketing, education, and outreach is reviewed more thoroughly in Section 5.3 below.

Disputes and Dispute Resolution

The program managers do not report any major, project-specific disputes. When there have been questions or issues, program managers report that it has been easy to convene a meeting with the applicant and their team to discuss the situation. The program staff have realized that strong communication during the application and feasibility study development allows them to identify and address potential problems. One program manager described the low project volume as providing a "luxury" that allows them to have adequate discussions with the customer and their teams.

External Variance

There do not seem to be any issues or situations external to the utility that affect the program uptake between the utility service territories. As discussed in Section 4.8 above, there are customer-specific factors, such as architectural committee or coastal authority requirements that may prevent TES installations, but none that affect a specific utility.

The lack of sufficient price different between SDG&E's peak and off peak demand charges undermines the economic attractiveness of TES projects within SDG&E service territory. This issue is external to the PLS program, but not to SDG&E.

5.1 Challenges

After the programs' launch, a number of challenging questions or situations came up related to program eligibility and specific issues with TES projects. These were unique issues that the program staff were not able to anticipate prior to the launch but the program managers worked collaboratively with each other and with the applicants and their vendors to resolve them. Situations related to eligibility included:

- PG&E received an application from a customer who also had a solar PV system. The proposed load shift included load served by solar PV. The utilities reviewed the situation and determined that the program should only provide incentive for the shift of the load served by utility. They have included this clarification in the statewide program manual.
- One applicant was removing a water-cooled chiller and installing an air-cooled chiller. They had calculated their incentive based on the air-cooled chiller, which has a higher incentive conversion factor (1.2) than a water-cooled chiller (0.7). There was some discussion about which baseline was appropriate. Ultimately, they agreed that the incentive should be calculated on the equipment being removed, not the equipment being installed.
- One applicant wanted to receive a PLS incentive for the installation of an absorption chiller, run off waste heat from a combined heat and power system. The program managers reviewed this situation and determined that this was fuel switching and not eligible for a PLS incentive. They have clarified in the statewide program manual that the system has to be electrically charged in order to be eligible.

The program staff report that they encounter challenges with the applicant's modeling or characterization of their projects:

- The validation of the customer's modeling has created challenges. During the feasibility study review, the program staff must confirm that the modeling used is a realistic representation of the facility operations. They report some very fundamental errors in the analysis, such as different operating schedules or chilled water efficiency.
- Correctly assessing an existing TES system has created challenges for program staff. Applicants have used a theoretical or nameplate capacity, which may be very different in practice. Actual measurement or interval data is needed to correctly understand an

existing system's actual performance. In one instance, an existing ice harvester system was rated at 1250 tons per hour, but the system was only able to provide about 60 to 70 percent of this value. The system was designed to produce multiple plates of ice but they were dropped too quickly, which caused them to fuse together, reducing the surface area.

- One applicant based their modeling on the central plant only, arguing that this is the only load they are shifting. They don't understand the program requirement to model the entire facility. Many applicants don't understand that the program incentive is based what the utility sees to their system and not just the equipment that will be directly affected. To accurately understand the facility load shift, you need three core elements: the cooling load demand, efficiency of the chilled water system, and the overall building load. Their first two elements are technically the load shift, but the facilities demand charges include the overall building load.

Addressing the issue of mature technologies was another challenging situation for the program managers. After the program launch, Ice Energy, who manufacturers the Ice Bear TES system for package rooftop units, petitioned the CPUC to be classified as an emerging technology (or not mature) so they could use the SGIP program instead of the PLS. Working through this petitioning process was time consuming and presented a challenge for the utilities to work through.

The last challenge deals with future uncertainty. The program managers anticipate additional unforeseeable situations to arise as the current projects advance through the remaining program processes. Although they believe they have adopted a robust process to verify, commission, and monitor the systems, and have thought through all of the possible variations, they acknowledge that there are likely more challenging issues to work through.

5.2 Best Practices

The PLS program managers have identified a number of best practices for implementing a PLS program. Arguably, these best practices fall under an umbrella category of effective communication. The utilities have found that open lines of communication have provided benefits to the program staff, PLS applicants, and the broader TES industry.

Over the first year of the program's implementation, the utilities worked together collaboratively to address many issues they could not have anticipated before roll out. Even when a situation only affected one utility, they worked through to a mutually agreeable resolution so that the programs are administered consistently across the utility service territories. Weekly team calls facilitated this process.

As the programs addressed these issues, they have clarified the program requirements accordingly, and documented them in the statewide PLS manual. Having this central repository of information will help to avoid similar situations in the future. One program manager asserts that the statewide manual could be an effective playbook for another jurisdiction contemplating a PLS program.

The program staff has taken the time to meet with manufacturers and other market actors to educate them on the program requirements. During this process, the utility program managers took care to lay out the program requirements and explain the reasoning behind them. They believe this has helped to prevent bad or in compete applications or misunderstandings of the program requirements. Because of this communication, it seems that most market actors understand the reasoning behind the program requirements, even if they would prefer another approach.

Close and early coordination with applicants and their team helps to improve the quality of the applications and feasibility studies and prevents frustrating situations and rework. All utilities make themselves available to customers early in the process to answer questions and clarify program requirements. When PG&E sends out their approval of the application, the packet contains detailed instructions and an offer to set up an appointment to walk through the program processes in person. They hope that this will diffuse any misunderstandings and feasibility study deficiencies. SCE has adopted the practice of completing a project pre-screening process when an applicant expresses interest in the program. Program staff meet with the customer to review their facilities and operations, and they review three years of utility usage data. This process helps to identify potential problems with the project feasibility before significant resources are expended on the customer or utility side.

5.3 Program Marketing, Education, and Outreach

Though the PLS program marketing activities have been limited, the strategies and channels pursued by the program managers have been appropriate considering the market for TES and the complexity of the technology. TES applicability is limited to facilities that are larger in size and sophisticated enough to have a chiller and have knowledgeable engineering staff that can effectively operate a TES system. These types of customers typically have an assigned utility account representative and the programs have leveraged these relationships. In addition, TES systems are generally custom-built systems and TES vendors engage in a one-on-one sales strategy. The PLS program managers have capitalized on these relationships as well.

PG&E and SCE conducted limited marketing at the program launch for two reasons. First, the feedback from the market actors engaged in the workshops leading up to the program launch was that there was significant pent up demand for these systems. The program managers and the vendor community anticipated that the program incentive funding would oversubscribe shortly after the program launch. Second, arguably, given the nature of the market for TES systems, the sales cycle and, therefore, program demand, would be vendor-driven. For these reasons, the program managers intentionally limited program marketing to building awareness of the program’s availability amongst market actors and educating them on the program requirements and processes. SDG&E was not granted an allocation for marketing in their program budget, and therefore, has not had the opportunity to conduct any traditional program marketing.

Marketing Activities

The utilities have pursed marketing activities that leverage the vendors’ “high touch” sales strategy and the utility account executive relationship with potential TES customers. The appropriate strategies are ones that allow for a more in-depth discussion of the program and TES technology. Any type of mass-market approach would not be appropriate to reach the target audience of customers or market actors. Therefore, the utilities have conducted the following marketing activities that focus on the customers and market actors in a forum appropriate for communicating sufficient program details. These include:

- ***Workshops:*** After the program launch, PG&E and SCE conducted several workshops at their training centers. These workshops were targeted at customers and market actors and focused on building awareness and educating the workshop participants on the program requirements and processes. The PG&E and SCE program managers note that future workshops will include information on the benefits and applicability of the TES technology so that the workshops will be useful to customers trying to decide whether to pursue a TES installation.
- ***Industry events:*** The utilities have attended ASHRAE and other industry meetings and events. Though attendance is typically sponsored by one utility, the program managers promote the availability of the program across California so that all of the utilities benefit. They have also attended some manufacturer-sponsored events, like Trane's Acceleration Now Tour.
- ***Utility account executives:*** Utilities have educated their account executives on the program through presentations at meetings, dedicated workshops, and one on one discussions. The account executive has been an important channel for SDG&E since they don't have a marketing budget. SDG&E has quarterly meetings with their account services staff and the program manager presents program information at these. The SDG&E PLS program manager regularly accompanies individual account executives on customer site visits to discuss the program with high-potential customers.

  At the time of the program interview, SCE was developing a half-day workshop on the program. The workshop would be an opportunity for the account executives to invite their customers with good TES potential to hear about the program and the TES technology.

  None of the utilities have PLS-specific targets for their account executives.
- ***Articles and ad placement:*** SCE and PG&E have placed ad and articles in appropriate industry publications, such as the ASHRAE newsletter. Similar to the industry events, these promote the availably of the program across California, regardless of the sponsoring utility.
- ***Energy Design Resources Content:*** SCE developed TES content for placement on the Energy Design Resources (EDR) website. EDR is a resource funded by the California utilities that develops and publishes decision-making tools and resources to support the design of energy-efficient buildings.

PG&E Marketing Plan

PG&E has worked with their implementation contractor and internal marketing staff to develop a marketing and outreach plan for the PLS program, though they had only begun executing the plan at the writing of this report. To develop the plan, PG&E analyzed customer load data to identify customer segments with large customers who have a daily load profile that would support a TES system. They used that information to identify the best market segments to target, but they also used it to notify the individual account executives of their customers with high TES potential.

The plan includes specific outreach activities, the timeframes for conducting the activities, and identifies the parties responsible for each. The primary outreach channels are through utility customers, account executives, market actors, such as engineers and manufacturers, and industry associations.   The plan lays out a schedule for specific workshops for customers, with industry groups, such as local chapters of ASHRAE, USGBC, or building owner associations, and lunch and learn sessions with design teams and manufacturer firms. PG&E will also leverage specific industry communication channels. PG&E will also develop articles for publication in trade journals and distribute program updates through industry association listservs and email distribution lists. The plan also anticipates developing and publishing case studies of completed TES projects, though these activities will be conducted in the future, after PLS projects installations are complete.

Materials and Messages

Based on the feedback the TRC team received from the applicants on their motivations for pursing their TES system and benefits they expect to realize, the marketing materials should emphasize the broad range of benefits from a TES system. The primary motivation was economic, but this benefit materialized in different ways. Besides reducing peak demand charges, applicants cited reducing the size (and expense) of a chiller upgrade, more efficient operation of cooling towers, and protection from electrical brown outs.

All three utilities have program materials related to the administration of the program: utility-specific program applications or agreements and handbooks. In addition, SCE and PG&E provide a program fact sheet. The fact sheets are dominated by practical information on program eligibility and requirements, but also emphasizes the cost-saving benefits of installing a TES system. These fact sheets share an overall structure, messaging, and very similar content, but each is designed with the look and feel of the individual utility materials.

All three utility PLS webpages contain all of the program materials, and fact sheets (in the case of PG&E and SCE). The PG&E and SDG&E sites included telephone numbers and email addresses of the program contact. SCE's contact information (phone and email) was provided in the program application, which was accessible from the PLS sub-site.

To navigate to the PLS sub-site, the user would need to have a basic understand of where the programs fell in the utility program structure. All three sub-sites were accessible through the main page by a link about energy savings (Save Money or Energy-Savings Solutions or Savings & Incentives), then to Demand Response programs.

Marketing Expenditures

As discussed above, the utilities purposely did not conduct much program marketing for fear of overcommitting their incentive budgets. PG&E overspent their marketing allocation on the outreach events they did conduct and on the development of a marketing plan for future activities. The utility marketing budgets and expenditures are presented in Table 8 below. The current PG&E and SCE marketing budgets are very small relative to their incentive budgets; less than 1.5 and 2.5 percent of the incentive budgets, respectively.

Table 8.PLS Program Marketing Budgets and Expenditures

	2012-2014 ME&O Budget	2013 Expenditures	2014 Expenditures (through August)	% of Total
PG&E	$200,000	$160,416	$132,170	146%
SCE	$310,000	$20,000	$20,000	13%
SDG&E	$0	$0	$0	0%

Per the research questions, the evaluation team attempted to determine the range of appropriate marketing costs for the PLS programs. Utility marketing activities should include the development of a marketing and outreach strategy (or an annual update), research to inform customer targeting or market segmentation, as well as the actual outreach activities. Outreach activities may include:

- Workshops for potential applicants, market actors, and account executives;
- Participation in and presentations at industry meetings, events, and conferences;
- Presentations, meetings, or lunch and learns for key or large industry players, such as manufacturers and system designers;
- Case studies and testimonials;
- Advertisements and article placement in industry journals, newsletters, or other publications;
- Marketing brochure or other collateral material; and
- Program websites.

To understand the marketing costs typical for an incentive program with similarly complex technologies and vendor-driven implementation approach, the evaluation team attempted to review the marketing budgets for California's SGIP and CSI programs. However, this information was not available publically. Instead, the evaluation team reviewed the PLS expenditures relative to the marketing activities that were conducted. PG&E conducted the most significant program marketing and developed a plan for future program marketing efforts. Their 2013 and 2014 expenditures were approximately $300,000 and included many of the activities described above. The evaluation team believes that this amount is within the range of reasonable costs for future PG&E activities as well.

To establish the marketing budgets across utility programs, the evaluation team recommends setting the marketing budgets as a percent of the incentive budget. This approach would provide for a marketing budgets scaled to the size of the program. The SDG&E marketing budget would be small but would provide funds to develop and execute a scaled outreach strategy to inform key customers and TES market actors of the availability of the program and educate them on the main program requirements. PG&E's budget would be larger and would allow for a broader range of activities.

The evaluation team recommends setting the PLS program marketing budgets at two to two and a half percent of the program's incentive budgets. Table 9 illustrates that the current PG&E expenditures fall within this range. Setting the marketing budgets as a percent of the incentive budget has the added advantage of allocating more funding for marketing if incentive budgets increase in future program cycles.

Table 9. PLS Marketing Budget Comparison

Utility	Incentive Budgets	Current marketing budgets as a % of incentive	2.5% of incentive budget	2% of incentive budget
PG&E	$13,500,000	1.48%	$337,500	$270,000
SCE	$12,690,000	2.44%	$317,250	$253,800
SDG&E	$2,235,000	N/A	$55,875	$44,700

5.4 Program Manager Feedback on Program Goals and Theory

None of the utilities had specific numeric targets for their programs. Each program manager had an unofficial objective to fully subscribe their incentive budgets, but none of them have accomplished this. PG&E also noted that they had an unwritten objective that the program not allow the same negative customer experiences to arise as past TES programs[11]. The level of detail required by the feasibility study and the five-year monitoring requirement were implemented specifically to support this objective. Though the current projects are still at an early stage of development, and it will be years before this objective proves out, the program managers believe that their execution of the program will support a more robust TES industry and individual projects that are long lived.

There is general agreement that the program's incentive helps to overcome the barrier of the high up front cost of the system. However, there was also agreement that this is only one of many barriers to the adoption of TES systems. To fully address the market barriers for TES, the following would also need to addressed:

- The upfront investment in a feasibility study and pre-monitoring can be significant and required at a point at which the project isn't assured;

[11] The utilities offered incentive programs for TES systems in the 1980s. Many of these systems were not well-designed and did not function properly, so the owners abandoned them.

- Increasing SDG&E's peak and off peak demand charge differentials to make a TES system economic;
- Utility rate structures could change unfavorably in the future, undermining the project economics; and
- The incentive "price point" is appropriate for larger systems but not for smaller systems.

Another observation is that the program is misplaced in the utility program structure. TES system do not provide demand response, but rather permanent load shift or generation.

6. Compare California's Program and Experience with Other TES Programs in the U.S.

Thermal energy storage systems are not new in California or other parts of the United States where managing summer peak demand is a high priority for utilities. TRC spoke with seven other programs in the United States that offer or have once offered incentives for customers to install thermal energy storage systems; two of these programs use the Ice Energy model. In addition to the interviews with the seven program managers, TRC reviewed information available from program websites for three programs that we were not able to reach for an interview.

Two utilities no longer provide incentives for TES projects because of shifts in resource goals or program incentive policies; one had offered incentives prior to 2007, but has since shifted their goals to energy and carbon reduction. The longest standing program was instituted about five years ago without much change to the program structure or incentives. Another program has been in existence for a few years, but substantially increased incentives in 2014 with the hopes of shifting large loads to off-peak hours. Lastly, one utility had received board approval for a TES incentive, but did not establish their program until late 2014 due to lack of customer interest.

The two Ice Energy projects both began in 2010; one of which has exhausted its budget and is fully enlisted. The Ice Energy model is a direct installation program where Ice Energy installs Ice Bear units at customer locations. The installations are entirely or mostly utility funded, depending on the selected arrangement. Ice Energy enters into a contract with the utility to provide a set amount of peak demand shift through customer installations. Each Ice Bear system has the capacity to shift about 10 kilowatts of demand. Ice Energy provides support services to the utility and the customer, such as customer recruitment, installation coordination with local contractors, and monitoring and maintenance of the systems.

Program managers for the following five TES incentive programs and two Ice Energy direct installation programs were interviewed for this evaluation:

- ***Duke Energy (Florida)*** offers TES as a prescriptive measure within an overall prescriptive program for commercial customers. Duke Energy manages the program in-house and offers incentives up to $300 per kW without customer or project caps. The application process requires a feasibility study and an initial on-site assessment with the design team.
- ***NYSERDA/Con Edison*** offers TES as a measure within a commercial retrofit program. Program incentive levels were increased and the newly launched program and has been in operation for about a year. Incentives increased from $600 per kW to $2,600 per kW with a cap at half the project cost for TES. The program is managed in-house between NYSERDA and ConEd. Projects are not required to submit a feasibility study, but a separate energy assessment program will conduct and fund a feasibility study for customers who go through with equipment installation (this program is not limited or specific to TES). The program strategy is to look at overall site upgrade opportunities, such as more efficient chillers, that can work in conjunction with a TES installation.

