LADWP
Concurrent Year 1 Evaluation
Fiscal Year 20/21

Submitted to:

Los Angeles Department of Water & Power

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Submitted by:

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Executive Summary

Los Angeles Department of Water and Power (LADWP) is the nation's largest municipal utility, with 8,019 megawatts (MW) of electric capacity and serving an average of 435 million gallons of water per day to the more than 4 million residents of Los Angeles, its businesses, and visitors. For more than 100 years, LADWP has provided the city with reliable water and power service in a cost-effective and environmentally responsible manner. With a workforce of more than 11,000 employees, LADWP is guided by the five-member Board of Water and Power Commissioners, appointed by the Mayor and confirmed by the City Council.

LADWP engaged ADM Associates, Inc. (herein referred to as the Evaluator) to conduct a concurrent impact and process evaluation of its portfolio of energy efficiency programs, during Fiscal Year 2020/2021 (FY 20/21). This chapter summarizes the impacts from FY 20/21 and $94,448,012 in spending, achieving over 100 GWh in energy savings.

ES.1. Regulatory Context

Senate Bill 1037 (SB 1037, signed September 29, 2005) - California's publicly owned utilities (POUs) prioritized cost-effective, reliable, and feasible energy efficiency resources over generation or other options.

Assembly Bill 2021 (AB 2021, signed September 29, 2006) - expanded annual reporting requirements. The expansion required reporting on investment funding, cost-effectiveness methodologies, and evaluation, measurement, and verification of public utility programs.

Senate Bill 350 (SB350, signed October 6, 2015) - increased California's renewable electricity procurement goal from 33% by 2020 to 50% by 2030. SB 350 also required California to double statewide energy efficiency savings in electricity and natural gas end-uses by 2030.

Senate Bill 100 (SB100, signed September 10, 2018) – Set a 2045 goal of fulfilling all retail electricity sold in California and state agency electricity needs with renewable and zero-carbon resources, updated the Renewables Portfolio Standard to ensure that by 2030 at least 60% of California's electricity is renewable, and required the California Energy Commission (CEC, or the Commission), CPUC and Air Resources Board to use programs under existing laws to achieve 100% clean electricity.

ES.2. Portfolio Performance Summary

Table ES-1 shows Ex-Ante and Ex-Post MWh savings and the realization rate for each program during FY 20/21. The overall MWh realization rate not including Codes, Standards, and Ordinances was 96%. Table ES-2 shows Ex-Ante and Ex-Post MW savings and the realization rate for each program during FY 20/21. The overall MW realization rate not including Codes, Standards, and Ordinances was 95%.

Table ES-1 FY 20/21 MWh Portfolio Performance Summary

Sector	Program	Ex-Ante MWh	Ex-Post MWh	Realization Rate
Non-Residential	Commercial Direct Install	4,315	3,789	88%
	Commercial Lighting Incentive Program	26,664	26,525	99%
	City Plants	6,618	6,618	100%
	Custom Performance Program	39,161	42,488	108%
	Food Service Program Comprehensive	118	122	104%
	Food Service Program Point-of-Sale	121	54	45%
	LADWP Facilities	970	668	69%
	LAUSD Direct Install	5,349	5,672	106%
	Saving By Design	233	375	161%
	Upstream HVAC	8,928	4,880	55%
Residential	Customer Rebate Program	8,555	7,069	83%
	Efficient Product Marketplace	1,251	1,246	100%
	Energy Savings Assistance Program	2,746	1,696	62%
	Refrigerator Exchange	122	106	87%
	Refrigerator Turn-in and Recycle Program	12	3	27%
	Residential Lighting Efficiency Program	27	23	85%
Cross-Sector	AC Optimization Program	200	200	100%
	California Advanced Home Program	56	56	100%
	Codes, Standards, and Ordinances	193,683	196,019	101%
	Multifamily Whole Building Program	1,418	1,475	104%
Total		300,545	299,083	100%
Total Excluding Codes, Standards, and Ordinances		106,862	103,064	96%

Table ES-2 FY 20/21 MW Portfolio Performance Summary

Sector	Program	Ex-Ante MWh	Ex-Post MWh	Realization Rate
Non-Residential	Commercial Direct Install	0.30	0.26	88%
	Commercial Lighting Incentive Program	2.92	2.91	99%
	City Plants	3.02	3.02	100%
	Custom Performance Program	5.63	6.16	109%
	Food Service Program Comprehensive	0.02	0.02	104%
	Food Service Program Point-of-Sale	0.02	0.01	46%
	LADWP Facilities	0.15	0.11	69%
	LAUSD Direct Install	0.56	0.59	106%
	Saving By Design	0.05	0.08	161%

Sector	Program	Ex-Ante MWh	Ex-Post MWh	Realization Rate
	Upstream HVAC	2.36	1.30	55%
Residential	Customer Rebate Program	2.85	2.66	93%
	Efficient Product Marketplace	0.53	0.51	100%
	Energy Savings Assistance Program	0.33	0.20	62%
	Refrigerator Exchange	0.03	0.03	87%
	Refrigerator Turn-in and Recycle Program	0.00	0.00	27%
	Residential Lighting Efficiency Program	0.00	0.00	85%
Cross-Sector	AC Optimization Program	0.06	0.06	100%
	California Advanced Home Program	0.01	0.01	100%
	Codes, Standards, and Ordinances	26.18	26.50	101%
	Multifamily Whole Building Program	0.23	0.23	104%
Total		45.26	44.67	99%
Total Excluding Codes, Standards, and Ordinances		19.08	18.17	95%

Figure ES-1 shows Ex-Ante and Ex-Post energy savings and the realization rate for each program during FY 20/21, while Figure ES-2 shows Ex-Ante and Ex-Post peak demand impacts and the realization rate for each program during FY 20/21. Both figures do not include energy and demand impacts from Codes, Standards, and Ordinances.

Figure ES-1 FY 20/21 Energy Impacts Not Including Codes, Standards, and Ordinances

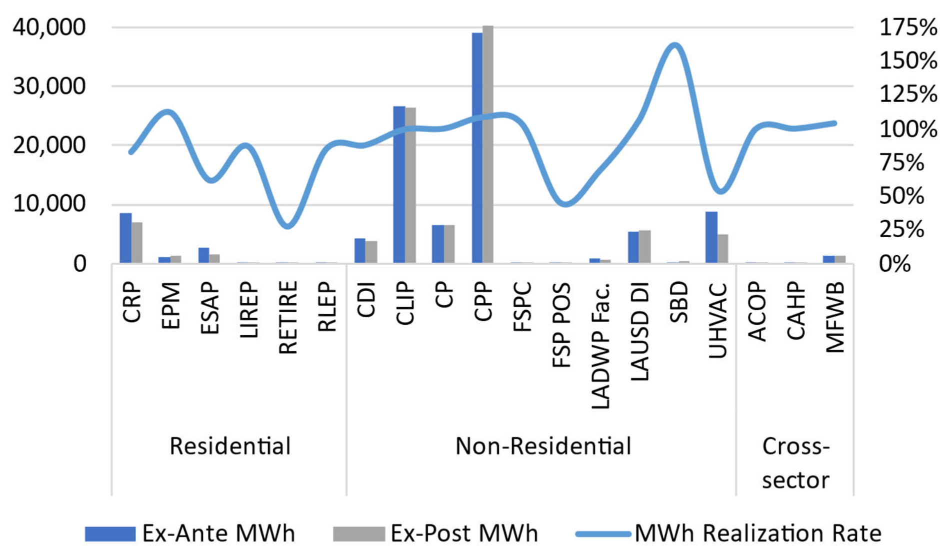
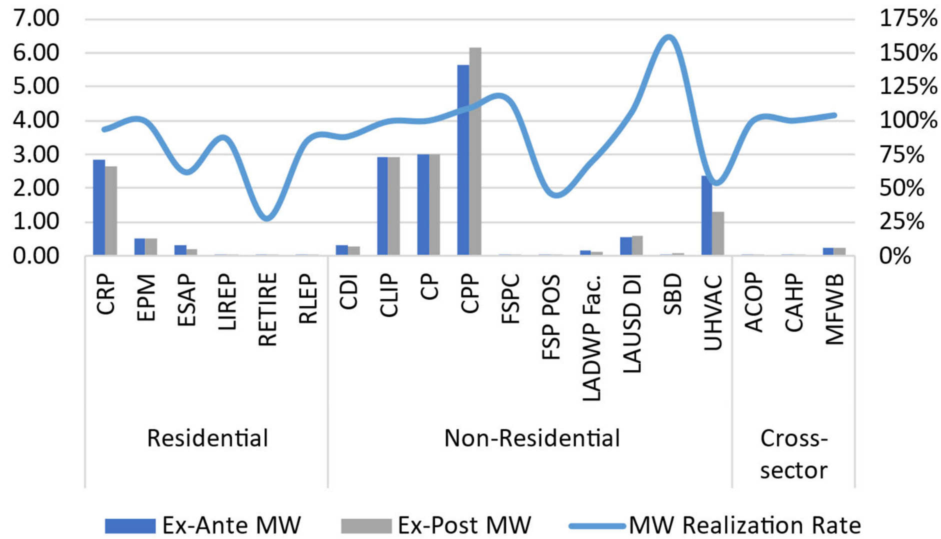


Figure ES-2 FY 20/21 Peak Demand Impacts Not Including Codes, Standards, and Ordinances

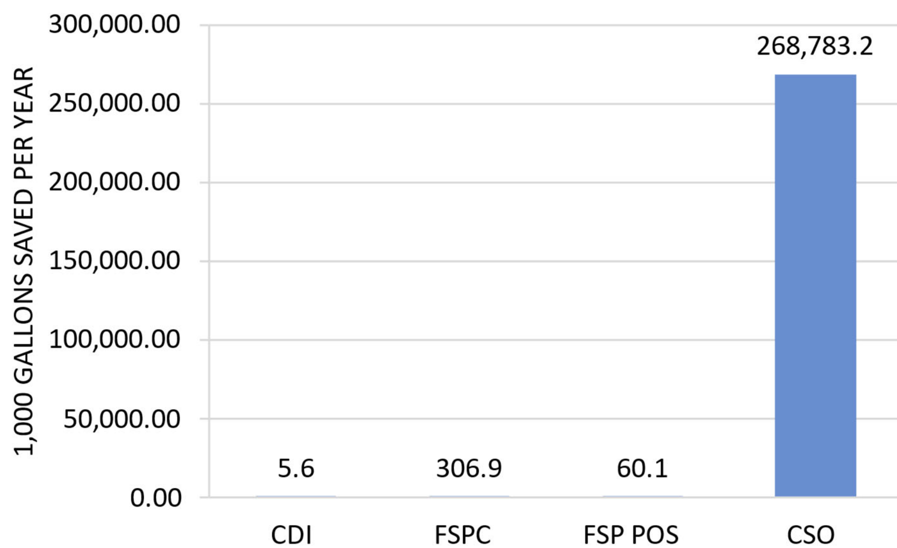


ES.3. Water Savings

The LADWP energy efficiency portfolio offered numerous water conservation measures that saved energy by reducing hot water loads and the energy used in the treatment and distribution of water (known as the “embedded energy” of water).

LADWP programs contributed to water savings via the Los Angeles Plumbing Ordinance, as well as through the direct installation of low flow fixtures in residential and small commercial facilities. See Figure ES-3 for a summary of water savings.

Figure ES-3 FY 20/21 Water Savings



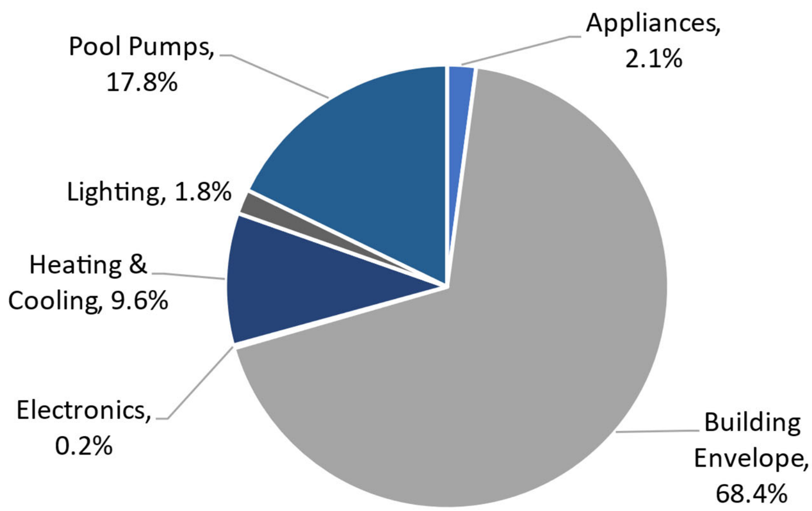
ES.4. Residential Impacts by Technology Type

Residential sector savings during FY 20/21 totaled 11,830,377 kWh (excluding savings from Codes, Standards, & Ordinances and AC Optimization Commercial).

Drivers of savings included:

1. Building Envelope: 68.4% of sector-level kWh savings achieved through the Consumer Rebate Program, Energy Savings Assistance Program, and Multifamily Whole Building Program.
2. Pool Pumps: 17.8% of sector-level impacts achieved through the Consumer Rebate Program.

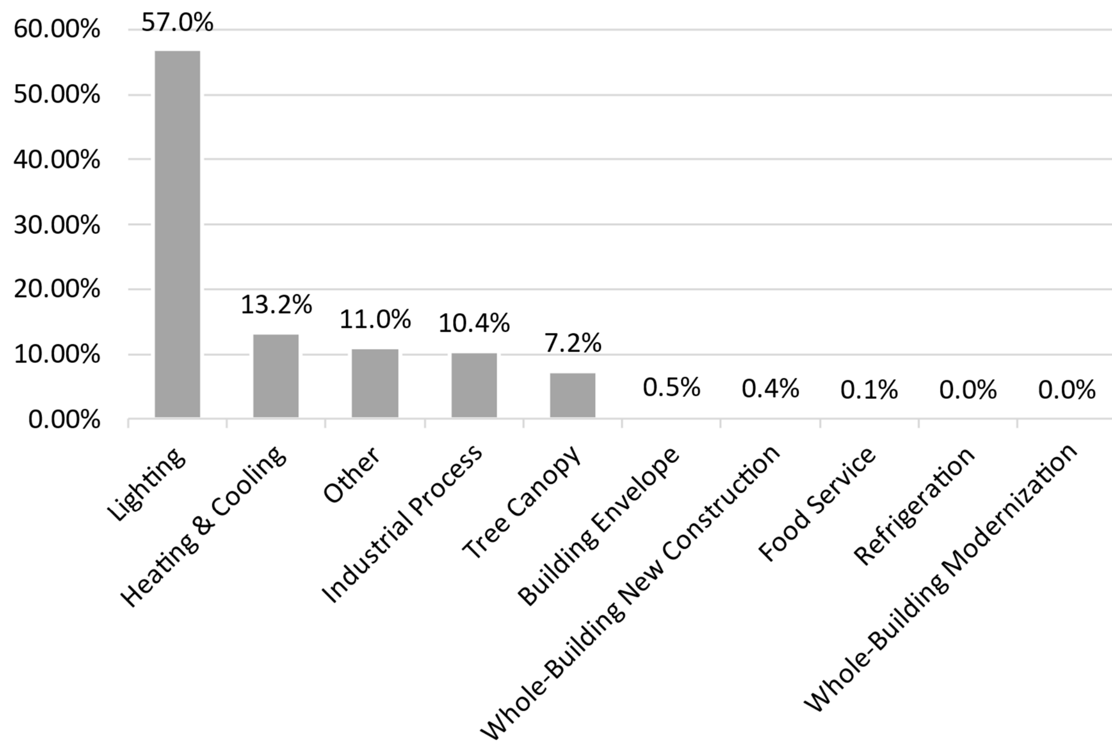
Figure ES-4 FY 20/21 Residential Savings by Technology



ES.5. Non-Residential Impacts by Technology Type

Non-residential sector savings during FY 20/21 totaled 91,390,707 kWh (excluding savings resulting from Codes, Standards, and Ordinances). Lighting accounted for a large share of total sector savings (57%).

Figure ES-5 FY 20/21 Non-Residential Savings by Technology



ES.6. Impact of COVID-19

This evaluation included a review of impacts of the COVID-19 pandemic and Safer-at-Home (SAH) orders. For programs analyzed via billing impacts, statistical models incorporated SAH status as an interaction term. For other programs, savings were re-estimated under COVID-19 and non-COVID-19 conditions based on a review of operating hours with representatives from program participants.

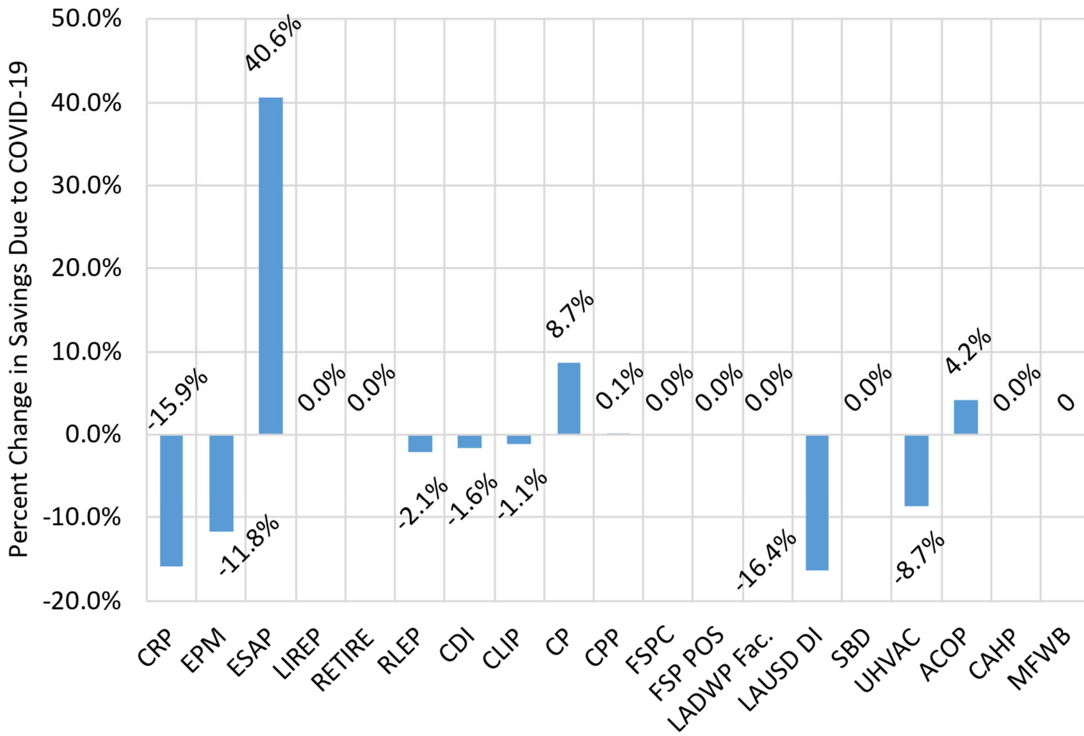
It should be noted that this analysis looked at impact on savings, not usage. If a facility reduced its hours of operation by 50% due to an SAH order, the resulting impact on savings potential from its lighting declined by 50%, even though their usage declined as a result of the shutdown.

ES.6.1. Changes in Methodology due to COVID-19 Pandemic

LADWP and the Evaluator prioritized customer safety in conducting this evaluation. Steps taken to ensure the safety of LADWP, their customers, and their contractors included:

1. Conducting update meetings remotely;
2. Replacing planned end-use metering with analysis of billing data;
3. Conducting virtual verifications instead of on-site verifications. Virtual verifications were conducted primarily via the STREEM platform, enabling customers to participate in the verification process via a mobile app; and
4. Collecting data in participant surveys addressing whether the participant’s home or business had been affected by the COVID-19 pandemic.

Figure ES-6 Impact of COVID-19 on FY 20/21 Program Savings



ES.6.2. Impact of COVID-19 Key Takeaways

The impact of COVID-19 on savings by program varied widely. Notable findings include:

- LAUSD DI demonstrated a 16.4% reduction in savings, due to the ongoing shutdown of most educational facilities.
- Many large programs showed little to low impact. Custom Performance and Commercial Direct Install both had savings impacted by less than a 3% net change.
- Codes, Standards, & Ordinances was not included in this re-estimation of savings.

ES.7. Cost Effectiveness Results

The cost-effectiveness of LADWP's programs was calculated based on reported total spending and verified energy savings for each of the energy efficiency programs. All spending estimates and incentive costs were provided by LADWP. The methods used to calculate cost-effectiveness are informed by the California Standard Practice Manual.

Table ES-3 lists benefits and costs along with cost effectiveness results for FY 20/21. Cost effectiveness results are shown for the Total Resources Cost (TRC) Test, Program Administrator Cost (PAC) Test, the Rate-payer Impact Measure (RIM) Test, Participant Cost Test (PCT), and Modified Total Resources Cost (MTRC) Test.

Table ES-3 FY 20/21 Portfolio-Level Cost Effectiveness Results

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$249,039,025	$249,039,025	$714,579,035	$249,039,025	$249,039,025
Total Costs	$105,569,049	$93,577,492	$46,873,401	$761,283,126	$93,577,492
Benefit/Cost Ratio	2.36	2.66	15.24	0.33	2.66

1 Introduction

This report is a summary of the evaluation, measurement, and verification (EM&V) effort of the portfolio of programs for Los Angeles Department of Water and Power (LADWP) during Fiscal Year 20/21 (FY 20/21). The evaluation was administered by ADM Associates, Inc (the Evaluator).

1.1 Regulatory Context

Two legislative bills, Senate Bill 1037 (SB 1037) and Assembly Bill 2021 (AB 2021) , were signed into law a year apart. SB 1037 requires that California's publicly owned utilities (POUs) – similar to the state's investor-owned utilities (IOUs)—place cost-effective, reliable, and feasible energy efficiency and demand reduction resources at the top of the utility resource loading order, giving priority to the efficiency resource in utility operating plans. Additionally, SB 1037 requires an annual report describing utility programs, expenditures, expected energy savings, and actual energy savings.

AB 2021, signed by the governor a year later, reiterated the loading order and annual report stated in SB 1037, as well as expanded on the annual report requirements. The expanded report required inclusion of investment funding, cost-effectiveness methodologies, and an independent evaluation that measures and verifies the energy efficiency savings and reductions in energy demand achieved by the energy efficiency and demand reduction programs. AB 2021 additionally required a report every 3 years that highlights cost-effective electric potential savings from energy efficiency and established annual targets for electricity energy efficiency and demand reduction over 10 years.

The California Energy Commission (CEC, or the Commission) was given the mandate to oversee POU SB 1037 and AB 1021 energy efficiency program and evaluation, measurement, and verification (EM&V) efforts, with the following requirements for CEC:

- Monitor POUs' annual efficiency progress;
- Review POU independent evaluation studies, reporting results, and, if necessary, recommend improvements; and
- Ensure that savings verification increases the reliability of savings and contributes to better program design.

The CEC was also mandated to provide the POUs with EM&V Guidelines under which plans should be submitted. This guidance is summarized in a checklist listed in Section 2.1.3.

This plan is submitted in compliance with the CEC EM&V guidelines. In this plan, the Evaluator provides description of the technical and economical reasoning including advantages and disadvantages of our recommended methods for each applicable energy efficiency program and energy efficiency measure in this document. EM&V methods meet or exceed the rigor requirement as prescribed by EM&V Protocols listed above.

1.1.1 EM&V and Related Protocols

ADM will use the following guidelines for Impact and Process Evaluation of LADWP programs:

- CEC POU EM&V Guidelines
- California Energy Efficiency Evaluation Protocols
- California Evaluation Framework

The following references will supplement the evaluation method as applicable:

- U.S. Department of Energy (DOE) Uniform Methods Project (both draft and final chapters)
- National Action Plan for Energy Efficiency (NAPEE) Program Impact Evaluation Guide (for net-to-gross [NTG] issues)
- International Performance Measurement and Verification Protocol (IPMVP) to determine best options for evaluating energy efficiency measures (EEMs).

1.1.2 CEC Reporting Schedule

LADWP is required to submit an annual report on its energy efficiency programs. Specifically, Article 1, Section 1311 of Title 20 of the California Code of Regulations requires that:

Beginning in 2008, and every year thereafter, each local publicly owned utility shall report no later than March 15 to the Commission its annual investments in energy efficiency and demand reduction programs for its previous fiscal year. The report shall include at least:

(a) for electric energy efficiency programs:

(1) a description of each program by category (residential, nonresidential, new construction, cross-customer, and other);

(2) expenditures by program category, identified as administrative costs, delivery costs, incentive and installation costs, and evaluation, measurement, and verification costs;

(3) expected and actual annual energy and peak demand savings by program category; and

(4) an explanation of how these energy efficiency programs were determined to be cost-effective.

(b) for demand reduction programs:

(1) a description of each program;

(2) expenditures associated with each program;

(3) expected demand reduction, and any actual reduction from the programs, and

(4) an explanation of how these demand reduction programs were determined to be cost-effective.

1.1.3 CEC Checklist

The following checklist is a guideline for submitting POU EM&V reports. It is based on the California Energy Commission EM&V Guidelines for Energy Efficiency Programs, "CEC Framework of Criteria" guidelines (Part D).

Contextual Reporting

- The EM&V report clearly states savings values consistent with the associated annual report.
- The evaluation covers a significant portion of LADWP's portfolio and clearly describes the programs and savings reported.
- The evaluation assesses risk or uncertainty in selecting components of the portfolio to evaluate.

Overview and Documentation of Specific Evaluation Effort

- The report clearly identifies what is being evaluated for each program.
- The evaluation includes an assessment of savings and end of useful life.
- The evaluation provides documentation of all engineering and billing analysis algorithms, assumptions, survey instruments, and methods.
- The methodology is described in sufficient detail in the report such that another evaluator could replicate the study and achieve similar results.
- All data collection methods are included in the appendix.

Gross Savings

- The report reviews the program's choice of baseline.
- The report clearly characterizes the population of participants.
- The report clearly discusses its sampling approach and sample design.
- The report states the sampling precision targets and achieves precision
- The report clearly presents the Ex-Post savings.
- The report clearly indicates where Ex-Ante savings are being passed through.
- The report explains the differences between Ex-Ante and Ex-Post savings.

Net Savings

- The evaluation includes a quantitative assessment of net-to-gross.
- The report clearly discusses its sampling approach and sample design.
- The report accounts for free-ridership and spillover.

EM&V Summary and Conclusions

- The report provides clear recommendations for improving program processes to achieve measurable and cost-effective energy savings.
- The evaluation assesses the reliability of the verified savings and areas of uncertainty.

1.2 LADWP Energy Efficiency Programs

The following sections describe the energy efficiency programs offered by LADWP during FY 20/21.

1.2.1 Commercial/Industrial/Institutional Customer Programs

The following are the non-residential programs offered by LADWP.

1.2.1.1 Commercial Direct Install (CDI)

The CDI Program targets small to large business customers in the LADWP service territory, offering upgrades to targeted systems, including lights, water, and natural gas. LADWP is partnering with Southern California Gas Company on CDI, with LADWP as the lead utility. This program is designed to integrate electric, water and natural gas efficiency measures. LADWP is leveraging its Power Construction Maintenance Group (PCM), contract personnel, an IT system, and strategically located community-based organizations (CBOs) to market and implement the CDI Program. The design is intended to maximize the electric, water and natural gas cost savings, in a cost-effective manner. CDI is a direct install program managed by the LADWP Mass Market Programs Group and implemented with the assistance of an external vendor (Lime Energy).

1.2.1.2 Commercial Lighting Incentive Program (CLIP)

CLIP uses a calculated savings approach, allowing customers to replace their lighting with a wider variety of more efficient systems. This not only gives customers greater flexibility in lighting design, but also offers the potential for greater energy savings. CLIP also offers customers an innovative approach to finding qualified light-emitting diode (LED) products that qualify for incentives. Customers may now search the Department of Energy’s Lighting Facts database for products that match their lighting needs and meet CLIP requirements.

1.2.1.3 Custom Performance Program (CPP)

LADWP’s Custom Performance Program offers cash incentives for energy saving measures not covered by existing prescriptive programs, such as equipment controls, industrial processes and other innovative energy saving strategies that exceed Title 24 or Industry Standards and that are not included in other LADWP non-residential Energy Efficiency Programs. Incentives for each project are paid per kilowatt-hour based on energy savings calculated or accepted by LADWP. In addition, two previously self-standing LADWP efficiency programs, Retro-commissioning and the Energy Efficiency Technical Assistance Program, were rolled into the CPP in 2017.

1.2.1.4 Food Service Program (FSP)

FSP is a program designed to assist grocery stores (small to large), liquor stores, convenience stores, restaurants, and other commercial customer with refrigeration and food service equipment. This program offers rebates for ice machines, glass and solid door freezers/refrigerators, commercial ovens, etc. The Food Service Program is designed to be utilized by major vendors and manufacturers to promote the highest efficiency refrigeration and food service equipment for retrofit projects.

1.2.1.5 LADWP Facilities and Upgrade Program

The LADWP Facilities Upgrade Program was established in 2009 in response to the City of Los Angeles Green LA directive. The program reduces energy and water consumption in LADWP facilities through energy efficiency and water conservation measures. The program is designed to provide technical design, project management experience and expertise in retrofitting LADWP facilities, with high efficiency HVAC equipment, lighting fixtures, plumbing fixtures, irrigation equipment and California Friendly landscaping utilizing LADWP engineering staff.

1.2.1.6 LAUSD Direct Install (DI) Program

The LAUSD DI Program was launched in October 2012 in response to the opportunities for energy and water efficiency within the District, the District's budget challenges and the numerous opportunities to be able to capture water, natural gas and electricity savings and budget to improve the financial standing of the District and enhance the learning environment for the students of LAUSD. The program entered a dormant period in FY 15-16 and was relaunched in May of 2016 with a focus on lighting. The program includes (1) direct install for LAUSD facilities, (2) Proposition 39 project management support, and (3) pilot efficiency projects.

1.2.1.7 Savings by Design (SBD) / LADWP Zero by Design (LADWP ZBD)

SBD was California's non-residential new construction energy efficiency program, administered statewide and adopted by investor owned (IOU) and publicly owned utilities (POU). This statewide approach offered the non-residential building industry a uniform, multi-faceted program designed to consistently serve the needs of the building community throughout California. SBD encouraged energy-efficient building design and construction practices by promoting the efficient use of energy by offering up-front design assistance supported by financial incentives based on project performance. Projects participating in SBD received services including design assistance, owner incentives, design team incentives, and energy design resources.

LADWP replaced the statewide SBD program that ended in December 2020 with LADWP's ZBD program in 2021. LADWP's redesign of SBD allowed for new construction projects to enter the program at later stages of the construction process. Buildings are eligible to participate once they have an energy model of the building developed, although the program offers design and energy modeling assistance to smaller builders. LADWP ZBD also offers incentives for individual measures incorporated into the new building in addition to incentives for whole building performance.

1.2.1.8 Upstream HVAC

Through an agreement with participating distributors and manufacturers, UHVAC provides incentives to participants to stock and upsell high efficiency HVAC equipment. Contractors and HVAC customers can then immediately access premium replacement technology that might not have been readily available to them without the program. The upstream approach allows LADWP to capture energy savings at the point of sale which would not have been applied for in LADWP's downstream programs.

1.2.2 Residential Customer Programs

The following are the residential programs offered by LADWP.

1.2.2.1 Consumer Rebate Program (CRP)

CRP is designed to offer and promote specific energy efficiency solutions within the residential market sector. By encouraging adoption of economically viable energy efficiency measures, the residential portfolio strives to overcome market barriers and to deliver programs and services aligned to support LADWP's energy efficiency objectives.

1.2.2.2 Efficient Product Marketplace (EPM)

The EPM program is designed to simplify shopping for energy efficient electronic products and streamline obtaining a rebate. The key feature of EPM is its website which provides an easy-to-use platform for customers to find energy efficient products, review details, and locate stores and online retailers. The website provides users with lists of eligible products, rebate information, energy savings estimates, Energy Star scores, product details, features, popularity/review ratings, an Eco review, and locations of where the product can be purchased within LADWP's service area.

1.2.2.3 Energy Savings Assistance Program (ESAP)

ESAP targeted income qualifying residents living in multi-family housing, providing no-cost energy and water saving measures for residents with an income under 200% of the Federal Poverty Guidelines. ESAP offers efficiency upgrades for individual residential units. The efficiency measures include weather stripping, caulking, low-flow showerheads, water heater blankets, and door and building envelope repairs that reduce air infiltration. LADWP has partnered with SoCalGas to jointly implement certain programs in order to provide more comprehensive services to customers and save on overall program costs.

ESAP ended December 2020 and is expected to relaunch in FY21/22.

1.2.2.4 Home Energy Improvement Plan (HEIP)

HEIP is a comprehensive whole house retrofit program that offers residential customers a full suite of products and services to improve the energy and water efficiency in the home by upgrading/retrofitting the home's core systems. The program is targeted to primarily serve LADWP's low-, moderate-, and fixed-income single- and multi-family residential customers. No income restrictions are in place, but the program is primarily marketed to the targeted customer segments.