- ***Los Angeles Department of Water and Power (LADWP)*** offers TES as a measure under a custom performance program and has been an offering for about one year. The program is managed in-house and offers $750 per kW of load shifted without customer or project caps. Projects are not required to submit a feasibility study, but must submit a year of baseline energy use and energy saving calculations. Projects must also include 5 percent energy reduction.
- ***Platte River Power Authority (PRPA)*** no longer provides incentives for TES. Previously, the city of Fort Collins offered a TES incentive to meet peak reduction goals. The city managed the program locally and offered $500 per kW for load shifted off peak.
- ***Orlando Utility Commission (OUC)*** no longer provides incentives for TES. A TES incentive was previously offered as a one-time offering. OUC cannot currently incent TES systems because the technology is not considered to be a permanent load reduction.
- ***Glendale Water and Power*** offered an Ice Energy program that began installations in 2010, and have since exhausted the contract budget for installations. A DOE grant partially-funded this project, and Ice Bear installations were offered at no cost to customers. Ice Energy conducted all of the outreach and coordinated equipment installation.
- ***Southern California Public Power Authority (SCPPA)*** offers an Ice Energy program that began installations in 2010. Member utilities support and fund the project in their territory to offer Ice Bears to customers at no cost. The contract for 53 MW of load shift has not yet been exhausted.

In addition, TRC reviewed publically available program information for the TES programs offered by Florida Power and Light, Austin Energy, and Otter Tail Power Company and incorporated the findings into the sections below. TRC provides detailed information on interview responses and program information in the Appendix.

6.1 Program Management

The five TES incentive programs (listed above) are all managed in-house by utility staff, and only one uses an outside consultant for the technical aspects of projects. Program managers chose to manage their programs using in-house staff because the project volume is small, the utilities have program staff and engineers with program experience, it is cheaper, and the utility can have more control and awareness of projects. Program managers mention that it is easier to control the program and effectively address customer projects that may not align perfectly with all of the program requirements.

Utilities use the Ice Energy model found that it is a simple way to introduce thermal energy storage into their service territory without having to run and manage a program. During preliminary market assessments and TES installations, these utilities found it difficult to secure customer participation because of the high costs. These program managers mention that the Ice Energy model is turnkey in that it seeks out potential customers, organizes and secures the installation, and provides maintenance and monitoring.

6.2 Program Eligibility and Requirements

Program and participation requirements vary by utility, but most at least require an energy assessment and pre-installation site visit, energy calculations to provide expected load shift, and a post-installation verification. None of the programs will pay an incentive for previously installed or refurbished equipment, and none of the programs have strict restrictions on the technologies used. Some mention that they look at each project and technology on a case-by-case basis to ensure that there will be a permanent and guaranteed load shift. Additionally, not all programs require that a customer be on a TOU rate or produce a minimum load shift to participate; although, they mention that a customer will get the most benefit on a TOU rate and they encourage it. For the one utility that currently offers a special TES rate, a customer must meet a minimum load shift to be eligible for this rate.

Load Shift

Two programs have a minimum load shift requirement for all participants, and one has a requirement only for customers who want to elect the special TES rate. One of the programs with a minimum load shift also allows for aggregator applications. For this type of application, the program requires that each aggregator shifts a minimum amount of demand and that the application as a whole meets the minimum total load shift requirement.

The Ice Energy contracts guarantee a specific total load shift from all installations once the contract is complete. However, for at least one of these projects, the contracts does not specify a date by which Ice Energy must meet the load shift.

Feasibility Study

Two TES programs require that all potential projects submit a feasibility study, and one program only requires a feasibility study for projects that expect to exceed a threshold demand load shift. Two utilities have separately established energy assessment or audit programs where customers can have a facility assessment and feasibility study performed and fully funded; however, the utility will only fund the study if the customer commits to move forward with the installation. Two other programs will provide funding up to a certain level for the required feasibility studies. Only one program requires a feasibility study and does not offer any type of funding.

The remaining programs trust that the customer will perform due diligence on the TES installation because of the high cost of the systems. One of these programs does require computer simulations to model potential load shift and one year of baseline energy use. Whether requiring a feasibility study or not, all of the programs require a pre-installation equipment assessment.

Monitoring

Three current programs require post-installation monitoring between one and six months because they pay their incentives based on performance. One of these programs also requires pre-installation monitoring for a minimum of one summer month, and another requires one year of baseline energy use. One of these programs will supply and pay for loggers if a customer does not have an EMS or BMS.

Ice Energy provide post-installation monitoring of systems as part of its service agreement. They monitor usage data and can show how the systems are operating.

6.3 Incentives

Program incentives vary by utility. Incentives range from $20 per kW to $2,600 per kW, and at least two programs pay incentives on tiers based on the amount of load shifted (incentives decrease for larger loads, and one caps the load shift it will incentivize). Two of the program managers interviewed report that their programs do not have caps on the amount of incentive paid. Two programs cap the incentive at 50 percent of the project cost, but do not have caps on customers participating with multiple facilities.

Three programs split the incentive into two payments: the first after completion of the installation and the second after measurement and verification. The programs will not pay the full second incentive payment if the project does not meet its intended load shift after measurement and verification. For larger projects that meet a set load shift threshold, one program allows projects to receive up to 15 percent of the expected capped incentive up front, and also offers bonuses on the capped incentive after measurement and verification.

One program manager notes that the incentive is helpful for customers, but it is not the main driver of the project, while another quotes a customer who says they would not have gone through with the project without the incentive.

6.4 Resources Provided to Customer

Some of the utilities associated with the other interviewed programs offer services such as special utility rates, paying for the installation of monitoring equipment, and funding feasibility studies or post-commissioning studies. Some utilities have separate assessment programs to conduct and fund an energy audit and feasibility study, then direct the customer to the TES or appropriate program. Only one utility currently provides a special rate tariff for TES customers.

6.5 Marketing and Outreach

The utility-managed programs do some marketing, but none have a specific or defined marketing plan and none mention that they rely heavily on marketing as a strategy to secure projects or spur interest. One program manager mentioned that typically the customer reaches out to the program with interest in a TES system. Marketing activities include meetings with TES vendors and utility major account executives, and attending or presenting at trade meetings and expositions. The programs are largely vendor-driven and rely on vendors, trade allies, and engineers to spur interest in TES installations. One program is looking into the possibility of establishing a trade ally network for their overall custom performance program, which includes TES incentives.

For Ice Energy projects, the Ice Energy team performs all of the customer outreach and project attainment. They will do a review of the customer base and then reach out to specifically targeted customers.

6.6 Integration with EE

Two utility-managed programs have direct strategies to integrate energy efficiency upgrades with TES installations. One of these programs takes a holistic approach at chiller plant upgrades, looking at not only the installation of the TES equipment, but also looking for opportunities to upgrade the efficiency of chillers and HVAC equipment. This particular utility notes that the chiller plants under discussion are typically older facilities that require these types of upgrades, and that this holistic approach may not be feasible for customers with newer equipment. The second program requires that projects integrate a five percent energy reduction into the project; for this, the TES installation is usually done in conjunction with other equipment or facility updates.

Ice Energy also looks for energy efficiency opportunities as well as potential for demand response in addition to the load shifting from their systems. Including energy efficiency upgrades helps to keep the overall costs and payback for the Ice Energy system lower.

6.7 Program Activity

Similar to the California program, none of the other PLS programs have experienced large volumes of participation. The average annual number of installations is between zero and two for these programs, and some programs have only seen a handful of projects over the life of the program. Even the program that has recently introduced higher incentives has not seen a lot of uptake; however, the program manager attributes this to the timing of the incentive rollout and expects more participation in the next year when facility managers can work a TES installation into their capital budgets.

Customer Motivation

According to the program managers, the main motivation for participation is the opportunity to move load out of the high peak period and reduce demand costs. Some programs also mentioned that the incentive is a motivator because customers may be able to front the costs, but actual implementation is usually based on getting the incentive. Another external motivator in California is schools with Proposition 39 funding to invest.

Ice Energy projects found that it did not take much to motivate customers; however, some were initially wary of participating in a no-cost project. The main driver for these customers is a constant supply of cold air at no additional cost, as well as the upgraded equipment.

Annual Budgets, Goals, and Results

Most of the utility programs offer the TES incentive within a larger program (three of five), and none have specific budgets or could share their budgets for TES installations and administration. Additionally, none of the programs have specific TES goals in terms of number of installations or demand shifted, but they do mention tracking their pipeline of potential projects when managing their budgets. None of the programs have exhausted their budgets, and some had expectations for participation that were not met. The only program that has successfully exhausted its budget is one of the Ice Energy projects, which had over 150 installations in less than a year.

Two programs were able to report on the projects in their pipeline: the expected load shift is 3,000 kW for one program, and 1000 kW for another. Again, these programs do not have demand reduction goals for TES installations, but have overall goals for the custom or demand management programs within which they operate.

6.8 Program Feedback

Due to low participation, the program managers have not been able to gather substantial feedback from program participants or the design community. The main feedback from customers is that finding space for the equipment is difficult and the long payback period is sometimes prohibitive.

For the Ice Energy projects, program managers report that customers are satisfied with the systems and would like to install more on other facilities; however, the program manager notes that these customers probably would not install these systems on their own.

Both Ice Energy projects and utility-managed projects report that customers lack an understanding of what the systems are actually going to provide. They attribute this to poor communication and explanation of expected outcomes from the project engineer or utility account executive.

6.9 Challenges and Barriers

For all of the utility-managed programs, the main barrier for customers is the cost and payback period for the system. This is amplified in areas without a large differential between on- and off-peak demand charges, as reported by a program manager in Florida. Some program managers note that in order for this installation to be cost-effective, customers have to be large and have a substantial load to shift. Other barriers include space constraints, especially in dense urban areas or when a project would consume potential usable square footage, and a lack of familiarity or knowledge with TES technology and its compatibility with existing equipment. Additionally, one program manager mentioned that representatives from the utility may not fully understand the value of TES and are not properly explaining the system and benefits to the customer.

The barrier of high upfront costs to customers is what motivated two programs to use the Ice Energy model.

6.10 Successes

Programs are able to secure projects with little to no marketing and outreach effort; participation is generated through general industry awareness of their overall custom or demand management programs. One project manager even notes that most of their projects have come from customers who reach out with specific interest in TES. The program that allows for aggregators hopes to secure some smaller projects that might not have the available load to shift in order to participate on its own. This same program seeks to bundle TES installations with other equipment upgrades; therefore, enhancing the savings a customer will see.

A demand management expert at one of these utilities mentioned that TES is more reliable and predictable than demand response technologies in ensuring load shift because customers have can opt out of demand response events. Additionally, customers have a better experience with TES than with demand response because TES does not require the customer to instantaneously cut usage or increase building temperatures.

For the Ice Energy projects, utilities have full control of system operations and the customer receives the benefit of the load shift. Ice Energy projects have seen far greater installation volume than customer-owned installations. Additionally, Ice Energy hires local trade allies to complete the installations and utilities are able to market this as community business development.

6.11 Program Outlook

Currently, one of the utilities no longer incentivizes TES installations because they have a policy to incentivize only guaranteed permanent demand reduction. The utility is concerned about a scenario where a customer does not store enough cooling capacity, even if only one day a year, and they have to run their chillers. In this scenario, the utility cannot claim permanent demand reductions and has not benefited from this TES installation.

Rate certainty is not a topic that came up for many programs. Other utilities realize it can be a barrier, but do not provide any guarantees to customers. Customers are aware that rates may change, and that changes could have adverse effects on their payback periods.

7. ASSESS THE PLS–TES MARKET OPPORTUNITY

This section investigates PLS-TES market opportunities with the aim of identifying methods of improving PLS market penetration. The market assessment utilizes both qualitative and quantitative analyses methods, and leverages the in-depth interviews conducted for this evaluation (see Section 2, Evaluation Methodology for a full list of interviewees).

The market assessment includes the following sub-tasks:

- Analysis of the customer value proposition for select TES applications, based on an economic analysis conducted from the customer perspective;
- Estimate of market potential for select applications and 'niche' low-hanging fruit applications of TES technologies;
- A forward looking assessment of market opportunities and customer risk in the context of a rapidly changing electricity grid; and
- An assessment of the how a PLS screening economic analysis tool may help motivate adoption of TES technologies and support market opportunities.

Market opportunity analysis is not a typical component of a process evaluation. However, it is useful to understand the customer value proposition and what types of applications may be better positioned to leverage the PLS program in order to improve market adoption.

7.1 Customer value proposition for select applications

We explored the customer value proposition for select TES applications. We first conducted a qualitative assessment to identify which sectors might be cost-effective from the customer perspective. The qualitative assessment largely drew from stakeholder interviews. Following the interviews, we identified specific sectors and applications to be analyzed in more detail by the Team. We performed more detailed analysis to understand the dependencies between customers' desired paybacks, rates, thermal and electric load shapes, and incentives.

Qualitative Assessment of Customer Value

We conducted stakeholder interviews with program participants, IOUs, implementers, and non-participating experts in the thermal energy storage community to identify applications and customers that are feasible candidates for TES. We probed the interviewees on the different aspects that affect feasibility —cost, space limitations, maintenance capabilities, presence of compatible cooling systems.

The table below summarizes the main findings.

Table 10. Feedback on ideal sectors/opportunities for TES

Stakeholder type	Applications/sector types, including missed opportunities
IOUs program representatives, account executives, third-party implementers	Convention centers, new casinos, new office/commercial complexes and campuses, colleges/campuses, prisons, wineries
Customers	Hospitals, colleges, K-12, casinos, supermarkets, malls
Participating actors (feasibility engineers, technology providers)	Education, healthcare, community colleges, office complexes, convention centers, large retail, data centers, hotels
Non participating market actors (consulting engineers, technology providers)	Government buildings, hospitals, education (including K-12), breweries, industrial processes, pharma, airports, data centers
Other programs (outside of CA)	Large buildings in the C&I sector; colleges

A few key common findings were observed across the different interviewee types.

- Sites must have adequate space and a capable operations staff to be good candidates for TES
- Both educational and commercial "campus" environments were frequently identified as promising target sectors
- TES is usually implemented as part of larger infrastructure projects. Customers do not evaluate TES in isolation, but in combination with other systems (cogen/combined heat and power, upgrades to chilled water plants)
- Economics is the core driver for customers considering TES, though a few indicated reliability as the core driver or added benefit
- In most cases, opportunities for new TES systems were highlighted. (Refurbished systems were also mentioned, but we treat this section separately under the "low hanging fruit" section below.)
- Most of the TES systems enabled through the program are being designed for serving existing rather than new cooling load

Many of the responses were similar to what was observed in the 2010 Statewide PLS Study, however, some responses were surprising and counter-intuitive;

- Community colleges were identified as attractive candidates. Although most do not currently have central chilled water plants, they represent an opportunity for upgrading to a central chilled water system with TES.
- Traditional thinking has been that facilities with high load factors are not well suited for TES as there is limited flexibility to reduce peak demand by shifting load. This opinion was expressed by many respondents. However, some respondents suggested that high

load applications (data centers, hospitals) can also be attractive when TES is coupled with an efficient chilled water system. . Data centers tend to have spare chilling capacity that can be employed to charge TES.

Based on the qualitative assessment, the following applications were identified for further quantitative exploration:

- Colleges, including community level
- Hospitals
- Casinos/hotels
- Office complexes/campuses
- Industrial: pharmaceuticals, biotech, data centers

While convention centers were indicated as attractive sectors, we did not have readily available data to analyze this sector and analyzed.

We obtained information on current TES costs and other economic criteria through interviews.

Table 11. Feedback on economic criteria and cost-effectiveness

Stakeholder type	Costs	Payback criteria	Benefits from bill savings vs. avoided capacity	Useful life
Customers/ applications	Most ranged from $200-$450/ton-hr	Ranged from 8-15 yr; two cases 25 years (winery and rice farm)	Mix between bill savings and avoided chiller capacity	
Other market actors and non-participating actors	$120-300/ton-hr Smaller systems will cost more	7-15 yr; in some cases 0 yr payback where TES capital cost (capex) avoids more expensive chiller capacity	Based on both, although there are cases where it is based on bill savings only; worth noting that EE savings can occur when TES is part of an overall chiller system upgrade (e.g., going from air cooled to water cooled)	Chilled water tanks can last 30-40 years though typically assumed at 20 years; ice systems have shorter lifetimes (15-20 yr)

The sector/opportunities information and economic inputs are used to assess the customer value proposition.

Quantitative Assessment of Customer Value

We analyzed the value proposition of TES to the customer by exercising the PLS cost effectiveness analysis tool developed by E3 under the Statewide study ('PLS CE tool')[12]. We updated this tool with current rates and exercised the tool to assess if the promising sectors identified through the qualitative analysis are cost-effective from the customer perspective. While the cost of TES systems will be very site specific, the bill savings can be used to assess the price points necessary for TES to be economic for the customer.

The following input assumptions were applied in the analysis:

- The following rates were analyzed: PG&E E-20S; SDG&E AL-TOU; SCE TOU-8B;
- Electrical load shapes were obtained from the California Commercial End Use Survey[13] (CEUS) as follows:
  - The following climate zones (CZ): CZ-3 and 8 (PG&E); CZ 8 and 10 (SCE); CZ 13 (SDG&E). The PG&E and SCE CZ's include one coastal and one inland zone
  - The lodging shape was used as a proxy for casinos.
  - The large office shape was used for office complexes.
- For the data center shapes, we assumed a pre-TES flat load shape[14]. We assumed 25% of the total load is from the chillers[15].
- Avoided chiller efficiency of 0.7 kW/ton was assumed;
- TES cost of $150 per ton-hour was assumed[16];
- We analyzed lifetimes of 15 years and 30 years. (15 years is consistent with the underlying cost-effectiveness analysis that informed the determination of the incentive. however, we also analyzed a 30 year lifetime since many systems, particularly chilled water tanks, have a longer lifetime.)

A key distinction between the customer value analysis conducted in the Statewide study and here is that we customized the load impact profiles for TES, taking into account varying thermal loads. The TES systems were sized to provide a full load shift during peak load.

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[12] The PLS Cost effectiveness tool is available here. https://ethree.com/public_projects/sce1.php

[13] California Energy Commission. March 2006. *California Commercial End Use Survey* (CEC-400-2006-005). Retrieved from http://energy.ca.gov/ceus/.

[14] Very little public data exists on actual data center loads, however, many universities make their energy use public. For a public example, you can view the University of California San Diego (UCSD) super computing facility energy consumption using the UCSD dashboard. http://energy.ucsd.edu/campus/campus.php

[15] For an estimate of data center energy use breakdown, see the following benchmarking studies. http://hightech.lbl.gov/documents/data_centers/self_benchmarking_guide-2.pdf and http://hightech.lbl.gov/documents/data_centers/aceee162.pdf

[16] This is equivalent to $2/gal for chilled water at a 30°F temperature differential.

The cost effectiveness results are shown in the table below. The benefits are the net present value (NPV) of the lifecycle bill savings. The costs are the TES capital cost net (including or excluding the incentive, as indicated).

Table 12. Benefits and Costs of Select Applications

Application	Rate	**Without incentive:** Simple Payback (yr)	**With incentive:** Simple Payback (yr)	**Without incentive:** PCT Benefit/Cost Ratio; 15 year life	**With incentive:** PCT Benefit/Cost Ratio; 15 year life	**Without incentive:** PCT Benefit/Cost Ratio; 30 year life	**With incentive:** PCT Benefit/Cost Ratio; 30 year life
Health care	PG&E E-20 S	7.4 - 8.0	3.7 - 3.9	1.0 - 1.1	2.1 - 2.3	1.3 - 1.4	2.7 - 2.9
	SCE TOU-8B	11.8 - 12.6	5.9 - 6.2	0.7	1.3 - 1.4	0.9	1.7 - 1.8
	SDG&E AL TOU	17.7	8.9	0.5	0.9	0.6	1.2
College	PG&E E-20 S	7.3 - 7.8	3.6 - 3.9	1.1	2.1 - 2.3	1.4 - 1.5	2.7 - 3.0
	SCE TOU-8B	12.3 - 12.7	6.1 - 6.4	0.6 - 0.7	1.3 - 1.4	0.8 - 0.9	1.7 - 1.8
	SDG&E AL TOU	23.5	11.4	0.4	0.7	0.5	1.0
Office	PG&E E-20 S	7.9 - 8.3	3.9 - 4.0	1.0	2.1	1.3 - 1.4	2.7 - 2.75
	SCE TOU-8B	11.3 - 11.4	5.7 - 5.7	0.7	1.5 - 1.5	0.9 – 1.0	1.9
	SDG&E AL TOU	14.1	6.3	0.6	1.33	0.8	1.7
Lodging/ casino	PG&E E-20 S	7.7 - 8.3	3.7 - 4.0	1.0 - 1.1	2.1 - 2.2	1.3 - 1.4	2.7 - 2.9
	SCE TOU-8B	10.5 - 18.8	5.2 - 9.2	0.4 - 0.8	0.9 - 1.6	0.6 - 1.0	1.2 - 2.0
	SDG&E AL TOU	32.1	16.1	0.3	0.5	0.3	0.7
Data center	PG&E E-20 S	15.7	7.9	0.5	1.1	0.7	1.4
	SCE TOU-8B	Negative	Negative	0.0	0.0	0.0	-0.1
	SDG&E AL TOU	Negative	Negative	-0.8	-1.7	-1.1	-2.2

The table illustrates that the rates and inclusion/ exclusion of the incentive have significant effects on cost-effectiveness, more so than the application type. In general, the examples analyzed using the PG&E rate and in the PG&E climate zones are more cost-effective than the same examples analyzed for the SCE climate zones and rate, which in turn are more cost-effective than the example analyzed using the SDG&E rate.

In many cases, the inclusion of the incentive turns a non-cost effective application into a cost-effective one. Extending the lifetime from 15 to 30 years roughly improves the cost effectiveness by about 30 percent. When the incentive is included, the only applications that struggle with cost-effectiveness are those using the SDG&E rate, likely, due to the presence of a relatively low peak-period demand charge, and large non-coincident demand charge. This was a finding, also, in the 2010 Statewide PLS Study.

Data center applications, generally, were found not to be cost-effective with the exception of the PG&E example when the incentive is considered. While the applications resulted in TOU energy charge savings, the all-hours demand charge was a barrier across all IOUs. This is an issue for any type of facility that has the potential to increase its overall demand due to the presence of a TES system. The relationship of cost-effectiveness among the IOU rates analyzed holds constant for the data center example as well (Assuming a PG&E rate results in the most cost-effective application, followed by SCE, followed by SDG&E).

7.2 Market Potential for Select Applications

This task consists of two distinct approaches. The first is an estimate of market potential for select TES applications, leveraging the customer value proposition analysis completed in Section 7.1. The second approach is a qualitative-based approach that explores what low-hanging fruit opportunities may exist; this approach draws heavily from stakeholder interviews.

Market Potential Estimate

We estimated a rough market potential for promising and cost-effective TES applications, leveraging the customer value analysis and interview findings. For example, interviewees identified colleges as promising target applications and our customer value analysis showed TES to be potentially cost-effective. As a result, we estimated the market potential for colleges.

We estimated the market potential in two steps:

- We estimate the total MW that could be displaced if all economical TES systems were adopted for the respective sector. This analysis relies on the estimates.
- We generate market potentials that account for barriers.

We estimated the customer-centric cost-effective potential for select target sectors using the following steps:

- Step 1. Identify target applications based on the cost effectiveness results of the customer value analysis.
- Step 2. For each sector, collect the relevant data pieces:

  - Individual system data: cooling system electrical load, cooling demand (thermal), whole building electrical demand, efficiency of the cooling system (This data was used in the customer value analysis); and
  - Aggregate data: total load for each sector and by utility territory.
- Step 3. For each sector, using data from Step 2, calculate the electrical load that can be shifted on an individual system basis. The shiftable load is the electrical load required to meet cooling demand for the customer. (This step was completed in the customer value analysis).
- Step 4. For each sector, scale up the individual system shiftable load to represent the total shiftable load for that sector. Because the shiftable load was conducted for a limited set of climate zones, we also matched the shiftable load factors determined in Step 3 for the climate zones analyzed in the customer value analysis with all climate zones for each IOU (See Appendix 10.3 for a table of factors).
- Step 5. For each sector, apply a further scaling to account for physical constraints, such as lack of space, central cooling plant, operating staff etc. (See Appendix 10.3 for a table of factors).

The market potential estimate reflects that portion of the economic potential that can realistically be achieved given market barriers (i.e., non-economic factors). Typical potential study methods apply fractions to reduce the economic potential to market potential. Rather than applying these arbitrary factors, we indicate application-specific market potentials as they relate to fractions of economic potential that may be adopted.

Based on this approach, the table below lists the economic and market potential for specific applications.

Table 13. Estimate of Target Sector Market Opportunity

IOU	Application	Estimate of market size from CEUS data (MW)	Further scaling for space availability, etc. (MW)	Estimate of market size @ 10% (MW)	Estimate of market size @ 25% (MW)
PG&E	College	47	23	2	6
	Healthcare	84	25	3	6
	Casinos/hotel	71	21	2	5
	Large offices	338	68	7	17
SCE	College	54	27	3	7
	Healthcare	124	37	4	9
	Casinos/hotel	83	25	2	6
	Large offices	260	52	5	13
SDG&E	College	57	29	3	4
	Healthcare	61	18	2	2
	Casinos/hotel	50	15	2	2
	Large offices	216	43	4	5
Total		1252	331	33	83

The estimated market size from the CEUS data totals ~1250 MW across all IOUs for the specific sectors analyzed. When applying the technical scaling factors, it is reduced to about 330 MW. Applying 10 percent and 25 percent market potential factors results in market sizes of roughly 35 MW and 85 MW, respectively. The currently active applications for the three IOU's total 22,475 tons of maximum on-peak cooling (Table 4). Assuming efficiencies of 0.6 to 0.8kW/ton, the active applications represent a peak cooling load of 13.5 to 18.0 MW (for the reasons discussed above, we would expect the shiftable load to be less than the peak cooling load). Thus, even the lower market size estimate suggests a potential to increase enrollment in the PLS program if attractive payback periods for the customers can be achieved. The table below shows the IOU and sector summaries. The estimates for colleges, healthcare, and hotel sectors are comparable to one another, with large office buildings resulting in significantly larger estimates, even after applying technical scaling factors.

Table 14. Estimate of Target Sector Market Opportunity, Utility and Sector Summaries

IOU	Application	Estimate of market size from CEUS data (MW)	Further scaling for space availability, etc. (MW)	Estimate of market size @ 10% (MW)	Estimate of market size @ 25% (MW)
PG&E	All	540	137	14	34
SCE	All	521	141	14	35
SDG&E	All	384	105	11	13
All	Coll	158	79	8	16
All	Hlth	269	81	8	18
All	Lodg	204	61	6	13
All	Loff	814	163	16	35

Low Hanging Fruit Exploration

We specifically explored opportunities of low-hanging fruit through stakeholder interviews. This investigation leveraged the findings of the 2010 Statewide PLS Study, which identified a few key segments as “low hanging fruit” due to attractive economics — namely refrigerated warehouses which required only a software investment and recommissioning of ‘legacy’ TES systems. Table 15 identifies the insights on low-hanging fruit.

Table 15. Feedback on Low Hanging Fruit Opportunities

Application	Insights
Refrigerated warehouses	Refrigerated warehouses are seemingly attractive but may represent a small market opportunity due to the tight temperature criteria demanded by produce and the harsh temperatures endured in the Central Valley. In some cases, the cold storage is still running at night (see footnote (a)).
Recommiss-ioning existing TES systems	Opportunities to refurbish tanks were indicated as a potential low-hanging fruit by a few interviewees. A barrier to pursuing these opportunities is identifying the actual locations of the tanks and reaching the proper contacts. ◆ One utility account executive indicated there are many opportunities here, indicating that some TES systems were not commissioned or are not running properly. ◆ SCE's implementer indicated the presence of a hardcopy database of previously installed TES systems from decades ago that might be a vehicle for identifying refurbished opportunities. At the request of SCE in the early 90's, they had identified 300 sites with TES. From this list, the implementer estimates that roughly 35 may be viable candidates, totaling 8.8 MW of shift potential, assuming 250 kW of shift potential per site. These are primarily chilled water office installations. ◆ At a public workshop, Air Treatment, a BAC rep, indicated they had lists of previous installations totaling hundreds that might be ripe candidates for refurbishment but had trouble reaching these facilities as contacts had changed. The sites include many wineries and schools and ice systems. One interviewee (and longtime TES expert) noted that recommissioning are not usually "controls-only" projects and require piping and system modifications as well. This interviewee had never encountered a controls-only TES project.
Other low hanging fruit applications	Opportunities in colleges, health care, biotech, agriculture and wineries were indicated. ◆ Colleges: Given the directive for energy savings and with the incentive, TES is a consideration. Of the types of TES systems, chilled water has been the preferred option because of its energy savings. Unlike in other sectors, installations in colleges have been pushed by facilities, rather than vendors. ◆ Health care, biotech: These types of facilities have sophisticated facility systems and have large/good load profiles. ◆ Agricultural facilities/ wineries that are already using glycol: They understand maintenance requirements on glycol. A common hurdle to ice storage is that operators are not familiar with how to use glycol. These opportunities which were specifically identified as "low-hanging fruit" were also indicated in the previous section (Table 13).

a) The implementer who had investigated cold storage previously indicated that for every hour that the product is at the outside temperature means 1 week of shelf life reduction.

Overall, the retrocommissioning/refurbished opportunity shows the most potential, although the actual market number is not known. Marketing and outreach to the relevant sectors may draw out these opportunities. Alternatively, working from the historical installation lists that reside with SCE's implementer and Air Treatment might be fruitful next steps if refurbished TES systems are pursued in a serious manner as a low hanging fruit.

Refurbishments/recommissioning qualifies from a program eligibility perspective under the following conditions:

- Proposed increased capacity on an existing and operative system (based on the actual shift being achieved currently), or
- Proposed refurbishment of a system that had been inoperative for three years (the three-year waiting period was established to prevent possible gaming to get some deferred maintenance paid by this incentive).

In the first case, the incentive is based on the additional capacity added to the TES system.

In the second case, SCE's implementer has been looking at the interval data to determine if there is any sign of shifting. A pre-inspection is conducted if the customer disagrees with the assessment. The non-operational criteria does not require pipe disconnectivity.

As indicated in the Eligibility Requirements (Section 4), clarification on the language around eligibility of refurbishing TES systems would be potentially helpful — specifically clarifying that either an increase in capacity of an operational system, or refurbishing a non-operational system qualifies.

7.3 Market Opportunities and Customer Risk in an Evolving Grid

We explored, qualitatively, customer risk to retail rate uncertainty as the grid evolves and new market opportunities that may evolve as the grid evolves and as retail rates also evolve. The overall issue of retail rate uncertainty is an important consideration when assessing market opportunities and customer value. The market actor feedback on this issue is described in an earlier section and affirms that retail rate uncertainty is a concern.

The PLS program and utility TOU rates have to date been designed to shift daytime on-peak load nighttime off-peak hours. Recent studies suggest that with increasing penetration of renewable generation increasing load during the day could actually be beneficial [17]. Specifically, reducing peak load will still be important in the summer, but in the spring and fall there will be periods of over-generation during the day and increasing daytime load could reduce curtailment of solar generation. Therefore, moving forward, PLS systems that have the potential to operate "flexibly" to compensate for over-generation periods may be very valuable.

[17] See, for example, Energy and Environmental Economics, 2014. Investigating a higher renewables portfolio standard in California. https://ethree.com/documents/E3_Final_RPS_Report_2014_01_06_with_appendices.pdf

As part of our interviews, we explored the following issues:

- Are customers' concerned about future rate changes due to increased renewables[18]?
- Can TES systems be operated flexibly (varying discharge/charge rates, multiple cycles)?[19]
- Are TES systems being designed for flexibility and operated in this manner?

The feedback suggested customers are not concerned about retail rate changes due to increased renewables on the grid. Moreover, the interviews indicated that TES systems are capable of providing flexible operations, and are already being designed for this purpose where the market drivers exist.

- Examples already exist where TES systems are being operated "flexibly" where real time markets exist and where the grid is experiencing excess power due to renewables (e.g., Texas, PJM market).
    - Example 1: Princeton university has a TES system where RTP exists.
    - Example 2: a Midwest customer in a municipal utility is being incentivized by the utility to upsize the TES system to provide flexible operation at night during excess power.
- Systems have to be designed for flexible operation. This requires having cooling system redundancy such that the chiller can meet cooling loads without the TES operating; some industries/applications are more likely to have this redundancy. In addition, pump capacities and internal components (diffusers, pipes, etc.) must be upsized.

  One designer indicated that, even in the case of lengthy peak periods, he has specified capacities for peripheral equipment that facilitate flexible operation.

  Another designer indicated that TES systems for data centers are designed for rapid charging and super high flows.
- Variable discharge/charge periods is more difficult with ice storage systems, as discharge and charge are controlled by heat transfer processes. Partial storage systems are less amenable to providing flexibility services as full storage systems.
- An example of non-traditional discharge/charge might include discharging in the late morning, recharging in the early afternoon when prices come down and when overgeneration occurs.

Flexible TES is not currently an explicit consideration for participation in the PLS program. While TES systems could be designed to operate flexibly and are operating flexibly in some cases, they are not being designed for that purpose in California. However, with increasing renewables on

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[18] Section 3 describes participants' general concerns towards retail rate uncertainty. Historically, retail rate uncertainty has been a subject of concern to some customers. Based on the interviews conducted in this study, it continues to be a concern to some customers.

[19] This type of operation could support renewables integration.

the grid in California and a great need for resources that can help balance supply and demand, providing incentives or technical support for customers to design TES systems for increased flexibility may be appropriate for utility PLS programs..

7.4 Benefits of a TES Screening Tool Towards Market Adoption

We explored the need and potential benefits of a TES screening tool. A number of interviewees responded when asked that a utility or independent third-party screening tool would be useful to engage customers with credible, unbiased analysis before undertaking a more expensive feasibility analysis. As a rule, existing tools are not specific to TES, not readily accessible for customers, or provided by vendors with limited transparency. A transparent, readily accessible screening tool that can use customer specific electric and cooling load data would provide a more convincing case on the economics of TES. This can motivate the customer to undertake the time and expense of a feasibility study, which can present a significant barrier to adoption.

8. Propose a Definition of Mature Thermal Energy Storage

We propose a new definition of mature TES that takes into account the current definition adopted by the program, and changes that could improve the program's effectiveness. We reviewed the current definition, including program eligibility criteria, related programs and rules; collected stakeholder feedback on the definition, including challenges, objections and needs; and recommended a new definition. Our recommendations are grounded in current debates and discussions on emerging technology and more specifically small TES systems.