1.2.2.5 Low Income Refrigerator Exchange Program (REP)

REP is designed to target LADWP residential customers that qualify on either LADWP's Low-Income or Senior Citizen/Disability Lifeline Rates. REP is an existing program that provides free new and efficient refrigerators, as well as pick-up and recycling of existing refrigerators. This program leverages a 3rd Party Contractor, ARCA, to administer the delivery of the program, while LADWP oversees and manages ARCA and the program. In addition to providing a new, energy-efficient refrigerator, the REP Program also retrieves and disposes of the existing refrigerator in an environmentally responsible manner, ensuring that these older refrigerators are taken off the grid forever.

1.2.2.6 Refrigerator Turn-In & Recycle (RETIRE) Program

RETIRE is designed to target LADWP residential customers that have either made a retail purchase of a new refrigerator and/or those that have 2, 3 or more refrigerators in the household. This program offers a monetary incentive ($50) to residential customers to turn-in old refrigerators and freezers. Eligible units must be fully operational and satisfy certain age and size requirements. This program leverages a 3rd Party Contractor, ARCA, to administer the delivery of the program, while LADWP oversees and manages the program and rebate processing to the end-use customers. The RETIRE Program picks up and safely and environmentally recycles old, energy-wasting refrigerators at no cost to the customer and rewards customers with a $50 rebate.

1.2.3 Cross-sector Programs

The following are the cross-sector programs offered by LADWP.

1.2.3.1 Air Condition Optimization Program (ACOP)

The AC tune-up program includes maintenance efficiency checks for residential and commercial air conditioning systems at no cost to the ratepayer, as well as incentives of up to $150, towards the purchase and installation of programmable thermostats. A wi-fi enabled smart programmable thermostat, including installation, is offered free of charge to program participants who do not already have a smart programmable thermostat.

1.2.3.2 City Plants (CP) Program

LADWP and City Plants are working in partnership to provide free shade trees for residents and property owners in the City of Los Angeles, along with essential information on where to plant those trees to maximize energy efficiency in the home or business. The program encourages the planting of California Friendly trees that are adapted to the region's semi-arid climate and use less water; native trees and drought tolerant trees that maximize sustainability are recommended.

1.2.3.3 Program Outreach & Community Partnerships (POCP)

The LADWP Program Outreach & Community Partnerships Program was established in 2010 in response to the City of Los Angeles Green LA Plan, utilizing formula-based Energy Efficiency and Conservation Block Grant (ARRA) funding from US Department of Energy. The program was considered successful and was extended utilizing ratepayer funding. This program is a partnership between LADWP and selected non-profit community organizations that compete to serve LADWP customers.

1.2.3.4 Codes, Standards & Ordinances (CSO)

The CSO Program addresses the needs of the ratepayers of the City of Los Angeles for water and energy conservation and sustainability through direct involvement with code-setting bodies for buildings, fixtures and appliance codes and standards in the strengthening of water and energy efficiency requirements. This program investigates emerging technologies and new methods of construction that promote conservation and sustainability and advocates for, and in some cases, develops local ordinances to address water and energy savings mandates specific to the requirements of the City of Los Angeles.

1.2.3.5 Emerging Technology Program (ETP)

ETP was introduced to LADWP's portfolio to support increased energy and water efficiency, market demand and technology supply by contributing to development and deployment of new and under-utilized energy and water efficiency technologies, practices, and tools, and by facilitating their adoption as measures supporting LADWP's aggressive energy and water savings goals. The LADWP Emerging Technologies Program accelerates the introduction of innovative energy and water efficient technologies, applications, and analytical tools that are not yet widely adopted in California. By reducing both the performance uncertainties associated with new products and technologies as well as institutional barriers, the ultimate goal of this program is to increase the probability that promising energy and water efficiency technologies will be commercialized.

1.2.3.6 Marketing, Education, and Outreach (MEO)

One of LADWP's most effective efficiency tools is the sustained efficiency ethic of its customers. LADWP has developed an extensive MEO program to increase customer awareness of energy efficiency, in general, and to increase participation in LADWP's efficiency programs. The MEO program is a multi-channel public education campaign to heighten and maintain customer awareness of the need for and importance of efficient energy use. The program includes outreach through education, advertising, informational materials, events, and social media. The program also includes collaborating with local universities and colleges to further enhance outreach and education efforts. LADWP's MEO Program is designed to offer and promote energy efficiency within all market sectors.

1.2.3.7 Program Analysis and Development Program (PADP)

This program covers activities performed by the Efficiency Solutions Group that support LADWP's efficiency programs, which are general in nature and not directly tied to any one program. These activities include program analysis, program development, special studies, pilot programs, support for other LADWP and City programs, regulatory reporting, and participation in technical professional groups. The work provided through this program results in direct improvements to the effectiveness of the entire portfolio of energy efficiency programs. Study results have been utilized to improve existing programs, identify the need for program changes and direct the focus of new program development. Participation in external professional groups generates new ideas that bring value to LADWP programs.

1.3 Evaluation Methodology

Evaluation methods used for FY 20/21 applied industry best practices, including:

- International Measurement & Verification Protocols (IPMVP);
- Uniform Methods Project (UMP);
- California Evaluation Framework; and
- California Standard Practice Manual: Economic Analysis of Demand-Side Projects and Programs.

Impact analysis methods included:

- Billing Data Analysis
    - Measuring impacts of projects on customer bills
    - Pre- and post- analysis, and analysis of post bills with usage adjusted to align with minimum code
- Project M&V
    - Audits of commercial & industrial projects
    - Apply International Performance Measurement and Verification Protocols
- Survey-Based Verification
    - Survey efforts with residential and nonresidential customers to address measure installation and persistence
- Virtual Verification
    - Virtual facility walkthroughs - customers show their project to evaluation staff through a user-friendly mobile app

1.3.1 Primary Data Collection

Data collected included program data that tracked projects completed by participants, documentation supporting the completion of projects, primary data collected during field visits, data showing billing or energy usage, and participant survey response data.

1.3.1.1 Program and Project Data Collection

The Evaluator completed the following types of data collection for the impact evaluation of non-residential programs:

Table 1-1 Non-Residential Program Data Collection

Data	Source
Program tracking data	Data requested from LADWP including all data tracking program participation
Desk review	Reviews of project documentation (Proposed Activity Report, Post Installation Report, energy models) of a sample of customers who have participated in the program

Data	Source
On site verification	Virtual or in-person site visits of a sample of customers to collect data used for savings calculations, to verify installation, and determine operating parameters

The Evaluator completed the following types of data collection for the impact evaluation of residential programs:

Table 1-2 Residential Program Data Collection

Data	Source
Program tracking data	Data requests to LADWP for all measure level program tracking data
Recipient and control group billing data	Data requests to LADWP for all relevant billing data in the study period
Participation in other LADWP programs	Data requests to LADWP for all residential program participation in the study period
Recipient and control group customer data	Data requests to LADWP for other customer information (e.g., demographics, contact permissions)

1.3.1.2 Program Staff Interviews

The evaluation team interviewed program and implementation staff evaluation staff early in the evaluation process. These interviews were qualitative, loosely structured, and exploratory in nature. The intent of these interviews was to better understand program design and delivery, any changes made to program operations, and program successes and challenges from the perspective of staff running the programs. Additionally, the evaluation used these interviews as an opportunity to gather any areas of concern or exploration that program staff wanted to explore in the evaluation.

Table 1-3 Summary of Program Staff Interviews Completed

Program	Number of Interviews
CDI	1
CLIP	2
CPP	1
FSP	2
LADWP Facilities	1
LAUSD DI	1
SBD/LADWP ZBD	1
Upstream HVAC	3
CRP	1
EPM	2
CSO	2
ETP	2

Program	Number of Interviews
MEO	7
PADP	4
PCOP	1

1.3.1.3 Participant Surveys

The Evaluator administered surveys to customers who participated in the following programs during FY 20/21:

- Commercial Lighting Incentive Program (CLIP);
- Custom Performance Program (CPP);
- Food Services Program (FSP) – Comprehensive and Point-of-Sale;
- Consumer Rebate Program (CRP); and
- Efficient Product Marketplace (EPM).

The surveys were designed to verify the measures that customers implemented through the programs recorded in program data and collect other information for use in assessing the energy impacts of the measures.

Survey samples were designed to achieve 90% confidence and ±10% precision for the program during FY 20/21. For the verification surveys, the Evaluator used one of the following approaches, depending on the program:

- Simple Random Sampling. Simple random sampling involved administering the survey to a random sample of all contacts for a program.
- Stratified Random Sampling. For some programs participants were grouped based on the types of measures they received through the program and then sampled customers at random with in the groups.

Sample frames were developed from program participation records. For most programs, the sample frame was developed from FY 20/21 program records. An exception was the use of FY 20/21 and FY 19/20 records to increase the probability of meeting the sample size target.

Table 1-4 Program Participant Survey Samples

Program	Number of Participants Contacted	Achieved Sample Size	Sample Type	Mode of Administration
CLIP	552	32	Census Attempt	Online
CPP	108	9	Census Attempt	Online
FSP	94	1	Census Attempt	Mailed letter push to web/ Telephone
CRP	4,597	284	Census Attempt /Simple Random Sample[1]	Online

Program	Number of Participants Contacted	Achieved Sample Size	Sample Type	Mode of Administration
EPM	1,814	240	Census Attempt /Simple Random Sample[1]	Online
1. The Evaluator attempted a census of participants implementing lower volume measures and used a simple random sample of contacts for higher volume measures.				

1.3.1.4 Interviews with Program Partners and Market Actors

For several of the programs, the Evaluator completed in-depth interviews with market actors, including recognized vendors, and other program partners. These interviews were largely qualitative, semi-structured and covered a variety of topics related to the goals of the evaluation.

Table 1-5 Summary of Program Partner Interviews Completed

Program	Group	Number of Interviews Completed
CLIP	Recognized vendors	9
CLIP	Unrecognized vendors	5
CPP	Participating contractors	1
FSP	Market actor interviews	9
LAUSD DI	LAUSD senior project manager	1
UHVAC	Market actor interviews	9
PADP	LADWP resource program staff	3 (9 staff)
POCP/MEO	POCP grantee interviews	5

1.3.2 Overview of Process Evaluation Approach

This section presents an overview of the process evaluation approach. This evaluation covers the three types of process evaluation summarized in Table 1-6.

Table 1-6 Process Evaluation Types and Research Objectives

Process Evaluation Type	Process Evaluation Objective
Technical	Evaluate energy saving algorithms and criteria used in development of the EEPs. Make recommendation on how to improve the EEPs development and algorithms used to estimate electric demand and electric consumption savings.
Administrative	Evaluate administrative process managed by utility staff.

Process Evaluation Type	Process Evaluation Objective
	Assess cost effectiveness on the Program Administrator Cost Test (PACT), Participant Cost (PCT), Rate Impact Measure Test (RIM), Total Resource Cost Test (TRC), Societal Cost Test (SCT).
Customer	Investigate the participation levels through surveys and interviews and make recommendations on how to improve the participation levels. Investigate whether the EEPs were successful by evaluating the participants' reactions and expectations. Determine net energy and demand savings.

The Evaluator is to complete a full process evaluation once during the concurrent period. Full process evaluations were completed in FY 20/21 for the following programs:

- Commercial Lighting Incentive Program (CLIP)
- Customer Performance Program (CPP)
- LADWP Facilities Upgrade
- Food Service Program (FSP)
- LAUSD Direct Install Program (LAUSD DI)
- Upstream HVAC Program (UHVAC)
- Consumer Rebate Program (CRP)
- Efficient Product Marketplace (EPM)
- Codes, Standards, and Ordinance Program (CSO)
- Emerging Technologies Program (ETP)

Additionally, full process evaluations were begun in FY 20/21 for these programs, and the reporting will be completed in the first quarter of 2022.

- Marketing, Education, and Outreach Program (MEO)
- Program Analysis & Development Program (PADP)
- Program Outreach & Community Partnerships (POCP)

Brief, summary process evaluations were completed in FY 20/21 for the following programs.

- Commercial Direct Install Program (CDI)
- Savings by Design / LADWP Zero by Design Program

1.4 Overview of Report

The report is organized as follows:

- The CDI Program evaluation is presented in Chapter 2 with technical details presented in Appendix A Section A.1
- The CLIP evaluation is presented in Chapter 3 with technical details presented in Appendix A Section A.2
- The CP evaluation is presented in Chapter 4 with technical details presented in Appendix A Section A.3
- The CPP evaluation is presented in Chapter 5 with technical details presented in Appendix A Section A.4
- The FSP Comprehensive evaluation is presented in Chapter 6 with technical details presented in Appendix A Section A.5
- The FSP POS evaluation is presented in Chapter 7 with technical details presented in Appendix A Section A.6
- The LADWP Facilities Program evaluation is presented in Chapter 8 with technical details presented in Appendix A Section A.7
- The LAUSD DI Program evaluation is presented in Chapter 9 with technical details presented in Appendix A Section A.8
- The SBD/LADWP ZBD Program evaluation is presented in Chapter 10 with technical details presented in Appendix A Section A.9
- The UHVAC Program evaluation is presented in Chapter 11 with technical details presented in Appendix A Section A.10
- The CRP evaluation is presented in Chapter 12 with technical details presented in Appendix A Section A.11
- The EPM Program evaluation is presented in Chapter 13 with technical details presented in Appendix A Section A.12
- The ESAP evaluation is presented in Chapter 14 with technical details presented in Appendix A Section A.13
- The REP evaluation is presented in Chapter 15 with technical details presented in Appendix A Section A.14
- The RETIRE Program evaluation is presented in Chapter 16 with technical details presented in Appendix A Section A.15
- The RLEP evaluation is presented in Chapter 17 with technical details presented in Appendix A Section A.16
- The ACOP evaluation is presented in Chapter 18 with technical details presented in Appendix A Section A.17
- The CSO Program evaluation is presented in Chapter 20 with technical details presented in Appendix A Section A.18

- The MFWB Program evaluation is presented in Section 5.5.2.
- The ETP evaluation is presented in Chapter 21 with technical details presented in Appendix A Section A.19
- The MEO Program evaluation is presented in Chapter 22 with technical details presented in Appendix A Section A.20
- The PADP evaluation is presented in Chapter 23 with technical details presented in Appendix A Section A.21
- The POCP Program evaluation is presented in Chapter 24 with technical details presented in Appendix A Section A.22
- The Cost Effectiveness evaluation is presented in Chapter 25 with measure level results presented in Appendix B
- The Net-to-Gross evaluation is presented in Appendix C (Due to confidential and privacy considerations, Appendix C was not published with the public version of the report)
- The survey instruments and interview guides used to perform process evaluations are included in Appendix D (Due to confidential and privacy considerations, Appendix D was not published with the public version of the report)
- The site-level non-residential sector reports are presented in Appendix E (Due to confidential and privacy considerations, Appendix E was not published with the public version of the report)

2 Commercial Direct Install Program

This chapter summarizes the impact evaluation of the Commercial Direct Install Program (CDI) that LADWP offered customers during Fiscal Year 20/21 (FY 20/21 or Concurrent Year 1).

The primary objective of this evaluation was to calculate energy savings and peak demand reduction impacts attributable to the CDI Program, as well as to perform a summary process evaluation.

2.1 Program Performance Summary

CDI is a program in partnership with SoCal Gas that provides direct installation of lighting, hot water, and gas efficiency measures to small and medium commercial customers (with monthly demand no greater than 250 kW). The program is supported and marketed by the LADWP Power Construction Maintenance Group and community-based organizations (CBOs).

2.1.1 Key Evaluation Takeaways

- The CDI program had greatly limited activity due to the COVID-19 pandemic.
- The overall program realization rate was 88%.
- Lime Energy and CBOs continued implementing strategies and processes to promote program enrollment.

2.2 Program Description

The CDI program is a direct install program managed by the LADWP Mass Market Programs Group and implemented with the assistance of an external vendor (Lime Energy). The program targets small to large business customers in the LADWP service territory, offering upgrades to targeted systems, including lights, water, and natural gas. LADWP partners with Southern California Gas Company on CDI, with LADWP as the lead utility. LADWP is also leveraging its Power Construction Maintenance Group (PCM), contract personnel, an IT system, and strategically located CBOs to market and implement the CDI Program.

Table 2-1 CDI Ex-Ante Savings Summary

Fiscal Year	Number of Projects	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	174	4,315,466	300.56

The design of the CDI program is intended to maximize the electric, water and natural gas cost savings in a cost-effective manner. Participating contractors provide light-touch building assessments, looking at existing lighting and water using devices, to determine what is inefficient and what is eligible for upgrades through the program. The program requires that the LADWP commercial customer is in good standing and possesses an average monthly electrical demand of 250 kwh or less. The program is offered to customers free of charge.

There were 208 CDI projects completed for FY 20/21, which resulted in 174 unique project sites as some sites had multiple projects. Table 2-2 summarize the measures installed and Ex-Ante kWh savings by measure.

Table 2-2 CDI Program Data Ex-Ante Savings by Measure

Measures	Program Data Ex-Ante kWh Savings
Retrofit Lighting	4,345,371
Faucet Aerators	6
Total	4,345,377

2.3 Methodology

This section presents the finding of the tracking data review and the methodology used to calculate verified Ex-Post energy savings and peak demand reduction for the program. As part of the impact evaluation, the Evaluator performed the following data collection activities outlined in Table 2-3:

Table 2-3 CDI Data Sources for Impact Evaluation

Data	Source
Program Tracking Data	Data requested to LADWP for all data tracking program participation
Desk Review	Reviews of project documentation (Proposed Activity Report, Post Installation Report) of a sample of customers who have participated in the program
On Site Verification	Site visits of a sample of customers to collect data for savings calculation, to verify installation, and determine operating parameters

LADWP provided the Evaluator the available program tracking data for rebated measures. The evaluation methodology consisted of the following key components,

- Tracking Data Review
  - The database review process started with tracking data review to ensure that the data provided sufficient information to calculate energy and peak demand impacts.
- M&V Sample Design
  - A random stratified sampling plan was developed using CDI program data. The resulting sample of 8 projects consisted of 4 categories, or strata. The sample precision based on Ex-Post annual energy savings (kWh) is ±23.7%

- Algorithms and References
  - Generally, for projects involving lighting measures, savings were determined utilizing Database for Energy Efficiency Resources (DEER) workpapers algorithms and interactive effects. Lighting hours of operation were sourced from the site visit information, and If applicable DEER workpapers hours were used.
- M&V Approach
  - The Evaluator obtained the primary data needed to estimate savings impacts with on-site verification visits, for a sample of sites. The site visits were used to verify installation, collect data regarding hours, HVAC systems, and other parameters that affect savings calculations.

A detailed evaluation methodology can be found in Appendix A, section A.1.1.

2.4 Impact Evaluation

Ex-Post kWh savings and peak kW reduction were calculated using the appropriate DEER workpapers and other proven industry techniques. Important input parameters were based on information collected during virtual site verification or available project documentation. The impact evaluation consisted of the following key components,

- Engineering Review Procedures
  - Analysis of lighting energy savings was accomplished using the Evaluator's custom-designed lighting evaluation model with system parameters (fixture wattage, operating characteristics, etc.) based on information either collected in person, referenced in project documentation or DEER workpapers and, if appropriate, referencing industry standards.
- Description of Factors Affecting Gross Realized Savings
  - Differing Hours of Operation: The verified lighting hours of use were less than the hours utilized by Ex-Ante.
  - Differing Interactive Effects: The Ex-Post savings calculations used interactive effects values dependent upon various project specific factors, such as building type, fixtures type, climate zone and whether a space is conditioned. The Ex-Post values were sourced from the DEER workpapers.
  - Difference in Baseline Wattage: The Evaluator applied EISA 2007 baseline wattages to A19 screw-ins and T12 fixtures.

A detailed impact evaluation can be found in Appendix A, section A.1.2.

2.5 Ex-Post Gross Savings

This section presents verified Ex-Post gross savings for CDI. Table 2-4 compares Ex-Post energy savings to Ex-Ante claimed savings from the tracking data. For Concurrent Year 1, the program level Ex-Post energy savings realization rate was 88% when comparing to tracking data Ex-Ante savings.

Table 2-4 CDI Evaluation Results by Strata

Stratum	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
1	459,083	363,788	79%
2	2,067,407	1,915,462	93%
3	1,066,737	1,079,303	101%
4	752,150	430,615	57%
Total	4,345,377	3,789,168	87%

The program level realization of 88% was driven by Projects 1,2,3, and 4 as seen below in Table 2-5. The realization rates for these projects were less than 100% because the Evaluator found that the lighting hours of operations were less than those used in the Ex-Ante estimation. The hours the Evaluator used in the Ex-Post savings were sourced from information collected during site visits. Table 2-6 presents program Ex-Post energy savings and peak demand reduction compared to Ex-Ante.

Table 2-5 CDI Sampled and Non-Sampled Project Savings

Project	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Project 1	11,434	8,141	71%
Project 2	118,135	94,499	80%
Project 3	419,001	213,392	51%
Project 4	38,906	31,945	82%
Project 5	29,112	31,074	107%
Project 6	3,346	3,571	107%
Project 7	50,054	52,287	104%
Project 8	90,100	91,514	102%
Non-sampled Projects	3,585,289	3,262,745	91%
Total	4,345,377	3,789,168	87%

Table 2-6 CDI Evaluation Results

Fiscal Year	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
FY 20/21	4,315,466	3,789,168	88%	300.56	265.12	88%

2.5.1 COVID-19 Impacts on Energy Use

In general, the Evaluator found a small COVID-19 era impact as seen in Table 2-7. Of the eight sampled sites, half did not have any changes in hours during the COVID-19 era. Of the remaining 4 sites, three samples' sites expressed slightly less COVID-19 era hours of operation while one site had increased hours of operation. Additionally, 21% of Ex-Ante kWh in the Evaluator's sample was exterior lighting which is typically photocell-controlled and not impacted by changes in operation related to the COVID-19 era.

Table 2-7 CDI COVID-19 Era Impact on Ex-Post Gross Energy Savings

Fiscal Year	Typical 1st Year Ex-Post kWh Savings (A)	COVID-19 Era Adjusted Annual Ex-Post kWh Savings (B)	COVID-19 Era Incremental Change Ex-Post kWh Savings (B-A)	COVID-19 Era % Change Ex-Post Savings [(B-A)/A]
FY 20/21	3,789,168	3,727,566	-61,602	-1.6%

2.6 Process Evaluation

The Evaluator completed a summary evaluation that was limited in scope for the CDI Program due to the COVID-19 pandemic. One in-depth interview was completed with program staff in December 2020, which explored program design, customer engagement and outreach, measures offered, and participation processes.

The findings from the in-depth interview are summarized in Appendix A, section A.1.3.

2.7 Cost Effectiveness Results

Table 2-8 presents benefits, costs, and the results of cost-effectiveness testing for the CDI Program. Overall, the Total Resource Cost (TRC) test indicates there could be areas for improvement to make the program cost effective.

Table 2-8 CDI Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure Test	Modified Total Resource Cost Test
Total Benefits	$1,464,984	$1,464,984	$8,982,958	$1,464,984	$1,464,984
Total Costs	$6,767,156	$3,873,898	$24,896	$12,831,960	$3,873,898
Benefit/Cost Ratio	0.22	0.38	360.83	0.11	0.38

2.8 Program Key Findings and Recommendations

Evaluation results indicate that there are impacts that negatively affect the program, mainly due to differing hours of operation and interactive effects used in the Ex-Post analysis. Implementing the following changes in the Ex-Ante savings estimates would improve the program realization rate;

- Utilizing as found hours;
- Utilizing interactive effects from DEER workpapers; and
- Place added focus on installing water saving devices at eligible businesses.

3 Commercial Lighting Incentive Program

This chapter presents an evaluation of the Commercial Lighting Incentive Program (CLIP) that LADWP offered customers during Fiscal Year 20/21 (FY 20/21 or Concurrent Year 1).

The primary objective of this evaluation was to calculate energy savings and peak demand reductions attributable to CLIP, as well as to perform an in-depth process evaluation.

3.1 Program Performance Summary

CLIP provides incentives for standard fixture replacements and installation of lighting controls. Participation is mostly contractor-driven, though customers may submit applications on their own behalf in lieu of using a contractor to do so.

3.1.1 Key Evaluation Takeaways and Recommendations

- CLIP activity was substantially limited due to the COVID-19 pandemic.
- The overall program realization rate was nearly 100%.
- Program participants reported being highly satisfied with the program and with individual program components.
- Lighting contractors known as Recognized Vendors deliver the program to LADWP businesses; Vendors reported being happy with CLIP incentive amounts.
- Hospitals, colleges, and refrigerated warehouses are smaller building segments that present an opportunity for the program given the relatively low LED saturations, so program implementation should focus on these business types.

3.2 Program Description

CLIP is designed to offer incentives to non-residential customers for replacing standard lighting fixtures with high efficiency fixtures, lamps, and/or controls. Any high efficiency lighting product that meets program requirements is eligible for incentives through CLIP. Participation in CLIP is mostly contractor driven, although there are multiple paths to participation. Table 3-1 summarizes the program's Ex-Ante energy savings and peak demand reduction for FY 20/21.

Table 3-1 CLIP Ex-Ante Savings Summary

Fiscal Year	Number of Projects	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	125	26,798,030	4,730.59

3.3 Methodology

The Evaluator performed a review of program tracking data for projects completed during FY 20/21. A stratified sample was created based on the project tracking data. The

Evaluator performed on-site and virtual verification visits for sampled projects in order to gather information and data which was utilized to calculate energy savings for sampled project. A detailed evaluation methodology can be found in Appendix A, section A.2.1.

3.4 Impact Evaluation

Documentation provided by LADWP was reviewed for the sampled projects. The Ex-Post energy savings and demand reduction values were determined using applicable Database for Energy Efficiency Resources (DEER) workpapers and other proven industry techniques, with key parameters based on information gathered during site visits or applicable project documentation. A full evaluation analysis was conducted on the 14 randomly sampled projects from FY 20/21, for which results were aggregated to determine a strata level realization rate for extrapolation to the population. Project-level and measure-level results can be found in the project site-level reports, which can be viewed in Appendix E. For confidential and privacy considerations of participants, Appendix E was not published with the public version of the report. Appendix E was provided only to LADWP as reference to supplement this EM&V report.

A detailed impact evaluation can be found in Appendix A, section A.2.2.

3.5 Ex-Post Gross Savings

A sample of 14 projects from FY 20/21 was created to meet confidence goals for the program analysis. The sample savings summary is detailed below in Table 3-2. Project savings were extrapolated by strata to determine overall program savings as shown in Table 3-4.

Table 3-2 CLIP Sample Savings Results by Strata

Stratum	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
1	2,968	3,246	109%
2	67,268	67,112	100%
3	167,310	131,654	79%
4	685,777	723,491	105%
5	2,321,065	2,364,549	102%
6	3,463,498	3,218,657	93%
Total	6,707,887	6,508,709	99%

Table 3-3 CLIP Sampled and Non-Sampled Project Savings

Project	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Project 1	3,463,498	3,218,657	93%
Project 2	696,994	803,173	115%

Project	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Project 3	775,101	706,165	91%
Project 4	456,914	477,947	105%
Project 5	392,056	377,264	96%
Non-sampled Projects	20,090,143	20,016,011	100%
Total	26,798,030	26,524,720	99%

Table 3-4 CLIP Evaluation Results

Fiscal Year	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
FY 20/21	26,663,687	26,524,720	99%	2,921.98	2,906.75	99%

3.5.1 COVID-19 Impacts on Energy Use

There was a minimal impact of COVID-19 on program savings, as evidenced in Table 3-5. During the evaluation, only one of the fourteen sampled sites was found to be affected by COVID-19. Although some of the sampled sites had hours of use that had been affected by the pandemic, most of the sites had returned to normal operating hours by the time FY 20/21 had begun.

Table 3-5 CLIP COVID-19 Era Impact on Ex-Post Gross Energy Savings

Billing Analysis Measures	Typical 1st Year Ex-Post kWh Savings (A)	COVID-19 Era Adjusted Annual Ex-Post kWh Savings (B)	COVID-19 Era Incremental Change Ex-Post kWh Savings (B-A)	COVID-19 Era % Change Ex-Post Savings [(B-A)/A]
Lighting	26,524,720	26,237,923	-286,797	-1.1%

3.6 Process Evaluation

The Evaluator completed a process evaluation of CLIP that included the following activities:

- Reviews of program documents and tracking data
- Interviews with program staff
- A survey of program participants
- In-depth interviews with recognized and unrecognized vendors

Net savings were estimated using data obtained from the participant survey. The self-report results were supplemented with market data collected through the California Commercial End-Use Survey (CEUS) that the Evaluator performed.

The key findings are presented below. A detailed process evaluation can be found in Appendix A, section A.2.3.

- Vendors stated that the LADWP incentives are effective for encouraging customers to install efficient lighting and are the highest in the region.
- Vendors reported difficulty identifying eligible customers who exceed the 200 kW threshold requirement for participating in the program.
- Vendors reported a desire for improved communication from the program and sited the implementation of the 200 kW threshold as an example where communication could have been more effective. Vendors reported that they were confused about the rationale for this program change and that LADWP did not provide enough support to help their businesses adapt to the change.
- Application and incentive processing times are often lengthy, with vendors reporting that they may wait up to 10 months for rebate processing. Participating customers also reported some dissatisfaction with rebate and incentive processing times.
- Vendors perceive the application process that requires email submissions of the excel based application materials, photos, and other forms of documentation, to be cumbersome and time consuming. Vendors also thought that the program rejected applications for what they thought were minor errors. Vendors believe web-based portals like those used by other regional utilities would be more effective.
- Overall, participating customers were satisfied with the CLIP program process.
- Customer responses indicate that the program incentives are influencing their decisions to install the efficient lighting equipment.
- Analysis of data collected through CEUS suggest that potential for LED lighting upgrades remains in the LADWP service area. Refrigerated warehouses, colleges, and health care facilities have particularly low LED saturations, and LED exterior saturations are considerably lower than interior saturations.

3.7 Cost Effectiveness Results

Table 3-6 presents benefits, costs, and the results of cost-effectiveness testing for the CLIP.

Table 3-6 CLIP Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$8,025,086	$8,025,086	$35,101,073	$8,025,086	$8,025,086
Total Costs	$12,830,886	$9,179,553	$2,053,013	$42,227,612	$9,179,553
Benefit/Cost Ratio	0.63	0.87	17.10	0.19	0.87

3.8 Program Key Findings and Recommendations

Evaluation of the Commercial Lighting Incentive Program found that most of the discrepancy in realization rates came from different hours of use and interactive effects. Recommendations to improve the realization rate of future iterations of CLIP will address the most common occurrences causing discrepancy, this includes:

- Cooperate with ADM to determine a source for interactive effects based on facility type, or utilize interactive effects taken from DEER.
- Determine a methodology with evaluator to determine peak demand reduction.
- Utilize multiple schedules for projects in which facilities may have multiple room types/different operating hours.

Support vendors in identifying eligible customers. Most vendors reported that their primary barrier to participation in the program is identifying eligible customers since the implementation of the 200 kW average monthly demand requirement. Vendors suggested that LADWP could help them identify leads using customer data and data from customers' participation in other programs, perhaps even providing vendors with a tool that would allow them to look up an address to see whether a customer qualifies for the program. Recognized Vendors suggested that LADWP could help them with directly marketing to customers via bill inserts or by facilitating meet-and-greet events to connect vendors with eligible customers.

Communicate with vendors early and often about upcoming program changes. Many vendors reported that they had little forewarning about the program change that required participating customers to have 200kW or more average monthly demand. Vendors also reported feeling confused about the rationale for this program change and felt that LADWP did not provide enough support to help their businesses adapt to the change. Program changes – particularly significant changes - should be communicated to vendors as early as possible and through all available communication channels. LADWP could consider developing a Frequently Asked Questions (FAQ) document that summarizes responses to key questions that vendors might have about what the changes mean for their current and future projects.

Consider ways to simplify program forms and processes. Vendors reported feeling that the application and verification process was complicated and time-consuming. Some reported that the processing times had an adverse impact on customer participation.

Consider identifying ways to streamline program processes – including automating more of the process for filling out or editing the application and finding ways to move applications and form submissions online where possible. Some vendors reported that having an online application process could reduce the inconvenience associated with submitting applications via email – especially for transferring large files (Program staff noted that they were considering an online application). Some vendors recommended having any sections of the application that require repeated information from other sections auto-populate from sections that have already been filled out. Additionally, adding flags that automatically alert vendors to potential errors in the application may help to reduce errors. Any reductions to verification and rebate processing times may also improve the vendor and customer experience. Two other suggested strategies are:

- Integrate multiple program application materials into a single workbook. This will have the advantage of simplifying the number of separate documents that need to be tracked and eliminate some redundancy. For example, the lighting spreadsheet and project information sheet both require hours of operation information, although in different forms, and location information.
- Consider offering a simpler application process for small lighting projects. Although the program targets larger customers and larger lighting projects, there are some projects with relatively small incentive and savings associated. For example, of 125 CY1 projects, 44 accounted for 80% of the project incentives and the smallest 22 projects accounted for one-percent of the incentives. A simpler form and process that did not require pre-verification may be expedite the processing of applications and improve Recognized Vendor perceptions.