Review of Current Definition, Eligibility Criteria, Program Rules

The original language in the mature and emerging categories in the 2010 Statewide PLS Study explicitly classifies TES systems, excepting small TES systems (such as Ice Energy's Ice Bear system), as "mature" and battery storage as "emerging". The 2010 Statewide PLS Study implicitly groups small TES systems with batteries. In Decision 12-04-045, the CPUC rejected the funding of emerging technologies through the IOU's proposed PLS programs. In Advice Letter R-4586, in their statewide PLS program proposal, the IOUs proposed incentives for all types of TES, including small TES, as mature technologies. After approval of the Resolution, a Petition for Modification (PFM) was filed to request reclassification of small TES as emerging technology. The PFM was resolved in Decision 14-08-029 that ordered small TES to "be deemed as an emerging technology on an interim basis until the Commission develops a record on and approves specific criteria for emerging technologies."

Review of Stakeholder Feedback on Definition

We obtained feedback on the definition through stakeholder interviews of PLS program staff, third-party implementers, and participating and non-participating market actors. The interpretation of the current definition is:

- With respect to active TES systems (stratified chilled water, ice systems), the interpretation has been that all of these systems, with the exception of package system ice systems (namely the Ice Bear product by Ice Energy), are mature TES technologies as they have been available and have been deployed for many years. With respect to package systems, these are incentivized under the SGIP program and characterized as "immature technology".

With respect to passive systems, the definition has been interpreted by some to be ambiguous. One implementer indicated that enquiries have been made around building-integrated phase change materials. These are cutting edge and are not regarded as mature.

Recommended Definition of Mature Technology

Based on our investigation, little ambiguity exists in terms of the interpretation of what technologies are considered mature versus emerging in the context of the TES program. On a broad level, mature TES systems should include technologies that have been commercially available for many years, are proven technologies, and have been adopted into the marketplace. A classic example of a mature TES technology is stratified chilled water tanks.

It is worth noting that there are no straightforward, black and white definitions of what is emerging versus mature technology. This challenge is present not only for TES technologies but also for other technologies and programs such as demand response, energy efficiency and renewable energy.

We develop a set of subjective criteria that can aid in the differentiation between emerging technologies and mature technologies. These criteria are inspired by the debates and discussions across various venues and programs, including the Self-Generation Incentive Program, the Electric Program Investment Charge, and emerging technologies programs. These criteria can be applied to assess if a particular TES technology is mature or is emerging but could be applied more broadly beyond TES systems.

Emerging technology criteria

- Breakthrough technology, or
- Breakthrough application of an existing technology, or
- New features of an existing technology, or
- Novel deployment scenario for an existing technology.

Mature technology criteria

- Technology has been technically proven, and
- Technology has been commercialized and is available, and
- Utility is comfortable deploying the technology in mass scale, and
- The deployment scenario for the existing technology is known, and
- Technology has surpassed the early adoption phase of market adoption.[20]

It is necessary to meet any one of the listed criteria under emerging technology to qualify as an emerging technology criteria. To qualify as a mature technology, all the criteria are ideally met. We illustrate the criteria with examples in the table below.

[20] To understand if the technology has surpassed the early adoption phase of market adoption, one should review the current relative market share of the technology and compare it to the eventual expected market penetration to make a judgment on whether a technology is considered to have passed the early adopter phase.

Table 16. Example Evaluation of Specific TES Technologies

Criteria	Stratified chilled water tanks	Package unit thermal energy storage system	Building integrated phase change materials
Emerging technology criteria			
Breakthrough technology	No	No	Yes
Breakthrough application of an existing technology	No	Yes	Yes
New features of an existing technology	No	Yes	No
Novel deployment scenario for an existing technology	No	Yes	Yes
Is technology an emerging technology?	*No*	*Yes*	*Yes*
Mature technology criteria			
Technically proven	Yes	Yes	No
Commercialized and available	Yes	Yes	Yes
Utility is comfortable deploying on a mass scale	Yes	Maybe	No
Technology has surpassed early adoption phase of market adoption	Yes	Maybe	No
Known deployment scenario for the existing technology	Yes	Maybe	No
Is technology a mature technology?	*Yes*	*Maybe*	*No*

Based on the criteria, the stratified chilled water tank is clearly not an emerging TES technology and is clearly a mature TES technology. Similarly, building integrated phase change materials are clearly emerging TES technology and not mature technology.

In the case where a technology may be argued to be either mature or emerging TES, such as package unit ice storage systems, an assessment may need to be made as to which category it falls under from a program perspective. From a regulatory perspective, it is not desirable to allow technologies to double-dip from program incentives. Therefore, the program process should ensure that if a particular TES technology for a particular application is receiving an incentive from one program type, it does not receive incentives from the other.

9. Key Findings and Recommendations

This section presents the TRC team's key findings from the evaluation and recommendations for program improvement and uptake. The reader should keep in mind that only a handful of customers have applied to the program and none of their projects had progressed through the entire program process.

9.1 Key Findings

Applicants and participating market actors are satisfied with this program and find it to be a wining situation for both the customer and the utility. Overall, applicants, participating market actors, and account executives are pleased with the involvement and responsiveness of the program staff and their consultants. However, many suggest that an earlier meeting or involvement of the program representatives would be beneficial to provide an opportunity to discuss requirements and the process.

Application, Eligibility Requirements, and Timeline

The majority of applicants and participating market actors do not have any issues with the application and are generally satisfied with the eligibility requirements, but feel that the program could be more lenient on some of these requirements. Some participating market actors find the language around eligible refurbishment projects to be unclear, and suggest that the program representatives look more closely at each project on a case-by-case basis rather than dismissing projects that do not meet the strict requirements.

Applicants and market actors, both participating and nonparticipating, do not think that the 18-month timeline is feasible for many projects, specifically entities which have extensive internal approval processes. Applicants have felt that the program staff from all three utilities are considerate of delays to projects and have been accommodating to special circumstances.

Feasibility Study

The feasibility study requirements and process are the most difficult portion of the program for both applicants and the market actors who develop the study, but feedback also suggests that the studies are valuable and provide ancillary benefits. Applicants and participating market actors report that the feasibility studies can be onerous and time consuming, but recognize the benefits they provide for the decision-making process and identifying project details that otherwise could become issues down the road.

Monitoring Requirements

The three months of pre-installation monitoring is troublesome for customers, whereas there is little concern over the five-year post-installation monitoring requirements. The main issues around the pre-installation monitoring appear to be the cost of monitoring equipment if the facility does not already have the required equipment; implementing the monitoring for 'campus' style sites containing multiple buildings, or the existing monitoring equipment or

EMS/BMS were not previously setup to capture the data in the required five-minute intervals making it difficult to meet the timeline.

Incentives

Although all applicants would prefer to receive higher incentives so that their project payback periods are shorter, they responded that they find the incentive to be generous and that it largely influenced the decision to move forward with the project. Both participating and nonparticipating market actors agree that the incentive helps open up the conversation around TES installations, but is usually not enough to mitigate the high upfront costs for the majority of customers.

A separate concern is over the customer incentive cap, which can limit customers from participating at multiple sites, or underfund large projects. A related concern is the limit on option to take an upfront payment; this amount is not enough to fully cover the cost of a feasibility study, so customers must pay some of the upfront costs for these studies.

Utility Rates

Although not an overwhelming sentiment from applicants, there is some concern over utility rate structures and the possibility of changes to these structures in the future. Most applicants do not expect there to be substantial rate changes that would render their system a bad investment; however, market actors list rate uncertainty as a main concern for the economic viability of TES installations.

Account Executives

Utility account executives are typically the first line of customer engagement with utility programs, and therefore must have broad knowledge of all program offerings. The program staff should consider them as facilitators that can identify TES installation opportunities and hand these off to the program rather than program experts who can provide full technical support to customers.

Challenges and Barriers

The challenges and barriers identified through interviews with applicants and market actors are: high costs, the 18-month timeline, rate tariffs, potential interaction with DR programs, lack of familiarity or knowledge of TES among the market, monitoring requirements for facilities with certain meter setups, space constraints, external entity approval, and reservation towards TES due to unfavorable past experience with these systems.

Marketing

Though the PLS program marketing activities have been limited, the strategies and channels pursued by the program managers have been appropriate considering the market for TES and the complexity of the technology. Based on the feedback the TRC team received from the applicants on their motivations for pursing their TES system and benefits they expect to realize, the marketing materials should emphasize the broad range of benefits from a TES system.

PLS–TES Market Opportunity

Based on the qualitative assessment, we identified the following applications as the most promising opportunities for TES installations: Colleges, including community level; hospitals; casinos; office complexes/campuses; and industrial facilities (pharmaceuticals, biotech, data centers). We explored the cost-effectiveness to the customer for a subset of these customer types using publicly available data (CEUS) and determined that most of these applications can be cost-effective, particularly when rates exhibit greater demand charge and energy differentials and when incentives are included. The applications analyzed using PG&E's E-20S rate were more cost-effective than SCE's TOU-8B rate, SDG&E's AL-TOU rate, which has a smaller on- to off-peak demand charge differential than PG&E or SCE rates, is not cost-effective in most of the scenarios analyzed. In some cases, the presence of the incentive turned an application from not being cost-effective to being cost effective. Our analysis identified that data centers may not be cost-effective, primarily, due to the presence of the all-hours demand charge, which is present in all rates we analyzed.

Low-hanging fruit opportunities in the area of refurbishing/recommissioning thermal energy storage systems were identified by a few applicants, indicating the presence of lists that could point the IOUs towards actual historical installations.

We roughly estimated the overall size of the market using the public CEUS data for college, healthcare, hotel and large office sectors. Our total ranges from ~ 33 MW to 330 MW when applying 'scaling' factors. A maximum of 1250 MW could be shiftable if the entire stock within each of those applications could host a TES system.

In comparison, the currently active applications for the three IOU's total 22,475 tons of maximum on-peak cooling and a peak cooling load of 13.5 to 18.0 MW. This suggests a potential to increase enrollment in the PLS program if attractive payback periods for the customers can be achieved.

Definition of Mature Technology

Based on our investigation, little ambiguity exists in terms of the interpretation of what technologies are mature versus emerging from a programmatic perspective. However, the definition is interpreted by some to be ambiguous with respect to passive systems (e.g., building-integrated phase change materials), which are not covered by the PLS program. Per the objectives of the process evaluation, we proposed a definition for mature technology (indicated below) that can be used to categorize specific TES technologies on an individual basis.

Other PLS Programs

Other PLS programs share some common characteristics, but due to the varying utility territories and priorities, variances occur in program management and requirements. Participation rates are low among all programs, except for Ice Energy projects, averaging between zero to two installations per year. Programs all report that high costs and long payback periods are the main barriers. All of these programs are managed in-house, and only one program has a contractor to support the engineering analysis. TES incentives for some entities are offered within a broader program category, such as a Demand Management Programs or

Custom Performance Programs. Additionally, the TES offerings that fall under this type of structure do not have their own budget, but operate within the budget for the broader program category.

None of the programs rely heavily on marketing TES installations, but aim to keep in contact with vendors, as they report the program is mostly vendor-driven. Only two programs require feasibility studies, and one of these only requires the study when a customer expects the load shift to exceed a threshold value. Some programs have direct strategies or requirements to incorporate energy efficiency upgrades with TES installations.

Incentives structures are not consistent among other programs; some offer the incentive in full after project completion, and others offer half of the incentive after project completion and the other half after measurement and verification. Only one program offers a TES utility rate tariff.

The majority of the identified issues to not apply to Ice Energy programs. These programs are the only ones to have high participation rates or be fully subscribed.

9.2 Recommendations

Continue to engage interested customers with the program early in the process. Program managers have come to realize the importance of engaging with a candidate project early to establish communications and identify and head off potential problems. The program managers should establish a direct line of communication with the applicant and/or their design team early on. Utility account executives should be engaged as facilitators rather than a primary point of contact.

Adopt SCE's practice of conducing brief reviews of the project feasibility to identify good TES candidates or identify major issues. Program staff should meet with the customer to assess their organizational readiness to effectively operate a TES system and determine whether the facility is capable of hosting a TES system (for instance, if there are space constraints that would prevent the installation of a tank). The utilities should also review the customer's interval data to determine if the loads are realistic or whether existing TES equipment has been in operation in the last three years.

Develop a pre-screening tool for customers. The utilities should support the development of a simple pre-screening tool that customers can use to understand their potential suitability for a TES system before investing in a feasibility analysis. This tool should incorporate electrical and thermal loads bracket, if available, to estimate high-level economic feasibility given utility rates and TES cost.

The utilities should provide tool-lending services for pre-installation monitoring equipment. The cost of conducting the required three-month equipment pre-monitoring is a barrier for some projects. Providing the necessary monitoring equipment would avoid the upfront cost to acquire the tools.

Make the statewide manual available publically. The programs have documented the clarifications around issues and questions that applicants have had on their systems in a statewide program manual, but it has not been made public. Posting the statewide manual publically will help prospective applicants understand the program more fully. The following applicant issues have been resolved and documented in the statewide manual:

- Costs and system components that can be included in the calculation of the incentive cap;
- Process and guidelines for requesting program extensions;
- How funds are reserved in cases where program funding is exhausted. The statewide manual clarifies that the incentive reservations are granted on a first-come, first-service basis upon completion of an approved application;
- The incentive multipliers are applied to the outgoing system, not the system being installed; and
- Order in which EE, distributed generation, demand response, and PLS program incentives should be applied for projects.

Modify the eligibility requirements around existing or refurbished TES systems. The current statewide manual language requires that existing TES systems increase shift capacity AND be inoperable for at least three years in order to qualify for a PLS incentive. This language should be changed to clarify that existing systems must increase shift capacity OR be inoperable for at least three years, consistent with the intent.

Conduct marketing and outreach to promote the program and increase participation. The utilities should actively promote the availability of the TES incentives to customers and TES market actors.

Workshops are an appropriate forum for communicating information on the PLS program. Workshops should be developed as both an educational channel and an opportunity to connect customers with TES vendors. Workshop content (and other marketing materials) should go beyond program information and promote the benefits of TES and information to help customers understand their TES potential.

As a primary point of contact between customers and the utilities, account executives should receive training so they are conversant on the program and understand how to identify a customer with good TES potential. Workshop attendance by account executives will broaden their understanding of the PLS program and TES technologies. In addition, account executives can promote the workshops by screening their assigned customers and extending invitations.

The programs should target high-potential market sectors with their marketing efforts. With modifications to the eligibility criteria, refurbished systems present an opportunity for increased program participation. The program managers should capitalize on these opportunities by using data or customer lists to target these sites.

Allow extensions to the program timelines for completion of certain activities. The current timeline of 18 months for completing the project installation is too short for some customers. Program managers report that they are willing to extend this and other timelines upon customer request and the statewide manual outlines the process and terms around extensions.

Consider modifying the customer incentive cap of $1.5 million from a per customer basis to a per site basis. Customers with multiple facilities may have opportunities for TES systems at more than one site, but are currently limited in the amount of incentive they can receive. Applying the incentive cap at the facility level would allow these customers to pursue projects at their other locations.

Conduct further research and analysis on the feasibility of TES projects for customers with high load factor facilities such as data centers and hospitals. Conventional wisdom says that these customers are not suitable for TES, however, interviews with TES stakeholders reveal that some customers are pursuing projects with success in these facilities. However, our analysis suggests that the non-coincident demand charges may be a barrier to economic feasibility since TES has the potential to increase the maximum demand in these types of facilities.

Explore feasibility of rate designs to improve economic feasibility and reduce customer risk. The high non-coincident demand charge of SDG&E serves as a disincentive to charging PLS systems at night. The utilities should investigate whether it is feasible to reduce the all-hours demand charge for PLS customers while still recovering the cost to serve them and not inappropriately shifting costs to other ratepayers. If feasible, this could significantly improve economic feasibility of PLS for some customers. Some interviewees indicated a special PLS rate that guarantees TOU and demand charge savings would be desirable. Overall, many stakeholders were not aware of potential rate design changes due to increased renewables, such as changes in peak period definitions that would affect customer savings unless PLS system operation adapts.

Mature TES should refer to technologies that have passed a set of criteria. These criteria include that the technology should be technically proven, commercialized and available, with a known deployment scenario, the early adoption phase has been surpassed, and the technology can be deployed on mass scale.

Explore opportunities for flexible operation of TES systems. Interviews indicated that TES systems are capable of providing flexible operations, and are already being designed accordingly where the market drivers exist. PLS program incentives and TOU rates do not currently provide incentives for customers to invest in flexible operation capabilities. Given the high level of interest in increasing system flexibility to integrate higher penetrations renewables, cost-effective methods for incentivizing flexible operation of TES should be explored.

Recommendations for Future Research

Conduct non-participant research to better understand the barriers to TES adoption. Market actors and applicants sometimes had different perspectives on barriers to TES adoption. For instance, market actors believe that future rate uncertainty is a serious issue when considering whether to invest in TES. However, the PLS applicants understood that future rate changes could affect their project economics, but they were not concerned. It may be that these customers have moved forward with TES adoption because they have a higher risk tolerance, but other customers may view this as a serious threat. Discussions with non-participating customers with TES potential would help to illuminate the true barriers. The TRC team attempted to contact PLS program drop outs but were not able to complete any interviews.

Conduct further research and analysis on the feasibility of TES projects for customers with high load factor facilities such as data centers and hospitals. Conventional wisdom says that these customers are not suitable for TES, however, interviews with TES stakeholders reveal that some customers are pursuing projects with success in these facilities. However, our analysis suggests that the non-coincident demand charges may be a barrier to economic feasibility since TES has the potential to increase the maximum demand in these types of facilities.