Consider ways to build trust with vendors – particularly Recognized Vendors. Many vendors reported feeling that LADWP's relationship with them felt punitive – with steep penalties for small application errors, limited communication between program staff and vendors, and limited support for vendor businesses. Based on staff interviews, this appears to be at least partially due to resource and staffing limitations exacerbated by the need for staff to resolve a high rate of errors in program applications. Simplifying the program applications may help to address this issue, but it may be helpful to take additional steps, including potentially having periodic meetings with a "advisory team" of Recognized Vendors to discuss program issues, or adding staff resources to support existing program staff with vendor communications.

Consider marketing and outreach strategies to reach segments with relatively low LED saturations. Hospitals, colleges, and refrigerated warehouses are smaller building segments that present an opportunity for the program given the relatively low LED saturations, although opportunities for hospitals are likely limited during the pandemic. These strategies may include identification of contractors that focus on these building types and targeted outreach by CLIP implementation staff.

4 City Plants

This chapter presents an evaluation of the City Plants Program (CP) that LADWP offered customers during Fiscal Year 20/21 (FY 20/21 or Concurrent Year 1).

The primary objective of this evaluation was to calculate energy savings and peak demand reductions attributable to CP Program.

4.1 Program Performance Summary

In 2020, over 3,000 new street trees were planted throughout Los Angeles under a large collaborative effort between LADWP and several organized groups and supporters. More than 20,000 yard trees were delivered to LA residents. In addition, 500 trees were planted in public parks across LA.

4.1.1 Key Evaluation Takeaways

- The overall program realization rate was 100%.
- Tree plantation affects the urban micro-climate in urban cities such as Los Angeles, which is an important reason for the successful implementation of the CP.

4.2 Program Description

LADWP and City Plants are working in partnership to provide free shade trees for residents and property owners in the City of Los Angeles, along with essential information on where to plant those trees to maximize energy efficiency in the home or business. The program encourages the planting of trees that are adapted to the region's semi-arid climate and use less water. Native trees and drought tolerant trees that maximize sustainability are recommended.

4.3 Methodology

This section presents the findings of the tracking data review and the methodology used to calculate verified Ex-Post energy savings for the program. As part of the impact evaluation, the Evaluator performed the following data collection activities outlined in Table 4-1.

Table 4-1 CP Data Sources for Impact Evaluation

Data	Source
Program Tracking Data	Data requested to LADWP for all data tracking program participation and project documentation
Literature Review	Literature review on programs and activities performed by others to quantify energy savings and benefits of shade trees
Interviews	Interviews with the LADWP staff and EcoLayers' staff to discuss details on energy saving calculations

Data	Source
Desk Review	Review of project documentation
Virtual Verification	Virtual verification of a small sample of projects, using Google Earth

LADWP provided Evaluator the available program tracking data for the shade trees. The evaluation methodology consisted of the following key components,

- Reviews of Project Documentation
  - Review of summary of City Plants savings calculations
  - Review of the assumptions used in the calculations
  - Review of inventories of shade trees, street trees, and open space shade trees.
  - Review of a sample of shade trees containing information on quantities, status, species, height, spread, and location.
  - Review of direct savings (shade only), indirect savings (due to ambient cooling), and total savings
  - Review of annual tree mortality rates
- Virtual Verification
  - Virtual verification of a small sample of projects, using Google Earth, to verify installation, quantities, type, height, canopy spread, location, and orientation of shade trees. These parameters were used in the i-Tree Design software to perform energy saving calculations
- Benchmarking Ex-Ante Estimates
  - ADM validated results using the modeling tool i-Tree Design.
  - ADM validated building assumptions used in EcoLayers using eQuest prototypical residential energy simulations.
- Industry Research
  - ADM conducted an online search of relevant information. ADM focused on peer reviewed publications.

A detailed evaluation methodology can be found in Appendix A, section A.3.1.

4.4 Impact Evaluation

This section presents a summary of the impact evaluation activities performed to verify annual energy savings from EcoLayers' software tool. The following activities took place as part of the impact evaluation:

- Virtual verification; and
- Benchmarking study including review of i-Tree design models, eQuest simulation models, and a literature review.

A detailed impact evaluation can be found in Appendix A, section A.3.2.

4.5 Ex-Post Gross Savings

Table 4-2 shows Ex-Post kWh savings compared to Ex-Ante. The program realization rate is 100%.

Table 4-2 CP Evaluation Results

Fiscal Year	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
FY 20/21	6,617,573	6,617,573	100%	3,018.61	3,018.61	100%

4.5.1 COVID-19 Impacts on Energy Use

The Evaluator determined COVID-19 era impacts as shown in Table 4-3. The COVID-19 impacts were calculated based on the information provided in a research article: "Impacts of COVID-19 on residential building energy use and performance", authored by Emily Kawka and Kristen Cetin[1]. According to this research, HVAC loads during the pandemic increased in total daily consumption compared to the same average daily temperatures of previous years, due the fact that typical daily routines of millions of people were disrupted as the country attempted to control the spread of the virus. The results of this research study showed an average percent increase of 8.7% in the total daily HVAC load. The COVID-19 energy savings are increased by 8.7% compared to typical 1st year Ex-post Gross savings.

Table 4-3 CP COVID-19 Era Impact on Ex-Post Gross Energy Savings

Billing Analysis Measures	Typical 1st Year Ex-Post kWh Savings (A)	COVID-19 Era Adjusted Annual Ex-Post kWh Savings (B)	COVID-19 Era Incremental Change Ex-Post kWh Savings (B-A)	COVID-19 Era % Change Ex-Post Savings [(B-A)/A]
FY 20/21	6,617,573	7,193,302	575,729	8.7%

4.6 Process Evaluation

The Evaluator did not complete a process evaluation of the FY 20/21 CP Program since it was not part of the scope of evaluation work. An in-depth process evaluation will be completed for the program in FY 21/22.

4.7 Cost Effectiveness Results

Table 4-4 presents benefits, costs, and the results of cost-effectiveness testing for the CP.

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[1] https://www.sciencedirect.com/science/article/pii/S0360132321006016

Table 4-4 CP Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$23,549,928	$23,549,928	$20,589,190	$23,549,928	$23,549,928
Total Costs	$4,863,274	$4,863,274	$1,535,761	$23,916,703	$4,863,274
Benefit/Cost Ratio	4.84	4.84	13.41	0.98	4.84

4.8 Program Key Findings and Recommendations

Trees improve the spaces surrounding buildings aesthetically and contribute to control the ambient temperature. That is how tree plantation affects the urban micro-climate in urban cities. And that explains why the consideration of green spaces is growing as an important aspect of city planning. LADWP and City Plants are working in partnership to provide free shade trees for residents and property owners in the City of Los Angeles.

Trees provide energy savings through shading buildings and decreasing ambient temperatures while also removing pollutants from the air, absorbing polluted runoff, providing aesthetic benefits, and more. LADWP's Efficiency Solutions unit will oversee the distribution of trees to maximize energy savings benefits in our communities.

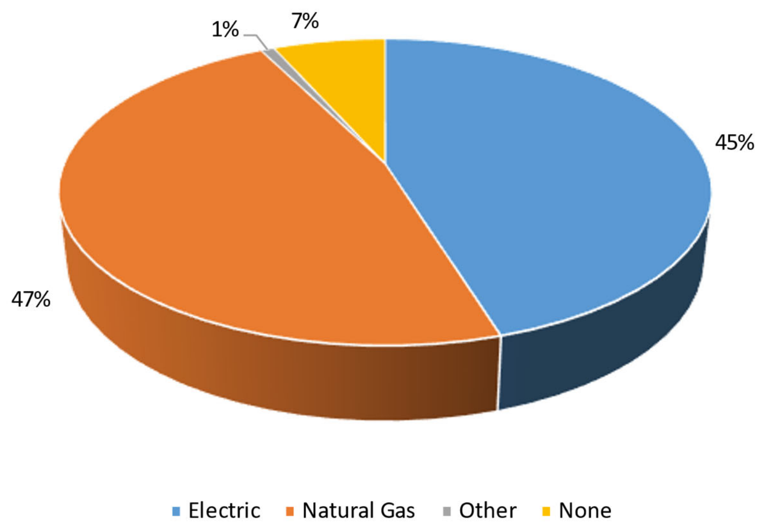
The CP program determines energy savings and carbon sequestration attained by trees planted near homes using several variables such as climate zone, tree species and age, location with respect to the home, age of home, and type of cooling system in the home. Recent calculations show over 4.9 million kWh of direct energy savings are achieved annually through shading by trees that LADWP provided to residents and businesses. These energy savings will provide greenhouse gas reductions of 3,473 Metric Tons.

As shown in Table A-16, the energy savings estimates by EcoLayers compare reasonably well with other methods, but they can be further improved based on the recommendations made here by the Evaluator.

The Ex-Ante energy savings consider the summer savings only, due to the tree shade. Winter savings, whether positive or negative, have been ignored. As depicted in Figure A-16, trees can contribute to winter savings as well. Depending upon the location of the tree and species, these savings could differ from installation to installation. For instance, a shade tree planted on the South side will block the sun during winter months, increasing the heating energy consumption. Similarly, non-deciduous tree species that do not shed leaves during winter will also increase the heating energy consumption.

Under LADWP's Residential Lighting Efficiency Program evaluation, ADM obtained information on the heating source from a sample of 376 participants. As shown in Figure 4-1, a significant number of houses (45%) were using electricity as a source of heating, 47% natural gas, 1% other sources, and 7% no heating. The impact on total energy savings could be considerably different if winter savings are also considered as part of the total energy impacts. While the energy impacts due to shade will most likely be negative in most cases, the windbreaking effect is likely to produce positive savings.

Figure 4-1 Proportion of Homes by Heating Fuel



Trees can be planted strategically to maximize energy conservation. Trees improve comfort conditions outdoors within the city by blocking hot and dust-laden winds and act like windbreaks that will lower the ambient wind speed; building physical characteristics will affect the building's cooling-energy use by lowering or raising it. In summer, trees block unwanted solar radiation entering the building and hence reduce the cooling load if placed properly around the building; while in winter, tree shade increases the heating loads. Planting deciduous trees is more appropriate, since they allow solar gains during winter, while minimizing it during summer.

Tree location is defined by tree-building distance and tree azimuth with respect to a building. Tree azimuth is the true compass bearing of a tree relative to a building. Changing tree location results in variation in the amount and timing of building shade.

The decision to offer the most suitable trees should consider land regulations and ownership, planting space, aesthetics, deciduous species, water use, shading and windbreaking properties, and maintenance requirements; all these factors contribute to achieving the highest chance of successful plantation.

As depicted in Figure A-14, the best orientation for planting a shade tree is West. Many researchers have investigated the impact of tree-building location on heating and cooling energy use. McPherson et al.[2] found that the best orientation to plant a tree around a building to reduce cooling costs is in front of west facing windows and walls, providing shade for these facades in the afternoon, when cooling demand is at its peak.

McPherson et al.[3] have reported that West trees produced greater annual cooling savings than east trees, which produced greater savings than south trees except in the South

[2] https://www.sciencedirect.com/science/article/abs/pii/S1618866704700254

[3] https://www.sciencedirect.com/science/article/abs/pii/S1618866704700254

Coast zone, where morning fog reduces cooling benefits from East trees. Savings from West trees were about 50–100% greater than savings from East trees. A similar pattern is observed for peak cooling savings, but the benefit from West trees is more pronounced. Annual cooling savings from trees located too far from homes to provide direct shade (climate only trees) is generally 25–50% of savings from West trees.

Trees planted too far from the building may produce much less or no energy savings. From the 2018 sample, it was observed that some trees were planted more than 30 feet away from the house. A study conducted by McPherson et al.[4] also reported that trees located at greater than 40 feet from buildings were among the "neutral sites", because their shade would not fall on the buildings and therefore, won't have any impact on the energy usage.

As the results show in Figure A-15 and Figure A-16, there is a considerable reduction in residential HVAC energy consumption by planting shade trees. This finding also has implications for the tree species planted while realizing energy savings in the future, such that savings can be maximized by selecting tree species that produce dense leaf canopies during the hot summer months. The deciduous tree species which lose their leaves during the winter months are highly recommended, so that the homeowners could enjoy the benefits of reduced cooling costs due to relatively dense shade during the summer while there is minimum or no negative impact on heating costs.

From the 2018 sample of shade trees, it appears that many trees planted under the CP program were not actually shade trees but rather ornamental. Also, many trees were non-deciduous that do not shed their leaves in winter. Homeowners should be made aware of relevant economic and energy conservation benefits from selecting the right species of trees that will optimize these benefits.

Previous shade tree program impact evaluations found that findings are sensitive to tree growth and mortality rates (McPherson and Simpson[5]). The growth will vary across climate zones, among species, and by location. SMUD's analysis over a 30-year period assumed low and high mortality rates of 25% and 45%, respectively.

In a research paper, titled "Long-term monitoring of Sacramento Shade program trees: Tree, survival, growth and energy-saving performance," McPherson and Simpson reported the 22-year post-planting survivorship was 42.4%; annual survival rate was 96.2%and annual mortality rate was 3.8%. The CP program considers 4.6% mortality for first year and 3% per year thereafter. However, the reported energy savings are discounted by 10% every year to account for tree mortality.

The Evaluator recommends conducting a program participant survey every 3-years to determine tree survival rates more accurately. The mortality rates could vary from year to year due to the variations in weather and availability of water. The survey results will also help determine which particular species have higher mortality rates and consequently assist with decision making process on which species should be offered in the future.

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[4] https://www.sciencedirect.com/science/article/abs/pii/S1618866704700254

[5] https://www.sciencedirect.com/science/article/abs/pii/S1618866704700254

5 Custom Performance Program

This chapter presents an impact and process evaluation of the Custom Performance Program (CPP) that LADWP offered customers during Fiscal Year 2020/2021 (FY 20/21).

The primary objective of this evaluation was to estimate energy (kWh) and peak demand (kW) impacts attributable to CPP.

5.1 Program Performance Summary

The CPP provides customized incentives for a range of equipment retrofits for the commercial and industrial sectors, including equipment controls, process improvements, heating and cooling retrofits, retro-commissioning, and any other improvement that cannot be readily captured by other LADWP programs.

5.1.1 Key Evaluation Takeaways

- CPP activity was not substantially affected by the COVID-19 pandemic; participation was down but realized energy savings were higher compared to FY 19/20.
- The overall program realization rate was 108%.
- Program participants generally reported being very satisfied with the program.

5.2 Program Description

The non-residential CPP provides incentives for energy saving measures which include equipment controls, industrial processes, retro-commissioning, chiller efficiency, and innovative energy saving strategies meeting or exceeding Title 24 or Industry Standards that are not included in other LADWP non-residential energy efficiency programs. Table 5-1 summarizes the program's Ex-Ante energy savings and peak demand reduction for FY 20/21.

Table 5-1 CPP Ex-Ante Savings Summary

Fiscal Year	Number of Projects	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	127	39,160,969	5,634.99

The Evaluator used the provided program tracking data to develop an impact evaluation sample at the project level. An evaluation realization rate is used to adjust ex-ante estimates based on verified findings.

5.3 Methodology

This section presents the methodology used to evaluate the CPP.

Ex-Post annual energy savings, lifetime energy savings, and peak demand reduction have been determined using the methodologies described. A site-specific approach was used to determine Ex-Post site level impacts with extrapolation to the population based on the design of the CPP. The methods employed include:

- Review of program tracking data for completeness and sampling;
- Project documentation review;
- Site-specific Measurement and Verification Plan (MV Plans);
- Primary data collection from site contacts;
- Engineering analysis for each sampled project; and
- Extrapolation of sample level results to determine program level impact estimates.

A detailed evaluation methodology can be found in Appendix A, section A.4.1.

5.4 Impact Evaluation

This section presents findings from the evaluation verification of a sample of projects to determine Ex-Post gross annual energy savings, lifetimes energy savings, and peak demand reduction through evaluation M&V efforts. Ex-Post kWh savings and peak kW reduction were estimated using proven industry techniques. Important input parameters were based on information collected during on-site or virtual verifications or available project documentation. The impact evaluation consisted of the following key components:

- Detailed program data review:
- Data collection and desk review activities; and
- Project-level impact evaluation.

A detailed impact evaluation can be found in Appendix A, section A.4.2.

5.5 Ex-Post Gross Savings

Aggregated verified gross energy impacts from the sample (by project) were extrapolated to the population by stratum. The evaluation sample was composed of 10 projects and an evaluation was completed for all sampled projects. Verified results from the evaluation sample resulted in a statistical precision of 16.80% at the 90% confidence interval for annual energy savings. Program level results are shown in Table 5-2.

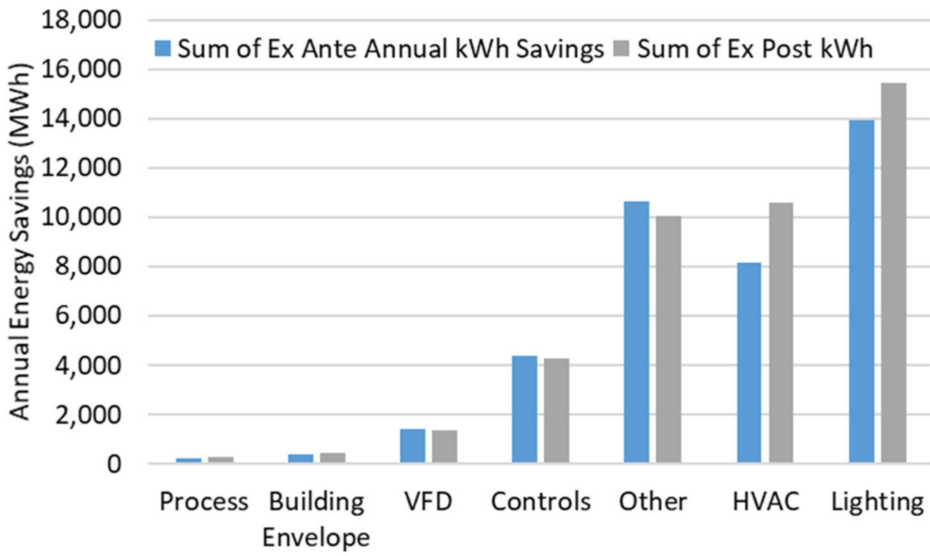
Table 5-2 CPP Evaluation Results by Strata

Stratum	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
1	1,880,215	1,814,771	97%
2	4,385,627	4,327,656	99%
3	10,171,639	12,147,332	119%
4	8,159,905	8,061,923	99%
5	6,995,938	11,360,804	162%
6	7,567,917	4,775,124	63%

Stratum	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Total	39,161,241	42,487,610	108%

Realization rate factors were found to have minimal influence on the overall population. Evaluation has the advantage of verifying energy savings after a post-installation time, allowing for increased accuracy in operating conditions of the installed equipment. This is a large factor in the evaluation's finding of different load profiles. There were an insignificant number of analytical and clerical errors. The impact of realization rate factors by measure category are shown in Figure 5-1.

Figure 5-1 CPP Ex-Post Impacts by Measure Category



Program level Ex-Post savings results for the fiscal year are shown in Table 5-3.

Table 5-3 CPP Evaluation Results

Measure	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
Building Envelope	10,036	445,777	>100%	2.71	120.23	>100%
Controls	4,270,926	4,295,280	101%	593.28	596.66	101%
HVAC	8,699,952	10,582,816	122%	1,539.62	1,872.83	122%
Lighting	12,054,097	15,440,925	128%	1,497.33	1,918.04	128%
Other	10,784,106	10,036,147	93%	1,514.83	1,409.77	93%
Process	389,046	300,699	77%	46.05	35.59	77%
VFD	2,952,805	1,385,966	47%	441.16	207.07	47%
Total	39,160,969	42,487,610	109%	5,634.99	6,160.19	109%

5.5.1 COVID-19 Impacts on Energy Use

The Evaluator analyzed the impact of COVID-19 for each sampled measure on annual energy savings. Analysis included information from the site contact regarding changes in operation due to the pandemic. The most likely causes of consumption change were due to occupancy changes and mechanical system setpoints. These results indicate the variance in annual energy savings expected if the impacts of COVID-19 were to persist into a typical fiscal year.

ADM found insignificant differences in annual energy savings due to the pandemic at the time of evaluation data collection. This may be due to several reasons:

- COVID-19 impacts were determined based on claimed changes to operating conditions. Site contacts may now think of pandemic conditions as normal.
- Data collection took place at a time of easing pandemic concern. All attempted on-site data collection was achieved with little concern from site contacts.
- Site with continued in-person business operation may have been more likely to participate in the program during the pandemic.

Quantified COVID-19 impacts are shown in Table 5-4.

Table 5-4 CPP COVID-19 Era Impact on Ex-Post Gross Energy Savings

Measure Category	Typical 1st Year Ex-Post kWh Savings (A)	COVID-19 Era Adjusted Annual Ex-Post kWh Savings (B)	COVID-19 Era Incremental Change Ex-Post kWh Savings (B-A)	COVID-19 Era % Change Ex-Post Savings [(B-A)/A]
Building Envelope	445,777	445,777	-	0.0%
Controls	4,295,280	4,303,856	8,576	0.2%
HVAC	10,582,816	10,593,780	10,964	0.1%
Lighting	15,440,925	15,452,893	11,968	0.1%
Other	10,036,147	10,036,147	-	0.0%
Process	300,699	300,699	-	0.0%
VFD	1,385,966	1,388,249	2,283	0.2%
Total	42,487,610	42,521,401	33,791	0.1%

5.5.2 Evaluation of the Multifamily Whole Building Program

The Multifamily Whole Building Program (MFWB) is a collaborative program with the Southern California Gas Company that offers energy consultation, audit, and incentives for energy-efficient electric, water, and natural gas upgrades to owners of existing multi-family properties. The MFWB incentives apply to measures in individual residential units as well as common areas throughout the property, including no- and low-cost measures, modifications to system controls and building automation, operational changes, and potential capital upgrades.

MFWB offers efficiency upgrades for both individual residential units and common areas throughout the property. The efficiency measures include lighting upgrades, insulation, HVAC upgrades, water heating upgrades, weatherization, controls, low-flow showerheads and faucet aerators, appliance upgrades, pool pumps, and window/door replacement/repair.

The Evaluator performed a desk review of available MFWB program data and applied average Ex-Post realization rates from the CPP analysis in order to calculate Ex-Post savings for the MFWB. Below are the results of that analysis by fiscal year.

Table 5-5 MFWB Evaluation Results

Measure	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
Low Income	538,935	560,525	104%	78.99	82.15	104%
Non-Low Income	878,803	914,009	104%	146.60	152.47	104%
Total	1,417,738	1,474,534	104%	225.59	234.63	104%

5.6 Process Evaluation

The Evaluator completed a process evaluation of CPP that included the following activities:

- Reviews of program documents and tracking data
- Interviews with program staff
- A survey of program participants
- Participant and contractor interviews

Net savings were estimated using data obtained from the participant survey.

The key findings are presented below. A detailed process evaluation can be found in Appendix A, section A.4.3.

- The LADWP project evaluation and quality control process is rigorous and thorough. The key features are:
    - Pre-inspection for most express track projects and all custom calculated projects.
    - Structured protocols for guiding savings estimation and project documentation for the custom calculate tracks including, development of a pre-inspection checklist to systemize data collection, documentation of an M&V plan, documentation of final project evaluation in a report.
    - A well-structure process for quality control review of the savings estimation and project documentation provided by the Energy Service Providers (ESPs) that evaluate the
    - A process for reviewing completed express track projects.
- The division of the project into express and custom calculated tracks has improved the efficiency of the program. The addition of the express track for simpler

measures, for which deemed savings values can be used, has simplified the program process and allowed staff to reallocate efforts to larger projects that are more impactful on overall program results.

- The quality control process for reviews of custom calculated projects is rigorous but burdensome. The process for reviewing ESPs project evaluations is designed to ensure the program procedures are being followed by the service providers and provide feedback to them. The reviews do not alter project savings. A drawback of the process is that it is time consuming and burdensome for LADWP staff and it can be difficult to find staff to complete the reviews in a timely manner.
- COVID-19 has restricted large business energy efficiency budgets, which has limited participation in the program.
- Based on limited survey responses, participants are primarily learning of the program from prior experience with it, from LADWP staff, and through internet research. Relatively few respondents reported learning of the program from contractors or vendors.
- Most participants were satisfied with the program overall. Dissatisfaction was highest with the effort to complete the application.
- Analyses of tracking data suggests that rebate processing times are shortening in recent months, suggesting that program processes are improving as intended by recent program changes – most significantly the addition of the “Express” program track that offers an expedited application process for simpler measures.

5.7 Cost Effectiveness Results

Table 5-6 presents benefits, costs, and the results of cost-effectiveness testing for the CPP.

Table 5-6 CPP Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$29,283,477	$29,283,477	$91,533,657	$29,283,477	$29,283,477
Total Costs	$12,834,146	$10,398,878	$5,096,313	$96,836,222	$10,398,878
Benefit/Cost Ratio	2.28	2.82	17.96	0.30	2.82

5.8 Program Key Findings and Recommendations

Evaluation efforts determined the following key findings:

- Verified annual energy savings confirmed ex-ante estimates at the program level. In general, higher savings were determined for HVAC and lighting portions of projects while MBCx and RCx projects introduced a small amount of evaluation risk. Additional post-installation data available during the evaluation was part of the cause with further discrepancy in the generation of a normalized baseline load profile.

- Realization rate factors included differing load profiles, differences in savings methodologies, additional consumption, and trend data, differing hours of operation, and differing baseline assumptions. Calculation and clerical errors as well as equipment installation rates were not found to be an issue; indicating a thorough QC process on project installation and commissioning.
- Measures with the highest evaluation risk are those impacted by site control of operating conditions. These include controls and set point changes as well as operating hours.
- The evaluator saw an improvement in the completeness and organization of project documentation compared to previous years.

ADM offers the following recommendations for the CPP Program:

- Continue a high level of rigor for QC on measures with the most evaluation risk (MBCx, RCx, Controls, VFD) when developing Ex-Ante savings.
- Continue critical review of energy savings methodologies employed for ex-ante estimates such as the development of normalized baseline load profiles and non-routine impacts on statistical analyses.
    - EETAP projects are the types of projects requiring complex analysis and therefore present a higher level of evaluation risk. ADM recommends continued high-rigor QC practices for remaining EETAP projects.

Continue to track and measure rebate processing time to confirm trend toward faster processing. LADWP appears to be making considerable progress toward their goal of improving rebate processing times by offering the Express program track. Program tracking data supports the conclusion that rebate processing times are shortening. Continue to track this trend to confirm that rebate processing times stay low.

We recommend reducing the number of quality control reviews in order to reduce the program administration costs. This recommendation is based the following findings:

- The quality control reviews do not affect savings estimations and do not impact incentive payments.
- The program has several quality assurance mechanisms including working with third-party technical experts to estimate the savings for all custom calculate projects, protocols for documenting and planning savings estimation approaches and results, as well as submitting supporting documentation and data.
- The Evaluator’s evaluation of the FY 15/16 through FY 19/20 programs found a high realization rate for the Ex-Ante savings estimated (95%).
- A review of feedback provided on 21 reviews of ESP projects completed by LADWP staff during 2021 found that in most cases the issues identified involved project documentation or organization of documents. Although these are important aspects of the projects, for nearly all of the reviews, the LADWP reviewer did not find issues that indicated the estimated savings was significantly incorrect.

The Evaluator recommends that LADWP consider a QA/QC protocol that would include the following elements:

- Complete a quick review of all custom calculated projects to verify that all supporting documentation has been provided. This information is necessary for LADWP's records as well as for third-party evaluations.
- Perform a review of a subset of projects that meet one of the following criteria:
  - Criterion 1: Review the first three projects submitted by an ESP, if added, to ensure that understanding of LADWP requirements and technical competence. We recommend three projects because that number should provide sufficient opportunity for new ESPs to understand LADWP requirements and provide LADWP confidence in the ESPs technical competence. However, should the review of the three projects not demonstrate understanding of LADWP requirements or technical competence, additional project should be reviewed.
  - Criterion 2: Focus full QC reviews on projects with incentives greater than $75,000. During CY1, these projects accounted for 71% of the program incentives and 39% of the program projects. By focusing on reviews on these projects LADWP will be providing additional due diligence with the projects that utilize the most program incentive dollars.
  - Criterion 3: Perform full QC reviews on projects that contain more complicated measures including controls, RCx/MBCx, VFDs, and industrial process improvements. Based on project descriptions in the CY1 tracking data, 28% of custom calculated projects included one or more of these measures. Reviews of these more complex projects will help to ensure ESPs are correctly analyzing savings and provide an opportunity for feedback from LADWP. (Criterion 2 and Criterion 3 combined accounted for 58% of the CY1 custom calculated projects.)

6 Food Service Program - Comprehensive

This chapter summarizes the impact evaluation of the Food Service Comprehensive Program (FSPC) that LADWP offered customers during Fiscal Year 20/21 (FY 20/21 or Concurrent Year 1).

The primary objective of this evaluation was to calculate energy savings and peak demand reduction impacts attributable to the FSPC Program, as well as to perform a process evaluation.

6.1 Program Performance Summary

FSPC provides rebates for efficient food service equipment, including cooking equipment, refrigerated and frozen food storage, and kitchen ventilation. Marketing efforts from the FSPC are intended to drive distributors and vendors to then encourage their customers to purchase high efficiency options.

6.1.1 Key Evaluation Takeaways and Recommendations

- FSPC activity was somewhat less than expected since demand was reduced for new food service equipment due to the COVID-19 pandemic.
- The overall program realization rate was 104%.

6.2 Program Description

The FSPC is a program designed to assist grocery stores (small to large), liquor stores, convenience stores, restaurants, and other commercial customers with refrigeration and food service equipment. This program offers rebates for ice machines, glass and solid door freezers/refrigerators, commercial ovens, etc. The FSPC is designed to be utilized by major vendors and manufacturers to promote the highest efficiency refrigeration and food service equipment for retrofit projects. Table 6-1 presents the FY 20/21 Ex-Ante energy savings summary.

Table 6-1 FSPC Ex-Ante Savings Summary

Fiscal Year	Number of Projects	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	18	117,921	15.50

Table 6-2 summarize the measures installed and Ex-Ante kWh savings associated with the measures.

Table 6-2 FSPC Program Data Ex-Ante Savings by Measure

Measures	Program Data Ex-Ante kWh Savings	Proportion of Ex-Ante kWh Savings
Auto Closer - Cooler Doors	1,612	1%

Measures	Program Data Ex-Ante kWh Savings	Proportion of Ex-Ante kWh Savings
Combination Oven	57,485	48%
Convection Oven	3,480	3%
Hot Food Holding Cabinet	5,009	4%
Ice Machine	1,319	1%
Kitchen Hood DVC	37,773	32%
Refrigerator/Freezer	12,311	11%
Total	118,989	100%

6.3 Methodology

This section presents the findings of the tracking data review and the methodology used to calculate verified Ex-Post energy savings and peak demand reduction for the program. As part of the impact evaluation, the Evaluator performed the following data collection activities outlined in Table 6-3.

Table 6-3 FSPC Data Sources for Impact Evaluation

Data	Source
Program Tracking Data	Data requested to LADWP for all data tracking program participation
Desk Review	Reviews of project documentation of a sample of customers who have participated in the program
On Site & Virtual Verification	Site visits of a sample of customers to collect data for savings calculation, to verify installation, and determine operating parameters

LADWP provided the Evaluator the available program tracking data for rebated measures. The evaluation methodology consisted of the following key components,

- Tracking data review
  - The database review process started with a tracking data review to ensure that the data provided sufficient information to calculate energy savings and peak demand impacts.
- M&V sample design
  - A random stratified sampling plan was developed using FSPC program data. The resulting sample of 6 projects consisted of 3 categories, or strata. The sample precision based on Ex-Post annual energy savings (kWh) is ±26.2%
- Algorithms and references
  - Generally, savings were determined utilizing Database for Energy Efficiency Resources (DEER) workpapers, project documentation, and information gathered during the site verification.

- M&V approach
  - The Evaluator obtained the primary data needed to calculate energy savings impacts with verification visits of the sampled sites. The site visits were used to verify equipment installation, collect data regarding hours of operation, and other parameters that affected savings calculations.

A detailed evaluation methodology can be found in Appendix A, section A.5.1.

6.4 Impact Evaluation

Ex-Post kWh savings and peak kW reduction were estimated using the appropriate DEER workpapers. Important input parameters were based on information collected during verification site visits or by reviewing available project documentation. The impact evaluation consisted of the following key activities:

- Engineering review procedures
  - Available documentation was reviewed for a sample of projects, with attention given to model numbers, ENERGY STAR rating, invoices, and unit specifications. Analysis of FSPC energy savings was accomplished using the Evaluator's custom-designed food service evaluation tool with system parameters (unit efficiencies, unite size/capacity, operating characteristics, etc.) based on information either collected in person, referenced in project documentation or DEER workpapers and, specification sheets
- Several factors affected realized savings. The factors that decreased realized savings were offset by factors that increased savings resulting in an Ex-Post gross savings realization rate of 103%. Description of factors affecting gross realized savings are as follows:
  - Differing Hours of Operation: The verified measure hours of use were less than the default DEER workpaper values utilized by Ex-Ante
  - Differing Efficient Parameters: Ex-Post utilizing purchased unit's specifications such as volume, idle energy rates, cooking efficiencies, and production capacities in lieu of default DEER work paper values used in the Ex-Ante estimation
  - Differing Reference Values: Source of kitchen hood DVC Ex-Ante savings value was unknown; hence the Evaluator used the DEER workpaper savings values
  - ENERGY STAR: A refrigerator that was not ENERGY STAR certified
  - Quantity: Instances where sites that purchased two units were only using one of those units
  - Zero Ex-Ante Savings: The Evaluator found an instance where the reported savings for an incentivized Auto Closer-Freezer were zero. The site visit verified the equipment was installed and operational. The Ex-Post savings were calculated utilizing the DEER workpapers

A detailed impact evaluation can be found in Appendix A, section A.5.2.

6.5 Ex-Post Gross Savings

This section presents Ex-Post gross savings for FSPC. Table 6-4 compares Ex-Post energy impacts to Ex-Ante claimed savings from the tracking data. For FY 20/21, the program level Ex-Post energy savings realization rate was 103% when comparing to tracking data Ex-Ante savings.

Table 6-4 FSPC Evaluation Results by Strata

Stratum	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
1	8,105	3,315	41%
2	47,072	80,590	171%
3	63,812	38,401	60%
Total	118,989	122,307	103%

The program level realization rate of 103% was driven by Project 2 and Project 5 as seen below in Table 6-5. Project 2 was a combination oven installation where the Evaluator used the purchased units' efficient parameters in lieu of the default DEER workpaper values used in the Ex-Ante estimate. Project 5 was a kitchen hood DCV site where the Ex-Post savings sourced from the DEER workpapers were greater than the Ex-Ante savings; the source of the Ex-Ante values was unknown.

Table 6-5 FSPC Sampled and Non-Sampled Project Savings

Project	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Project 1	25,822	22,737	88%
Project 2	11,497	20,218	176%
Project 3	808	685	85%
Project 4	22,994	6,640	29%
Project 5	8,916	14,730	165%
Project 6	1,067	82	8%
Non-sampled Projects	47,885	57,215	119%
Total	118,989	122,307	103%

Table 6-6 shows Ex-Post kWh savings compared to Ex-Ante. The program realization rate is 103%.

Table 6-6 FSPC Evaluation Results

Fiscal Year	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
FY 20/21	117,921	122,307	104%	15.50	16.08	104%

6.5.1 COVID-19 Impacts on Energy Use

The Evaluator found that the sites that participated in FSPC remained open during FY 20/21. None of the sample sites expressed any impact due to COVID-19 during FY 20/21. Additionally, the nature of energy savings for measures such as refrigerators are only dependent on the size of the unit, and refrigerators made up roughly half of the incentivized equipment.

6.6 Process Evaluation

The Evaluator completed a process evaluation of FSPC that included the following activities:

- Reviews of program documents and tracking data
- Interviews with program staff
- Qualified dealer interviews
- Participant and contractor interviews

Net savings were estimated using data obtained from qualified dealers participating in the program.

The key findings are presented below.

- Overall, the program application and review processes are well documented and thorough. However, while the comprehensive program has a check point to determine if a rebate has been previously claimed for submitted equipment, the Evaluator did not find documentation of a similar check for payment across the POS and Comprehensive programs. That is the POS process does not appear to include a check to determine if a downstream rebate was paid through the Comprehensive Program.
- COVID-19 has disrupted the food service industry and these impacts have made it difficult for the Food Service Program to reach its planned energy savings goal.
- Dealers generally found the equipment rebates to be helpful in selling efficient equipment
- The materials provided by LADWP such as signs, stickers, and panels are welcomed by POS dealers and are perceived to be effective at steering shoppers toward more efficient equipment.
- Dealers offered positive feedback on other aspects of the program, including the enrollment process and the sales and administrative trainings.

- All dealers highlighted program paperwork as a key pain point in the overall participation process, in particular, dealers struggled to collect customer signatures. One dealer estimated that they have not submitted about 100 sales to the program because of the signature requirement.
- The customer verification process also presents challenges. Dealers reported that finding the correct address can be a challenge and the tool is not always current – an issue for the food services industry where the properties tend to frequently change ownership.
- Analysis of supplementary data collected through the CEUS indicates that ENERGY STAR equipment specifications are generally low across groceries, restaurants, and liquor/convenience stores.

A detailed process evaluation for the Food Service Comprehensive and Point of Sale Programs are combined and reported in section A.6.3.

6.7 Cost Effectiveness Results

Table 6-7 presents benefits, costs, and the results of cost-effectiveness testing for the FSPC.

Table 6-7 FSPC Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$82,021	$82,021	$277,994	$82,021	$82,021
Total Costs	$262,972	$262,972	$16,967	$523,999	$262,972
Benefit/Cost Ratio	0.31	0.31	16.38	0.16	0.31

6.8 Program Key Findings and Recommendations

The Evaluator offers combined key findings and recommendations for both Food Service Comprehensive and Point of Sale programs below and in Section 7.8.

Key Findings:

- Ensure incentivized equipment is ENERGY STAR certified.
- The program should utilize installed unit specific specifications in leu of default DEER workpaper values. For kitchen equipment, it is important to document actual cooking metrics and equipment sizes. Installed unit specific parameters such as unit volumes and cooking efficiencies are present in available documentation such as the LADWP qualifying equipment list.

Recommendations:

Given the lasting impacts of the pandemic, particularly supply chain issues, consider targeted marketing to boost participation to achieve planned program goals. Dealer feedback indicated that small, independent customers are most likely to be influenced POS rebates, while larger chain stores and institutional customers are more influenced by corporate policy, using consistent equipment across locations, and operating costs. Targeted marketing could both help direct customers to the program they are most likely to participate in (Comprehensive vs. POS) and include messaging that most appeals to each customer type. For example, while POS materials promoting upfront cost savings appear to be effective for the small and independent restaurants that tend to participate in that program offering, comprehensive marketing materials could emphasize how efficient equipment may help reduce operating costs, which may appeal to institutional customers with tight operating budgets. Collecting and leveraging dealer insight may also help LADWP identify and target customers with emerging market needs, such as restaurants or large institutional customers seeking to reopen following pandemic

Seek ways to expand the number of dealers participating in the FSP program, including collecting and sharing testimonials from participating dealers and reducing rebate payout times. Feedback from the implementer and participating dealers indicated that these techniques may be effective in increasing the number of dealers participating in the overall FSP. Recruiting additional dealers to the program may help increase the projects submitted to the program, which may help FSP reach its annual savings goals.

Continue working to identify opportunities to address the signature requirement, which directly affects participation. All dealers interviewed indicated this requirement was a key pain point in the participation process. One dealer indicated that a large number of projects were not submitted to the program due to this requirement.

Track metrics to assess the building types and organization size of businesses participating in the FSP. Building type and organization size could be collected through the program application or a post-participation survey. This field is already included in the Comprehensive program application and could be included on the POS application as well. These metrics could help LADWP better understand customers served through the program and work to address any gaps and hard-to-reach customers.

Ensure contact name, contact email, and phone number is tracked for all participants in the FSP. Currently phone contact information is tracked for 96% of participants and emails are tracked 17% of participants. Contact name is tracked for nearly all Comprehensive program participants but is largely complete for Point-of-Sale participants. Tracking more complete information will make it easier to reach customers to assess their experience with FSP and identify potential improvements.

Create materials to educate customers about why LADWP promotes energy efficiency. One dealer indicated that suspicion about the utility's motives in promoting efficient equipment may prevent some customers from participating. Educational materials that raise customer awareness on the importance of energy efficiency and lend further credibility to LADWP's programs. This information could also be used by dealers to better field questions about the program from customers.

Consider creating follow-up materials on the importance of maintenance for continued efficient operation of equipment that could be shared with customers via mail, email or through dealers. These materials could remind customers of the importance of equipment maintenance and share the link to the CA Energy Wise website. This may help improve the energy and bill savings customers realize through the program and their experience with their new food service equipment, leading to greater satisfaction with the Food Service Program and higher potential for repeat participation or recommending the program to others.

Results from the nets savings analysis and data collected on equipment saturations support continuation of all incentives. ENERGY STAR food service equipment saturations were low and the estimate of free ridership from interviews with dealers support the continuation of incentives for all equipment types.

Consider adding a verification process to the program. During the Ex-Post analysis of savings, the Evaluator failed to confirm the installation of the equipment for two projects.

7 Food Service Program – Point-of-Sale

This chapter summarizes the impact evaluation of the Food Service Program Point of Sale (FSP POS) that LADWP offered customers during Fiscal Year 20/21 (FY 20/21 or Concurrent Year 1).

The primary objective of this evaluation was to calculate energy savings and peak demand reduction impacts attributable to the FSP POS, as well as to perform a process evaluation.

7.1 Program Performance Summary

FSP-POS is a new initiative from LADWP that transitions the food service rebates to an instant rebate from the participating retailer or distributor. This removes the need of a project rebate application from the purchaser. The program launched in August of 2019, and the results presented in this report summarize 10 months of participation.

7.1.1 Key Evaluation Takeaways

- FY 20/21 was the second year of FSP POS implementation, so program activity was higher than FY 19/20, with higher participation and higher energy savings; however, it is possible that the COVID-19 pandemic affected program participation to some degree.
- The overall program realization rate was 45%.
- LADWP should seek ways to expand the number of dealers participating in the FSP POS, including collecting and sharing testimonials from participating dealers and reducing rebate payout times.

7.2 Program Description

The FSP POS is a program designed to assist grocery stores (small to large), liquor stores, convenience stores, restaurants, and other commercial customers with food service equipment needs. A Point-of-Sale (POS) component was added in fiscal year 19/20 to enable customer to receive their rebate as a line item discount directly on their sales invoice for eligible equipment. The program targets the commercial market sector and is managed in collaboration with SoCal Gas. Some of the program offerings include discounts on ice machines, refrigerators/freezers, and commercial ovens.

Table 7-1 FSP POS Ex-Ante Savings Summary

Fiscal Year	Number of Projects	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	92	120,591	15.85

Table 7-2 summarize the measures installed and ESP Ex-Ante kWh savings by measure.

Table 7-2 FSP POS ESP Data Ex-Ante Savings by Measure

Measures	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
Ice Machine	4,339	0.57
Convection Oven	11,750	1.54
Hot Food Holding Cabinet	21,352	2.81
Steamer	37,443	4.92
Refrigerator/Freezer	45,706	6.01
Total	120,591	15.85

7.3 Methodology

This section presents the findings of the tracking data review and the methodology used to calculate verified Ex-Post energy savings and peak demand reduction for the program. As part of the impact evaluation, the Evaluator performed the following data collection activities outlined in Table 7-3.

Table 7-3 FSP POS Data Sources for Impact Evaluation

Data	Source
Program Tracking Data	Data requested to LADWP for all data tracking program participation
Desk Review	Reviews of project documentation of a sample of customers who have participated in the program
On Site Verification	Site visits of a sample of customers to collect data for savings calculation, to verify installation, and determine operating parameters

LADWP provided the Evaluator the available program tracking data for rebated measures. The evaluation methodology consisted of the following key components,

- Tracking data review
    - The database review process started with a tracking data review to ensure that the data provided sufficient information to calculate energy savings and peak demand impacts.
- M&V sample design
    - A random stratified sampling plan was developed using FSP POS program data. The resulting sample of 8 projects consisted of 3 categories, or strata. The sample precision based on Ex-Post annual energy savings (kWh) was ±33.5%

- Algorithms and references
  - Generally, savings were determined utilizing Database for Energy Efficiency Resources (DEER) workpapers, project documentation, and information gathered during the site verification.
- M&V approach
  - The Evaluator obtained the primary data needed to calculate savings impacts with verification visits, for a sample of sites. The site visits were used to verify installation, collect data regarding hours of operation, and other parameters that affected energy savings calculations.

A detailed evaluation methodology can be found in Appendix A, section A.6.1.

7.4 Impact Evaluation

Ex-Post kWh savings and peak kW reduction were calculated using the appropriate DEER workpapers. Critical input parameters were based on information collected during site verification or the available project documentation. The impact evaluation consisted of the following key components:

- Engineering review procedures
  - Available documentation was reviewed for a sample of projects, with attention given to model numbers, ENERGY STAR rating, invoices, and unit specifications. Analysis of FSP POS energy savings was performed using the Evaluator's custom-designed food service evaluation tool with system parameters (unit efficiencies, unite size/capacity, operating characteristics, etc.) based on information either collected in person, referenced in project documentation, DEER workpapers, or specification sheets.
- Several factors affected realized savings. A description of factors affecting gross realized savings are provided below.
  - Equipment In-Service Rate: There were instances where the equipment was not presently installed during the Evaluator site visit. As such, these units were deemed to have zero energy savings.
  - Differing Efficient Parameters: Ex-Post calculations utilized purchased unit's specifications such as volume, idle energy rates, cooking efficiencies, and production capacities in lieu of default DEER work paper values used in the Ex-Ante estimate.
  - Differing Hours of Operation: The verified operating hours of use were less than the default DEER workpaper values used in the Ex-Ante estimate.

A detailed impact evaluation can be found in Appendix A, section A.6.2.

7.5 Ex-Post Gross Savings

This section presents Ex-Post gross savings for FSP POS. Table 7-4 compares Ex-Post energy impacts to Ex-Ante claimed savings from the tracking data. For the concurrent period, the program level Ex-Post energy savings realization rate was 56% when comparing to tracking data Ex-Ante savings.

Table 7-4 FSP POS Evaluation Results by Strata

Stratum	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
1	29,210	26,234	90%
2	23,418	10,521	45%
3	43,177	17,196	40%
Total	95,805	53,952	56%

The program level realization rate of 56% was driven by Projects 2, 3, 4, and 5 as seen below in Table 7-5. Projects 2 and 5 were sites where the incentivized equipment was not present during the Evaluator's site visit. The Evaluator was unable to evaluate savings on these units and it cannot be proven that the equipment was installed within the LADWP territory.

Project 3 was a hot food holding cabinet site where the Evaluator used the purchased unit's volume of 18 cu. ft. in lieu of the default DEER workpaper value of 25 cu. ft.

Project 4 was a steamer project where it was confirmed during the site visit that the annual operating hours (207) of the unit were significantly less than the default DEER workpaper value (2873).

Table 7-5 FSP POS Sampled and Non-Sampled Project Savings

Project	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Project 1	9,361	10,689	114%
Project 2	3,357	0	0%
Project 3	3,203	2,342	73%
Project 4	18,722	766	4%
Project 5	2,135	0	0%
Project 6	931	856	92%
Project 7	1,068	1,439	135%
Project 8	259	213	82%
Non-sampled Projects	56,769	37,647	66%
Total	95,805	53,952	56%

Table 7-6 shows overall Ex-Post energy savings and peak demand impacts for FSP POS compared to ESP savings. The overall kWh realization rate is 45%.

Table 7-6 FSP POS Evaluation Results

Fiscal Year	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
FY 20/21	120,591	53,952	45%	15.85	7.31	46%

7.5.1 COVID-19 Impacts on Energy Use

The Evaluator found that the sites remained opened during FY 20/21. None of the sample sites expressed any impact due to COVID-19 during FY 20/21. A sampled site communicated they opened during the COVID-19 era and hours of operation remained unchanged. Additionally, energy savings calculations for measures such as Refrigerators are only dependent on the size of the unit, and Refrigerators made up roughly half of the incentivized equipment.

7.6 Process Evaluation

The following is a summary of the process evaluation approach and methodology for FSP POS.

- Document Review
    - The Evaluator reviewed all available program documentation for the Comprehensive and POS programs, including outreach and marketing materials, point-of-sale materials, process flow charts, application forms, organization charts, and process and operations manuals.
- Staff Interviews
    - The Evaluator completed two 60-minute phone interviews: one with LADWP program staff, covering both the Comprehensive and POS program, and one with Energy Solutions, covering just the POS program.
- Qualified Dealer Interviews
    - The Evaluator conducted 30-45 minute interviews with qualified dealers participating in the POS FSP.
- Participant Survey
    - The Evaluator administered a 15-minute phone and web-based survey to FY 20/21 participants in the Comprehensive and POS Food Service programs.
    - Surveys collected information on customer awareness, motivations, barriers, and satisfaction with the program, as well as to understand policies, processes, and decision making related to the installation of efficient equipment.
- Tracking Data Review
    - The Evaluator reviewed tracking data to characterize participation, costs, savings, and participant characteristics.

A detailed process evaluation for the Food Service Comprehensive and Point of Sale Programs are combined and reported in section A.6.3.

7.7 Cost Effectiveness Results

Table 7-7 presents benefits, costs, and the results of cost-effectiveness testing for the FSP POS.

Table 7-7 FSP POS Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$33,765	$33,765	$163,319	$33,765	$33,765
Total Costs	$250,636	$203,038	$6,732	$359,625	$203,038
Benefit/Cost Ratio	0.13	0.17	24.26	0.09	0.17

7.8 Program Key Findings and Recommendations

The Evaluator offers the following key findings and summarized recommendations for FSP POS. Detailed recommendations are provided in Section 6.8.

Key Findings:

- Ensure incentivized equipment is ENERGY STAR certified.
- The program should utilize installed unit specific specifications in leu of default DEER workpaper values. For kitchen equipment, it is important to document actual cooking metrics and equipment sizes. Installed unit specific parameters such as unit volumes and cooking efficiencies are present in available documentation such as the LADWP qualifying equipment list.

Recommendations:

- Given the lasting impacts of the pandemic, particularly supply chain issues, consider targeted marketing to boost participation to achieve program goals.
- Seek ways to expand the number of dealers participating in the FSP POS, including collecting and sharing testimonials from participating dealers and reducing rebate payout times.
- Continue working to identify opportunities to address the signature requirement, which directly affects participation.
- Track metrics to assess the building types and organization size of businesses participating in the FSP.
- Ensure contact name, contact email, and phone number is tracked for all participants in the FSP.
- Create materials to educate customers about why LADWP promotes energy efficiency.

- Consider creating follow-up materials on the importance of maintenance for continued efficient operation of equipment that could be shared with customers via mail, email or through dealers.

Detailed recommendations for the Food Service Comprehensive and Point of Sale are combined and reported in section A.6.3.

8 LADWP Facilities Program

This chapter summarizes the impact evaluation of the LADWP Facilities Program that LADWP offered customers from fiscal year 2020 through 2021 (FY 20/21 or Concurrent Year 1).

The primary objective of this evaluation was to estimate energy and peak demand impacts attributable to the LADWP Facilities Program as well as to complete a process evaluation.

8.1 Program Performance Summary

The LADWP Facilities Program was established in 2009 in response to the City of Los Angeles Green LA Directive. The program provides funding for direct install improvements for LADWP facilities, from which operational cost reductions then become ratepayer benefits.

8.1.1 Key Evaluation Takeaways

- The overall program realization rate was 69%.
- Program administration is migrating to electronic and online format, and there are plans to identify a program manager to aid in energy efficiency project implementation; a program manager will help advocate for continued prioritization of energy efficiency within LADWP facilities.
- There are still opportunities for lighting upgrades and integration of building controls.

8.2 Program Description

The LADWP Facilities Upgrade Program was established in 2009 in response to the City of Los Angeles Green LA directive. The program reduces energy and water consumption in LADWP facilities through energy efficiency and water conservation measures. The program is designed to provide technical design, project management experience and expertise in retrofitting LADWP facilities, with high efficiency HVAC equipment, lighting fixtures, plumbing fixtures, irrigation equipment and California Friendly landscaping utilizing LADWP engineering staff. Table 8-1 summarizes the program's ESP Data Ex-Ante energy savings and peak demand reduction during fiscal year 2020/21.

Table 8-1 LADWP Facilities Retrofit Program Ex-Ante Savings Summary

Fiscal Year	Number of Projects	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	3	969,545	152.63

8.3 Methodology

This section presents the finding of the tracking data review and the methodology used to calculate verified Ex-Post energy savings and peak demand reduction for the program.

As part of the impact evaluation, the Evaluator performed the following data collection activities outlined in Table 8-2:

Table 8-2 LADWP Facilities Data Sources for Impact Evaluation

Data	Source
Program Tracking Data	Data requested to LADWP for all data tracking program participation
Desk Review	Reviews of project documentation (Review of lighting fixture inventory and control types) of projects who have participated in the program
On Site Verification	Site visits of projects to collect data for savings calculation, to verify installation, and determine operating parameters

LADWP provided the Evaluator the available program tracking data for rebated measures. The evaluation methodology consisted of the following key components,

- Tracking data Review
  - The database review process started with tracking data review to ensure that the data provided sufficient information to calculate energy and peak demand impacts.
- M&V sample design
  - The FY 20/21 LADWP Facilities program included three projects. For such a small population, the census sample was considered for evaluation.
- Algorithms and references
  - Generally, for projects involving lighting measures, savings were determined utilizing Database for Energy Efficiency Resources (DEER) workpaper algorithms and interactive effects. If applicable DEER workpapers hours were used.
- M&V approach
  - The Evaluator obtained the primary data needed to calculate energy savings impacts with on-site verification visits of participant sites. The site visits were used to verify installation, collect data regarding hours and HVAC system information, and other parameters that affected savings calculations. Information on hours of use due to COVID-19 was also collected to quantify COVID-19 impacts.

A detailed evaluation methodology can be found in Appendix A, section A.7.1.

8.4 Impact Evaluation

Ex-Post kWh savings and peak kW reduction were calculated using the appropriate DEER workpapers and other proven industry techniques. Important input parameters were based on information collected during on-site verifications or available project documentation. The impact evaluation consisted of the following key components,

- Engineering review procedures
  - Analysis of lighting savings was accomplished using the Evaluator's custom-designed lighting evaluation model with system parameters (fixture wattage, operating characteristics, etc.) based on information either collected in person, referenced in project documentation or DEER workpapers and, if appropriate, referencing industry standards.
- Description of factors affecting gross realized savings
  - Difference in hours of use (HOU)
  - Difference in analytical approach
  - Clerical errors

A detailed impact evaluation can be found in Appendix A, section A.7.2.

8.5 Ex-Post Gross Savings

This section presents Ex-Post gross savings for the LADWP Facilities Program. *Table 2-4* Table 8-3 compares Ex-Post energy impacts to Ex-Ante claimed savings from the tracking data for sampled sites only and Table 8-4 compares Ex-Post energy impacts to Ex-Ante claimed savings from the tracking data for the Fiscal year 20/21. For FY 20/21, the program level Ex-Post energy savings realization rate was 79% when comparing to tracking data Ex-Ante savings.

Table 8-3 LADWP Facilities Census Project Savings

Project	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Project 1	438,382	353,466	81%
Project 2	329,280	245,392	75%
Project 3	74,278	69,351	93%
Total	841,940	668,209	79%

Table 8-4 LADWP Facilities Evaluation Results

Fiscal Year	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
FY 20/21	969,545	668,209	69%	152.63	105.19	69%

8.5.1 COVID-19 Impacts on Energy Use

The COVID-19 impacts were calculated based on the information provided by the site contact. According to the site contact, during FY 20/21, there has been no impact on lighting operating hours during the COVID-19 period. Therefore, the COVID-19 savings are same as typical 1st year Ex-post Gross savings.

8.6 Process Evaluation

The Evaluator completed a process evaluation of the LADWP Facilities Program that included an interview with the acting Program Supervisor.

The Evaluator applied a deemed net-to-gross ratio of 1.0 to the program because the LADWP is using program dollars to fund improvements in the facilities and would not likely have access to other funds to make these improvements.

The key findings are presented below. A detailed process evaluation can be found in Appendix A, section A.7.3.

- Lighting audits and completed projects address energy reduction targets and impacts on working conditions and safety. Program staff review which building-type is used in order to design the lighting projects in addition to considering factors such as occupancy, hours of operation, and the type of work done in the facility.
- The program tries to standardize lighting projects to facilitate equipment procurement and installation, however supply chain disruptions have made this more difficult.
- Project tracking is largely a paper process, but recently the program has moved to electronic project tracking.
- The program does not currently have a permanent program manager who could assist with prioritizing lighting projects.

8.7 Cost Effectiveness Results

Table 8-5 presents benefits, costs, and the results of cost-effectiveness testing for the LADWP Facilities Program.

Table 8-5 LADWP Facilities Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$503,590	$503,590	$1,453,981	$503,590	$503,590
Total Costs	$1,936,099	$1,985,123	$49,023	$3,390,081	$1,985,123
Benefit/Cost Ratio	0.26	0.25	29.66	0.15	0.25

8.8 Program Key Findings and Recommendations

Although the ex-ante does provide a spreadsheet calculator, the exact source of error is hard to determine as the scope of this calculator is limited since the calculations use different methods of calculating savings and demand reduction. Several reasons make up the difference; a difference in wattages of both baseline and efficient measures, a difference in reduction of output of the new fixtures used in the ex-ante, and a difference in the hours of use. The Ex-Ante calculator calculates savings using the expected life of the fixture, resulting in lifetime savings for the new fixture. To calculate the savings per year the Ex-Ante calculator divides total lifetime savings by the measure EUL, which results in more than 8,760 hours of operation per year and therefore indicates an error in the Ex-Ante calculation.

There was no change in lighting operation reported during the COVID-19 Era; therefore, there was no difference in savings during COVID-19 Era vs. Ex-post savings under normal operation.

The Evaluator offers the following recommendations for the LADWP Facilities program:

- Evaluation results indicate some impacts from differing hours of operation, incorrect analytical approaches, analysis errors, or baseline assumptions. A relatively low annual energy savings realization rate is due to a combination of these factors.
- Most LADWP facilities projects were missing detailed savings analyses, conducted throughout the application process. ADM re-generated Ex-Ante savings based on the available information. For the lighting retrofit projects, calculation of fixture connected load (kW), corresponding hours of use and resulting electricity consumption should have been provided. For the fixtures using lighting controls, the factors used to adjust the hours of use were also desired. Information on whether or not interactive effects were taken into consideration while estimating the savings would have been useful. Detailed calculations and organization of documentation reduces savings discrepancies and resources for future inquiries. Structured identification of analysis files associated with filed results provides a clean documentation trail.

LADWP should identify a permanent Program Manager as soon as can be done practically. A permanent Program Manager is needed to advocate for greater prioritization of lighting projects and facilitate communication between the Program and other LADWP administrative units.

LADWP should assess decision-making within, and communication across, administrative units to determine whether changes can be made to facilitate implementation of energy efficiency projects, and then should implement changes that can be feasibly carried out. Lack of prioritization of lighting upgrades may prevent or delay energy savings as well as create safety concerns. As an energy efficiency program administrator, LADWP should set an example by maintaining a high standard of energy efficiency in its facilities, and as a public entity, it should set the example of prioritizing worker safety and comfort.

9 LAUSD Direct Install Program

This chapter summarizes the impact evaluation of the Los Angeles Unified School District Direct Install (LAUSD DI) Program that LADWP offered customers from fiscal year 2020 through 2021 (FY 20/21 or Concurrent Year 1).

The primary objective of this evaluation was to estimate energy and peak demand impacts attributable to the LAUSD DI Program as well as to complete a process evaluation.

9.1 Program Performance Summary

LAUSD-DI targets facilities within the Los Angeles Unified School District with electric, water, and gas saving measures. LAUSD-DI was launched in 2012 in response to budget challenges faced by LAUSD, and the program also provided technical and project management assistance to facilitate project completion.

9.1.1 Key Evaluation Takeaways

- LAUSD DI activity was not substantially affected by the COVID-19 pandemic.
- The overall program realization rate was 106%.
- There is effective and constant communication between LAUSD Staff, LADWP program managers, and Willdan (the implementation contractor), which keeps energy efficiency projects on track to completion and ready for the next phase of implementation.

9.2 Program Description

The LAUSD DI Program was launched in October 2012 in response to the opportunities for realizing energy savings and improving water efficiency within the District, the budget challenges facing the District and improving the financial standing of the District and enhancing the learning environment for LAUSD students. The initial program was designed to provide technical design and project management experience, and to provide retrofit installation of lighting, HVAC, water and natural gas measures, utilizing LADWP engineering and PCM staff, and through partnering with SoCalGas. The program entered a dormant period in FY 15-16 and was relaunched in May of 2016 with a focus on lighting equipment. This chapter presents the results from the projects completed in FY 20/21.

Table 9-1 LAUSD DI Ex-Ante Savings Summary

Fiscal Year	Number of Projects	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	37	5,348,832	560.17

9.3 Methodology

This section presents the findings of the tracking data review and the methodology used to calculate verified Ex-Post energy savings and peak demand reduction for the program.

As part of the impact evaluation, the Evaluator performed the following data collection activities outlined in Table 9-2:

Table 9-2 LAUSD DI Data Sources for Impact Evaluation

Data	Source
Program Tracking Data	Data requested to LADWP for all data tracking program participation
Desk Review	Reviews of project documentation (Review of lighting fixture inventory and control types) of a sample of customers who have participated in the program
On Site Verification	Site visits of a sample of customers to collect data for savings calculations, to verify installation, and determine operating parameters

LADWP provided the Evaluator the available program tracking data for rebated measures. The evaluation methodology consisted of the following key components:

- Tracking data Review
  - The database review process started with review of tracking data to ensure that the data provided sufficient information to calculate energy and peak demand impacts.
- M&V sample design
  - A random stratified sampling plan was developed using program data. The resulting sample of 5 projects consisted of 5 strata.
- Algorithms and references
  - Generally, for projects involving lighting measures, savings were determined utilizing Database for Energy Efficiency Resources (DEER) workpaper algorithms and interactive effects. If applicable, DEER workpapers hours were used.
- M&V approach
  - The Evaluator obtained the primary data needed to calculate savings impacts with on-site verification visits, for a sample of sites. The site visits were used to verify installation, collect data regarding lighting hours of operation, HVAC systems, and other parameters that affect energy savings calculations. Information on hours of use due to COVID-19 was also collected to quantify COVID-19 impacts.

A detailed evaluation methodology can be found in Appendix A, section A.8.1.

9.4 Impact Evaluation

Ex-Post kWh savings and peak kW reduction were estimated using the appropriate DEER workpapers and other proven industry techniques. Important input parameters were based on information collected during on-site verifications or available project documentation. The impact evaluation consisted of the following key components:

- Engineering review procedures
  - Analysis of lighting savings was accomplished using the Evaluator's custom-designed lighting evaluation model with system parameters (fixture wattage, operating characteristics, etc.) based on information either collected in person, referenced in project documentation or DEER workpapers and, if appropriate, referencing industry standards.
- Description of factors affecting gross realized savings
  - The primary factor affecting the project realization rate for this measure was Differing Hours of Operation.

A detailed impact evaluation can be found in Appendix A, section A.8.3.

9.5 Ex-Post Gross Savings

This section presents Ex-Post gross savings for the LAUSD DI program. Table 9-3 compares Ex-Post energy impacts to Ex-Ante claimed savings from the tracking data for sampled sites only. For FY 20/21, the program level Ex-Post energy savings realization rate was 106% when comparing to tracking data Ex-Ante savings.

Table 9-3 LAUSD DI Evaluation Results by Strata

Stratum	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
1	66,206	78,009	118%
2	153,953	161,263	105%
3	196,955	215,316	109%
4	311,533	335,121	108%
5	506,115	521,419	103%
Total	1,234,762	1,311,129	106%

Table 9-4 compares Ex-Post energy impacts to Ex-Ante claimed savings from the tracking data by sampled project, and for the program overall. For FY 20/21, the program level Ex-Post energy savings realization rate was 107% when comparing to tracking data Ex-Ante savings. Table 9-5 presents comparisons of Ex-Ante and Ex-Post energy savings and peak demand reduction for the fiscal year.

Table 9-4 LAUSD DI Sampled and Non-Sampled Project Savings

Project	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Project 1	506,115	521,419	103%
Project 2	311,533	335,121	108%
Project 3	196,955	215,316	109%
Project 4	153,953	161,263	105%
Project 5	66,206	78,009	118%

Project	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Non-sampled Projects	4,053,303	4,360,778	108%
Total	5,288,066	5,671,907	107%

Table 9-5 LAUSD DI Evaluation Results

Fiscal Year	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
FY 20/21	5,348,832	5,671,907	106%	560.17	594.00	106%

9.5.1 COVID-19 Impacts on Energy Use

The Evaluator found COVID-19 era impact as shown in Table 9-6. The COVID-19 impacts were calculated based on the information provided by the site contact. According to the site contact, during FY 20/21, there had been 90 % reduction in lighting usage in various areas. However, there were also many photocell-controlled fixtures which operated as normal during the COVID-19 era. Therefore, the overall impact was not as great as anticipated. Overall, the COVID-19 savings are estimated as 16% less than typical 1st year Ex-post gross savings.

Table 9-6 LAUSD DI COVID-19 Era Impact on Ex-Post Gross Energy Savings

Fiscal Year	Typical 1st Year Ex-Post kWh Savings (A)	COVID-19 Era Adjusted Annual Ex-Post kWh Savings (B)	COVID-19 Era Incremental Change Ex-Post kWh Savings (B-A)	COVID-19 Era % Change Ex-Post Savings [(B-A)/A]
FY 20/21	5,671,907	4,742,796	-929,111	-16.4%

9.6 Process Evaluation

The Evaluator completed a process evaluation of LAUSD DI Program that included the following activities:

The process evaluation for the LAUSD Direct Install (DI) Program consisted of an interview with the acting Program Supervisor, on September 21, 2021, and a Senior Project Manager for LAUSD on November 18, 2021.