10. Appendices

10.1 Interview Guides

Interview Guide for Investor–Owned Utility Staff

Introduction

Hello, I'm [INTERVIEWER'S NAME] with TRC Energy Services. I wanted to first thank you for taking the time to participate in this interview today. As you may already know, we are conducting a process evaluation of the California IOU joint Statewide Permanent Load Shifting Program to identify opportunities to streamline the program's administration and delivery process, increase customer uptake, and enhance the customer's experience with Thermal Energy Storage. Dan Engel at PG&E is the evaluation project manager. We'd like to record this call, with your permission. We will not share the recording outside of our project team, and its primary use will be to make sure we capture your points. Our findings will be documented in the written program process evaluation. Though we will not use your names in the report, we will attributed your feedback to your respective utility.

Are you okay with being recorded?

This interview should last about one hour. Do you have any questions before we begin?

Interview questions

1. Could you please describe your responsibilities related to the PLS program? How long have you been working with the program?

Service Delivery and Quality Control

2. Please describe generally how the utility manages PLS TES projects through the program? [Interviewer should probe for the time it takes the applicant to complete the feasibility study and the time it takes the utility to review and approve.]
    a. What are the steps in the program process, from the program's initial engagement with the customer or vendor through to the final incentive payment?
    b. Who is responsible for completing each step?
    c. How long does each step take to complete?
    d. What problems or challenges have you encountered with each step? Have you been able to resolve these challenges? How so?

    [If not offered by the respondent, interviewer should probe for the feasibility study, review of project design and specification, and verification of installation.]

3. What quality control systems are in place for the review of project design and specification? Please describe them.
4. Does the program have a process in place for ensuring a system's long-term operation?
5. Do applicants submit program materials (applications, feasibility studies, proof of installation etc.) electronically or in hard copy?
6. Is there a single point of contact for the customer?
7. Who typically makes inquiries regarding the project, the customer or vendor?
8. Who typically completes and submits the application, the customer or vendor?
9. [For PG&E and SCE:] Are you satisfied with the support and education provided by the implementer to customers and to participating vendors? What is working well? What areas need improvement? Have additional areas of support been identified?
10. [For SDG&E:] What feedback have you received from customers and participating vendors on the support and education provided by your program? What is working well? What areas need improvement? Have additional areas of support been identified?
11. Have you seen situations where a customer's overall energy usage increases even while reducing peak load? What customer behaviors or design strategies lead to this?

Resources and Management

12. How many utility staff support the program? Do you have any third-parties supporting the program? How many?
    a. Can you provide their titles and briefly describe their responsibilities?
    b. How long has each been involved with the program?
    c. Do they support the program full time? [If not, ask:] What percent of their time do they support the program?
13. Do you think the staffing levels are sufficient to provide the needed oversight and support? [If not, ask:] What additional support would you like to have?
14. What aspects of program administration and implementation do you coordinate with the other IOUs?
    a. How is coordination of responsibilities and information among the various IOU territories handled?
    b. Has this coordination posed any challenges?

Program Theory and Implementation

15. Please describe your knowledge of the program theories or rationale.
16. Please describe the program goals regarding:

   a. Market transformation.
   b. Shift persistence.

17. Please describe your experience initially implementing the program in terms of:
    a. Identifying internal staff and resources to support the program.
    b. Coordinating with the other IOUs and CPUC.
    c. Engaging the vendor community.
18. What challenges were encountered as the program was being developed ?
    a. How were these challenges addressed?
    b. Are there any remaining challenges that you are facing or resolving? Please describe.
    c. What needs to be done to resolve these remaining challenges?
19. [For PG&E and SCE:] Why did you decide to engage a third-party for program implementation?
    a. Has the third-party administration of your PLS program been effective? Why or why not?
    b. What are the advantages and disadvantages of third-party implementation?
20. If a customer wants to enroll multiple facilities in multiple IOU territories, is there a streamlined process for that?
21. Have opportunities for PLS changed over time?
    a. Has demand/interest changed over time? What are the key drivers of these changes?

Marketing and Recruitment

22. Does the program have a performance target or other goals? Please describe.
    a. Are you meeting those targets? [If not, ask:] What barriers are you facing in meeting your targets?
    b. Do the account executives have program targets? [If yes, ask:] Are these targets tied to their financial compensation, such as an annual bonus or performance review?
23. How do you market the program and recruit potential participants?
    a. Do you coordinate with other organizations (e.g., industry associations), when marketing or delivering the program?
    b. Do you coordinate marketing or referrals with other EE or DR programs within your utility?
24. Do other industry actors or associations promote the program and generate leads?

   a. Have any partnerships developed with industry groups in terms of increasing the uptake of the TES Program?
   b. How are referrals to the PLS program from account executives, utility programs and other market actors received and tracked?

25. How have the current project leads been generated? Through customers, utility account managers, or vendors?
26. What are the barriers you have encountered in recruiting customers to participate in the program?
27. What building sector or sectors seems to have the most interest in applying for the PLS program?
28. Which TES technologies have been the most popular among customers, and why?
29. How much of the 2013-2014 program budget is allocated to marketing?
    a. How much of the marketing budget has been spent to date? [If marketing budget still remaining, ask:] Do you think the remaining budget should be allocated to something else?
    b. Do you think the budgets established for administration and marketing are appropriate? How so? Too low? Too high?

Customer Experience

30. What sort of feedback have you received from applicants or potential applicants on the application/documentation requirements?
    a. From vendors?
31. How do customers feel about the size of the incentive?
    a. How do vendors feel about the size of the incentive?
    b. Are the incentives sufficient for overcoming the financial barriers to TES adoption?
32. What feedback have you received from customers or vendors on system operation? Are the TES systems affecting their day to day business?
33. Are quality control systems in place for customer complaints or dispute resolution? Please describe them.
    a. Have any complaints or disputed been raised? Please elaborate.
34. Are you aware of any issues encountered with local agencies or regulators that have delayed or prevented projects from being installed?
    a. [If yes, ask:] Have you had any conversations with these agencies on their issues?
    b. Have you provided any support or resources to applicants or vendors to overcome these issues? Please describe.

Monitoring

35. Do you require monitoring and verification data to be collected on-site?
    a. [If yes, ask:] What are the requirements?
    b. Do you require sub-metering?
    c. Do you have a plan for enforcing these requirements?
    d. Are monitoring and sub-metering systems routinely implemented by the vendor, or do they implement them because it is a program requirement?
36. What performance data do you collect from the PLS equipment?
    a. Have you encountered performance issues? Ambient temperature, etc.
    b. Are certain technologies not meeting performance specs or having lifecycle issues?

Recommendations

37. What changes would you like to make to improve the PLS program going forward?
    a. What are the barriers to making those changes?
38. Is there anything else you'd like us to know?
39. Are you aware of other TES or PLS programs in the US or Canada that are outside of California?
    a. Do you have any contacts with this program? Can you give us their name and information?
40. Can you give us the names and contact information for one to two account managers assigned to PLS project applicants?

Market opportunity and definition of mature TES

41. One goal of the process evaluation is to identify low hanging fruit TES applications, such as legacy units that can be recommissioned, those that require only controls investments (such as warehouse precooling). Have you come across applications that are of this type of nature?
42. Can you summarize the types of sectors for which applications are being proposed: e.g., campuses, laboratories?
    a. What types of TES systems?
    b. What types of paybacks?
    c. What was the motivation (economic, reliability, "greenness")?
    d. What types of tools are they using for the analysis?
    e. What kinds of plans are in place to ensure good operation?

   f. Are TES being bundled with other applications?
   g. What kinds of TES system prices are you seeing?

43. Do you maintain any kind of summary document (e.g., XLS) that describes salient aspects of the applications and key elements from feasibility analysis? Can you share this with us? (It would help us assess the market opportunities).
44. If you were to pick 10 TES applications/ customer types to analyze for further targeted deployment, what would they be?
45. Can you describe any internal efforts that are identifying promising applications for TES deployment? What has been the process in this effort? (Load analysis, customer interviews etc.) Would it be possible to link us with this effort?
46. One issue we are exploring is customer risk to retail rate change, and whether TES systems can be operated flexibly (discharge/charge at different periods, etc.). Are the systems being proposed in the applications suitable for varied operation?
47. What is your view on what should be considered “mature” TES? Size, type of TES system, etc.? In your view, has the current definition or lack of definition been a barrier to TES adoption?

Conclusion

We’ve reached the end of the prepared questions. (If time permits) I’d like to open the discussion now in case there is anything additional you would like to add that we have not discussed.

Thank you for your participation. If you have any questions, please reach out to Dan Engel, and I hope you have a good day.

Interview Guide for Implementers

Introduction

Hello, I'm [INTERVIEWER'S NAME] with TRC Energy Services. I wanted to first thank you for taking the time to participate in this interview today. As you may already know, we are conducting a process evaluation of the California IOU joint Statewide Permanent Load Shifting Program to identify opportunities to streamline the program's administration and delivery process, increase customer uptake, and enhance the customer's experience with Thermal Energy Storage. Dan Engel at PG&E is the evaluation project manager. We'd like to record this call, with your permission. We will not share the recording outside of our project team, and its primary use will be to make sure we capture your points. Our findings will be documented in the written program process evaluation. Though we will not use your names in the report, we will attribute your feedback to your organization.

Are you okay with being recorded?

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Interview questions

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Service Delivery and Quality Control

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    c. How long does each step take to complete?
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    [If not offered by the respondent, interviewer should probe for the feasibility study, review of project design and specification, and verification of installation.]
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4. Does the program have a process in place for ensuring a system's long-term operation?

5. Do applicants submit program materials (applications, feasibility studies, proof of installation etc.) electronically or in hard copy?
6. Is there a single point of contact for the customer?
7. Who typically makes inquiries regarding the project, the customer or vendor?
8. Who typically completes and submits the application, the customer or vendor?
9. What feedback have you received from customers and participating vendors on the support and education provided by your program? What is working well? What areas need improvement? Have additional areas of support been identified?
10. How would you characterize the general level of 'awareness/education' in the community regarding areas that have been identified as lacking in the past (e.g., energy simulation skills; basic knowledge of TES systems, importance of controls and operating strategies)?
11. Please describe the energy efficiency aspects of the systems:
    a. What types of design and operating strategies have you observed in the plans that are anticipated to result in energy savings? And what are the % savings being quoted?
    b. Conversely, have you seen situations where a customer's overall energy usage increases even while reducing peak load? What customer behaviors, TES system types, or design strategies lead to this?
    c. Have you observed "missed opportunities" for energy savings based on your design review and site inspection?

Resources and Management

12. How many of your staff support the program?
    a. Can you provide their titles and briefly describe their responsibilities?
    b. How long has each been involved with the program?
    c. Do they support the program full time? [If not, ask:] What percent of their time do they support the program?
13. Do you think the staffing levels are sufficient to provide the needed oversight and support? [If not, ask:] What additional support would you like to have?
14. What aspects of program implementation do you coordinate with the other IOUs?
    a. How is coordination of responsibilities and information among the various IOU territories handled?
    b. Has this coordination posed any challenges?

Program Theory and Implementation

15. Please describe your knowledge of the program theories or rationale.
16. Please describe your experience initially implementing the program in terms of:
    a. Identifying internal staff and resources to support the program.
    b. Coordinating with the other IOUs and CPUC.
    c. Engaging the vendor community.
17. What challenges were encountered as the program was being developed?
    a. How were these challenges addressed?
    b. Are there any remaining challenges that you are facing or resolving? Please describe.
    c. What needs to be done to resolve these remaining challenges?
18. If a customer wants to enroll multiple facilities in multiple IOU territories, is there a streamlined process for that?
19. Have opportunities for PLS changed over time [If stumped, probe to include experience with TES that predates this particular program]?
    a. Has demand/interest changed over time? What are the key drivers of these changes?

Marketing and Recruitment

20. Does the program have a performance target?
    a. Are you meeting those targets? [If not, ask:] What barriers are you facing in meeting your targets?
21. How do you market the program and recruit potential participants?
    a. Do you coordinate with other organizations (e.g., industry associations), when marketing or delivering the program?
    b. Do you coordinate marketing or referrals with other utility EE or DR programs?
22. Do other industry actors or associations promote the program and generate leads?
    a. Have any partnerships developed with industry groups in terms of increasing the uptake of the TES Program?
    b. How are referrals to the PLS program from account executives, utility programs and other market actors received and tracked?
23. How have the current project leads been generated? Through customers, utility account managers, or vendors?
24. What are the barriers you have encountered in recruiting customers to participate in the program?

25. What building/customer types seem to have the most interest in applying for the PLS program and what have been their key motivations for applying (e.g., economics, sustainability, reliability)?

26. Describe these types along the lines of new construction/expansion TES (e.g., new wing of a building or new building) vs. existing building vs. retuning of existing TES system.

27. Which TES technologies have been the most popular among customers, and why?

28. As the program implementer, how much of the 2013-2014 program budget assigned to you is allocated to marketing?
    a. How much of the marketing budget has been spent to date? [If marketing budget still remaining, ask:] Do you think the remaining budget should be allocated to something else?
    b. Do you think the budgets established for your administration and marketing costs are sufficient? How so? Too low? Too high?

Customer Experience

29. What sort of feedback have you received from applicants or potential applicants on the application/documentation requirements?
    a. From vendors?

30. How do customers feel about the size of the incentive?
    a. How do vendors feel about the size of the incentive?
    b. Are the incentives sufficient for overcoming the financial barriers to TES adoption?

31. What feedback have you received from customers or vendors on system operation? Are the TES systems affecting their day to day business?

32. Are quality control systems in place for customer complaints or dispute resolution? Please describe them.
    a. Have any complaints or disputes been raised? Please elaborate.

Monitoring and Operations

33. As the implementer, do you require monitoring and verification data to be collected on-site?
    a. [If yes, ask:] What are the requirements?
    b. Please describe the monitoring requirements in the application phase, and then after the project has been constructed.
    c. Have you established a method for estimating the PLS impact? Could you please describe it and how it is used?
    d. Do you have a plan for enforcing these requirements?

   e. Are monitoring and sub-metering systems routinely implemented by the vendor, or do they implement them because it is a program requirement?

34. What performance data do you collect from the PLS equipment?
    a. Have you encountered performance issues?
    b. If any TES systems have been installed, are certain technologies not meeting performance specs or having lifecycle issues?
35. Are there any changes to operating strategies that could improve the performance of the system? What are the barriers to customers/operators implementing these?
36. Have operating strategies planned for year round shifting or summer only, assuming cooling load is present?

Market Opportunity and Definition of Mature TES

37. One goal of the process evaluation is to identify low hanging fruit TES applications, such as legacy units that can be recommissioned, those that require only controls investments (such as warehouse precooling). Have you come across applications that are of this type of nature?
38. Can you summarize the types of sectors for which applications are being proposed: e.g., campuses, laboratories?

    What types of TES systems?

    What types of paybacks?

    What types of tools are they using for the analysis?

    What kinds of plans are in place to ensure good operation?

    Are TES being bundled with other applications?

    What kinds of TES system prices are you seeing?
39. Do you maintain any kind of summary document (e.g., XLS) that describes salient aspects of the applications and key elements from the feasibility analysis? Can you share this with us? (It would help us assess the market opportunities).
40. If you were to pick 10 TES applications/ customer types to analyze for further targeted deployment, what would they be?
41. What are the ranges of costs you are aware of for different types of applications ($ per kW or more preferably $ per ton-hour or $/gallon) along the following dimensions: new construction vs. retrofit; recommissioning (software only) vs. new tank; underground vs. above ground; ice vs. chilled water vs. package system (e.g., Ice Bear)
42. One issue we are exploring is customer risk to retail rate change, and whether TES systems can be operated flexibly (discharge/charge at different periods, etc.). Are the systems being proposed in the applications suitable for varied operation?

43. Any views on what you would consider “mature” TES? Size, type of TES system, etc.?

Recommendations

44. Are there any changes you would like to make to improve the PLS program going forward?
    a. What are the barriers to making those changes?
45. What information or insights would you like to learn from this process evaluation?
46. Are you aware of other TES or PLS programs in Canada or in the US outside of California? And if yes, are there any specific aspects you would like us to pay attention to in these programs?
    a. Do you have any contacts with this program? Can you give us their name and information?
47. Is there anything else you’d like us to know?

Conclusion

We’ve reached the end of the prepared questions. (If time permits) I’d like to open the discussion now in case there is anything additional you would like to add that we have not discussed.

Thank you for your participation. If you have any questions, please reach out to Dan Engel, and I hope you have a good day.

INTERVIEW GUIDE FOR PARTICIPATING MARKET ACTORS

Introduction

Hello, I'm [INTERVIEWER'S NAME] with TRC Energy Services. I wanted to first thank you for taking the time to participate in this interview today. As a reminder, we are conducting a process evaluation of the California Utilities Joint Statewide Permanent Load Shifting Program to identify opportunities to streamline the program's administration and delivery process, and enhance the customer's experience with thermal energy storage. Dan Engel at PG&E is the evaluation project manager. If you feel the need to reach out to him for confirmation that PG&E is sponsoring this work, he is available at dce4@pge.com or can be reached by phone at 415-972-5119. Our findings will be documented in the written program process evaluation. Your feedback will be reported anonymously and we will not use your name in the report. Also, please note that the report (when completed in first quarter 2015) will be posted on the CALMAC website and hence available to you.

With your permission, we'd like to record this call. We will not share the recording outside of our project team, and its primary use will be to make sure we capture your points. Are you okay with being recorded?

This interview should last about an hour. Do you have any questions before we begin?

Interview questions

1. Please clarify your role with respect to TES, and specifically this project. *[Use this response to identify appropriate questions to ask or skip, respectively]*
    a. Feasibility analysis
    b. Project sponsor or customer agent
    c. Manufacturer
    d. Installation contractor
    e. Commissioning agent (most likely the installation contractor or project sponsor)
2. What has been your history with TES? E.g., designed TES systems for 20 years?