The Evaluator interviewed LAUSD representatives to understand and assess the role of the program on the installation of the program lighting equipment.

The key findings are presented below. A detailed process evaluation can be found in Appendix A, section A.8.4.

- The program funds retrofits in approximately 12 schools per year. The schools consist of a mix of high schools, middle schools, and elementary schools.

- Projects are initiated with an audit that leads to a proposed retrofit with estimated energy savings and costs. The program supervisor reviews the cost and cost effectiveness and approves anything that costs $3/kWh or less.
- All sites receive a walk-through inspection to verify that the measures are installed and working.
- LAUSD is very pleased with the program and does not believe they could implement these retrofits without the assistance of the program.
- COVID-19 has increased installation costs because installations must be performed at night and contractors must sanitize the classrooms before they enter and leave a classroom.

9.7 Cost Effectiveness Results

Table 9-7 presents benefits, costs, and the results of cost-effectiveness testing for the LAUSD DI Program.

Table 9-7 LAUSD DI Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$3,707,933	$3,707,933	$21,242,980	$3,707,933	$3,707,933
Total Costs	$11,110,543	$1,925,427	$276,019	$22,892,388	$1,925,427
Benefit/Cost Ratio	0.33	1.93	76.96	0.16	1.93

9.8 Program Key Findings and Recommendations

Ex-post savings are slightly more than expected, mainly due to the difference in hours of lighting operation. The Ex-ante estimate uses estimated hours of use for all interior and exterior spaces at these facilities. The Ex-post calculations use hours of use which were verified during site visits performed by the Evaluator. Overall, a gross realization rate of 106% indicates that lighting fixtures operated and generated energy savings as expected.

The COVID-19 Era impacts were calculated based on the reduced hours of operation reported by the site contact. The analysis shows a reduction of 16% in energy savings during the COVID-19 Era compared to normal operation.

ADM offers the following recommendations for the LAUSD DI program:

- Evaluation results indicate some impacts from differing hours of operation. A slightly higher annual energy savings realization rate indicates equipment installation and operation performed as expected.
- LAUSD DI projects tend to have missing detailed calculations of energy savings throughout the CY1 Period. For the lighting retrofit projects, calculation of fixture connected load (kW), corresponding hours of use and resulting electricity consumption should have been provided. For the fixtures using lighting controls, the factors used to adjust the hours of use were also desired. Information on

whether or not interactive effects were taken into consideration while estimating the savings would have been useful. The Evaluator re-generated Ex-Ante savings based on the available information. Detailed calculations and organization of documentation reduces savings discrepancies and resources for future inquiries. Structured identification of analysis files associated with filed results provides a clean documentation trail.

The Evaluator offers the following combined key findings and recommendations for the LAUSD Program.

LADWP may consider asking the implementer to provide the Program Supervisor with direct access to project tracking data. The Program runs smoothly, and the implementer promptly provides the Program Supervisor with any requested information. It may be useful, however, for the Program Supervisor to have direct access to the implementer's project tracking system. This may allow the Program Supervisor to download information more frequently and provide broader QC opportunities.

If possible, LADWP may consider conducting some onsite inspections with its own staff to speed up that process. This may reduce delays in expense tracking, which may reduce the overall management load for the project. Limited school resources for onsite post-installation inspections create delays in contractor invoicing. This does not appear to affect program operations or installations but does delay expense tracking.

LADWP may consider adding a requirement that contractors submit invoices within a specified time after the completion of onsite inspections, with penalties for delay. This may reduce delays in expense tracking, which may reduce the overall management load for the project. Subcontractor delays in invoicing may occur for reasons other than limited school resources for onsite post-installation inspections. This does not appear to affect program operations or installations but does delay expense tracking.

10 Savings by Design / LADWP Zero by Design Program

This chapter presents an impact evaluation of the Savings by Design (SBD) program that LADWP offered customers during the fiscal year 20/21 (FY 20/21). No LADWP Zero by Design (LADWP ZBD) projects were completed in CY1. The primary objective of this evaluation was to estimate energy and peak demand impacts attributable to the SBD program. A brief summary process evaluation for LADWP ZBD is also provided.

10.1 Program Performance Summary

SBD is a statewide program model that provides incentives for new construction and modernization ("gut rehab") projects that exceed Title 24 energy code requirements. SBD has been discontinued by LADWP and is to be replaced with a new program design that is unique to LADWP.

10.1.1 Key Evaluation Takeaways

- SBD is sunsetting as a program and activity was also limited due to the COVID-19 pandemic.
- The overall program realization rate was nearly 161%.
- LADWP ZBD is taking the place of SBD; LADWP ZBD will have more flexible participation requirements, provide energy modeling assistance, and be more cost effective to implement, among other benefits.

10.2 Program Description

The non-residential SBD program provides incentives for New Construction or Modernization projects that exceed Title 24 energy standards. This evaluation represents projects completed in fiscal year 2020-2021. Table 10-1 summarizes the program's Ex-Ante energy savings and peak demand reduction for FY 20/21.

Table 10-1 SBD Program Ex-Ante Savings Summary

Fiscal Year	Number of Projects	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	4	233,010	51.10

10.3 Methodology

This section presents a summary of the methodology used to evaluate the SBD program. Ex-Post annual energy savings, lifetime energy savings, and peak demand reduction were determined using the methodologies described. A site-specific approach was used to determine Ex-Post site level impacts with extrapolation to the population based on the design of the SBD program. The methods employed included:

- Review of program tracking data for completeness and sampling;

- Project documentation review;
- Site-specific Measurement and Verification Plan (MV Plans);
- Primary data collection from site contacts;
- Engineering analysis for each sampled project; and
- Extrapolation of sample level results to determine program level impact estimates

A detailed evaluation methodology can be found in Appendix A, section A.9.1.

10.4 Impact Evaluation

This section presents findings from the determination of Ex-Post gross annual energy savings, lifetimes energy savings, and peak demand reduction through evaluation M&V efforts. Ex-Post kWh savings and peak kW reduction were estimated using proven industry techniques. Important input parameters were based on information collected during on-site verifications or available project documentation. The impact evaluation consisted of the following key components:

- Detailed program data review:
- Data collection and desk review activities; and
- Project-level impact evaluation.

A detailed evaluation methodology can be found in Appendix A, section A.9.2.

10.5 Ex-Post Gross Savings

Program level gross energy savings are the aggregation of the evaluated projects. Energy impacts were disaggregated by project type: new construction and modernization. Ex-Post Savings results are shown in Table 10-2.

Table 10-2 SBD Evaluation Results

Project Type	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
Modernization	32,002	32,100	100%	7.02	7.04	100%
New Construction	201,008	343,291	171%	44.08	75.28	171%
Total	233,010	375,391	161%	51.10	82.32	161%

While there appear to be stark differences in realization rates by project types, the driving forces of realization rate factors are the assumptions of modeled operating conditions resulting in load profile impacts. These differences can be the result of variances in operating conditions over time, in which evaluation has the opportunity to identify.

10.5.1 COVID-19 Impact on Energy Use

As these facilities evaluated were completed during the pandemic, variance as to how the facilities would operate in pre-pandemic conditions could not be quantified. The Evaluator has concluded that the typical year energy savings presented in Table 10-2 represent current and future operating conditions.

10.6 Process Evaluation

Due to the sunsetting of the SBD Program, a summary process evaluation was performed for the LADWP ZBD Program. To complete the summary process evaluation, the Evaluator reviewed the business plans and other relevant program materials and completed two interviews with LADWP program staff which provided background information on the program design and processes involved in the LADWP ZBD program.

The following are some key differences between the SBD and LADWP ZBD Program:

- LADWP ZBD provides additional flexibility in participation requirements, compared with SBD;
- LADWP ZBD provides energy modeling assistance, whereas SBD required participants to perform their own energy modelling;
- LADWP ZBD will be more cost-effective to administer;
- The LADWP ZBD program offers express and whole building tracks for customers; and
- LADWP ZBD is a more streamlined process, whereas the SBD application process could take several years to complete.

A full process evaluation for LADWP ZBD can be found in Appendix A, section A.9.3.

10.7 Cost Effectiveness Results

Table 10-3 presents benefits, costs, and the results of cost-effectiveness testing for the SBD Program.

Table 10-3 SBD Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$376,856	$376,856	$857,515	$376,856	$376,856
Total Costs	$1,647,695	$1,647,695	$106,831	$2,398,380	$1,647,695
Benefit/Cost Ratio	0.23	0.23	8.03	0.16	0.23

10.8 Program Key Findings and Recommendations

ADM offers the following key findings and recommendations for the SBD program:

- Evaluation results indicate annual energy savings have been impacted for these projects based on current operating conditions. Some findings indicate end-use load profile's that could only be identified over time as the facilities evolved into their current operating conditions. However, some findings may have been mitigated through further benchmarking of simulation results. Finding current and relevant benchmarking data is difficult, but when the California Commercial End

Use Study (CEUS) results become available they may present an opportunity to increase the accuracy of the simulations.

- Separate lighting analysis using the lighting power density methodology indicates that lighting consumption may deviate from the simulation. Simulations often batch space types in a manner that might not accurately represent as-built lighting conditions. When efficient lighting is a driver of energy savings it may be beneficial to perform a separate analysis or increase the detail of space types.
- Billing data is not always available through the LADWP web-portal. Increased access to billing data may provide for a more efficient means to calibrate energy simulations in the post period.
- Provided documentation for some projects appeared to inconsistently represent analysis versions. ADM recommends a project documentation tracking system in which the final documents, including energy simulation files, are properly labeled as such.
    - New Construction and Modernization projects require a high level of rigor for all stakeholders when energy simulations are conducted. It may be beneficial to perform a pre-analysis review of the facility to determine if an energy simulation is the most appropriate course of action to determine energy savings. Smaller projects might be identified as new construction lighting projects that would reduce the burden on stakeholders.

11 Upstream HVAC Program

This chapter summarizes the impact evaluation of the Upstream Heating Ventilation, and Air Conditioning (UHVAC) Program that LADWP offered customers during Fiscal Year 20/21 (FY 20/21 or Concurrent Year 1).

The primary objective of this evaluation was to estimate energy and peak demand impacts attributable to the UHVAC Program as well as to complete a process evaluation.

11.1 Program Performance Summary

UHVAC partners with distributors and manufacturers to provide incentives to upsell high efficiency HVAC equipment. The goal of this effort is to increase availability of and marketing for high efficiency options, so that this will facilitate equipment selection by contractors and end-use customers.

11.1.1 Key Evaluation Takeaways

- UHVAC activity did not appear affected by the COVID-19 pandemic in terms of energy savings realized, although program participants noted that the pandemic affected their participation in the program.
- The overall program realization rate was 55%.
- Market actors with a greater degree of involvement in the program expressed higher satisfaction with UHVAC.
- Market actors expressed interest in additional support from the program and the implementation team.

11.2 Program Description

Through an agreement with participating distributors and manufacturers, UHVAC provides incentives to participants to stock and upsell high efficiency HVAC equipment. Contractors and HVAC customers can then immediately access premium replacement technology that might not have been readily available to them without the program. The upstream approach allows LADWP to capture energy savings at the point of sale which would not have been applied for in LADWP's downstream programs. Table 11-1 presents the number of projects, Ex-Ante energy savings and peak demand reduction.

Table 11-1 UHVAC Ex-Ante Savings Summary

Fiscal Year	Number of Measures	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	1,293	8,927,912	2,364.23

In FY 20/21 the program included various types and sizes of heat pumps, unitary AC units, packaged AC units, and variable refrigerant flow (VRF) systems. Using the provided program data, the FY 20/21 evaluation included the equipment types summarized in

Table 11-2. A large proportion of program reported annual energy savings are from VRF systems.

Table 11-2 UHVAC Equipment Type Summary

Stratum	Count of Measures	Program Data Ex-Ante kWh Savings	Proportion of kWh Savings
AC < 5.4	515	1,140,804	13%
AC > 63.3	10	172,225	2%
AC 11.3-20.0	29	245,750	3%
AC 20-63.3	54	865,690	10%
AC 5.4-11.3	91	382,732	4%
ACC < 150	9	417,613	5%
ACC > 150	2	451,952	5%
Ductless Multi Split	3	2,964	0%
Multi-Family VRF > 80	35	230,650	3%
Single Phase < 5.4	32	84,628	1%
VRF < 80	127	2,723,655	30%
VRF > 80	135	1,515,891	17%
WCAC 5.4-11.3	1	2,591	0%
WSHP < 5.4	249	723,427	8%
WSHP 5.4-11.3	1	5,162	0%
Total	1,293	8,965,732	100%

11.3 Methodology

The concurrent impact evaluation consisted of a prescriptive savings approach with a thorough review of all available project documentation and customer data, followed by an analysis of energy savings methodologies. The prescriptive approach utilized applicable energy savings rates found in the Database for Energy Efficiency Resources (DEER) workpapers. Energy savings were also calculated using industry standard algorithms to benchmark results since some details are not available in the workpaper calculations. The approach can be summarized as:

- Tracking data review;
- Sample project database review;
- Sample measure and specification review;
- DEER Workpaper review and analysis;
- Industry standard analysis;
- Billing analysis; and
- COVID-19 impact analysis

The methodologies described in the chapter were used to estimate Ex-Post impact evaluation results for annual energy savings, peak demand reduction, and lifetime energy savings. A detailed evaluation methodology can be found in Appendix A, section A.10.1.

11.4 Impact Evaluation

The Evaluator conducted an impact evaluation to determine Ex-Post annual energy savings, peak demand reduction, and lifetime energy savings for FY 20/21. The Evaluator incorporated the methodologies described in the previous section. Energy savings calculation results were reported by measure type. A detailed impact evaluation can be found in Appendix A, section A.10.2.

11.5 Ex-Post Gross Savings

The Evaluator determined the extrapolation of sampled Ex-Post gross energy savings based on the use of appropriate DEER workpapers to present program level Ex-Post gross savings results. The evaluation sample was based on estimating precision based on requirements for FY 20/21, FY 21/22, and FY 22/23. Precision is determined through ratio estimation of a randomly chosen stratified sample. Sample stratification was applied based on equipment type (AC, HP, VRF) as well as measure level program tracking data line item Ex-Ante annual energy savings. Evaluation sample results presented by tracking data "Model Type" are shown in Table 11-3. The extrapolated results are presented with a +/- 19.43% precision at a 90% confidence interval.

Table 11-3 UHVAC Detailed Ex-Post Gross Results by Model

Model Type	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
AC < 5.4	1,140,804	366,993	32%
AC > 63.3	172,225	46,205	27%
AC 11.3-20.0	245,750	60,680	25%
AC 20-63.3	865,690	216,612	25%
AC 5.4-11.3	382,732	94,437	25%
ACC < 150	417,613	110,371	26%
ACC > 150	451,952	123,219	27%
Ductless Multi Split	2,964	1,600	54%
Multi-Family VRF > 80	230,650	208,585	90%
Single Phase < 5.4	84,628	31,129	37%
VRF < 80	2,723,655	2,284,159	84%
VRF > 80	1,515,891	1,063,570	70%
WCAC 5.4-11.3	2,591	663	26%
WSHP < 5.4	723,427	269,215	37%
WSHP 5.4-11.3	5,162	2,080	40%
Total	8,965,732	4,879,518	54%

Table 11-4 shows results simplified into three equipment type categories.

Table 11-4 UHVAC Evaluation Results

Equipment Type	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
AC	3,726,164	786,995	21%	967.83	204.41	21%
HP	731,552	536,209	73%	190.01	139.27	73%
VRF	4,470,196	3,556,314	80%	1,206.39	959.76	80%
Total	8,927,912	4,879,518	55%	2,364.23	1,303.44	55%

11.5.1 COVID-19 Impacts on Energy Use

During the pandemic, advice was provided by government and trade organizations to increase supply air ratios at businesses. At the same time, businesses were instructed to close their doors to customers and in some instances shut down all operations. It was expected that the influence of the pandemic would have mixed results on energy consumption based on the facility type.

The Evaluator selected ten random participant addresses from the program year to analyze the impact of COVID-19 on annual energy consumption for those sites. Hourly billing data was used for linear regression analysis to quantify the impact. The selected addresses included office space, retail, a school, and a hospital.

Linear regressions were run for billing data at each address from 3/31/2019 through 4/18/2021 (based on consistent available billing data). Parameters considered included weather (HDD and CDD), efficient mechanical system installation date (binary variable), weekday type, a binary COVID-19 flag starting on 3/17/2020, and non-routine adjustments as necessary. Regression coefficients were applied to TMY3 weather data (either Burbank/Glendale/Pasadena, Jack Northrop Field, or Fullerton Municipal) to determine a normalized non-COVID-19 annual energy consumption and a normalized COVID-19 annual energy consumption.

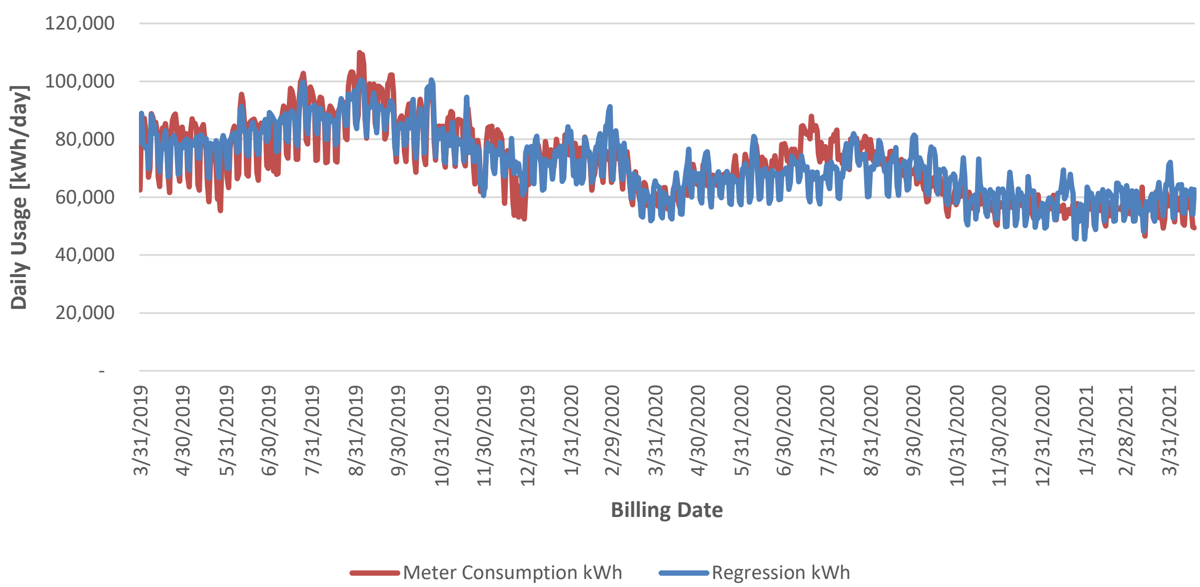
Regression results for three of the ten locations were not statistically significant. Regressions could not be further improved without interviewing a site contact. The remaining seven locations were considered adequate based on the COVID-19 parameter t-stat. Billing data for the seven sites was aggregated to run a single regression to represent an overall COVID-19 impact on energy consumption. These results show a 9% decrease in annual energy consumption with statistical significance. Each site's regression results are shown in Table 11-5.

Table 11-5 UHVAC Site Level COVID-19 Regression Results

Site	Normalized Annual Consumption Reduction	Regression Analysis R^2	COVID-19 Parameter t-stat
Office & Retail	37%	74%	(27.47)
Medical Institution	5%	81%	(8.71)
Office	16%	72%	(21.66)
School Building	20%	61%	(21.49)
Retail	13%	75%	(9.57)
Office	32%	81%	(32.69)
Office	13%	67%	(22.32)
Aggregated	9%	78%	(3.45)

The regression estimate versus aggregated billing data for the seven sites is shown in Figure 11-1. One will notice that the regression provides a similar load profile and demonstrates the overall reduction in the COVID-19 Era. This regression meets the requirements of ASHRAE Guide 14. In addition to the statistics shown, the CVRMSE is 8%.

Figure 11-1 UHVAC Billing Data versus COVID-19 Regression Estimates



As reduction in consumption is shown throughout the year with a reduced summer peak, it can be assumed that the reduction in consumption correlates to a reduction in annual energy savings. However, this is not verifiable without the use of submetering of mechanical systems. While a larger percentage of fresh air is recommended during the COVID-19 Era, most facility types have seen a reduction in occupancy hours. This has resulted in reduced cooling demand. Impacts on program level annual energy savings are shown in Table 11-6.

Table 11-6 UHVAC COVID-19 Era Impact on Ex-Post Gross Energy Savings

Billing Analysis Measures	Typical 1st Year Ex-Post kWh Savings (A)	COVID-19 Era Adjusted Annual Ex-Post kWh Savings (B)	COVID-19 Era Incremental Change Ex-Post kWh Savings (B-A)	COVID-19 Era % Change Ex-Post Savings [(B-A)/A]
Total	4,879,518	4,455,215	424,303	8.7%

11.6 Process Evaluation

The Evaluator completed a process evaluation of UHVAC that included the following activities:

- Reviews of program documents and lists of participating distributors and manufacturers
- Interviews with program staff
- Interviews with participating distributors and manufactures

Net savings were estimated using data obtained from the interviews with distributors and manufacturers.

The key findings are presented below.

- Overall, the UHVAC participation and application process is streamlined. The program leverages an online tool and requires relatively few inputs. The inputs needed are essential from the perspective of estimating savings and ensuring that the sale is made to an LADWP customer and include equipment specification and quantities, as well as building location. The program does not require an account or a customer signature (as is required by the LADWP point-of-sale food services program).
- Program staff has considered making equipment installation verification a requirement for the program but noted that this has been difficult because the customer may not be aware that they have participated in an LADWP sponsored program.
- The COVID-19 pandemic impacted program participation and the commercial HVAC market in general.
- Participating distributors who were more active in the program also tended to be more satisfied with the program than the less active distributors.
- Distributors believe that the program works best for plan and spec projects that allow for time to establish site and equipment eligibility, and determine the incentive amounts. The program is less well suited for emergency replacements.

- The LADWP incentives are higher than the statewide incentives but do not affect stocking decisions, which are more likely to be based on the statewide program equipment list.
- The LADWP incentives support VRF installations in the region, which are not covered under the statewide program.
- The participating market actors reported an interest in increased communication and program support. Participating market actors also reported varying levels of support from the Energy Solutions team. For example, one dealer noted that the ES team would provide them a clear list of what products were eligible for the rebates, while another distributor noted that they had to put it in the systems and check manually to see if a particular product was eligible.
- Procedures are in place to ensure that UHVAC project savings are not counted in a downstream program and that the installation location receives service from LADWP.

A detailed process evaluation can be found in Appendix A, section A.10.3.

11.7 Cost Effectiveness Results

Table 11-7 presents benefits, costs, and the results of cost-effectiveness testing for the UHVAC Program.

Table 11-7 UHVAC Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$6,184,146	$6,184,146	$13,455,609	$6,184,146	$6,184,146
Total Costs	$2,798,916	$1,567,617	$518,029	$14,505,197	$1,567,617
Benefit/Cost Ratio	2.21	3.94	25.97	0.43	3.94

11.8 Program Key Findings and Recommendations

The Evaluator found annual energy savings to be reduced from Ex-Ante estimates. Based on the structure of the Upstream HVAC program, baseline condition is not recorded. Therefore, the Evaluator found it necessary to determine annual energy savings as the difference from energy code baseline to the efficient condition. The value of this difference has been determined based on savings rates provided by DEER workpapers. Additionally, the Evaluator made minor updates to energy savings calculation inputs based on a sample of measures reviewed. Inputs in addition to replacement type that may have impacted energy savings include equipment specifications (efficiency and capacity), facility type, climate zone, savings rate selection within the DEER workpaper, and appropriate selection of DEER workpaper.

The Evaluator provides the following recommendations:

- The design of the program and implementation strategy may want to consider the advantages and disadvantages of capturing replacement type. While necessitating further information collected on the baseline condition, it presents the opportunity to capture additional energy savings.

- Proper selection of applicable workpaper can be complicated. During concurrent evaluation periods, the Evaluator recommends that the implementer work with the evaluator to ensure consistency in workpaper selection.
- The program remains to see large participation with VRF equipment. The DEER workpapers for VRF systems do not include a wide range of facility types to apply accurate energy savings rates. The workpapers state that additional energy simulations for VRF systems are available upon request but ADM has so far been unable to acquire these models. Acquisition of these energy models may support accurate energy savings estimates for future participants.
- As baseline conditions become more efficient, better-than-code systems will continue to increase in complexity. The program already sees large participation in VRF systems. It is important that contractors maintain the knowledge and ability to support better-than-code systems such that the program continues to be a benefit. For example, VRF air cooled AC systems saw an increase in baseline IEER from the 2016 energy code to the 2019 energy code.

Create additional opportunities for connection with market actors. We heard from market actors that they are interested in additional conversation and support from the program and the implementation team. Several market actors requested more two-way communication to understand the rationale for why incentives change or measures were dropped and/or to be able to provide recommendations around measure mix. While the evaluation team understands that the decisions around measure eligibility and incentive amount have to do with broader portfolio planning and cost-effectiveness, the upstream program relies on the participating market actors as partners, and this feedback suggests that there is opportunity to cultivate an experience of partnership across participating market actors.

- For example, customers expressed a desire for additional communication around incentive values and any upcoming changes to incentives.
- Several market actors shared experiences where they bid on a project with the expectation of an incentive for a given piece of equipment, but by the time the equipment was installed, the incentive amount had decreased, or the equipment was no longer eligible for a program incentive. The program may consider providing a larger window of notice around upcoming changes to the incentive amount or measure mix.

Assess program process to ensure that the experience is similar for high and low participating market actors. The interviews with market actors suggest that there are significant differences in the level of support and interaction market actors experience from the program administration team. In our interviews, these differences were correlated with level of participation, where more highly participating market actors expressed greater support and interaction from the ES team than did less frequent participating market actors.

12 Consumer Rebate Program

This chapter presents an evaluation of the Consumer Rebate Program (CRP) that LADWP offered customers during fiscal year 20/21 (FY 20/21 or Concurrent Year 1).

The primary objective of the evaluation was to estimate energy savings and peak demand reduction attributable to CRP, as well as perform a process evaluation.

12.1 Program Performance Summary

The CRP provides prescriptive incentives for a range of residential home energy improvements, including attic insulation, pool pumps, heating and cooling system replacement, cool roofs, dual pane windows, and appliances.

12.1.1 Key Evaluation Takeaways

- CRP activity did not appear to be impacted by the COVID-19 pandemic.
- The overall program realization rate was nearly 83%.
- Program participants reported being highly satisfied with the program and with individual program components.
- The CRP Fact Sheet could be expanded to include benefits messages tailored to each measure offered and to help customers move forward with equipment purchases.

12.2 Program Description

The CRP provides incentives to residential customers to promote the use of energy efficient products. Applications can be completed online or mailed, with proof of purchase and additional documentation.

The Ex-Ante savings for the CRP program are listed in Table 12-1.

Table 12-1 CRP Ex-Ante Savings Summary

Measure	Number of Orders	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
Attic Insulation	19,897	3,869,182	1,764.93
Central Air Conditioner	227	92,123	42.02
Central Heat Pump	26	11,448	4.53
Cool Roof	487	624,801	285.00
Dual Pane Skylights & Windows	39	4,373	1.99
Pool Pump and Motor	4,720	3,952,326	747.79
Whole House Fan	2	848	0.16
Total	25,398	8,555,101	2,846.43

12.3 Methodology

The gross energy savings were determined by billing analysis or TRM-based savings algorithms for the measures listed in Table 12-2. The ISR was determined by both field site visits and completed participant surveys. A detailed description for the evaluation methodology for the CRP is found in Section A.11.1.

Table 12-2 CRP Evaluation Methodology by Measure

Measure	Savings Calculation Method	Site Visits	Completed Participant Surveys
Attic Insulation	Billing Analysis	4	136
Cool Roof	Billing Analysis	-	37
HVAC	Billing Analysis	4	13
Variable Speed Pool Pump/Motor	Billing Analysis	17	97
Energy Star Windows	Engineering Calculation	-	1
Whole House Fan	Engineering Calculation	-	0

12.4 Impact Evaluation

Energy savings for attic insulation, central air conditioner, central heat pump, cool roof and pool pumps were determined by billing analysis. The energy savings for dual pane windows were calculated by the CMUA measure, “Energy Efficient Measures,” and the whole house fan savings by the Database for Energy Efficiency Resources (DEER) Resources measure, “Whole House Fan, Residential.” A detailed impact evaluation is found in Appendix A, section A.11.2.

12.5 Ex-Post Gross Savings

The summary of the participant surveys and residential site visits are listed in Table 12-3.

Table 12-3 CRP In-service Rates and Replacement Type

Operating Condition	Attic Insulation	Cool Roof	HVAC	Variable Speed Pool Pump/Motor	Energy Star Windows	Whole House Fan
Installed	100%	100%	100%	100%	100%	-
Early Replacement	0%	0%	0%	0%	0%	-
Responses	136	37	13	97	1	-
Precision	+/-0.10	+/-0.19	+/-0.20	+/-0.06	NA	NA

The energy savings and peak demand reduction are summarized in Table 12-4 and Table 12-5.

The program realization rate is 82.6% with 7,068,919 kWh savings. The program peak demand reduction totaled 2,660.46 kW, resulting in a 93.5% realization rate.

Table 12-4 CRP kWh Evaluation Results

Measure	Quantity	ISR	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross Realization Rate
Attic Insulation	19,897	100%	3,869,182	4,573,069	118%
Central Air Conditioner	227	100%	92,123	58,625	64%
Central Heat Pump	26	100%	11,448	14,781	129%
Cool Roof	487	100%	624,801	273,988	44%
Dual Pane Windows	9,938	100%	4,373	38,616	883%
Pool Pump and Motor	2,431	100%	3,952,326	2,108,875	53%
Whole House Fan	2	100%	848	965	114%
Total	25,398	100%	8,555,100	7,068,918	83%

Peak demand impacts were not reported in the ESP data. The tracking data Ex-Ante kW is listed for comparison. The Ex-Post demand impacts are summarized by measure.

Table 12-5 CRP Peak Demand Evaluation Results

Measure	Quantity	ISR	ESP Data Ex-Ante kW Savings	ESP Data Ex-Post kW Savings	Gross Realization Rate
Attic Insulation	19,897	100%	1,764.93	2,086.01	118%
Central Air Conditioner	227	100%	42.02	26.74	64%
Central Heat Pump	26	100%	4.53	5.85	129%
Cool Roof	487	100%	285.00	124.98	44%
Dual Pane Windows	9,938	100%	1.99	17.61	883%
Pool Pump and Motor	2,431	100%	747.79	399.11	53%
Whole House Fan	2	100%	0.16	0.16	98%
Total	25,398	100%	2,846.43	2,660.46	94%

12.5.1 COVID-19 Impacts on Energy Use

A billing analysis estimated the energy usage or developed an adjustment factor, by end use during COVID-19 Era for the first year annual savings. For the remaining useful life years, the savings are equal to or less than the first year savings in most measures. The factor that contributes to the change is decreased hours of use in the home after the COVID-19 Era. Table 12-6 lists the first year savings, and the savings for the remaining useful life, after the COVID-19 Era.

Table 12-6 CRP COVID-19 Era Impact on Ex-Post Gross Energy Savings

Measure	Typical 1st Year Ex-Post kWh Savings (A)	COVID-19 Era Adjusted Annual Ex-Post kWh Savings (B)	COVID-19 Era Incremental Change Ex-Post kWh Savings (B-A)	COVID-19 Era % Change Ex-Post Savings [(B-A)/A]
Attic Insulation	4,573,069	3,562,273	-1,010,796	-22.1%
Central Air Conditioner	58,625	31,993	-26,632	-45.4%
Central Heat Pump	14,781	9,772	-5,009	-33.9%
Cool Roof	273,988	192,972	-81,015	-29.6%
Dual Pane Windows	38,616	38,616	0	0.0%
Pool Pump and Motor	2,108,875	2,108,875	0	0.0%
Whole House Fan	965	827	-136	-14.3%
Total	7,068,918	5,945,328	-1,123,591	-15.9%

12.6 Process Evaluation

The Evaluator completed a process evaluation of CRP that included the following activities:

- Reviews of program documents and program tracking data
- Interviews with program staff
- Surveys of participating customers

A net-to-gross ratio was developed from the survey responses provided by program participants.

The key findings are presented below.

- Overall, CRP is doing an excellent job based on the thousands of products being rebated and level of satisfaction determined from survey respondents. However, the program could improve the time it takes for customers to receive rebates.
- CRP staff may also want to explore different marketing messages for different products as well as talking with participating contractors to understand why certain ethnicities are underserved.
- Overall, customers were satisfied with the CRP program. Dissatisfaction with the program centered on the long time to receive the rebates, a difficulty that program managers were aware of and sought to ameliorate.

A detailed process evaluation can be found in Appendix A, section A.11.3.

12.7 Cost Effectiveness Results

Table 12-7 presents benefits, costs, and the results of cost-effectiveness testing for the CRP.

Table 12-7 CRP Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$18,614,204	$18,614,204	$46,174,421	$18,614,204	$18,614,204
Total Costs	$33,206,682	$40,418,147	$35,596,973	$50,995,595	$40,418,147
Benefit/Cost Ratio	0.56	0.46	1.30	0.37	0.46

12.8 Program Key Findings and Recommendations

The sections below list the impact and process evaluation key findings and recommendations.

12.8.1 CRP Impact Key Findings and Recommendations

12.8.1.1 Pool Pumps and Motors

The savings for pool pump and motor were determined by a billing analysis, which did not differentiate by the replacement type to establish the baseline. Looking forward to FY 21/22, the baseline will be changed. California Title 20 set the dedicated pool pump motor baseline to a two speed motor for capacity greater than 1 THP in 2018, which aligns with the specifics of the measures offered by the CRP program. The Department of Energy (DOE) rule for Dedicated Purpose Pool Pumps was effective as of July 2021. The DOE rule requires manufacturers to meet minimum Weighted Energy Factors (WEF) by the size of the pump and motor. The CRP should collect the WEF value (kgal/kWh) along with the nameplate data and estimate the annual energy savings against the minimum standard WEF value.

During site visits performed by the Evaluator for pool pumps it was found there were occurrences of both certified contractor installations and non-certified contractor installations that were programmed to operate the motor during peak demand periods. It could not be determined if the programming was changed after the installation, but the peak demand impacts may be less than expected.

12.8.1.2 Cool Roofs

The savings for cool roofs were determined by billing analysis, which did not differentiate by the replacement type or code baseline. Los Angeles County Title 31, Green Buildings Standard Code has stipulated 3 year SRI values for new roof construction and roof replacements. The code enforcement by LADBS (LA Department of Building and Safety), requires a Cool Roof Council listed roofing material, for roof replacements of over 50% of the area. The minimum listed cool roof material has an SRI value of 75 for low slope and 16 for steep slope. The current incentive tiers start at the code minimum value, and do not provide any beyond-code savings to the program. The Evaluator recommends tracking these lowest SRI values as zero energy savings.

12.8.2 CRP: Process Key Findings and Recommendations

Review all application forms and update based on feedback from people not associated with the program.

Customers complained about the application forms and updating these forms based on feedback from a focus group held with customers or from LADWP staff LADWP staff not familiar with the efficiency programs, would enable CRP to take advantage of how non-participants perceive the form and make useful changes.

Provide a way for a customer to track their rebate online.

Many customers expressed dissatisfaction with not knowing if LADWP had received their application and difficulty reaching a customer service person to figure it out. Enabling an online tracking system could reduce the stress levels of customers and increase satisfaction around rebate timing.

Review payment process for all measures and especially for Dual Pane Windows.

LADWP needs to determine how to best reduce the time for processing rebates when there is a surge in rebates (as occurred this program year).While there were few dual pane windows paid through the program (N=38), they had the highest average time between ordering and payment (194 days or about 6 months). Additionally, dual pane windows had higher average payment times for three of the four quarters of the fiscal year (almost double the time for a similar number of central heat pumps with rebates).

Consider tailoring the CRP Fact Sheet to address measure-specific messages around saving utility costs, increasing comfort, etc.

Expand the message about benefits by tailoring it to the different types of equipment; for example, describe the benefits about installing an energy efficient pool pump like lower electric bill costs, a cleaner pool, and less costs for equipment repairs. Additionally, consider providing contractors with similar tailored messages that they could use to increase eligible product sales.

Talk to participating CRP contractors to determine why the program is underserving Asian and Black communities.

The 2021-2029 Housing Element indicates that 39% of Asian households and 29% of Black households are homeowners. This year’s program served only 18% of homeowners across both groups.

If the reason for lack of participation in these areas is a lack of contractors, CRP may want to work with other agencies within Los Angeles to help bring in additional contractors who will serve these communities.

13 Efficient Product Marketplace

This chapter presents an evaluation of the Efficient Product Marketplace (EPM) Products that LADWP offered customers during fiscal year 20/21 (FY 20/21 or Concurrent Year 1).

The primary objective of the evaluation was to estimate energy savings and peak demand reduction attributable to EPM, as well as perform a process evaluation.

13.1 Program Performance Summary

EPM is an online marketplace for residential customers, offering efficient options including lighting, smart thermostats, advanced power strips, refrigerators, clothes washers, televisions, and room air conditioners.

13.1.1 Key Evaluation Takeaways

- EPM program performance during FY 20/21 was similar to prior years.
- The overall program realization rate was nearly 112%.
- Program participants reported being highly satisfied with the program and with individual program components, with most customers stating the marketplace website made it easy for them to find a product they needed.
- The marketplace website provides a good opportunity to cross-link to other programs in order to raise awareness about other LADWP program offerings.

13.2 Program Description

The EPM program operates from the web platform administered by Enervee Corporation, which hosts the LADWP marketplace website. The website provides energy efficient product comparisons and provides links to customers in order to make online purchases or allows customers to submit receipts for approved equipment in order to receive a rebate for the purchased equipment.

Table 13-1 EPM Ex-Ante Savings Summary

Measure	Number of Enrollments	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
Air Conditioner	315	9,790	4.47
Light Bulb	183	2,244	0.25
Power Strip	58	22,260	4.21
Refrigerator	2,363	119,592	22.63
Television	8	1,176	0.22
Thermostat	4,941	1,096,003	499.94
Total	7,868	1,251,065	531.72

13.3 Methodology

The data collection activities for the EPM Program are listed in Table 13-2.

Table 13-2 EPM Program Data Collection

Data	Source
Program Tracking Data	Data requests to LADWP for all measure level program tracking data
Program Participant Surveys	Survey administered to a sample of program participants via email contact
Recipient and control group billing data	Data requests to LADWP for all relevant billing data in the study period
Participation in other LADWP programs	Data requests to LADWP for all residential program participation in the study period
Recipient and control group customer data	Data requests to LADWP for other customer information (e.g., demographics, contact permissions)

A detailed evaluation methodology for engineering calculations and billing analysis can be found in Appendix A, section A.12.1.

13.4 Impact Evaluation

Measure energy savings were determined by engineering analysis based on Database for Energy Efficiency Resources (DEER) Resources Workpapers or by utility billing analysis. A detailed impact evaluation can be found in Appendix A, section A.12.2.

13.5 Ex-Post Gross Savings

This section focuses on the causes for realization rates being above or below the expected Ex-Ante savings. Table 13-3 shows ISRs calculated from the participant survey. The thermostat ISR is provided to understand the billing analysis savings results but was not factored by the per unit thermostat savings.

Table 13-3 EPM In-service Rates and Replacement Type

Operating Condition	Air Conditioner	Lighting	Powerstrip	Refrigerator	Television	Thermostat
Installed	100%	100%	100%	100%	100%	100%
Early Replacement	29%	85%	83%	38%	0%	75%
Total Responses	20	16	8	81	1	97

Ex-Post gross energy savings and the realization rates at the measure level are listed in Table 13-4. Although, there is high variability in the realization rates among the measure types, the program Ex-Post total savings of 1,245,893 has a 99.6% realization rate.

Table 13-4 EPM kWh Evaluation Results

Measure	Quantity	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross Realization Rate
Air Conditioner	315	9,790	45,288	>100%
Light Bulb	183	2,244	35,780	>100%
Power Strip	58	22,260	21,779	98%
Refrigerator	2,363	119,592	139,634	117%
Television	8	1,176	346	29%
Thermostat	4,941	1,096,003	1,003,067	92%
Total	7,868	1,251,065	1,245,894	100%

Table 13-5 presents the measure types and Ex-Post peak kW reduction and Ex-Ante kW along with realization rates.

Table 13-5 EPM Peak Demand Evaluation Results

Measure	Quantity	ESP Data Ex-Ante kW Savings	ESP Data Ex-Post Gross kW Savings	Gross Realization Rate
Air Conditioner	315	4.47	20.66	>100%
Light Bulb	183	0.25	3.93	>100%
Power Strip	58	4.21	4.12	978%
Refrigerator	2,363	22.63	26.42	117%
Television	8	0.22	0.07	29%
Thermostat	4,941	499.94	457.55	92%
Total	7,868	531.72	512.74	100%

13.5.1 COVID-19 Impacts on Energy Use

The billing analysis identified savings for the post COVID-19 Era, based on lower usage of the home for the thermostat measure. Also, the billing analysis developed end use factors that were applied to the other measures as part of the engineering analysis.

Table 13-6 EPM COVID-19 Era Impact to Ex-Post Gross Energy Savings

Measure	Typical 1st Year Ex-Post kWh Savings (A)	COVID-19 Era Adjusted Annual Ex-Post kWh Savings (B)	COVID-19 Era Incremental Change Ex-Post kWh Savings (B-A)	COVID-19 Era % Change Ex-Post Savings [(B-A)/A]
Air Conditioner	45,288	28,074	-17,214	-38.01%
Light Bulb	35,780	185,319	149539	417.94%
Power Strip	21,779	23,850	2071	9.51%
Refrigerator	139,634	139,634	0	0.00%
Television	346	376.32	30.32	8.76%
Thermostat	1,003,067	722,208	-280,859	-28.00%
Total	1,245,894	1,099,462	-146,433	-11.75%

13.6 Process Evaluation

The Evaluator completed a process evaluation of EPM that included the following activities:

- Reviews of program documents and program tracking data
- Interviews with program staff
- Surveys of participating customers

A net-to-gross ratio was developed from the survey responses provided by program participants.

The key findings are presented below.

- Participants were satisfied with the website and most indicated that they were able to find what they wanted on the website.
- The site provides some information about other programs, but customers are looking for more information.
- Forty-two percent (42%) of customers who obtain a rebate on the website wanted to see information on other products not on the website. Other products of interest include water saving fixtures, battery storage, EV chargers, and electric yard equipment.
- LADWP has additional opportunities to help renters become more efficient. The EPM website includes products like kitchen or laundry equipment that are of interest to households who own a house as well as products of interest to households who rent like window air conditioners, televisions, or air purifiers.

However, 63% of households in Los Angeles rent, but only 30% are taking advantage of rebates through EPM.

A detailed process evaluation can be found in Appendix A, section A.12.3.

13.7 Cost Effectiveness Results

Table 13-7 presents benefits, costs, and the results of cost-effectiveness testing for the EPM Program.

Table 13-7 EPM Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$2,033,313	$2,033,313	$2,722,592	$2,033,313	$2,033,313
Total Costs	$2,078,533	$2,304,387	$854,065	$4,172,914	$2,304,387
Benefit/Cost Ratio	0.98	0.88	3.19	0.49	0.88

13.8 Program Key Findings and Recommendations

The section below lists the process evaluation key findings and recommendations.

Consider adding more information on products of interest to customers.

Items suggested: water saving equipment, back-up batteries, and lawn equipment, as well as financing for efficient refrigerators.

Consider targeted marketing to begin to draw in renters and Hispanic (Latinx) customers.

While the survey did not ask questions to shed light on language capabilities, staff may want to determine if it is worthwhile to apply a language translation capability to the site so that people with English as a second language may be more comfortable using the site.

Cross-link programs to raise awareness of other LADWP customer opportunities.

While it may not be feasible to put in specific links to all LADWP programs onto the EPM website, it may be good to have a single link that makes a person on the website want to go explore other LADWP programs. Specific options may include the following.

- About three quarters of EPM survey respondents are homeowners (70%) who might be able to benefit from Consumer Rebates Program (CRP) rebates, yet half to two-thirds of homeowner respondents were unaware of products available through CRP.[6] As such, the EPM website may be a suitable location to add a link

[6] CRP offers rebates for products that are typically more expensive than those on the EPM website and items that homeowners purchase more often than renters. (i.e., CRP has rebates for windows, attic insulation, variable speed pool pumps, cool roofs, HVAC, and whole house fans).

specifically to the CRP landing page.[7]

- Close to a third of EPM respondents (who provided their income) are low-income and may be able to participate in the Home Energy Improvement Program or appreciate knowing they could obtain free water conservation measures (through the Free Water Conservation items).
- Over half of EPM respondents are single family homeowners who may be grateful to know that there are ways to reduce their water bills through the Turf Replacement Program.

Create a link directly to the Solar Marketplace that is easily followed.

[7] The website does have a link to the general LADWP home page, but it is hard to find and a link directly to the energy efficiency page or CRP site would make it easier for residential customers to explore these rebate options.

14 Energy Savings Assistance Program

This chapter presents an evaluation of the Energy Savings Assistance Program (ESAP) that LADWP offered customers during fiscal year 20/21 (FY 20/21 or Concurrent Year 1).

The primary objective of the evaluation was to estimate energy savings and peak demand reduction attributable to ESAP.

14.1 Program Performance Summary

ESAP is California's statewide low income weatherization program. LADWP partners with SoCal Gas to co-fund weatherization of electric and gas customers in Los Angeles. In FY 20/21, over 9,000 low income residents had their home weatherized through the ESAP Program.

14.1.1 Key Evaluation Takeaways

- ESAP performance during FY 20/21 was similar to prior years.
- The overall program realization rate was 62%.
- The program is sunsetting and FY 20/21 is the last year of implementation.

14.2 Program Description

ESAP is a statewide low-income weatherization program administered by California utilities. This program targets income-qualified residents living in multi-family housing, providing no-cost energy and water savings measures for residents with an income under 200% of the Federal Poverty Guidelines. ESAP offers efficiency upgrades for individual residential units. The efficiency measures include weather stripping, caulking, low-flow showerheads, water heater blankets, and door and building envelope repairs that reduce air infiltration. LADWP has partnered with SoCalGas to jointly implement this program to provide more comprehensive services to customers and to save on program costs.

Table 14-1 summarizes the program's Ex-Ante energy savings and peak demand reduction for the FY 20/21.

Table 14-1 ESAP Ex-Ante Savings Summary

Fiscal Year	Number of Projects	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	9,987	2,745,787	331.02

Table 14-2 provides a complete list of ESAP measure offerings for FY 20/21.

Table 14-2 ESAP Measure Offerings

Measure Category	Measures
Lighting	LEDs LED Night Lights Torchieres (LEDs)
Hot Water	Showerheads Aerators HE Clothes Washers Thermostatic Shower Valves Thermostatic Tub Spouts
Building Shell/HVAC	Furnace Clean & Tune Weatherization Air Sealing
Miscellaneous	Smart Power Strips

The following table summarizes the number of measures installed and total Tracking Data Ex-Ante kWh energy savings by measure for FY 20/21.

Table 14-3 ESAP Ex-Ante Savings by Measure

Measure	Quantity	Annual kWh Ex-Ante Savings Per Unit	Program Data Ex-Ante kWh Savings
Shower Heads*	1,433	-	0
Aerators*	5,135	-	0
Weatherization / Air Sealing	4	12	48
HE Clothes Washer	1	14	14
Thermostatic Shower Valve (TSV)*	859	-	0
Thermostatic Tub Spout*	0	-	0
Furnace Clean & Tune*	148	-	0
LEDs	19,638	92	1,806,696
LED Night Lights	13,292	19	252,548
Smart Power Strips	4,628	58	270,275
Torchieres (LED)	923	453	418,119
Total	46,061	-	2,747,700

*These measures were not assigned electric savings in Ex-Ante savings.

14.3 Methodology

This section presents a summary of the tracking data review and the methodology used to calculate verified Ex-Post energy savings and peak demand reduction for the program. The evaluation methodology is summarized below:

- **Tracking data review.** LADWP provided the Evaluator the available program tracking data for measures installed between July 1, 2020, through December 15,

2020. The Evaluator reviewed available program data and counted the total number of unique households that participated in each fiscal year. These household counts were used to extrapolate household-level regression analysis to program-level savings for FY 20/21.

- **Ex-Ante savings review.** The Evaluator was provided with tracking data that was nearly equal in terms of savings to the reported ESP Ex-Ante kWh savings. In addition, the program tracking data did not provide estimated peak kW reduction for the measures in the program, whereas the reported ESP Ex-Ante values reported peak kW impacts for FY 20/21.
- **M&V approach.** The approach the Evaluator used to determine Ex-Post kWh savings and peak kW reduction for ESAP was based on statistical analysis of billing data. The Evaluator took the following steps during the evaluation approach:
  - First, the Evaluator conducted an exploratory data analysis that made use of all provided participant billing data;
  - Second, the Evaluator used regression models to make longitudinal and cross-sectional comparisons of energy consumption before and after installation of energy efficiency measures to determine how electricity use changed after a measure was installed at a household; and
  - Third, the Evaluator quantified whole home savings by extrapolating regression model outputs with weather and number of participants for FY 20/21.
- **Billing analysis approach.** The Evaluator performed a billing analysis to evaluate the energy savings for ESAP.

A detailed evaluation methodology can be found in Appendix A, section A.13.1.

14.4 Impact Evaluation

The Evaluator estimated verified energy savings and peak demand reduction impacts from ESAP for FY 20/21 using a billing analysis methodology which is presented in greater detail in section A.13.2. The billing analysis steps are summarized below:

- **Billing Data Preparation.** LADWP provided both participant and non-participant bi-monthly billing data. Because billing periods varied across participants and did not correspond to the start and end of calendar months, all billing data was calendarized.
- **Propensity Score Matching (PSM). The Evaluator utilized PSM to develop a** comparison group from the non-participant pool. The Evaluator developed five pre-treatment variables for use in the PSM:
  - The average daily kWh annually,
  - The average daily kWh for winter (December through February),
  - The average daily kWh for spring (March through May),
  - The average daily kWh for summer (June through September), and

- The average daily kWh for fall (October through November).

- **Degree Day Base Optimization.** After developing the participant and non-participant group, the Evaluator used historical weather data to optimize the heating degree day (HDD) and cooling degree day (CDD) bases for each customer.
- **Regression Model.** To estimate participant savings, the Evaluator used a post-period regression with pre-period control variables. This model isolates the post-treatment period and uses customer-specific variables generated from the pre-treatment period to control for individual variation.

14.5 Ex-Post Gross Savings

Table 14-4 summarizes the household-level Ex-Post kWh savings and peak kW reduction for FY 20/21. These values were calculated as part of the billing analysis.

Table 14-4 ESAP Summary Ex-Post Per-household Energy Savings

Fiscal Year	Per-household Ex-Post kWh Savings	Per-household Ex-Post Peak kW Savings
20/21	170	0.03

The verified household-level energy savings for FY 20/21 is 170 kWh per year. The verified household-level demand reduction is 0.03 kW per year.

The Evaluator extrapolated the above household-level energy savings and peak demand reduction with the total number of unique households in FY 20/21 period presented in the program tracking data. Table 14-5 summarizes the program-level Ex-Ante and Ex-Post energy savings for FY 20/21.

Table 14-5 ESAP kWh Evaluation Results

Fiscal Year	Quantity	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross Realization Rate
20/21	9,987	2,745,787	1,695,641	62%

The Evaluator verified a total of 1,695,641 kWh energy savings for ESAP across 9,987 participating households. The verified gross realization rate was 61.71% for FY 20/21.

Table 14-6 summarizes the program-level Ex-Ante and Ex-Post peak demand reduction for FY 20/21.

Table 14-6 ESAP kW Evaluation Results

Fiscal Year	Quantity	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Realization Rate
20/21	9,987	331.02	204.42	62%

The Evaluator calculated a total of 332.35 peak kW reduction for ESAP during FY 20/21. The verified gross realization rate is undefined due to lack of Ex-Ante peak kW value. FY 20/21 did not have an estimate for Ex-Ante peak kW reduction; however, the Evaluator estimated peak demand reduction impacts for the fiscal year. Therefore, the overall gross realization rate for peak demand impacts is undefined.

The Evaluator did not possess a calculation methodology for the measure-level Ex-Ante kWh. However, the Evaluator assumed the Ex-Ante measure-level savings values were underrepresenting energy savings occurring during peak periods.

14.5.1 COVID-19 Impacts on Energy Use

The method for estimating COVID-19 impacts for ESAP follows the method detailed for billing data regression in Appendix A. Table 14-7 presents the typical first year Gross Ex-Post savings and COVID-19 adjusted Gross Ex-Post savings. For interpretation purposes, the COVID-19 savings are presented as full 12-month annual adjusted savings.

Table 14-7 ESAP COVID-19 Era Impact to Ex-Post Gross Energy Savings

Billing Analysis Measures	Typical 1st Year Ex-Post kWh Savings (A)	COVID-19 Era Adjusted Annual Ex-Post kWh Savings (B)	COVID-19 Era Incremental Change Ex-Post kWh Savings (B-A)	COVID-19 Era % Change Ex-Post Savings [(B-A)/A]
Whole House	1,695,641	2,384,828	689,187	40.6%

14.6 Process Evaluation

No process evaluation was completed for ESAP during FY 20/21.

14.7 Cost Effectiveness Results

Table 14-8 presents benefits, costs, and the results of cost-effectiveness testing for the ESAP.

Table 14-8 ESAP Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$117,760	$117,760	$917,247	$117,760	$117,760
Total Costs	$453,258	$453,258	$444,298	$926,207	$453,258
Benefit/Cost Ratio	0.26	0.26	2.06	0.13	0.26

14.8 Program Key Findings and Recommendations

Since the methodology for validating program savings for ESAP is a whole building analysis, it is difficult for the Evaluator to point out areas under specific measures for improving gross realization rates. Therefore, the Evaluator is unable to provide actionable recommendations to improve the program.

The Evaluator found the monthly measure count and savings summaries difficult to match with the measure-level tracking data and therefore difficult to recreate measure-level counts using the available tracking data. Although annual reporting for ESAP did not provide specific measures for all years, it did provide measure breakdowns starting FY 20/21. However, of the measure breakdowns provided, project-level tracking data including customer name, customer address, measure name, measure quantity, and measure install date were difficult to match against monthly measure total summaries provided by LADWP. Totals from project-level tracking data were not consistent with monthly measure totals.

The Evaluator recommends tracking project-level customer identifiers, measure identifiers, measure energy savings, measure non-energy savings, measure price, measure install or labor cost, and project details for each individual project in one tracking database. This tracking database should be used to summarize monthly and measure-level savings. Measure names should also be consistent within each program year. This will ensure consistent summaries and reporting across the program. In addition, the Evaluator recommends providing data sources for referenced kWh and kW savings per measure.

The Evaluator recommends that measures are tracked consistently across program years and worksheets and that Ex-Ante savings estimates for residential lighting equipment adhere to EISA adjustments and CA Title 20 regulations.

15 Low Income Refrigerator Exchange Program

This chapter presents an evaluation of the Low Income Refrigerator Exchange Program (REP) that LADWP offered customers during fiscal year 20/21 (FY 20/21 or Concurrent Year 1). The REP Program was administered by LADWP with implementation services provided by ARCA, Inc. (ARCA).

The primary objective of this evaluation was to estimate energy and peak demand impacts attributable to the REP.

15.1 Program Performance Summary

REP targets low income customers and replaces old, operable refrigerators in their homes with new ENERGY STAR-rated units. Once replaced, 95% of the materials from the removed refrigerator are recycled. This prevents the resale of old, inefficient units in the secondary market.

15.1.1 Key Evaluation Takeaways

- REP was suspended for nearly all of FY 20/21 due to the COVID-19 pandemic; therefore, program activity was greatly reduced compared to prior years.
- The overall program realization rate was 85%.

15.2 Program Description

LADWP's REP Program is designed to help customers reduce their energy consumption by removing old, working refrigerators from their homes to recycle them, and providing a new ENERGY STAR rater refrigerator, free of charge. As an added environmental benefit, 95% of the materials from the old units can be recycled (metals, plastic, glass, oil, etc.) and disposed of in an environmentally responsible manner, thus preventing the materials from reaching landfills and contaminating the environment.

By offering a new energy efficient refrigerator and free pick up services, LADWP seeks to remove old inefficient units, prevent the continued use of older appliances as secondary units after new primary units are purchased, and prevent older units from being resold or transferred to other LADWP customers when no longer needed in the participant home.

LADWP's REP Program is operated as a turn-key program implemented by ARCA. The program is open to any LADWP income-qualified residential customer, or multi-residential or non-profit customer. The old refrigerator must be a minimum size 14 cubic feet. Customers can request a home pick up through an online portal or over the phone with ARCA representatives.

In addition to pickup and delivery services of refrigerator units, LADWP offered residential customers a free kit containing LED bulbs. The energy impacts attributed to the LED kits is described in Chapter 17.

Table 15-1 presents ESP summary savings for the REP FY 20/21 Evaluation.

Table 15-1 REP Ex-Ante Savings Summary

Fiscal Year	Number of Units	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	152	121,954	34.30

15.3 Methodology

This section provides an overview of the methodology used by the Evaluator in the impact evaluation of the REP Program during FY 20/21. The following activities were performed:

- Tracking data review;
- Ex-Ante savings review; and
- M&V approach;

A detailed evaluation methodology can be found in Appendix A, section A.14.1.

15.4 Impact Evaluation

This section presents an overview of the impact evaluation of the REP during FY 20/21. The following impact evaluation activities were performed:

- Full-year UEC calculation;
- Per-unit gross peak demand reduction; and
- Description of factors affecting gross realized savings.

A detailed impact evaluation can be found in Appendix A, section A.14.2.

15.5 Ex-Post Gross Savings

This section presents program-level Ex-Post gross energy savings and demand reduction for FY 20/21. Table 15-2 and Table 15-3 combine the number of exchanged refrigerators through the program with per-unit Ex-Post gross impact estimates to show program-level gross energy savings and peak demand reduction.

Table 15-2 REP kWh Evaluation Results

Measure	Quantity	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross Realization Rate
Refrigerator	152	121,954	105,988	87%

Table 15-3 REP kW Evaluation Results

Measure	Quantity	ESP Data Ex-Ante kW Savings	ESP Data Ex-Post kW Savings	Gross Realization Rate
Refrigerator	152	34.30	29.81	87%

15.5.1 Gross Realization Rate Distribution by Measure

In order to calculate the realization rate for REP, the Evaluator leveraged the realization rate calculated for FY 19/20 and applied it to measures installed during FY 20/21. As a result, the gross realization rate distribution is uniform across all 152 households that participated in the program.

15.5.2 COVID-19 Impacts on Energy Use

COVID-19 impacts were not calculated for refrigerators because there was no significant indication that COVID-19 had an impact on refrigerator energy use or appliances that operate 8,760 annual hours.

15.6 Process Evaluation

The REP was suspended for most of FY 20/21 due to COVID-19 precautions. There was limited program participation. As such, a process evaluation was not completed.

15.7 Cost Effectiveness Results

Table 15-4 presents benefits, costs, and the results of cost-effectiveness testing for the LIREP.

Table 15-4 REP Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$110,302	$110,302	$333,106	$110,302	$110,302
Total Costs	$562,550	$474,637	$2,888	$804,856	$474,637
Benefit/Cost Ratio	0.20	0.23	115.34	0.14	0.23

15.8 Program Key Findings and Recommendations

The Evaluator does not recommend further modifications to the assumptions or inputs used to calculate energy and peak demand impacts for the REP.

The ARCA tracking data could not be easily tied to the LADWP ESP summary reports to verify that both sources represented the same number of refrigerators delivered during FY 20/21. Therefore, the Evaluator recommends that data entered into ESP is checked to ensure that measure quantities match tracking data measure quantities.

16 Refrigerator Turn-in and Recycle Program

This chapter presents an evaluation of the Refrigerator Turn-in and Recycle Program (RETIRE) that LADWP offered customers during fiscal year 20/21 (FY 20/21 or Concurrent Year 1). The RETIRE Program was administered by LADWP with implementation services provided by ARCA, Inc. (ARCA).

The primary objective of this evaluation was to estimate energy and peak demand impacts attributable to the RETIRE Program.

16.1 Program Performance Summary

RETIRE provides incentives for LADWP residential customers to recycle and dispose of older, operable refrigerators in an environmentally conscientious manner. Units include older models that customers are replacing with a new unit as well as secondary refrigerators, stand-alone freezers, and portable room and window air conditioners.

16.1.1 Key Evaluation Takeaways

- RETIRE was suspended for nearly all of FY 20/21 due to the COVID-19 pandemic; therefore program activity was greatly reduced compared to prior years.
- The overall program realization rate was 27%.

16.2 Program Description

LADWP's RETIRE Program is designed to help customers reduce their energy consumption by removing old, working refrigerators and freezers from their homes to recycle them. The program provides annual electric energy savings for the remaining life of the unit by permanently removing the appliance from service. As an added environmental benefit, 95% of the materials from these units can be recycled (metals, plastic, glass, oil, etc.) and disposed of in an environmentally responsible manner, thus preventing the materials from reaching landfills and contaminating the environment.

The RETIRE Program provides free refrigerator/freezer pick up and recycling services for LADWP customers in addition to a $50 rebate for each unit. By offering financial incentives and free pick up services, LADWP seeks to remove unnecessary secondary units, prevent the continued use of older appliances as secondary units after new primary units are purchased, and prevent older units from being resold or transferred to other LADWP customers when no longer needed in the participant home.

Recycled refrigerators and freezers are typically quite old, are often located in unconditioned space such as a garage, and generally require more electricity for cooling compared to a newer unit. The recycling process halts their inefficient use of electric energy and safely disposes of environmentally harmful materials.

LADWP's RETIRE Program is operated as a turn-key program implemented by ARCA. The program is open to any LADWP residential or institutional customer. Customers may recycle up to two units per residential address, per year. The units can range in size from 10 to 27 cubic feet. Customers can request a home pick up through an online portal or over the phone with ARCA representatives.

In addition to pick up and recycling services of refrigerator and freezer units, LADWP offered residential customers pick up and recycling services of old room air conditioners (ACs), and a free kit containing LED bulbs. The energy impacts attributed to room ACs are described later in this chapter. The energy impacts attributed to the LED kits are described in Chapter 17.

Table 16-1 presents ESP summary savings for the RETIRE Program FY 20/21 Evaluation.

Table 16-1 RETIRE Ex-Ante Savings Summary

Fiscal Year	Number of Projects	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	6	11,676	1.80

16.3 Methodology

This section provides an overview of the methodology used by the Evaluator in the impact evaluation of the RETIRE Program during FY 20/21. The following activities were performed:

- Tracking data review;
- Ex-Ante savings review; and
- M&V approach;

A detailed evaluation methodology can be found in Appendix A, section A.15.1.

16.4 Impact Evaluation

This section presents an overview of the impact evaluation of the RETIRE during FY 20/21. The following impact evaluation activities were performed:

- Verification of units recycled;
- Full-year UEC calculation;
- Part-use factors and counterfactual actions
- Per-unit gross peak demand reduction; and
- Description of factors affecting gross realized savings.

A detailed impact evaluation can be found in Appendix A, section A.15.2.

16.5 Ex-Post Gross Savings

This section presents program-level Ex-Post gross energy savings and demand reduction by fiscal year. Table 16-2 and Table 16-3 combine the number of verified refrigerators recycled through the program with per-unit Ex-Post gross impact estimates to show program-level gross energy savings and peak demand reduction.

Table 16-2 RETIRE kWh Evaluation Results

Measure	Quantity	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross Realization Rate
Refrigerator	6	11,676	3,193	27%

Table 16-3 RETIRE kW Evaluation Results

Measure	Quantity	ESP Data Ex-Ante kW Savings	ESP Data Ex-Post kW Savings	Gross Realization Rate
Refrigerator	6	3.28	0.90	27%

16.5.1 Gross Realization Rate Distribution by Measure

In order to calculate the realization rate for RETIRE, the Evaluator leveraged the realization rate calculated for FY 19/20 and applied it to measures installed during FY 20/21. As a result, the gross realization rate distribution is uniform across all 6 households that participated in the program.

16.5.2 COVID-19 Impacts on Energy Use

COVID-19 impacts were not calculated for refrigerators because there was no significant indication that COVID-19 had an impact on refrigerator energy use or appliances that operate 8,760 annual hours.

16.6 Process Evaluation

The RETIRE Program was suspended for most of FY 20/21 due to COVID-19 precautions. There was limited program participation. As such, a process evaluation was not completed.

16.7 Cost Effectiveness Results

Table 16-4 presents benefits, costs, and the results of cost-effectiveness testing for the RETIRE Program.

Table 16-4 RETIRE Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$1,182	$1,182	$3,331	$1,182	$1,182
Total Costs	$174,705	$174,972	$628	$177,676	$174,972
Benefit/Cost Ratio	0.01	0.01	5.31	0.01	0.01

16.8 Program Key Findings and Recommendations

The Evaluator recommends that refrigerator full year UEC is adjusted using the UMP Protocol as well as calculating part use adjusted UEC using the 2010-2012 CA ARP evaluation methodology, in order to achieve the desired Ex-Post gross realized savings for the program.

17 Residential Lighting Efficiency Program

This chapter presents an evaluation of the Residential Lighting Efficiency Program (RLEP) that LADWP offered customers during fiscal year 20/21 (FY 20/21 or Concurrent Year 1).

The primary objective of this evaluation was to estimate energy and peak demand impacts attributable to the RLEP.

17.1 Program Performance Summary

RLEP is designed to distribute free LED bulbs in a cost effective way and to deliver energy efficiency directly to all LADWP residential customers, both in single family and multifamily homes. LADWP has distributed free LED bulbs to all its customers (nearly 125,000 homes in its service territory) in each of three major campaigns. LED bulb kits are also distributed for free through the ESAP, LIREP, and RETIRE Program, and other community outreach events.