Application and Marketing

[*Ask only interviewees that are classified as Question 1a or 1b (i.e. the customer agent, project sponsor, or engineering firm conducting the feasibility analysis), otherwise, skip this section*]:

3. How did you first learn about the PLS program?
    a. [UTILITY] Website/Marketing Materials
    b. Approached by customer

c. Have you heard about the program through any other channels? What were they?

4. Who completed and submitted the application, you or the customer?

5. Who typically completes and submits the application, you or the customer?

6. Were any parts of the application or application process unclear or difficult to understand or respond to?

d. Which item(s) on the application was problematic? **[Multiple value picklist]**

Section 1: Customer Contact Information

Section 2: Project Sponsor Information (if applicable)

Section 3: Payee Information (Who is paid the Incentive)

Section 4: Agreement

PLS-TES Project Summary

General Narrative of the proposed TES and cooling system, physical location

description and attach a sketched schematic

Thermal Energy Storage System Details

PLS-TES Peak Demand Shift Details and Incentive Estimate

Feasibility Study information

e. What was the specific problem?

f. What would have made it easier?

7. Was the Program information you needed available online?

g. [If no, ask:] What additional Program Information would you like to see online? How did you ultimately find the information you were looking for?

8. Did you or your team participate in any of the public training workshops offered?

h. If so, did you find them helpful in completing the application?

- Do you have suggested improvements on their content?

Program Experience

[*Ask only interviewees that are classified as Question 1a or 1b (i.e. the customer agent, project sponsor, or engineering firm conducting the feasibility analysis), otherwise, skip this section*]:

9. How long did it take for the PLS program to complete their review of your feasibility study and approve your project?

10. Do the program processes and requirements align with the project installation process and timing? [Probe for any inconsistencies or hurdles, make sure to address feasibility study, timing of incentive check, etc.]

11. What challenges or barriers did you face with respect to the PLS program application process?

12. What types of challenges or barriers did you encounter with respect to the technical requirements of the program (e.g., monitoring and feasibility study requirements)?

13. Have you engaged with the PLS program in more than one IOU territory?

    a. [If yes, ask:] Are there any differences in the program requirements or how it is run in different territories? What were some elements you liked or disliked?

14. What challenges or barriers are faced by customers considering PLS?

Feasibility Study

[*Ask only interviewees that are classified as Question 1a or 1b (i.e. the customer agent, project sponsor, or engineering firm conducting the feasibility analysis), otherwise, skip this section*]:

15. How long did it take to complete the feasibility study?

16. Were any parts of the Feasibility Study Requirements unclear?
    a. Which Feasibility Study item(s) was unclear? **[Multiple value picklist]**
    Cover Page
    Executive Summary
    Project Background
    Existing HVAC Systems
    Existing (and Future) Current and Electric Loads using approved computer modeling programs and provide outputs as follows:
    Estimated Demand Reduction and Energy Use
    Energy Efficiency Information
    Operations and Maintenance
    Economic Analysis
    Recommendation
    Appendices (Computer Models, Diagrams and Schematics, Photos, Illustrations, Tables/Charts)
    b. What was the specific problem with the item(s)?
    c. What would have made it clearer?

17. Were there any parts of the Feasibility Study difficult to complete?
    d. Which components were difficult to complete? **[Multiple value picklist]**
    Cover Page
    Executive Summary
    Project Background

Site Review
Cooling and Electrical Load Profiles
Thermal Energy Storage System Options and Type Selection
Estimated Demand Reduction and Energy Use
Energy Efficiency Information
Emissions Prevention Summary (Optional)
Utility Rate Schedules Used in Analysis
Cooling Equipment Sizing and Efficiencies
Operations and Maintenance
Economic Analysis
Conclusions and Recommendation
Appendices

e. What was the specific problem with the component(s)?
f. What would make these easier to achieve?

18. Did you have enough support from the involved utility throughout the Feasibility Study process?
19. What could have made this experience better?

Satisfaction

[*Ask only interviewees that are classified as Question 1a or 1b (i.e. the customer agent, project sponsor, or engineering firm conducting the feasibility analysis), otherwise, skip this section*]:

20. On a scale of 1 to 5, with 5 being the highest, please rate your level of satisfaction with the following:
21. [For low ratings of 1 and 2 and high ratings of 4 and 5, ask "Why did you give it this rating?"]

Feasibility study requirements & timeline:

Very dissatisfied		Neutral		Very satisfied
1	2	3	4	5

Eligibility requirements for the program:

Very dissatisfied		Neutral		satisfied
1	2	3	4	5

Eligibility requirements for equipment:

Very dissatisfied		Neutral		satisfied
1	2	3	4	5

The monitoring requirements:

Very dissatisfied		Neutral		Very satisfied
1	2	3	4	5

The incentive amount:

Very dissatisfied		Neutral		Very satisfied

	1	2	3	4	5
The program overall:					
	Very dissatisfied		Neutral		satisfied
	1	2	3	4	5

Incentives, Financing and Rates

22. How long is the expected payback for the system you are installing?
    a. 1 year
    b. 2 years
    c. 3 years
    d. 4 years
    e. 5 years
    f. 6-10 years
    g. More than 10 years
    h. Don't know / refused to answer
23. Are the financial savings based on expected bill savings alone, or on avoided capacity (e.g., electric chiller) investments as well?
24. What is the estimated cost of the system (total $ or $/ton-hour or $/gallon)?
25. Did financing play a role in your participation in this program? Did your customer apply to the PLS program before securing additional financing?
26. Is your customer planning to switch to a different rate after the TES system is installed?
27. How concerned are you about changes to the utility rates – either demand charge or TOU charge – affecting the payback or future bill savings?
    i. If yes, what might help mitigate your concern? Such as a guaranteed TOU difference?
28. Do you have any recommendations on incentive value or alternative preferences for the form of the incentive? e.g., feasibility incentive regardless of participation; performance based incentive, etc.
29. On a scale of one to five, with five meaning "Very important," one meaning "Not at all important," and three meaning "Neutral," how important was the availability of rebates from the program in deciding whether to go forward with this project?

Not at all important		Neutral		Very important
1	2	3	4	5

Technology

30. What types of TES Systems do you manufacture, design, commission etc.?

31. What is the expected useful life of the TES equipment that you offer or are aware of?

32. What are the ranges of costs of the TES systems ($ per ton-hour; $ per gallon and assumed kW shifted)

33. Describe your practices for ensuring good operation of TES equipment.

    j. Are there industry benchmarks and best practices for commissioning TES equipment?

    k. What steps do you take to increase equipment reliability and minimize the risks of failure?

34. Do you routinely implement monitoring and sub-metering systems with TES systems?

35. Have you seen situations where a customer's overall energy usage increases while reducing peak load? What customer behaviors or design strategies lead to this?

36. What TES systems would you consider to be 'mature'? By mature, we mean TES systems that have been commercially available for some time and are not considered emerging or experimental technology. What technologies would you consider emerging TES technologies? This is for the purpose of delineating what technologies should qualify for the PLS program vs. other programs that address emerging technologies.

37. Given many TES system technologies have been in the market for some time, what types of technological improvements have you seen in the last few years or do you expect in the future?

Market Opportunity

38. One goal of the process evaluation is to identify low hanging fruit TES applications, such as legacy units that can be re-commissioned, or those that require only controls investments (such as warehouse precooling).

    l. Have you come across applications that are of this type?

    m. Do you have other suggestions in the way of low hanging fruit applications?

39. If you were to pick 10 TES applications/ customer types to analyze for further targeted deployment, what would they be? Please distinguish between new construction/expansion vs. shifting existing building load.

40. Based on your experience, what have been the customers' key drivers for installing TES?

    n. Are the reasons economic, reliability, sustainability, environment, etc. (or combinations)?

41. In your opinion, what is the biggest challenge to greater deployment of TES systems? (TES system cost, technical challenges such as lack of skilled operators, utility rates and uncertainty of utility rates)?

42. Do you have tools that allow you to quickly assess the potential value of TES systems (without running a detailed model, simulation tool, etc.)?

o. If not, and assuming you would find this type of tool useful, what types of outputs would you want in this tool? For example, these might include payback period, bill savings, optimal discharge and charge sequences.

p. What types of features would you like (e.g., ability to perform sensitivity analysis on rates, tank cost, discharge/charge sequences, ability to choose between partial and full-load shift designs, ability to generate the "optimal" sizing according to desired payback period)?

q. We would envision this type of tool to require the user to enter rough electrical and thermal loads, utility rates, tank costs. Is this a reasonable expectation from the user for a quick assessment tool?

43. One issue we are exploring is customer risk to retail rate change. With the increasing level of renewables coming onto the electric grid, peak periods could potentially shift.

r. Can the TES systems you work with be operated flexibly (discharge/charge at different periods, etc.), and if so, within what types of ranges? (e.g., is charging possible between 12 pm-3 pm?)

s. Do you have any experience designing TES systems for capacity or ancillary services?

44. Are the systems being proposed in the applications suitable for varied operation?

Other Programs

45. As part of this evaluation, we are also comparing California's PLS program with those offered in other states or Canada. We would greatly appreciate any insight or information you may have.

46. Are you aware of other TES or PLS programs in the US or Canada that are outside of California?

t. [If Yes, ask:] With which states/Programs do you have experience? How is the experience different than in CA? What elements of these programs do you recommend for the CA program?

u. Do you have any contacts with this program? Can you give us their name and information?

Future needs and participation

47. Do you anticipate the needs or technologies associated with the PLS market changing in the next 2-5 years? How?

48. Would you recommend this program to others firms?

49. Would you participate again in the future?

50. What parts of the PLS-TES program design do you think work well? What would you change, and why?

Conclusion

We've reached the end of the prepared questions.

I want to thank you for your participation. I hope you have a good day. Thanks again.

Interview Guide for Other Market Actors

Introduction

Hello, I'm [INTERVIEWER'S NAME] with TRC Energy Services. I want to first thank you for taking the time to participate in this interview today. As a reminder, we are conducting a process evaluation of the California Utilities Joint Statewide Permanent Load Shifting Program to identify opportunities to streamline the program's administration and delivery process, and enhance the customer's experience with thermal energy storage. Dan Engel at PG&E is the evaluation project manager. If you feel the need to reach out to him for confirmation that the California utilities are sponsoring this work, he is available at dce4@pge.com or can be reached by phone at 415-972-5119. Our findings will be documented in the written program process evaluation. Your feedback will be reported anonymously and we will not use your name in the report. Also, please note the report (when completed in first quarter 2015) will be posted on the CALMAC website and hence available to you.

With your permission, we'd like to record this call. We will not share the recording outside of our project team, and its primary use will be to make sure we capture your points. Are you okay with being recorded?

This interview should last about 30 minutes. Do you have any questions before we begin?

Interview questions

1. Please clarify your role with respect to TES.
    a. Feasibility analysis
    b. Project sponsor or customer agent
    c. Manufacturer
    d. Installation contractor
    e. Commissioning agent (most likely the installation contractor or project sponsor)
2. What has been your history with TES? E.g., designed TES systems for 20 years?
3. What has been your experience with the current PLS program?
4. Describe the challenges with the current program you are aware of?
5. What recommendations for improvement of the program do you have?

Financing and Rates

6. How long is the expected payback for the TES systems you most frequently encounter?
    a. 1 year
    b. 2 years

c. 3 years
d. 4 years
e. 5 years
f. 6-10 years
g. More than 10 years
h. Don't know / refused to answer

7. Are the financial savings based on expected bill savings alone, or on avoided capacity (e.g., electric chiller) investments as well?
8. How concerned are you about changes to utility rates – either demand charge or TOU charge – affecting the payback or future bill savings?
    a. If yes, what might help mitigate your concern? Such as a guaranteed TOU difference?

Technology

9. What types of TES Systems do you manufacture, design, commission etc. [*dependent on role identified previously*]?
10. What is the expected useful life of the TES equipment that you offer or are aware of?
11. What are the ranges of costs of the TES systems ($ per ton-hour; $ per gallon and assumed kW shifted)?
12. Describe your practices for ensuring good operation of TES equipment.
    a. Are there industry benchmarks and best practices for commissioning TES equipment?
    b. What steps do you take to increase equipment reliability and minimize the risks of failure?
13. Do you routinely implement monitoring and sub-metering systems with TES systems?
14. Have you seen situations where a customer's overall energy usage increases while reducing peak load? What customer behaviors or design strategies lead to this?
15. What TES systems would you consider to be mature? By mature, we mean TES systems that have been commercially available for some time and are not considered emerging or experimental technology. What technologies would you consider emerging TES technologies? This is for the purpose of delineating what technologies should qualify for the PLS program vs. other programs that address emerging technologies.
16. Given many TES system technologies have been in the market for some time, what types of technological improvements have you seen in the last few years or do you expect in the future?

Market Opportunity

17. One goal of the process evaluation is to identify low hanging fruit TES applications, such as legacy units that can be re-commissioned, or those that require only controls investments (such as warehouse precooling).
    a. Have you come across applications that are of this type?
    b. Do you have other suggestions in the way of low hanging fruit applications?
18. If you were to pick 10 TES applications/ customer types to analyze for further targeted deployment, what would they be? Please distinguish between new construction/expansion vs. shifting existing building load.
19. Based on your experience, what have been the customers' key drivers for installing TES?
    a. Are the reasons economic, reliability, sustainability, environment, etc. (or combinations)?
20. In your opinion, what is the biggest challenge to greater deployment of TES systems? (TES system cost, technical challenges such as lack of skilled operators, utility rates and uncertainty of utility rates)
21. Do you have tools that allow you to quickly assess the potential value of TES systems (without running a detailed model, simulation tool, etc.)?
    a. If not, and assuming you would find this type of tool useful, what types of outputs would you want in this tool? For example, these might include payback period, bill savings, optimal discharge and charge sequences.
    b. What types of features would you like (e.g., ability to perform sensitivity analysis on rates, tank cost, discharge/charge sequences, ability to choose between partial and full-load shift designs, ability to generate the "optimal" sizing according to desired payback period)?
    c. We would envision this type of tool to require the user to enter rough electrical and thermal loads, utility rates, tank costs. Is this a reasonable expectation from the user for a quick assessment tool?
22. One issue we are exploring is customer risk to retail rate change. With the increasing level of renewables coming onto the electric grid, peak periods could potentially shift.
    a. Can the TES systems you work with be operated flexibly (discharge/charge at different periods, etc.), and if so, within what types of ranges? (e.g., is charging possible between 12 pm-3 pm?)
    b. Do you have any experience designing TES systems for capacity or ancillary services?
23. Are the systems with which you work suitable for varied operation?

Other Programs

As part of this evaluation, we are also comparing California's PLS program with those offered in other states or Canada. We would greatly appreciate any insight or information you may have.

24. Are you aware of other TES or PLS programs in the US or Canada that are outside of California?
    a. [If Yes, ask:] With which states/Programs do you have experience? How is the experience different than in CA? What elements of these programs do you recommend for the CA program?
    b. Do you have any contacts with this program? Can you give us their name and information?

Future needs and participation

25. Do you anticipate the needs or technologies associated with the PLS market changing in the next 2-5 years? How?

Conclusion

We've reached the end of the prepared questions.

I want to thank you for your participation. I hope you have a good day. Thanks again.

INTERVIEW GUIDE FOR APPLICANTS

Introduction

Hello, I'm [INTERVIEWER'S NAME] with TRC Energy Services. I want to first thank you for taking the time to participate in this interview today. As a reminder, we are conducting a process evaluation of the California Utilities Joint Statewide Permanent Load Shifting Program to identify opportunities to streamline the program's administration and delivery process, increase customer uptake, and enhance the customer's experience with thermal energy storage. Dan Engel at PG&E is the evaluation project manager. If you feel the need to reach out to him for confirmation that PG&E is sponsoring this work, he is available at dce4@pge.com or can be reached by phone at 415-972-5119. Our findings will be documented in the written program process evaluation. Your feedback will be reported anonymously and we will not use your name in the report.

We'd like to record this call, with your permission. We will not share the recording outside of our project team, and its primary use will be to make sure we capture your points. Are you okay with being recorded?

This interview should last about 45 minutes. Do you have any questions before we begin?

Interview questions

1. Why are you installing a TES system?
    a. Are the reasons economic, reliability, sustainability, environment, etc. (or combinations)?

Application

[Ask these Questions to SCE and SDG&E applicants only – these Questions are from Waypoint's Application Survey for PG&E applicants]

2. How did you first learn about the PLS program?
    a. [UTILITY] Website/Marketing Materials
    b. Approached by vendor/HVAC designer
3. Were any parts of the application or application process unclear or difficult to answer?
    a. Which item(s) on the application was problematic? **[Multiple value picklist]**

        Section 1: Customer Contact Information

        Section 2: Project Sponsor Information (if applicable)

        Section 3: Payee Information (Who is paid the Incentive)

        Section 4: Agreement

PLS-TES Project Summary

General Narrative of the proposed TES and cooling system, physical location description and attach a sketched schematic

Thermal Energy Storage System Details

PLS-TES Peak Demand Shift Details and Incentive Estimate

Feasibility Study information

   b. What was the specific problem?
   c. What would have made it easier?

4. What on line resources did you access? Which were the most helpful? Which the least?
   a. [If no, ask:] What additional Program Information would you like to see online?
5. Did you or your team participate in any of the public training workshops offered?
   a. If so, did you find them helpful in completing the application?
      - Do you have suggested improvements on their content?