17.1.1 Key Evaluation Takeaways

- RLEP was suspended for nearly all of FY 20/21 due to the COVID-19 pandemic; therefore program activity was greatly reduced compared to prior years.
- The overall program realization rate was 85%.

17.2 Program Description

The RLEP program distributed LED lighting kits at zero cost to the participant in conjunction with other residential programs. Kits were delivered along with program offerings for ESAP, LIREP, and RETIRE Program. Each kit contained energy savings cutsheets and two A19, medium base, LED screw in lamps that were Energy Star listed.

Table 17-1 RLEP Program Ex-Ante Savings

Fiscal Year	Number of LED Kits	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	777	26,954	-

17.3 Methodology

Tracking data was reviewed to ensure that the data provided sufficient information to verify program participation and to calculate energy and peak demand impacts.

Data collection was leveraged by the General Population Survey completed for FY 15/16 through FY 19/20, as the FY 20/21 population is small by comparison. Savings were evaluated via the efficient product specifications, referenced workpapers for interactive factors, and survey response data for lamp usage in the household.

A detailed evaluation methodology and impact evaluation can be found in Appendix A, section A.16.1.

17.4 Impact Evaluation

Collected data for inputs to the savings algorithm are listed in Table 17-2.

Table 17-2 RLEP Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
kWh, kW	Measure savings per program year	Algorithm from Database for Energy Efficiency Resources (DEER) Resources workpapers	Equation A-42 and Equation A-43
Qty_{ver}	Quantity verified in tracking data to ESP data	RLEP tracking data	100% aligned
HOU	Annual hours of use	RLEP General Population Survey, 2021	Interior: 716 hours Exterior: 2,884 hours
$Watts_{base}$	Weighted baseline mix of existing lamps	California Statewide Residential Appliance Saturation Study 2019	LADWP service area weighted baseline mix: 29.9 W
$Watts_{efficient}$	LED Lamp wattage	RLEP Program	12 W
IE	Interactive Effects Factor by climate zone	LA Assessor Data Climate Zones & DEER Lighting Interactive Factors by Climate Zone	Varies by climate zone
ISR	In Service Rate	RLEP General Population Survey, 2021	75% (14,716 Surveys Deployed)
CDF	Coincident Diversity Factor	LA Assessor Data Climate Zones & DEER Lighting Factors by Climate Zone	Varies by climate zone

A detailed impact evaluation can be found in Appendix A, section A.16.2.

17.5 Ex-Post Gross Savings

Gross energy savings and peak demand for the program were calculated using the following equations, respectively:

$$kWh = Kits\ x \frac{Lamps}{Kit} x \left(watt_{base} - watt_{eff}\right) x \frac{1000W}{kW} x\ HOUR\ x\ IE\ x\ ISR$$

Equation 17-1

$$kW = Kits\ x \frac{Lamps}{Kit} x \left(watt_{base} - watt_{eff}\right) x \frac{1000W}{kW} x\ \ IE\ x\ ISR\ x\ CDF$$

Equation 17-2

Table 17-3 summarizes the FY 20/21 gross kWh realization rate for the RLEP by delivery channel. Table 17-4 shows the overall realized peak demand savings.

Table 17-3 RLEP kWh Evaluation Results

Delivery Channel	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Deliveries with LIREP	5,273	4,482	85%
Non HEIP-Grantee	2,602	2,212	85%
Non HEIP-Other	19,079	16,219	85%
Total	26,954	22,914	85%

Table 17-4 RLEP kW Evaluation Results

Fiscal Year	ESP Data Ex-Ante kW Savings	ESP Data Ex-Post kW Savings	Gross kW Realization Rate
FY 20/21	-	2.145	>100%

17.5.1 COVID-19 Impacts on Energy Use

The increased usage by hours for lighting in the home during the COVID-19 Era was estimated for each climate zone in the LADWP service territory by a utility billing analysis comparing the current fiscal year to the pre-installation period. The values were weighted by the population in each climate zone, resulting in a factor of 1.019. The factor was applied to the hours of use, resulting in the savings values in Table 17-5.The post COVID-19 Era with typical savings is also listed for the remaining useful life period.

Table 17-5 RLEP COVID-19 Era Impact on Ex-Post Gross Energy Savings

Fiscal Year	Typical 1st Year Ex-Post kWh Savings (A)	COVID-19 Era Adjusted Annual Ex-Post kWh Savings (B)	COVID-19 Era Incremental Change Ex-Post kWh Savings (B-A)	COVID-19 Era % Change Ex-Post Savings [(B-A)/A]
FY 20/21	22,489	22,914	424	1.9%

17.6 Process Evaluation

The RLEP was suspended for most of FY 20/21 due to COVID-19 precautions. There was limited program participation. As such, a process evaluation was not completed.

17.7 Cost Effectiveness Results

Table 17-6 presents benefits, costs, and the results of cost-effectiveness testing for the RLEP.

Table 17-6 RLEP Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$17,474	$17,474	$58,299	$17,474	$17,474
Total Costs	$2,124	$2,124	$794	$59,629	$2,123
Benefit/Cost Ratio	8.23	8.23	73.40	0.29	8.23

17.8 Program Key Findings and Recommendations

The Evaluator does not have any recommendations for FY 20/21 since direct install residential lighting programs have likely passed peak savings potential given the large share of LED lamps already installed in residential applications. Furthermore, LED lighting has attained a high proportion of market share of all types of available lighting and therefore there is little for additional program intervention in the market.

18 Air Conditioning Optimization Program

This chapter presents an evaluation of the Air Conditioning Optimization Program (ACOP) that LADWP offered customers during fiscal year 20/21 (FY 20/21 or Concurrent Year 1).

The primary objective of this evaluation was to estimate energy and peak demand impacts attributable to the ACOP.

18.1 Program Performance Summary

ACOP is a cross-sector program that provides incentives for heating and cooling system tune-ups, replacements, and installation of system controls that reduce energy use through reduction of systems' dehumidification process.

18.1.1 Key Evaluation Takeaways

- ACOP was suspended for nearly all of FY 20/21 due to the COVID-19 pandemic; therefore, program activity was greatly reduced compared to prior years.
- The overall program realization rate was 100%.

18.2 Program Description

ACOP provides services to LADWP residential and commercial customers by licensed, certified HVAC technicians to service space cooling systems and provide free of charge maintenance and energy efficiency services.

Free of charge services offered include:

- Replacement or cleaning of standard air filters;
- Outdoor coil cleaning;
- System diagnostic test;
- Refrigerant charge adjustment (up to 2 lbs. of refrigerant will be provided, if applicable);
- Installation of smart, Wi-Fi enabled thermostat (for compatible residential systems only, if customer does not already have a smart thermostat);
    - Zoned systems only qualify for one thermostat; and
- If the customer's home is not Wi-Fi enabled, or would prefer not to have a smart thermostat installed, the following AC system or Heat Pump alternatives can be installed at no charge to the customer:
    - Western Cooling Control

Table 18-1 summarizes the ACOP Ex-Ante energy savings and peak demand reduction for FY 20/21.

Table 18-1 ACOP Ex-Ante Savings Summary

Fiscal Year	Number of Projects	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
20/21	1,829	199,741	57.12

18.3 Methodology and Impact Evaluation

This section presents an overview of the tracking data review, and the methodology used to calculate verified Ex-Post energy savings and peak demand reduction for the program. The following key activities were performed:

- Tracking Data Review;
- Ex-Ante Savings Review;
- M&V Approach; and
- Billing Analysis Approach.

A detailed evaluation methodology and impact evaluation can be found in Appendix A, section A.17.1.

18.4 Ex-Post Gross Savings

Table 18-2 summarizes the measure-level per-unit Ex-Post kWh savings and peak kW reduction for FY 20/21.

Table 18-2 ACOP Summary Ex-Post Per-unit Energy Savings

Measure	Per-unit Ex-Post kWh Savings
Commercial	109
Multi-Residential	73
Single Family	118
Undetermined	-
Total	109

The Evaluator extrapolated the above measure-level energy and demand savings with the total number of unique measures presented in the program tracking data. Table 18-3 summarizes the program-level ESP Ex-Ante and Ex-Post energy savings for FY 20/21.

Table 18-3 ACOP kWh Evaluation Results

Measure	Quantity	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post Gross kWh Savings	Gross Realization Rate
Commercial	1,467	159,993	159,993	100%
Multi-Residential	68	4,989	4,989	100%

Measure	Quantity	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post Gross kWh Savings	Gross Realization Rate
Single Family	294	34,759	34,759	100%
Undetermined	0	0	0	-
Total	1,829	199,741	199,741	100%

Table 18-4 summarizes the program-level Ex-Ante and Ex-Post peak demand savings for FY 20/21.

Table 18-4 ACOP kW Evaluation Results

Measure	Quantity	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Gross Peak kW Savings	Gross Realization Rate
Commercial	1,467	39.31	39.31	100%
Multi-Residential	68	1.97	1.97	100%
Single Family	294	15.83	15.83	100%
Undetermined	0	0.00	0.00	-
Total	1,829	57.12	57.12	100%

18.4.1 COVID-19 Impacts on Energy Use

The billing analysis approach used to calculate COVID-19 impacts for ACOP is found in Appendix A, Section A.17.1.4.3. Table 18-5 presents the COVID-19 Impacts to ACOP energy savings.

Table 18-5 ACOP COVID-19 Era Impact to Ex-Post Gross Energy Savings

Billing Analysis Measures	Typical 1st Year Ex-Post kWh Savings (A)	COVID-19 Era Adjusted Annual Ex-Post kWh Savings (B)	COVID-19 Era Incremental Change Ex-Post kWh Savings (B-A)	COVID-19 Era % Change Ex-Post Savings [(B-A)/A]
Commercial	159,993	141,307	-18,686	-11.7%
Multifamily	4,989	12,096	7,107	142.5%
Single Family	34,759	54,786	20,027	57.6%
Undetermined	0	-	-	-
Total	199,741	208,189	8,448	4.2%

18.5 Process Evaluation

The ACOP was suspended for most of FY 20/21 due to COVID-19 precautions. There was limited program participation. As such, a process evaluation was not completed.

18.6 Cost Effectiveness Results

Table 18-6 presents benefits, costs, and the results of cost-effectiveness testing for the ACOP.

Table 18-6 ACOP Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$128,945	$128,945	$329,718	$128,945	$128,945
Total Costs	$155,186	$208,807	$198,996	$339,529	$208,807
Benefit/Cost Ratio	0.83	0.62	1.66	0.38	0.62

18.7 Program Key Findings and Recommendations

In general, there is a large discrepancy between Tracking Ex-Ante and ESP Portfolio Ex-Ante, which is driving the large change in realization rate. When comparing the realization rate between Ex-Post and Tracking Ex-Ante, the realization rate is 88%, 139%, and 122% for Commercial, Multi-residential, and Single Family, respectively. The biggest driver for this discrepancy appears to the continued impact of COVID-19, which the Evaluator accounted for in first year incremental results. During this time, the Evaluator continues to advise for greater adopted kWh per ton values for the generation of Ex-Ante values in the Residential sector to compensate for the expanded HVAC load in Residential during this time and, therefore, more extensive savings. Despite this, when compared to the Evaluator's typical year savings (i.e., without the impact of COVID-19), the realization rates change to 98%, 94%, and 83% for Commercial, Multi-residential, and Single Family, respectively. The reduction for Single Family may be attributable to shifting market saturation, with more efficient units being serviced through the program and thus resulting in lowered program savings, although a formal market saturation study was not undertaken as part of this effort.

19 California Advanced Homes Program

This chapter presents a summary of the California Advanced Homes Program (CAHP) that LADWP offered customers during fiscal year 20/21 (FY 20/21 or Concurrent Year 1).

The evaluator did not perform an evaluation to estimate energy and peak demand impacts attributable to the CAHP. This chapter only presents a program description with energy savings and cost effectiveness results.

19.1 Program Description

CAHP is offered through a diverse portfolio of programs by participating California utilities. Participation is open to single-family, low-rise and high-rise multi-family residential new construction built in participating IOU service areas. CAHP is a comprehensive residential new construction concept with a cross-cutting focus on sustainable design and construction, energy efficiency, demand reduction and emerging technologies. Through a combination of education, design assistance and financial support, CAHP works with building and related industries to exceed compliance with the California Code of Regulations, Title 24, Part 6, 2016 Building Energy Efficiency Standards for Residential and Nonresidential Buildings (Standards), to prepare builders for changes to the Standards and to create future pathways beyond compliance and traditional energy savings objectives.

SoCalGas and LADWP have collaborated to help the residential building industry smoothly transition to the next energy code, design and develop more environmentally friendly communities, and support the State of California's efforts for new homes to reach Zero Net Energy. The SoCalGas and LADWP CAHP is funded under the auspices of the CPUC and the City of Los Angeles.

The incentive structure for CAHP single family and multifamily low-rise is based on the CAHP Delta Energy Design Rating (EDR), which is the difference between the "Standard Design EDR" and the "Proposed Design EDR." For single family and multifamily low-rise (three stories or less), the minimum performance requirement is a CAHP Delta EDR of 3. Incentives are added incrementally as the Delta EDR increases. The LADWP CAHP single family incentive structure is presented in Table 19-1 and the multifamily low rise incentive structure is presented in Table 19-2.

Table 19-1 CAHP Incentives for Single Family

Delta EDR Points	Incremental Incentives
3 (minimum)	$300/lot
4-6	$150/lot
≥7	$300/lot

Table 19-2 CAHP Incentives for Multifamily Low-rise

Delta EDR Points	Incremental Incentives
3 (minimum)	$150/lot
4-6	$50/lot
≥7	$100/lot

For multifamily high-rise projects (four stories or more), the minimum baseline qualification is 10 percent above 2016 Title 24 building code, with increasing incentives for 15 percent, 20 percent, and 30 percent or more above 2016 Title 24 building code; see Table 19-3.

Table 19-3 CAHP Incentives for Multifamily High-rise

Percent Above 2016 Title 24 Code	Incremental Incentives
≥10% to <15%	$150/unit
≥15% to <20%	$200/unit
≥20% to <30%	$300/unit
≥30	$500/unit

Table 19-4 summarizes the CAHP Ex-Ante energy savings and peak demand reduction for FY 20/21.

Table 19-4 CAHP Ex-Ante Savings Summary

Measure	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
Appliances	85	0.02
Heating & Cooling	16,042	6.76
New Construction	40,359	6.77
Total	56,486	13.55

19.2 Ex-Post Gross Savings

Table 19-5 summarizes the program-level ESP Ex-Ante and Ex-Post energy savings for FY 20/21.

Table 19-5 CAHP kWh Evaluation Results

Measure	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post Gross kWh Savings	Gross Realization Rate
Appliances	85	85	100%
Heating & Cooling	16,042	16,042	100%
New Construction	40,359	40,359	100%
Total	56,486	56,486	100%

Table 19-6 summarizes the program-level Ex-Ante and Ex-Post peak demand savings for FY 20/21.

Table 19-6 CAHP kW Evaluation Results

Measure	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Gross Peak kW Savings	Gross Realization Rate
Appliances	0.02	0.02	100%
Heating & Cooling	6.76	6.76	100%
New Construction	6.77	6.77	100%
Total	13.55	13.55	100%

19.3 Cost Effectiveness Results

Table 19-7 presents benefits, costs, and the results of cost-effectiveness testing for the CAHP.

Table 19-7 CAHP Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$69,177	$69,177	$200,419	$69,177	$69,177
Total Costs	$114,011	$114,011	$91,175	$223,255	$114,011
Benefit/Cost Ratio	0.61	0.61	2.20	0.31	0.61

20 Codes, Standards, and Ordinances Program

This chapter presents an evaluation of the Codes, Standards, and Ordinances (CSO) Program that LADWP offered customers during fiscal year 20/21 (FY 20/21 or Concurrent Year 1).

The primary objective of this evaluation was to estimate energy and peak demand impacts attributable to the CSO Program, as well as to perform a process evaluation.

20.1 Program Performance Summary

CSO conducts advocacy to improve code requirements for building, appliance, and water use efficiency. CSO aggregates the impacts of enhancements to statewide codes and standards (Title 20 and Title 24) in addition to local codes. This evaluation period included Title 24, LA Plumbing Ordinance, and LA Cool Roof Ordinance.

20.1.1 Key Evaluation Takeaways

- Through the CSO Program, LADWP has an opportunity to help program staff prepare for the impacts of new codes and standards on their program processes and the savings they can claim.
- LADWP has an opportunity to identify ideas for new programs or changes to existing programs that could help prepare the market for proposed code changes.

20.2 Program Description

The Codes, Standards, and Ordinances (CSO) program conducts advocacy to improve code requirements for building, appliance, and water use efficiency. The CSO program aggregates the impacts of enhancements to statewide codes and standards (Title 20 and Title 24) in addition to local codes adopted in the City of Los Angeles. The history of code adoptions is summarized below.

Table 20-1 CSO Title 24 Editions & Adoption Dates

Title 24 Edition	Effective Date
2013 Edition	1/1/2014
2016 Edition	1/1/2017
2019 Edition	1/1/2020

In addition, the CSO program incorporates impacts from the following Los Angeles ordinances:

- Plumbing Ordinances – Residential
    - Toilets: ≤ 1.28 gallons per flush (GPF)
    - Showerheads: ≤ 2.0 GPM
    - Urinals: ≤.125 GPF

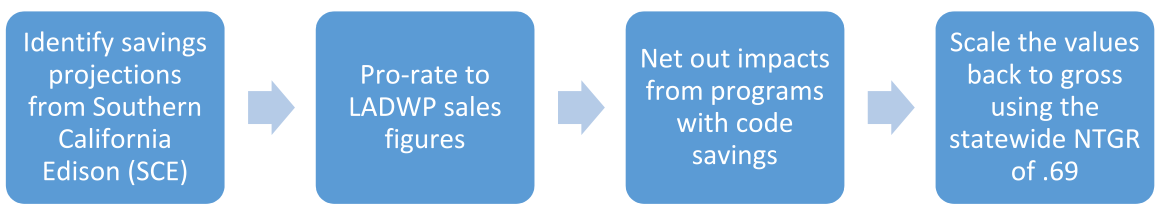
- Cooling Towers: minimum 5.5 cycles of concentration
- Prohibited use of single-pass cooling systems

- Plumbing Ordinances – Non-residential
    - Urinals: ≤.125 GPF
    - Public lavatory faucets: ≤ .5 gallons per minute (GPM)
    - Pre-rinse spray valves (PRSVs): ≤ 1.6 GPM
    - Dishwashers: lower high-temp and chemical gallons/rack by system type
    - Cooling Towers: minimum 5.5 cycles of concentration
    - Prohibited use of single-pass cooling systems

20.3 Methodology

The methodology for evaluation of impacts for the CSO Program entailed a review of the allocation procedure applied by LADWP to allocate Title 24 impacts to the LADWP service territory and to scale the impacts of the Cool Roof and Plumbing Ordinances. LADWP applies the FY 14/15 Electric Resource Assessment Model (ELRAM) Potential Study projection for Codes and Standards impacts. These are scaled as:

Figure 20-1 CSO Savings Estimation Process Flow



LADWP uses the CPUC's Integrated Standard Savings Model (ISSM) to estimate the attribution factor for statewide codes and standards savings. Attribution factors are analogous to net-to-gross factors for standard programs. Attribution factors range from 53% to 75% for Title 20 and Title 20/24, and the weighted average of these factors is 69.2%. SCE's estimates are then scaled up by this factor to convert attribution factors into gross impacts.

20.3.1 Ex-Ante Savings Review

Savings estimates for CSO were aligned between data provided by LADWP to the Evaluator and to that filed by LADWP in ESP. Ex-ante savings estimates are summarized in Table 20-2.

Table 20-2 CSO Ex-Ante Savings Summary

Measure	ESP Data Ex-Ante kWh	Program Data Ex-Ante kWh	ESP Data Ex-Ante Peak kW	Program Data Ex-Ante kW
Plumbing Ordinances	1,319,760	1,319,760	178.40	245.97
Title 20/24	192,363,020	194,199,475	26,002.67	26,250.91
Total	193,682,780	195,519,235	26,181.06	26,496.88

20.4 Impact Evaluation

This section presents the findings of the impact evaluation of the CSO Program during FY 20/21. Ex-post gross energy savings and peak demand reduction are presented at the measure level.

20.4.1 Plumbing Ordinances

The Plumbing Ordinance applied a simplified estimation of impacts based on:

1. US EPA WaterSense[8] estimates of a 12-15 year cycle of fixtures

2. Energy intensity of water taken from the Urban Water Management Plan[9] (1.60 MWH/Acre Foot), derived for the period of 2003-2010

The resulting estimate is 2,160 acre-feet per year (AFY). The Evaluator did not adjust the water savings estimates as these are a long-term, longitudinal estimate for a 20 year horizon of code compliance and thus mid-cycle adjustments run the risk of adversely affecting accuracy on this longer horizon examined by the City of Los Angeles. However, the water intensity estimate was an older value and does not reflect current conditions (such as ongoing drought conditions after 2010). In an updated study of regional water intensity performed for the CPUC , the South Coast region was found to have an aggregate water intensity of 2.206 MWH per foot acre. The resulting impacts are summarized in Table 20-3.

Table 20-3 CSO Plumbing Ordinance Savings

Measure	ESP Data Ex-Ante kWh	Program Data Ex-Post kWh	Gross Realization Rate	ESP Data Ex-Ante kW	ESP Data Ex-Post kW	Gross Realization Rate
Plumbing Ordinances	1,319,760	1,819,619	138%	178.40	245.97	138%

20.4.2 Title 20/24

LADWP assigns savings for Title 20/24 on a pro-rated basis, comparing total sales to Southern California Edison. In LADWP’s prior evaluation, savings for code attribution were adjusted upwards due to an adjustment to how LADWP pro-rated impacts; formerly,

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[8] https://www.epa.gov/watersense/watersense-calculator

[9] https://water.ca.gov/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency

LADWP compared impacts to statewide totals, but this was changed in the last evaluation to align with SCE sector-level values. The Evaluator concurred with this revision, and thus concluded that LADWP correctly pro-rated SCE codes and standards values to scale for the LADWP service territory. However, in Table 20-4 Program Data Ex-Post is being compared to ESP Data Ex-Ante which differs from Program Data Ex-Ante, hence the 1.0% difference between tabled values.

Table 20-4 CSO Title 20/24 Savings

Measure	ESP Data Ex-Ante kWh	Program Data Ex-Post kWh	Gross Realization Rate	ESP Data Ex-Ante kW	ESP Data Ex-Post kW	Gross Realization Rate
Title 20/24	192,363,020	194,199,475	101%	26,002.67	26,250.91	101%

20.5 Ex-Post Gross Savings

This section presents program-level Ex-Post gross energy savings and demand reduction by fiscal year for the CSO Program.

Table 20-5 CSO Realization Rate Summary

Measure	ESP Data Ex-Ante kWh	Program Data Ex-Post kWh	Gross Realization Rate	ESP Data Ex-Ante kW	ESP Data Ex-Post kW	Gross Realization Rate
Plumbing Ordinances	1,319,760	1,819,619	138%	178.40	245.97	138%
Title 20/24	192,363,020	194,199,475	101%	26,002.67	26,250.91	101%
Total	193,682,780	196,019,094	101%	26,181.06	26,496.88	101%

20.5.1 COVID-19 Impacts on Energy Use

Impact estimates for CSO are based on long-term average projections under business-as-normal conditions. Without revisions to code impact estimates from the CA IOUs and the CPUC, estimation of COVID-19 impacts for LADWP is not feasible.

20.6 Process Evaluation

The Evaluator completed a process evaluation of CSO Program that included the following activities:

- Reviews of program materials
- Staff interviews
- Cross-program interviews with staff at the following resource programs: CPP, LADWP ZBD, CAHP, UHVAC, EPM, RLEP, REP, and RETIRE
- Logic model development
- Industry scan

A detailed process evaluation can be found in Appendix A, section A.18.1.

20.7 Cost Effectiveness Results

Table 20-6 shows benefits and costs and the results of cost effectiveness testing for the CSO Program.

Table 20-6 CSO Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$154,734,881	$154,734,881	$470,181,624	$154,734,881	$154,734,881
Total Costs	$13,519,676	$13,519,676	$0	$483,701,301	$13,519,676
Benefit/Cost Ratio	11.45	11.45	0.00	0.32	11.45

20.8 Program Key Findings and Recommendations

LADWP's CSO program currently supports improvements to codes and ordinance compliance by providing training for code officials to help them understand and enforce energy codes. These trainings have been co-funded with SoCalGas, Pacific Gas & Electric/Energy Solutions, and Southern California Edison. Opportunities exist to expand training offerings to include the larger design and construction community – contractors, builders, and engineers, in addition to the existing training offerings to code officials.

A potential opportunity for LADWP's CSO program is to support enforcement more directly by having an LADWP engineer review permits for the Department of Building and Safety to identify potential code violations. Permits could be selected purposively or randomly but would ideally be selected with an eye toward equitable enforcement.

LADWP resource program staff interviewed had varying levels of awareness for CSO program activities and how codes and standards were integrated into program design and savings. The evaluation found opportunities to increase the program's effectiveness in providing these knowledge management services by developing and disseminating informational materials that keep staff apprised of relevant changes to CSOs and how those changes may impact program savings or processes

To support the sustainability of program processes and to aid in training any new CSO program staff, CSO program staff identified an opportunity to develop and maintain documentation detailing CSO program processes. This documentation could also be useful as a model for other utilities, as limited resources are available to guide CSO program administrators. This would be particularly useful for program administrators at other municipal utilities, as guidance for administrators in these roles is extremely limited in the existing literature.

CSO Program staff also identified an opportunity to track metrics related to CSO program activities, to help document the program's outputs and, over time, its impacts. Evaluating program outcomes and characterizing the causal mechanisms for producing these outcomes through program activities are long-term goals

21 Emerging Technology Program

This chapter presents the process evaluation of LADWP's Emerging Technology Program (ETP) that operated during fiscal year 20/21 (FY 20/21 or Concurrent Year 1).

21.1 Program Description

The LADWP Emerging Technologies Program (ETP) accelerates the introduction of innovative energy-efficient and water-efficient technologies, applications, and analytical tools that are not yet widely adopted in California. By reducing both the performance uncertainties associated with new technologies as well as institutional barriers, the ultimate goal of this program is to increase the probability that promising energy- and water- saving technologies will be commercialized.

In its current design, vendors approach the ETP with their most recent developments and demonstrations, and the ETP team establishes pilots to study them as opportunity and bandwidth allows. However, the program is considering updating some processes, most notably through the addition of a model developed with the National Renewable Energy Laboratory (NREL) designed to inform program goals and enhance technology screening. This ongoing effort may ultimately create updates to the overall program design.

21.2 Process Evaluation

The Evaluator completed a process evaluation of EPM that included the following activities:

- Interviews with program staff
- Review of program documents
- An industry scan to see how LADWP's program compares to similar programs offered by other entities

The key findings are presented below. A detailed process evaluation can be found in Appendix A, section A.19.

- The ETP does not currently identify a specific goal for the program, such as GWh savings, program spend, greenhouse gas (GHG) emission reduction or quantity of completed projects.
- Currently, the ETP has no dedicated staff. Instead, LADWP staff are pulled into program work as needed.
- Historically, the ETP pipeline was a reactive and ad hoc process driven by submissions from vendors. In July 2020, the ETP took a proactive approach and sent out an open request for ideas (RFI).
- In its current design, ETP staff are pulled in as needed for idea review and selection.
- The ETP implementation process includes six phases: technology prioritization, research planning, assessment, work paper development, tool development, and

program implementation, all of which necessitate a high degree communication and hand-off coordination between program staff and contractors.

21.3 Program Key Findings and Recommendations

The key findings and recommendations from the evaluation of the ETP are summarized below.

Establish specific program goals, and create and track specific, measurable program metrics which map directly to them.

- Progress toward the ETP's objectives may be most easily monitored and achieved if they are linked to quantifiable goals for which a set of program metrics can be established**.**
    - Examples of potential program metrics relevant to the ETP's current objectives include quantity of ideas collected, quantity of projects funded, number of ideas transferred into the LADWP portfolio, and savings impact of ideas transferred into the portfolio. If LADWP expects ETP funding to be variable, the ETP might consider normalizing metrics on a budget or per project basis.
- Identify and create mechanisms to track these metrics on a regular basis.
    - The ETP could consider using project management software to track idea submissions, the results of the NREL model, as well as the progress of funded projects. The ETP might also consider establishing a cadence and format of summarizing and reporting this data on a recurring basis.

Increase pipeline and programmatic fit of submitted ideas by creating targeted solicitations.

- Engage LADWP program teams to identify research needs and program gaps.
    - The ETP could consider incorporating this information into a road mapping framework to identify current state, future state, and what types of projects will meet LADWP's mid and long-term needs.
- Create and share targeted RFPs designed to help meet identified needs.
- To increase diversity of idea submissions, expand the ETP distribution list to include other potential collaborators, including universities and national labs.

Improve submitted idea quality by making research priorities and selection criteria clear and publicly available.

- Make the metrics used in the NREL screening tool clearly and publicly available.
    - This could include posting them on a website on including them in future RFIs and RFPs.
- Communicate the program's objectives and research priorities.
    - This approach may be especially important if the ETP prefers to keep a more reactive approach. Consider stating the program's current research

priorities on documents or webpages that mention the ETP's standing open request for ideas.

Create regimented time periods for key program processes, specifically idea solicitation and selection.

- Consider establishing defined solicitation and selection intervals.
  - Using an ETP calendar to specify routine activities may allow for ETP staffing to remain flexible because the timing and expectation of team coordination is established. This could ensure that staffing needs are more predictably timed so that such appointments could be anticipated in the larger LADWP planning effort.
- Identify and empower an ETP champion or point-of-contact to plan, lead and maintain adherence to this calendar.
  - Consider having this person also lead the effort to identify, establish and socialize this calendar with relevant program staff and internal stakeholders.

22 Marketing, Education, and Outreach

This chapter presents the process evaluation of LADWP's Marketing, Education, and Outreach (MEO) that operated during fiscal year 20/21 (FY 20/21 or Concurrent Year 1).

22.1 Program Description

LADWP marketing efforts aim to increase customer awareness of energy efficiency and participation in LADWP's efficiency programs. The MEO program encompasses program-specific marketing to heighten and maintain customer awareness of the need for and importance of efficient energy use. Each energy efficiency program conducts outreach to customers; LADWP also conducts outreach to historically underserved communities through grants through the Program Outreach and Community Partnerships (POCP), and funds education about energy in the LAUSD schools through an MOU with the school district. LADWP's MEO Program is designed to offer and promote energy efficiency within all market sectors.

22.2 Process Evaluation

The Evaluator completed a process evaluation of the MEO Program that included the following activities:

- Interviews with program staff
- Interviews with community-based organizations that received grants through the POCP.
- Development of a high-level marketing process visualization of the program process and participant journey.
- Analysis completed of residential and commercial participant surveys. The Evaluator included questions in about marketing channels and effectiveness in participant surveys for both commercial and residential program participants.

22.3 Program Key Findings and Recommendations

Provide cross-program support and coordination.

- **Create an annual calendar of marketing promotions.** A calendar of all program promotions happening across the year provides insight into what marketing customers are receiving and may identify opportunities to consolidate marketing. This calendar can be built from coordinating with the Marketing Services Division's campaign calendar and adding across-program awareness from the paragraph below.
- **Raise awareness across programs**. MEO can best support cross program participation by identifying and leveraging opportunities to increase awareness of multiple LADWP programs. For example, after a customer participates in a program, this is an opportunity for marketing further programs they may be eligible for participate in. In addition, the marketing calendar may indicate opportunities where marketing for multiple programs may be most effective.

Provide additional POCP support.

- **Provide a library of marketing images for POCP grantee organizations to easily use.** Some POCP organizations mentioned challenges with being able to quickly produce marketing materials approved by LADWP. By providing LADWP-approved images and guidance on how to use them, this will reduce the time needed for grantee organizations to develop materials and decrease the material approval time.

Offer direct customer support and/or customer expectations support to programs.

- **Target marketing around customer experience pain points to set expectations, provide tips, and offer resources.** Focusing on addressing common pain points across programs in marketing can allow for greater satisfaction from customers. Setting expectations for wait times in applications and rebates and providing tips on common mistakes to avoid can prepare the customer and give them a sense control in their experience.

Take foundational steps to provide the basis for market support metrics.

- **Develop a program theory and logic model for the MEO program, and then identify specific metrics to track to establish progress toward market support program metrics.** The program should develop a program theory and logic model and once that has been established, identify specific metrics to track to show progress toward goals. A program theory and logic model can also offer the program additional benefits, like refining program inputs and activities, which may help to inform the most appropriate structure for MEO going forward.

23 Program Analysis and Development Program

This chapter presents the process evaluation of LADWP's Program Analysis and Development Program (PADP) that operated during fiscal year 20/21 (FY 20/21 or Concurrent Year 1).

23.1 Program Description

The Program Analysis and Development Program (PADP) is a non-resource function designed to reduce the overall burden on LADWP energy efficiency program teams by monitoring the performance of LADWP's energy efficiency portfolio, supporting ongoing improvements to existing programs, and the development of new programs.[10] PADP looks at how effective programs are in terms of capturing savings, keeping customers satisfied, responding to market demand, meeting portfolio cost-effectiveness goals, and helping LADWP align with long-term regulatory and strategic objectives. The PADP team also monitors results from potential studies and evaluation reports to help decide what measures should be added or removed, what business process improvements should be made, and whether the creation of a new program is warranted at the portfolio level.