Program Experience

6. If your project has been approved, how long did it take for the PLS program to complete their review of your feasibility study and approve your project?
7. Do the program processes and requirements align with the project installation process and timing? [Probe for any inconsistencies or hurdles, make sure to address feasibility study, timing of incentive check, etc.]
8. What challenges or barriers did you face with respect to applying to the PLS program?
9. What challenges or barriers did you face in pursuing the TES project? [If needed, provide the following items: initial investment, building structural limitations, or maintaining the system.]
10. Have you engaged with the PLS program in more than one California Utility territory?
    a. [If yes, ask:] Are there any differences in the program requirements or how it is run in different territories? What were some elements you liked or disliked?

Feasibility Study

[Ask these Questions to SCE and SDG&E applicants only – these Questions are from Waypoint's Application Survey for PG&E applicants]

11. Were any parts of the Feasibility Study Requirements unclear?
    a. Which Feasibility Study item(s) was unclear? **[Multiple value picklist]**

Cover Page

Executive Summary

Project Background

Existing HVAC Systems

Existing (and Future) Current and Electric Loads using approved computer modeling programs and provide outputs as follows:

Estimated Demand Reduction and Energy Use

Energy Efficiency Information

Operations and Maintenance

Economic Analysis

Recommendation

Appendices (Computer Models, Diagrams and Schematics, Photos, Illustrations, Tables/Charts)

b. What was the specific problem with the item(s)?
c. What would have made it clearer?

12. Were there any parts of the Feasibility Study difficult to complete?
    a. Which components were difficult to complete? **[Multiple value picklist]**

Cover Page

Executive Summary

Project Background

Site Review

Cooling and Electrical Load Profiles

Thermal Energy Storage System Options and Type Selection

Estimated Demand Reduction and Energy Use

Energy Efficiency Information

Emissions Prevention Summary (Optional)

Utility Rate Schedules Used in Analysis

Cooling Equipment Sizing and Efficiencies

Operations and Maintenance

Economic Analysis

Conclusions and Recommendation

Appendices

b. What was the specific problem with the component(s)?
c. What would make these easier to achieve?

13. Did you have enough support from [Utility] throughout the Feasibility Study process?

14. What could have made this experience better?

Satisfaction

On a scale of 1 to 5, with 5 being the highest, please rate your level of satisfaction with the following:

[For low ratings of 1 and 2 and high ratings of 4 and 5, ask "Why did you give this rating?"]

15. Feasibility study requirements & timeline:

Very dissatisfied		Neutral		Very satisfied
1	2	3	4	5

16. Eligibility requirements for the program:

Very dissatisfied		Neutral		satisfied
1	2	3	4	5

17. Eligibility requirements for equipment:

Very dissatisfied		Neutral		satisfied
1	2	3	4	5

18. The monitoring requirements:

Very dissatisfied		Neutral		Very satisfied
1	2	3	4	5

19. The incentive amount:

Very dissatisfied		Neutral		Very satisfied
1	2	3	4	5

20. The program overall:

Very dissatisfied		Neutral		satisfied
1	2	3	4	5

Incentives, Financing and Rates

21. How long is the expected payback for the system you are installing?
    a. 1 year
    b. 2 years
    c. 3 years
    d. 4 years
    e. 5 years
    f. 6-10 years
    g. More than 10 years
    h. Don't know / refused to answer
22. Did financing play a role in your participation in this program? Did you apply to the PLS program before securing additional financing?
23. Are you planning to switch to a different rate after the TES system is installed?
24. How concerned are you about changes to your utility rates – either demand charge or TOU charge – affecting your payback or future bill savings?

a. If yes, what might help mitigate your concern?

25. Do you have any recommendations on incentive value or alternative preferences for the form of the incentive? e.g., feasibility incentive regardless of participation; performance based incentive, etc.

26. On a scale of one to five, with five meaning "Very important," one meaning "Not at all important," and three meaning "Neutral," how important was the availability of rebates from the program in deciding whether to go forward with this project?

Not at all important		Neutral		Very important
1	2	3	4	5

Technology

27. Was your final choice of TES type and size affected by the PLS program? [If yes, how?]

28. Are you installing a new or refurbishing an existing TES system; underground or above ground?

29. Was space a consideration or limiting factor on the type of TES system you selected?

30. Is the installation for meeting existing cooling load, or for future growth in cooling load, possibly due to a facility expansion or new building?

31. The program requires that monitoring equipment be installed. Aside from the requirement, do you anticipate any fringe benefits from having the monitoring equipment? (e.g., improved EE, overall HVAC system performance?)

Market Opportunity

32. One of the goals of the study is to help identify suitable applications for TES. Based on your experience considering TES, are there additional similar types of facilities or other types of facilities that may be suitable candidates for TES?

Future needs and participation

33. Do you have any concerns regarding the PLS program?

34. Would you recommend this program to other firms or organizations? [If reluctant to answer, probe for other non-competing firms]

35. Would you participate again in the future? [Probe to consider another location the company owns or perhaps even additional load shift at the same location depending on future needs]

Optional Interview Questions (If time permits)

Application

36. Did you seek the program out, or was it brought to you?
37. Have you heard about the program through any other channels? What were they?
38. Was the Program information you needed available online?

Program Experience

39. Who completed and submitted the application, you, the consulting engineer, or the equipment vendor?
40. How long did it take to complete the feasibility study?

Incentives, Financing and Rates

41. Are the financial savings based on expected bill savings alone, or on avoided capacity (e.g., electric chiller) investments as well?
42. What is the estimated cost of the system (total $ or $/ton-hour or $/gallon)?

Technology

43. Prior to this program, were you familiar with TES technology?
    a. How did you become familiar with TES?
    b. Was there more that the program could have done to help your understanding?
44. What types of arrangements, if any, have you made internally to support good operation of the TES system, such as in terms of additional or more skilled operator support?

Conclusion

We've reached the end of the prepared questions. I want to thank you for your participation. I hope you have a good day. Thanks again.

Interview Guide for Non–Participants

Introduction

Hello, I'm [INTERVIEWER'S NAME] with TRC Energy Services. I want to first thank you for taking the time to participate in this interview today. As a reminder, we are conducting a process evaluation of the California utilities joint statewide Permanent Load Shifting Program to identify opportunities to streamline the program's administration and delivery process, increase customer uptake, and enhance the customer's experience with thermal energy storage. Dan Engel at PG&E is the evaluation project manager. If you feel the need to reach out to him for confirmation that PG&E is sponsoring this work, he is available at dce4@pge.com or can be reached by phone at 415-972-5119. Our findings will be documented in the written program process evaluation. Your feedback will be reported anonymously and we will not use your name in the report.

We'd like to record this call, with your permission. We will not share the recording outside of our project team, and its primary use will be to make sure we capture your points. Are you okay with being recorded?

This interview should last about 30 - 45 minutes. Do you have any questions before we begin?

Interview questions

1. Why did you initially consider installing a TES system?
    a. Were the reasons economic, reliability, sustainability, environment, etc. (or combinations)?
2. Why have you not pursued the installation?
3. Do you think you will pursue installing a TES system in the future?
    a. What would need to change to motivate you to pursue the installation?

Application

[For PG&E applicants ask, "We understand that you may have answered these questions for someone else, but would you mind running through them again with me?" If they refuse, then skip them.]

4. How did you first learn about the PLS program?
    a. [UTILITY] Website/Marketing Materials
    b. Approached by vendor/HVAC designer
    c. Other [capture]

5. How far into the application process did you pursue the project? [If needed, offer "for instance, did you hire a vendor, complete a feasibility study, or get cost quotes for the installation?]

6. Were any parts of the application or application process unclear or difficult to answer?
   a. As applicable to how far you reached in the application process, which item(s) on the application was(were) problematic? **[Multiple value picklist]**

      Section 1: Customer Contact Information

      Section 2: Project Sponsor Information (if applicable)

      Section 3: Payee Information (Who is paid the Incentive)

      Section 4: Agreement

      PLS-TES Project Summary

      General Narrative of the proposed TES and cooling system, physical location description and attach a sketched schematic

      Thermal Energy Storage System Details

      PLS-TES Peak Demand Shift Details and Incentive Estimate

      Feasibility Study information

   b. What was the specific problem?
   c. What would have made it easier?

7. What on line resources did you access? Which were the most helpful? Which the least?
   a. [If no, ask:] What additional Program Information would you like to see online?

8. Did you or your team participate in any of the public training workshops offered?
   a. If so, did you find them helpful in completing the application?
      - Do you have suggested improvements on their content?

Program Experience

9. If your project had been approved, how long did it take for the PLS program to complete their review of your feasibility study and approve your project? How did the program engage your project during the application process? Do you feel that the level of engagement provided adequate support for your project?

10. What challenges or barriers did you face with respect to applying to the PLS program? [specify this is just on the application process]

11. What challenges or barriers did you face in pursuing the TES project? [If needed, provide the following items: initial investment, building structural limitations, or maintaining the system.]

12. Have you engaged with the PLS program in more than one California Utility territory?
    a. [If yes, ask:] Are there any differences in the program requirements or how it is run in different territories? What were some elements you liked or disliked?

Feasibility Study

[If non-participant completed a feasibility study, proceed with the following questions; otherwise, skip this section.]

13. Were any parts of the Feasibility Study Requirements unclear?
    a. Which Feasibility Study item(s) was unclear? **[Multiple value picklist]**
       Cover Page
       Executive Summary
       Project Background
       Existing HVAC Systems
       Existing (and Future) Current and Electric Loads using approved computer modeling programs and provide outputs as follows:
       Estimated Demand Reduction and Energy Use
       Energy Efficiency Information
       Operations and Maintenance
       Economic Analysis
       Recommendation
       Appendices (Computer Models, Diagrams and Schematics, Photos, Illustrations, Tables/Charts)
    b. What was the specific problem with the item(s)?
    c. What would have made it clearer?

14. Were there any parts of the Feasibility Study difficult to complete?
    a. Which components were difficult to complete? **[Multiple value picklist]**
       Cover Page
       Executive Summary
       Project Background
       Site Review
       Cooling and Electrical Load Profiles
       Thermal Energy Storage System Options and Type Selection
       Estimated Demand Reduction and Energy Use
       Energy Efficiency Information
       Emissions Prevention Summary (Optional)
       Utility Rate Schedules Used in Analysis
       Cooling Equipment Sizing and Efficiencies
       Operations and Maintenance
       Economic Analysis
       Conclusions and Recommendation

Appendices

b. What was the specific problem with the component(s)?
c. What would make these easier to achieve?

15. Did you have enough support from [Utility] throughout the Feasibility Study process?

16. What could have made this experience better?

Satisfaction

On a scale of 1 to 5, with 5 being the highest, please rate your level of satisfaction with the following:

[For low ratings of 1 and 2 and high ratings of 4 and 5, ask "Why did you give this rating?"]

17. Feasibility study requirements & timeline:

Very dissatisfied		Neutral		Very satisfied
1	2	3	4	5

18. Eligibility requirements for the program:

Very dissatisfied		Neutral		satisfied
1	2	3	4	5

19. Eligibility requirements for equipment:

Very dissatisfied		Neutral		satisfied
1	2	3	4	5

20. The monitoring requirements:

Very dissatisfied		Neutral		Very satisfied
1	2	3	4	5

21. The incentive amount:

Very dissatisfied		Neutral		Very satisfied
1	2	3	4	5

22. The program overall:

Very dissatisfied		Neutral		satisfied
1	2	3	4	5

Incentives, Financing and Rates

23. How long is the expected payback for the system you were considering installing?

a. 1 year

b. 2 years

c. 3 years

d. 4 years

e. 5 years

f. 6-10 years

g. More than 10 years

h. Don't know / refused to answer

24. Did financing play a role in your participation in this program? Did you apply to the PLS program before securing additional financing?

25. Were you planning to switch to a different rate after the TES system is installed?

26. How concerned were you about changes to your utility rates – either demand charge or TOU charge – affecting your payback or future bill savings?

    a. If yes, what might help mitigate your concern?

    b. Did this affect the decision to not move forward with the installation?

27. Do you have any recommendations on incentive value or alternative preferences for the form of the incentive? e.g., feasibility incentive regardless of participation; performance based incentive, etc.

28. On a scale of one to five, with five meaning "Very important," one meaning "Not at all important," and three meaning "Neutral," how important was the availability of rebates from the program in deciding to pursue this project?

Not at all important		Neutral		Very important
1	2	3	4	5

Future needs and participation

29. Do you have any other feedback regarding the PLS program?

30. Would you recommend this program to other firms or organizations? [If reluctant to answer, probe for other non-competing firms]

Conclusion

We've reached the end of the prepared questions. I want to thank you for your participation. I hope you have a good day. Thanks again.

Interview Guide for Investor–Owned Utility Account Executives

Interview Guide

Introduction

Hello, I'm [INTERVIEWER'S NAME] with TRC Energy Services. I want to first thank you for taking the time to participate in this interview today. We are conducting a process evaluation of the California Utilities Joint Statewide Permanent Load Shifting Program to identify opportunities to streamline the program's administration and delivery process, and enhance the customer's experience with Thermal Energy Storage. Dan Engel at PG&E is the evaluation project manager. If you feel the need to reach out to him for confirmation that PG&E is sponsoring this work, he is available at dce4@pge.com or can be reached by phone at 415-972-5119. Our findings will be documented in the written program process evaluation. Your feedback will be reported anonymously and we will not use your name in the report. Also, please note that the report (when completed in first quarter 2015) will be posted on the CALMAC website and hence available to you.

With your permission, we'd like to record this call. We will not share the recording outside of our project team, and its primary use will be to make sure we capture your points. Are you okay with being recorded?

This interview should last about 30 minutes. Do you have any questions before we begin?

Interview questions

1. How long have you been with [Utility]?
2. How long have you been an Account Rep with [Utility]?
3. How long have you been working with thermal energy systems?
4. What is your background with TES?

Marketing and Recruitment

5. What is your role in marketing the PLS program and recruiting potential participants?
6. Do you have targets associated with attaining a certain number of program applicants or participants?
    a. [If yes, ask:] Are these targets tied to your financial compensation, such as an annual bonus or performance review?
7. What are the barriers you have encountered in recruiting customers to participate in the program?

8. What building sector or sectors seems to have the most interest in applying for the PLS program?
9. Which TES technologies have been the most popular among customers, and why?
10. Do you coordinate marketing or referrals with other EE or DR programs within your utility?
11. How are referrals to the PLS program from account executives received and tracked?
12. Do you feel that you have the resources you need to effectively sell this incentive program? *[If no, ask:*] What do you think you need?

Cross-promotion

13. How do you handle a customer that wants to enroll multiple facilities in multiple IOU territories? Is there a streamlined process for that?
14. Are there other EE or DR programs that overlap with potential PLS applicants? What are they?

Customer Experience

15. What sort of feedback have you received from applicants or potential applicants on the application/documentation requirements?
16. How do customers feel about the size of the incentive?
    a. Are the incentives sufficient for overcoming the financial barriers to TES adoption?
17. How do customers feel about the eligibility requirements?
18. Are quality control systems in place for customer complaints or dispute resolution? Please describe them.
    a. Have any complaints or disputed been raised? Please elaborate.
19. Are you aware of any issues encountered with local agencies or regulators that have delayed or prevented projects from being installed?
    a. [If yes, ask:] Have you had any conversations with these agencies on their issues?
    b. Have you provided any support or resources to applicants to overcome these issues? Please describe.
    c. Have you shared these challenges and any proposed solutions with the PLS Program Manager?

Market opportunity and definition of mature TES

20. One goal of the process evaluation is to identify low hanging fruit TES applications, such as legacy units that can be recommissioned, those that require only controls

investments (such as warehouse precooling). Have you come across applications that are of this nature?

21. Can you summarize the types of sectors for which applications are being proposed: e.g., campuses, laboratories?
    a. What types of TES systems?
    b. What types of paybacks?
    c. What was the motivation (economic, reliability, "greenness")?
    d. Is TES being bundled with other applications?
22. If you were to pick 10 TES applications/ customer types to analyze for further targeted deployment, what would they be?

Recommendations

23. What changes would you like to make to improve the PLS program going forward?
    a. What are the barriers to making those changes?
24. Are you aware of other TES or PLS programs in the US or Canada that are outside of California?
    a. Do you have any contacts with this program? Can you give us their name and information?
25. Is there anything else you'd like us to know?

Conclusion

We've reached the end of the prepared questions. (If time permits) I'd like to open the discussion now in case there is anything additional you would like to add that we have not discussed.

Thank you for your participation. I hope you have a good day.

Interview Guide for Other PLS TES Program Managers

Introduction

Hello, I'm [INTERVIEWER'S NAME] with TRC Energy Services. I wanted to first thank you for taking the time to participate in this interview today. We are conducting a process evaluation of the California Utilities Joint Statewide Permanent Load Shifting Program to identify opportunities to streamline the program's administration and delivery process and enhance the customer's experience with thermal energy storage.

Our findings will be documented in the written program process evaluation. Your feedback will be reported anonymously and we will not use your name in the report. Also, please note that the report (when completed in first quarter 2015) will be posted on the CALMAC website and hence available to you.

With your permission, we'd like to record this call. We will not share the recording outside of our project team, and its primary use will be to make sure we capture your points. Are you okay with being recorded?

This interview should last about 30 minutes. Do you have any questions before we begin?

Program Background

1. Please describe your role and responsibilities for the program.
2. When was this program first introduced? Have there been any major changes to the program since then? If so, what and why were these changes made?
3. What types of technologies are eligible for program incentives?
   - What is the rationale for selecting these technologies?
4. *Is the program trying to achieve Energy efficiency in addition to load shifting? (if not energy efficiency, can I assume that it does not have energy neutrality requirements?)*

Program Administration

5. Is the PLS program managed in house (by the sponsoring utility or agency) or by a third party implementer?
   - Why did you decide on this structure?
   - What are the benefits of the selected management strategy?

Program Activity

6. What is the annual program budget broken out for incentives, administration, and marketing and outreach? (if program manager cannot provide exact numbers, encourage them to give an estimate and try to at least get the incentive budget.)

- Does the program go through this budget annually? [If no] What percent of the budget is typically used? [If yes,] What do they do when they exhaust their budget?

7. How many participants have applied for the program since its inception? What is the average annual number of applications?
    - How many of these applicants have installed TES and are currently participating? What is the annual number of installations (or for 2013 if available)?
    - What are the sizes of these projects (installation size or demand shifted)?
    - What TES technologies have been installed?
8. [If more applications than installations] What is the barrier or main reason for a customer to not participate after applying?
9. Has the program met annual saving and participation targets?
    - [If no] What is the level of participation that is being achieved relative to the goal?
    - [if yes] What tactics have worked best for the program to secure participation?

Incentives

10. According to the program website, the incentive structure is [insert information here from website], is this correct? [if no] What is the incentive structure? (Are there different levels of incentives based on technology type? Tiered incentives based on installed capacity or production?)
11. How are incentives paid? Are they capacity-based or performance-based? (If needed, say: are they paid up front or are they held until verification of system performance?)
12. Are there customer or site caps for incentives?
    - [If yes] What are these caps based on?
13. Is the incentive rate adequate to spur participation? OR What is the customer feedback on the incentive rate?
    - [If no] What level do customers find acceptable?
14. Have there ever been any changes to the incentive structure? If yes, what changes were made and why? If yes, what have the results been?

Eligibility and Participation Requirements

15. What criteria must a customer meet in order to participate (e.g. commercial, municipal, direct access, TOU rates, etc.)?
16. Is there anything offered to customers for rate certainty, such as guaranteed rates?
17. Who sets the criteria and why were these criteria selected?

- Do you feel that they align with your program goals? Would you prefer they were different?

18. What are the requirements around load shift for a participating project? Why were these requirements selected and do you feel that they serve your program goals? Would you prefer they were different?
19. What are the main steps in the approval and participation process?
    - Do customers find any of these steps to be difficult? Why or why not?
    - What would they like to see in terms of a different approach?
20. Is the customer required to monitor their systems after installation? [If yes] How long?
    - Are they required to provide any data to the program? [If yes] How long? If yes, what data?

Marketing and Outreach

21. What strategies are taken for program marketing and outreach? (e.g. direct marketing to customers, indirect marketing to design community or manufacturers?)
    - Do you feel that this marketing strategy is effective?
22. What level of program resources are invested in marketing and outreach? Do you think this is an adequate amount?
23. What market actors are involved with the program and what are their roles?
    - How does the program interact with each of the market actors?
    - What has the program done to support or grow the market?
        - Do you think these activities were effective?

Program Feedback

24. What feedback has the program received in terms of barriers and interests from each of the following (and have they suggested any specific improvements?):
    - Customers (both applicants and participants)?
    - Manufacturers?
    - A&Es/ Design community?
25. How has the program responded to this feedback?

Factors to Support Participation

26. How influential is financing for program participation? (financing in the form of loans or other support). [If respond that it is influential, ask them to elaborate].

27. Does the program utilize any enabling factors, such as rate tariffs or tax credits, to provide additional support?
28. Are there other factors that may have helped or hindered program success?
    - What advice can you offer for new programs?

Conclusion

We've reached the end of the prepared questions.

I want to thank you for your participation and ask if there is anything additional information you would like to share. I hope you have a good day. Thanks again.

10.2 Other TES Program Interview and Web Search Responses

Table 17. Other TES Program Interview Responses

	Topic/Question	Duke Energy (FL)	NYSERDA/ConEd	LADWP	Platte River Power Authority	Orlando Utility Commission
Program Background	*Maturity of Program*	5 years	<1 year	<1 year	No longer offered	No longer offered
	Technologies eligible for program	All technologies	All technologies	Evaluate on individual case basis	All technologies	All technologies
	Program energy efficiency goals	None	None	Project must include 5% energy reduction; usually doing TES in conjunction with other upgrades.	None	None
Program Administration	*Management strategy*	In-house. Easier and more cost-effective to control the program.	In-house, but do have and engineering consultant. Have experience managing programs.	In-house. Project volume is manageable.	Local management by city.	In-house

	Topic/Question	Duke Energy (FL)	NYSERDA/ConEd	LADWP	Platte River Power Authority	Orlando Utility Commission
Program Activity	*Annual program budget*	TES is included with other prescriptive measures under one budget for existing buildings and new construction.	TES is included with other measures under one budget for existing building upgrades.	TES is included with other measures under a custom performance program.	N/A	N/A
	Does the program typically exhaust the budget?	No budget, but TES not using large portion of overall budget.	Unknown; first year. Do not plan to exhaust budget.	No budget, but TES not using large portion of overall budget.	N/A	N/A
	Average annual number of applicants	1-2/year	1-2/year (prior program); expecting more with new incentive levels.	Unknown; currently 1 in first year	N/A	N/A
	Total number of participants (since program inception)	Unknown	Less than a handful (prior to new incentives levels)	N/A	<10	1

Topic/Question	Duke Energy (FL)	NYSERDA/ConEd	LADWP	Platte River Power Authority	Orlando Utility Commission
Number of annual installations	1-2/year; 0 in 2014	1-2/year, expecting more with new incentive levels.	N/A	N/A	N/A
Size of projects	Unknown	1,000 kW for 1 project	3,000 kW for 1 project	Unknown	Unknown
TES technologies that have been installed	Unknown	Trane and Calmac ice storage because limited space	Chilled water	Mostly Ice Bear	Unknown
Main barrier for customers to participate	None have dropped out after applying. Some do not pursue TES because the payback is too long. Looking for 2-5 years.	Space constraints, lack of familiarity with technology, first costs	Cost and space constraints	Lack of familiarity and cost of the systems.	N/A
TES Program goals or targets	None	None	None	N/A	N/A

	Topic/Question	Duke Energy (FL)	NYSERDA/ConEd	LADWP	Platte River Power Authority	Orlando Utility Commission
	*Tactics to secure participation**	None	Allow for aggregators.	N/A	Utility engineers conducted assessments and recommended TES.	N/A
Incentives	*Incentive rate*	Up to $300/kW	$2,600/kW, plus opportunity for additional bonus for efficient chillers ($600/kW previously)	$750/kW	$500/kW	Unknown
	Incentive structure	50% after installation, 50% after M&V (couple of months). It is possible customer does not receive full second half based on actual load shifted from M&V.	60% after installation, 40% after M&V. Can also offer 10-15% upfront.	50% after installation, 50% after M&V.	Unknown	Unknown
	Site or customer caps on incentives	None	Project cap of 50%.	None	Unknown	Unknown

Topic/Question	Duke Energy (FL)	NYSERDA/ConEd	LADWP	Platte River Power Authority	Orlando Utility Commission
Is the incentive rate adequate to spur participation?	Incentive helps, but not the main driver. Main driver is reducing demand cost.	Not as much as expected, likely due to poor timing of program launch.	Yes	Yes, plus the large coincident summer demand charge.	N/A
Program incentives for commissioning	Unknown	Unknown	Unknown	Unknown	Unknown
Changes to the incentive rate or structure over time	None	Yes, 2014 rollout with higher incentives.	None	No longer offered	Offered to one customer, but utility no longer incents TES because not seen as a permanent and secure load reduction.
Policies for rate certainty or guarantee	None	None. Do not have issue of rate differential in their territory.	None	N/A	N/A

	Topic/Question	Duke Energy (FL)	NYSERDA/ConEd	LADWP	Platte River Power Authority	Orlando Utility Commission
Eligibility and Participation Requirements	*Customer criteria to participate*	All-electric, energy audit, feasibility study, on-site assessment, post-installation verification and monitoring	Complete project prior to June 2016, install new equipment, provide 1 pre- and post-installation summer month of monitored data.	Be on TOU rate, provide approved computer simulations and calculations.	N/A	N/A
	Load shift requirements	None	50kW (Aggregators must have at least 10kW each)	None	Unknown	Unknown

	Topic/Question	Duke Energy (FL)	NYSERDA/ConEd	LADWP	Platte River Power Authority	Orlando Utility Commission
	Main steps in approval and participation process	1. On-site assessment or meet with design team for NC 2. Feasibility study 3. Incentive reservation 4. Energy audit 5. Installation 6. Post-installation inspection 7. Post-installation monitoring and M&V	1. Energy analysis (do not require feasibility study) 2. Application 3. Pre-installation visit 4. Pre-installation monitoring 5. Installation 6. Post-installation monitoring and M&V	1. Provide schematics of installation or manufacturer spec sheets 2. Provide energy savings calculations and simulations, including 1 year of baseline energy use 3. Pre-installation visit 4. Installation 5. Post-installation visit 6. M&V	Unknown	Unknown
	Customer feedback on process	No issues on process. Some concerns over not producing expected savings after M&V.	None yet	None yet	Unknown	Unknown

	Topic/Question	Duke Energy (FL)	NYSERDA/ConEd	LADWP	Platte River Power Authority	Orlando Utility Commission
	Monitoring requirements	Post-installation monitoring for a few months for M&V.	Minimum 1 month pre- and post-installation monitoring.	Minimum 6 months of post-installation monitoring	Unknown	Unknown
Marketing and Outreach	*Program marketing and outreach strategies*	Program brochure available on website. Customers usually contact program or Account Rep identifies opportunity.	Webinars, trade expos, outreach through vendors.	Not TES specific. Custom program attends events, keeps in contact with contractors, major account reps, and BOMA meetings.	Utility engineer reached out to customers.	N/A
	Level of program resources invested in marketing/outreach	None	Unknown, there is a separate marketing budget for overall program, not TES.	Unknown	N/A	N/A
	What market actors involved in the program? What are their roles?	No response	Vendors are biggest players to do outreach and find program leads.	Vendors and trade allies who are aware of the program offerings and introduce project leads.	N/A	N/A

	Topic/Question	Duke Energy (FL)	NYSERDA/ConEd	LADWP	Platte River Power Authority	Orlando Utility Commission
Program Feedback on Barriers and Interests	*Customers*	Space availability is an issue	Space availability is an issue	None	N/A	N/A
	Manufacturers	Not aware of any feedback	None	None	N/A	N/A
	A&Es/Design Community	Not aware of any feedback	None	None	N/A	N/A
Factors to Support Participation	*How influential is financing?*	Do not offer financing	Unknown	Do not offer financing through custom program, other program identifies financing and other rebate opportunities.	N/A	N/A
	Are other enabling factors used to provide customer support (e.g. rate tariffs)?	Tax credits and other supporting factors assessed in customer feasibility study.	Separate program will fund feasibility study.	Separate program will fund feasibility study.	None	None

	Topic/Question	Duke Energy (FL)	NYSERDA/ConEd	LADWP	Platte River Power Authority	Orlando Utility Commission
	Have other factors helped or hindered program success?	Off-peak charges recently increased and made TES less advantageous.	Timing of program launch was not in-line with building budgeting. Program looks at other opportunities beyond TES which can introduce energy efficiency features.	Main drivers are moving load out of peak period. Incentive is leading to implementation of equipment	At the time, the local utility had a $13/kW summer peak coincident charge. The local utilities also had peak reduction goals, which are no longer in place.	Small differential between peak and off-peak demand charge.

Table 18. TES Program Information from Publically Available Documents

	Topic/Question	Florida Power and Light	Austin Energy	Otter Tail Power Company
Incentives	Technologies eligible for program	Unknown	Unknown	Chilled-water, ice storage, and eutectic salt systems (phase change).
	Incentive rate	Different based on existing technology. Maximum $580/kW	0-100 kW = $350/kW 101-500 kW = $200/kW >501 kW = $100/kW	$40/kW up to 200 kW, additional $20/kW up to 1,000 kW.
	Incentive structure	1. 100% after installation 1. 50% when construction half complete, 50% plus commissioning after completion and M&V for one billing cycle.	Unknown	Unknown
Eligibility and Participation Requirements	Customer criteria to participate	Must install new equipment and provide HVAC system commissioning report	Must install new equipment; cannot be used for backup or redundant systems	Unknown

	Topic/Question	Florida Power and Light	Austin Energy	Otter Tail Power Company
	Load shift requirements	Unknown	Load shift threshold requirement in order to eligible for TES rate.	Minimum 9 kW. System must be able to provide cooling to entire space during maximum control period.
	Main steps in approval and participation process	1. Pre-approval documents including design loads 2. Original input data files 3. Schematic diagrams 4. Hourly design day operating sequences 5. Commissioning report from utility 6. Feasibility and post-commissioning studies 7. Potential random inspections	1. Application packet and supporting documentation 2. Feasibility study for projects >100kW 3. TES application 4. Project approval 5. Installation 6. Post-installation inspection 7. Post-installation monitoring and M&V	Unknown
	Monitoring requirements	Unknown	Yes, utility installs monitoring equipment.	Unknown
Factors to Support Participation	Are other enabling factors used to provide customer support (e.g. rate tariffs)?	Offer up to $2,500 for feasibility study or post-commissioning report.	TES Rate available and offer funding for feasibility study.	3 rate systems available, not TES specific, but can make TES advantageous.

Table 19. Interview Response with Ice Energy Programs

	Topic/Question	Glendale Water and Power	Southern California Public Power Authority (SCPPA)
Program background	Maturity of Program	Began contract in 2010	Began contract in 2010
	Technologies eligible for program	Ice Bears	Ice Bears
	Program energy efficiency goals	None, but HVAC system had to be a certain age so usually installing new equipment.	None, but Ice Energy looks for energy efficiency opportunities.
Program Administration	Management strategy	Ice Energy. Handle all of the recruiting, outreach, and customer management. Utility does not have the resources to manage its own program.	Ice Energy. They can provide a level of support to customers that utility cannot due to limited resources.
Program Activity	Annual program budget	Received a DOE grant, utility funded the rest.	N/A
	Does the program typically exhaust the budget?	Budget was exhausted	
	Average annual number of applicants	N/A	N/A

	Topic/Question	Glendale Water and Power	Southern California Public Power Authority (SCPPA)
	Total number of participants (since program inception)	160	200
	Number of annual installations	50 to >100	50 to >100
	Size of projects	Unknown	Contract for 53 MW
	TES technologies that have been installed	Ice Bears	Ice Bears
	Main barrier for customers to participate	None. Cost is main barrier for customer-owned program.	Lack of understanding or familiarity with system. Poor program communication to customers on technology.
	TES Program goals or targets	Ice Energy targets oldest and largest AC systems.	Ice Energy targets oldest and largest AC systems.
	Funding	DOE and utility funded. No customer contribution required.	Most utilities in contract pay for entire system, some will require customer contribution.
Eligibility and Participation Requirements	Customer criteria to participate	HVAC system had to be of a certain age.	Ice Energy prioritizes older and larger HVAC units, but no specific criteria.

	Topic/Question	**Glendale Water and Power**	**Southern California Public Power Authority (SCPPA)**
	Main steps in approval and participation process	1. Ice Energy meets with customer 2. On-site evaluation 3. Customer signs an easement agreement. 4. Ice Energy provides maintenance services.	1. Ice Energy meets with customer 2. On-site evaluation 3. Customer signs an easement agreement. 4. Ice Energy provides maintenance services.
	Customer feedback on process	Unknown	No negative feedback
	Monitoring requirements	Ice Energy monitors systems.	Ice Energy and utility monitor equipment.
Marketing and Outreach	Program marketing and outreach strategies	Ice Energy did analysis of customer base, then targeted specific buildings for participation.	Ice Energy does all marketing and outreach.

	Topic/Question	Glendale Water and Power	Southern California Public Power Authority (SCPPA)
	Level of program resources invested in marketing/outreach	Included in overall contract with Ice Energy.	Included in overall contract with Ice Energy.
	What market actors are involved in the program? What are their roles?	Key account reps and Ice Energy meet with customer to explain program	Unknown
Program Feedback on barriers and interests	Customers	Reluctant at first, but then love them.	Some customers were expecting energy savings and did not understand what the system was offering.
	Manufacturers		Ice Energy wanted more information about customers, and some utilities cannot provide that due to privacy clauses.
	A&Es/Design Community		
Factors to Support Participation	How influential is financing?	Very influential; do not think customer would purchase system on their own.	Very influential

	Topic/Question	Glendale Water and Power	Southern California Public Power Authority (SCPPA)
	Have other factors helped or hindered program success?	Unknown	Meeting with the Ice Energy consultant was a major selling point for customers.
	Advice for other or new programs	Through pilot study, did not think that customer-owned model would work.	Ice Energy provides a turnkey program and is ideal for utilities that have limited program resources.

10.3 Market Opportunity Scaling Assumptions

Table 20. Ratio of Shiftable to Total Load Based on CEUS Load Shape Data

CZ	Application	Shift ratio estimate from CEUS data
3	College	0.28
	Healthcare	0.32
	Casinos/hotel	0.40
	Large offices	0.40
5	College	0.18
	Healthcare	0.25
	Casinos/hotel	0.25
	Large offices	0.26
8	College	0.24
	Healthcare	0.26
	Casinos/hotel	0.26
	Large offices	0.25
10	College	0.24
	Healthcare	0.33
	Casinos/hotel	0.31
	Large offices	0.32
13	College	0.21
	Healthcare	0.24
	Casinos/hotel	0.25
	Large offices	0.28

Table 21. Technical Potential Scaling Factor

Application	Technical Potential Scaling Factor
College	50%
Healthcare	30%
Casinos/hotel	30%
Large offices	20%