In addition to these activities, PADP is responsible for collection and monitoring of program metrics and regulatory reporting, coordinating collaborations with academic, government agencies, and technical groups to advance energy efficiency analysis, and supporting other LADWP groups, including Power Systems and Communications, with analysis and reporting.

This evaluation focuses on activities for new energy efficiency program development and ongoing improvements to existing programs to understand PADP program processes, stakeholder experiences, key objectives, primary work outputs, and metrics, including an exploration of opportunities for LADWP to use existing or new program metrics to demonstrate alignment with CPUC criteria for Market Support programs.[11]

23.2 Process Evaluation

The Evaluator completed a process evaluation of the PADP that included the following activities:

- Interviews with program staff.
- Materials review and development of baseline logic model and process flow chart.

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[10] LADWP staff have also used other names to refer to the program, including the PA&D program and the Program Development program.

[11] LADWP stays up to date on industry trends in many ways. While as a municipal energy service provider, LADWP is not regulated by the California Public Utilities Commission (CPUC), the company monitors CPUC decisions to understand the local market. In May 2021, the CPUC adopted an approach for segmenting energy efficiency portfolio programs into the areas of resource acquisition, market support, or equity. The CPUC defines these segments in the related filing (see source). In response, LADWP added to this study an exploration of metrics that could demonstrate PADP's alignment with Market Support. Source: [https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M385/K864/385864616.PDF], accessed on 6/24/21.

- Stakeholder interviews with LADWP resource program staff.
- Development of metrics to track PADP as a market support program.

23.3 Program Key Findings and Recommendations

The Evaluator developed a baseline logic model that characterizes the goals, activities, outputs, short-term outcomes, and long-term outcomes of the PADP program (see Figure 23-1). Additional description of the baseline logic model is presented in section A21.2.1.

Figure 23-1 PADP Baseline Logic Model

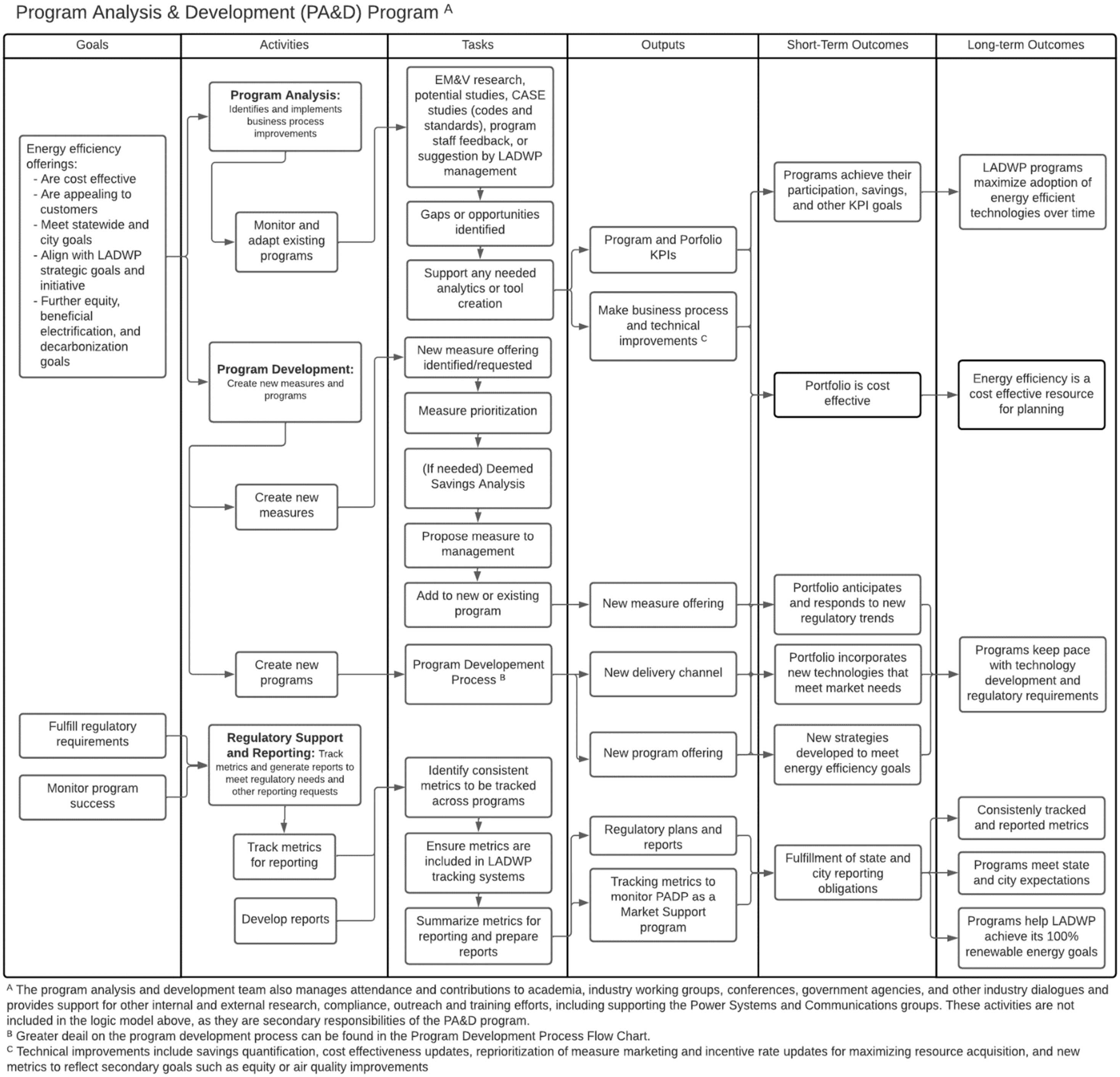
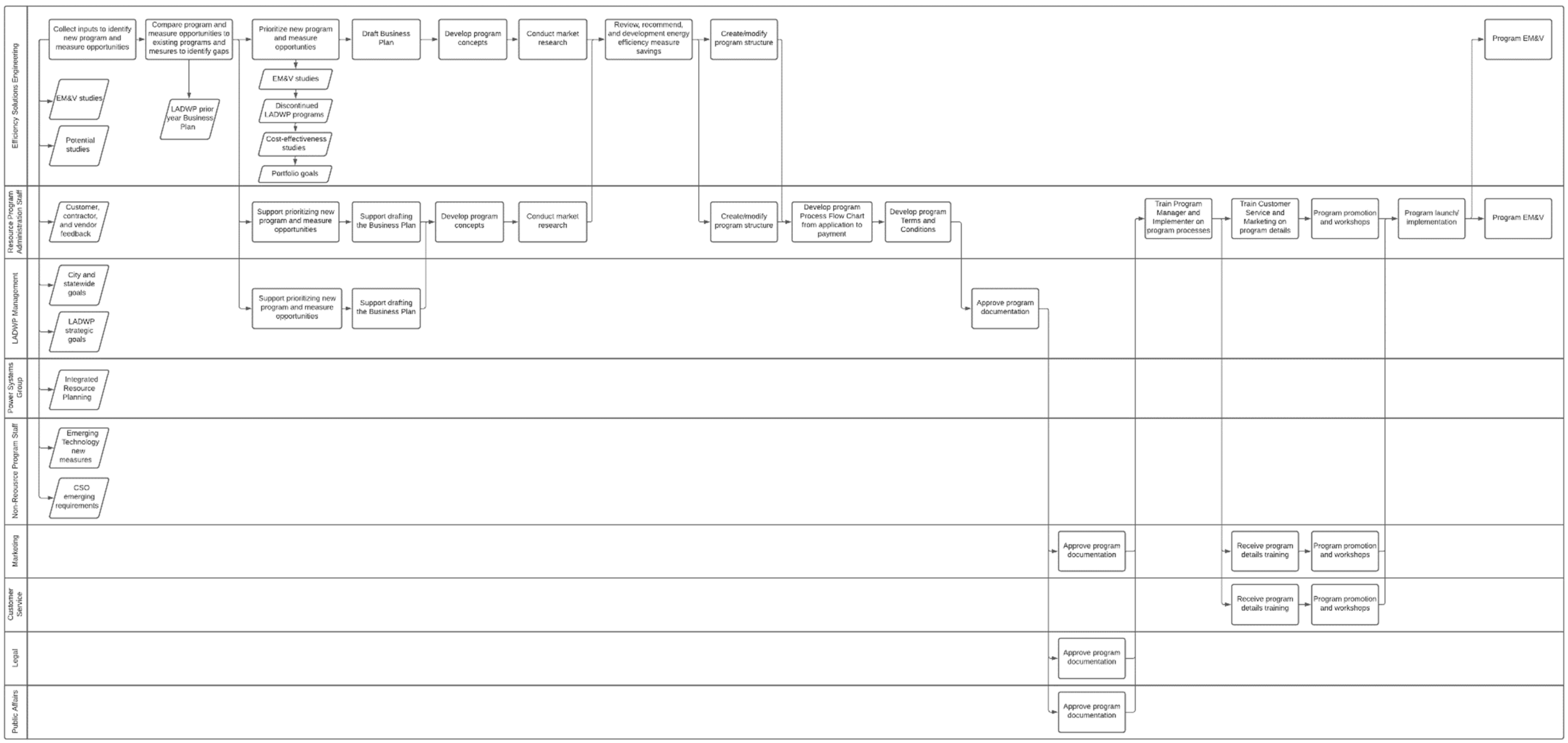


Figure 23-2 presents LADWP's new program development process. The figure presents the intended process for new program development. LADWP staff have noted that this formalized process is new and still being rolled. In this process, the Efficiency Solutions Engineering (ESE) group is highly involved in collecting inputs to identify and prioritize new programs and measures. Once the program structure has been defined, resource program staff become the key players in ensuring the program has the necessary plans, documentation, tools, and applications to launch.

Figure 23-2 PADP New Program Development Process Flow Chart



At the request of LADWP, the Evaluator identified metrics that would allow LADWP to classify PADP as a Market Support program. Section A21.2.1.5 presents the metrics for the two applicable sub-objectives (Innovation and Accessibility and Access to Capital) identified by the CAEECC-Hosted Market Support Metrics Working Group. Table 23-1 presents the alignment of LADWP non-resource programs with Innovation and Accessibility Metrics. Table 23-2 presents the alignment of non-resource programs with Access to Capital Metrics. Notably, meeting either of these sub-objectives and tracking the related metrics may require PADP to expand its goals, activities, and associated outputs. LADWP should assess internally which sub-objectives and outputs are most aligned with the other goals and overall capacity of the PADP program. LADWP may also consider whether PADP meets a sub-objective related to the Market Support segment that was not included in the MSMWG recommendations.

Table 23-1 Proposed alignment of LADWP Non-Resource Programs with Innovation and Accessibility Metrics

Metric Type:	PADP	ET	CSO	MEO
Applicable Existing Metrics that will continue to be collected	• None	• ETP-T1: Prior year: % of new measures added to the portfolio that were previously ETP technologies • ETP-T2: Prior Year: # of new measures added to the portfolio that were previously ETP technologies • ETP-T5: Savings of measures currently in the portfolio that were supported by ETP, added since 2009. Ex-ante with gross and net for all measures, with ex-post where available	• ETP-T3: Prior year: % of new codes or standards that were previously ETP technologies • ETP-T4: Prior Year: # of new codes and standards that were previously ETP technologies	• None
New Metrics with data that can	• Number of market support projects (outside of ETP) that validate the	• Number of new, validated technologies	• None	• None

Metric Type:	PADP	ET	CSO	MEO
be collected now (program outputs for relevant programs)	technical performance, market, and market barrier knowledge, and/or effective program interventions of an emerging/under-utilized or existing energy efficient technology • Cost effectiveness of a technology prior to market support programs relative to cost effectiveness of a technology after intervention by the market support programs (% change in cost effectiveness)	recommended to CalTF		
New Metrics with data that needs to be collected later	• Percent market penetration of emerging/under-utilized or existing EE products or services • Aggregated confidence level in performance verification by product, project, and service (for relevant programs)	• None	• None	• Percent market participant aware of emerging/under-utilized or existing EE products or services
Indicators (for relevant programs)	• None	• Number of providers for performance verification services	• None	• None

Table 23-2 Proposed alignment of LADWP Non-Resource Programs with Access to Capital Metrics

Metric Type:	PADP	MEO
Applicable Existing Metrics that will continue to be collected	• Participant data, e.g., credit score, census tract income, CalEnviroScreen Scores of areas served, zip code • Comparisons between market-rate capital vs. capital accessed via EE programs, e.g. interest rate, monthly payment	• None
New Metrics with data that can be collected now (program outputs for relevant programs)	• Total projects completed/measures installed and dollar value of consolidated projects • Ratio of ratepayer funds allocated to private capital leveraged • Differential of cost defrayed from customers (e.g., difference between comparable market rate products and program products).	• None
New Metrics with data that needs to be collected later	• None	• % of market participants aware of capital access opportunities for investments in energy efficient projects, products, and/or services (awareness) • % of market participants knowledgeable about capital access opportunities for investments in energy efficient projects, products, and/or services (knowledge) • % of market participants interested in leveraging capital access opportunities for investments in energy efficient projects, products, and/or services (attitude) • % of market participants that were unable to take action due to access to capital or affordability of energy efficient projects, products, or services (behavior)

Regularly revisit program objectives, activities, tasks, short-term, and long-term outcomes to ensure that current activities and tasks are aligned with program objectives and goals. Since the PADP program encompasses a wide variety of goals and outcomes, we recommend that LADWP regularly revisit the logic model for PADP to ensure that current activities are aligned with desired program outcomes. This will help

PADP remain responsive to LADWP strategic and regulatory objectives in an everchanging environment. This will also ensure that PADP staff have the resources and support to conduct activities that will help them achieve program goals.

Establish metrics that track PADP progress towards short and long-term outcomes. These metrics can be quantitative, qualitative, or procedural in nature. Metrics should be defined based on program activities, outputs, and how these lead to outcomes.

Consider which Market Support sub-objectives PADP may help fulfill and consider tracking related metrics. Depending on the sub-objectives selected PADP may consider updating the program logic model to reflect these.

Bridge the divide between intended and actual Program Analysis and Program Development process by:

- Raising awareness among LADWP staff about new program development processes and the program improvement process
- Clearly defining, delineating, and communicating roles and responsibilities, especially for tasks which involve multiple parties
- Giving resource program managers a point of contact for questions about new processes
- Giving resource program managers a way to provide feedback/suggestions related to new processes, such as regular check in points or internal surveys
- Ensuring program managers understand the value of new processes, such as ensuring savings calculations and incentives are updated regularly or that programs are tracking relevant and consistent metrics.

24 Program Outreach & Community Partnerships (Community Partnership Grants)

This chapter presents the process evaluation of LADWP's Program Outreach & Community Partnerships Program (POCP) that operated during fiscal year 20/21 (FY 20/21 or Concurrent Year 1).

24.1 Program Description

The LADWP Program Outreach & Community Partnerships Program (POCP), commonly referred to as the Community Partnership Grants program, was established in 2010 in response to the City of Los Angeles Green LA Plan, utilizing formula-based Energy Efficiency and Conservation Block Grant (ARRA) funding from US Department of Energy. This non-resource program was considered successful and was extended utilizing ratepayer funding.

POCP is an advocacy program that strives to improve customer awareness among LADWP's "hard-to-reach" customers of electric and natural gas efficiency and water conservation programs through the activities of community organizations. This program offers grants to local non-profit organizations with grassroots networks and "trusted advisor" status for targeted populations. Grantees go through a competitive selection process to work in one of the fifteen Los Angeles City Council Districts or on an at-large basis to improve community and customer awareness of LADWP's core energy efficiency and water conservation programs, and free steps customers can take to reduce energy and water use.

24.2 Process Evaluation

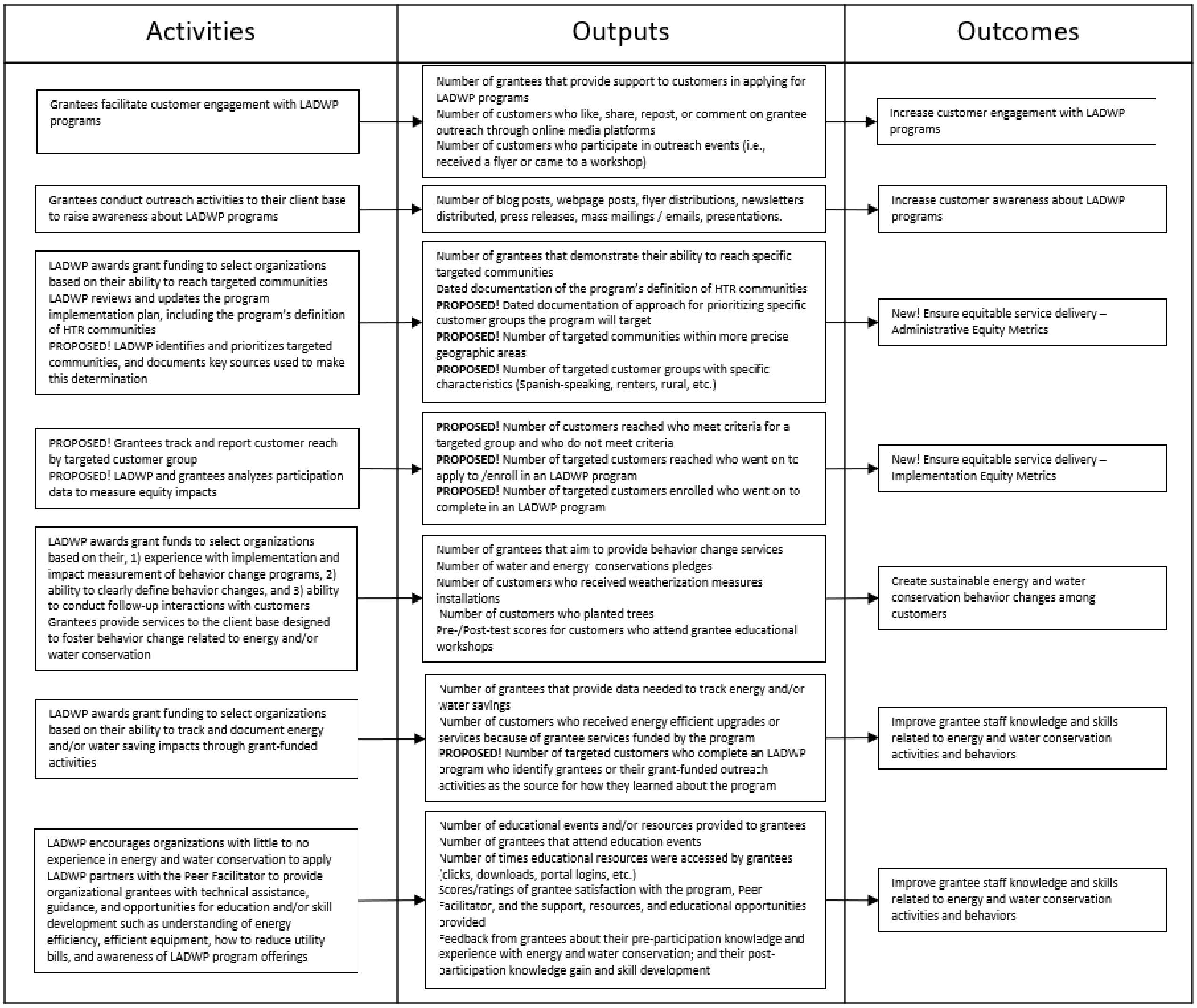
The Evaluator completed a process evaluation of the POCP that included the following activities:

- Interviews with program staff.
- Review of program materials and tracking data.
- Interviews with program grantees.
- Development of a baseline program theory logic model and program metrics.

24.3 Program Key Findings and Recommendations

The Evaluator developed a logic model of the program and relevant metrics. A simplified version of the logic model is presented in Figure 24-1 and a more detailed logic model and program metrics are presented in section A.22.3.5.

Figure 24-1 POCP Baseline Logic Model



Consider incorporating more in-depth, customized guidance to grantees looking for effective and sustainable strategies for data collection and impacts measurement, particularly for behavior change over time and electricity or water savings. Several grantees indicated an interest in or need for this level of support. In-depth guidance might include gathering or creating step-by-step frameworks, one-on-one consultations, program evaluability assessments for grantees, and more.

Optimize grantees' time during interactions with LADWP. Grantees suggested opportunities to streamline the marketing approval process, the process for getting status updates on applications to other programs that grantees submit for customers, and time they or their customers spend navigating the LADWP website.

- Grantees pointed to the LADWP marketing materials approval process as the greatest challenge in conducting their outreach activities. To address this, grantees suggested:

  - Easy-to-access library of pre-approved images grantees could use for their marketing and outreach materials
  - LADWP liaison that can facilitate a faster approval process for grantee materials in general and provide real-time status updates on customer program applications
  - Faster approval process for translations, particularly Spanish translations
- Grantees described how their customers have trouble finding things or figuring out what services are available to them through the LADWP website. To address this, consider simplifying the path from the home page on the LADWP website to the various efficiency solution programs. For example, add a button directing visitors to a landing page for all efficiency programs to the home page or make the "Save Money" tab more prominent on the Residential and Commercial landing pages linked to the home page.

The Evaluator identified metrics in the baseline program theory logic model that can demonstrate the program's progress toward reaching outcomes. The Evaluator also identified barriers to measurement and potential solutions. The barrier of grantees' limited ability to gather quality information about individual customers' characteristics, participation, and actions following their initial interactions with grantees has implications for measuring several outcomes including levels of customer awareness and understanding of LADWP programs and levels of engagement in LADWP because of grantee efforts. The Evaluator recommends that LADWP consider the following potential solutions for overcoming this barrier.

Consider creating a new proxy measure for the program's impact on customer engagement in other LADWP programs. For example, create a new cross-program participant (i.e., for all customers who participated in LADWP programs other than POCP within a designated timeframe) questionnaire or add a question to an existing questionnaire to estimate the proportion of customers who participated in other LADWP programs that recall POCP outreach efforts. This would be the rate of POCP recall. Then, take the raw number of customers who received POCP outreach (or the number to whom grantees report sending outreach materials) and determine the rate of POCP outreach by calculating the portion of the general, eligible customer base that raw number represents. This would be the rate of POCP outreach. Finally, compare the rate of POCP outreach to the rate of POCP recall. The result is an estimated rate of POCP program influence or impact on customers' decisions to participate in other programs.

Alternatively, consider systematically capturing how customers learned about other LADWP programs when they enroll in them and specifically probe on grantee or POCP-related activities. Given the various activities that the sometimes more than 20 different grantees offer each cycle (Phases I and II), the Evaluator suggests that the systematic approach use cascading questions. For example, first ask how customers learned about the program providing higher-level response options like, 'community workshop,' 'community event,' or, 'flyer from a community organization'. Next, ask the subset of customers who select response options that correlate to grantee activities about more specific activities. For example, ask customers who select 'community workshop' about what the workshop was about using grantee workshop topics like, 'sustainable gardening,' or 'how to save energy in my home.' The Evaluator notes that secondary questions that more specifically probe on activities will need to be regularly updated with each grant cycle and should include options referring to grantee activities from up to three years past.

Consider building on this approach to create proxy measures for the program's impact on customer awareness of other LADWP programs. For example, create a new cross-program participant questionnaire or add questions to an existing questionnaire to estimate their current levels of awareness of other LADWP programs. Then, apply the rate of POCP recall described above and compare levels of awareness between customers that recall POCP outreach efforts and customers that do not. Alternatively, create or add awareness questions to a broader general population survey and compare rates of awareness between respondents that recall POCP outreach efforts, respondents that do not, respondents who are LADWP program participants, and non-participant respondents.

Consider optimizing market engagement (MEO) and program marketing and outreach strategies based on insights from grantees. Grantees have trusted relationships with the communities, including hard to reach (HTR) customers, they serve. Their experience enables them to understand and incorporate culturally relevant messaging and outreach strategies to effectively engage HTR customers. This is a key value that the POCP program lends to LADWP's efficiency solutions portfolio. LADWP could build on this value by leveraging grantee insights to form optimized marketing and outreach strategies across portfolio programs.

Select the most relevant CalEnviroScreen indicators when leveraging CalEnviroScreen indicator scores to determine geographic areas where DACs are located. Scores from the most relevant indicators to a specific program should take priority over the overall CalEnviroScreen score. This approach will more effectively help the program identify, reach, and engage customers with needs that the program could best address.

Consider focusing outreach to HTR customers by targeting and prioritizing specific geographic areas (census block group or zip code) or customer characteristics (limited English speakers, single-parent households, etc.). Then reassess selected targeted customer groups at regular intervals such as each grant cycle or every 3 years. Over time, certain customer groups may become more or less important to target depending on the needs of the customer market, regulation, or strategic LADWP initiatives.

Consider incorporating the newly proposed administrative metric to demonstrate how well the program delivers services equitably. Continuously revise the frequency of updated documentation for the program's definition of HTR communities and the approach for identifying and prioritizing HTR communities to target.

Upon availability of individual customer data from grantees, consider implementation-based equity metrics to demonstrate how well the program delivers services equitably. Measure the rate of targeted customers reached, customer application to LADWP programs, customer program enrollment, and customers program completion.

25 Cost Benefit Analysis

This chapter provides an overview of cost effectiveness for the LADWP energy efficiency portfolio, along with total program costs and benefits, as well as a summary of the cost effectiveness analysis. Costs include program costs incurred in the implementation of the LADWP energy efficiency portfolio during FY 20/21. Cost effectiveness results by program are available in Section 25.2.

25.1 Cost Effectiveness Summary

The cost-effectiveness of LADWP's programs was calculated based on reported total spending and verified energy savings for each of the energy efficiency programs. All spending estimates and incentive costs were provided by LADWP. The methods used to calculate cost-effectiveness are informed by the California Standard Practice Manual.

To calculate the cost-effectiveness of each program, measure lives were assigned on a measure-by-measure basis. When available, measure life values were obtained from Database for Energy Efficiency Resources (DEER) workpapers. Additionally, assumptions regarding incremental/full measure costs were necessary. Avoided energy, capacity, and transmission/distribution costs used to calculate cost-effectiveness were provided by LADWP.

The LADWP portfolio consisted of nineteen programs with verified gross kWh savings of 299,240,178. Total spending in FY 20/21 equaled $94,448,012. Table 25-1 lists benefits and costs along with cost effectiveness results for FY 20/21. Cost effectiveness results are shown for the Total Resources Cost (TRC) Test, Program Administrator Cost (PAC) Test, the Rate-payer Impact Measure (RIM) Test, Participant Cost Test (PCT), and Modified Total Resources Cost (MTRC) Test.

Table 25-1 FY 20/21 Portfolio Level Cost Effectiveness Results

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$249,039,025	$249,039,025	$714,579,035	$249,039,025	$249,039,025
Total Costs	$105,569,049	$93,577,492	$46,873,401	$761,283,126	$93,577,492
Benefit/Cost Ratio	2.36	2.66	15.24	0.33	2.66

25.2 Cost Effectiveness Program Results

Table 25-2 provides a summary of program cost effectiveness results for PAC, TRC, PCT, RIM, and MTRC. Measure-level cost effectiveness program results are presented in Appendix B .

Table 25-2 FY 20/21 Program Level Cost Effectiveness Results

Program	PAC Ratio	TRC Ratio	PCT Ratio	RIM Ratio	MTRC Ratio
CDI	0.22	0.38	362.42	0.11	0.38
CLIP	0.63	0.87	17.10	0.19	0.87
CP	4.84	4.84	13.41	0.98	4.84
CPP	2.28	2.82	17.96	0.30	2.82
FSP Comprehensive	0.35	0.35	18.24	0.17	0.35
FSP POS	0.14	0.17	24.77	0.10	0.17
LADWP Facilities	0.26	0.25	29.66	0.15	0.25
LAUSD DI	0.33	1.93	76.96	0.16	1.93
SBD	0.23	0.23	8.03	0.16	0.23
UHVAC	2.21	3.95	25.97	0.43	3.95
CRP	0.56	0.46	1.30	0.37	0.46
EPM	1.03	0.93	3.64	0.47	0.93
ESAP	0.26	0.26	2.06	0.13	0.26
LIREP	0.20	0.23	115.34	0.14	0.23
RETIRE	0.01	0.01	5.31	0.01	0.01
RLEP	8.23	8.23	73.40	0.29	8.23
MFWB	1.27	1.50	12.54	0.30	1.50
ACOP	0.83	0.62	1.66	0.38	0.62
CAHP	0.61	0.61	2.20	0.31	0.61
CSO	11.45	11.45	0.00	0.32	11.45
Portfolio Total	2.35	2.65	15.24	0.33	2.65

Appendix A Program-Level Evaluation Methodology & Impact/Process Evaluation

This appendix presents detailed evaluation methodology descriptions, as well as the work performed to complete impact evaluations and process evaluations for the LADWP Energy Efficiency Programs offered during FY 20/21.

A.1. CDI Program

This section details the impact evaluation for the Commercial Direct Install (CDI) program that LADWP offered customers during FY 20/21. The primary objective of this evaluation was to calculate energy savings and peak demand impacts attributable to the CDI Program.

A.1.1. Evaluation Methodology

This section presents the findings of the tracking data review and the methodology used to calculate verified Ex-Post energy savings and peak demand reduction for the program. As part of the impact evaluation, the Evaluator performed the following data collection activities outlined in Table A-1.

Table A-1 CDI Data Sources for Impact Evaluation

Data	Source
Program Tracking Data	Data requested to LADWP for all data tracking program participation
Desk Review	Reviews of project documentation (Proposed Activity Report, Post Installation Report) of a sample of customers who have participated in the program
On Site Verification	Site visits of a sample of customers to collect data for savings calculation, to verify installation, and determine operating parameters

A.1.1.1. Tracking Data Review

Program tracking data for measures incentivized between July 2020 and June 2021 was provided by LADWP. The database was reviewed to ensure that the data provided sufficient information to calculate energy and peak demand impacts. Some key details contained in the data that were needed to calculate energy savings included fixture or lamp system watts and quantity, description of lighting, and building type.

A.1.1.2. M&V Sample Design

A sample design was developed for site level analysis utilizing the tracking data provided. The Evaluator selected a stratified sample for projects sites (known as ratio estimation) to represent the population of program. The FY 20/21 sample projects are enough to estimate the total achieved savings with ±23.7% precision at a 90% confidence interval. The Evaluator’s current sample (FY 20/21) and future samples (FY 21/22, FY 22/23) will in total be enough to estimate the total achieved savings with ±10% precision at a 90% confidence interval.

Project sites were categorized to each stratum by Ex-Ante kWh savings. The boundaries of each stratum were developed to ensure the extrapolation of impacts is appropriately distributed. Realization rates (the ratio of Ex-Post kWh savings to Ex-Ante kWh savings) for projects sampled in each stratum were only extrapolated to other projects within that stratum. Table A-2 presents the number of projects and tracking Ex-Ante kWh savings for the sampled projects by stratum.

Table A-2 CDI Population Statistics used for Sample Design

	Stratum 1	Stratum 2	Stratum 3	Stratum 4	Totals
Strata boundaries (kWh)	<12,500	12,500 – 50,000	50,000 – 100,000	>100,000	
Population Size	72	83	16	3	174
Total Ex-Ante kWh Savings	459,083	2,067,407	1,066,737	752,150	4,345,377
Average Ex-Ante kWh Savings	6,376	24,909	66,671	250,717	
Standard deviation of Ex-Ante kWh savings	3,725	9,385	12,211	153,578	
Coefficient of variation	0.58	0.37	0.18	0.43	
Final design sample	2	2	2	2	8

The resulting sample of 8 project sites consisted of 4 categories, or strata. The Ex-Post gross annual energy savings (kWh) precision is ±23.7%.

A.1.1.3. Baseline Assumptions Review

Generally, for projects involving lighting measures, savings can be determined as follows:

$$kWh = \frac{Watt_{base} * HOU_{base} * Qty_{base} - Watt_{installed} * HOU_{installed} * Qty_{installed}}{1000} * IEFe \qquad \textit{Equation A-1}$$

$$\Delta \mathrm{kW} = (Watt_{base} - Watt_{installed}) * CF * IEFd/1000 \qquad \textit{Equation A-2}$$

Equation A-1 and Equation A-2 detail the algorithms used to determine energy savings and peak demand reduction for lighting measures.

Where:

- $base$ represents the pre-existing condition or old lighting equipment,
- $installed$ represents the existing condition or new lighting equipment,
- $Watt$ represents the watts of the lighting system,
- HOU represents the operating hours of use,
- Qty represents the quantity in bubs or fixtures of the lighting equipment,
- $IEFe$ represents the interactive effects factor for energy,
- $IEFd$ represents the interactive effects factor for peak demand, and
- CF represents the coincidence factor.

Specific variables are defined in more detail below.

Baseline Wattage: For the Ex-Post savings analysis, the baseline wattage was considered as the wattage of the pre-retrofit lighting fixture. However, when applicable, EISA 2007 baseline wattage standards were applied to pre retrofit lighting fixtures such as A19 incandescent. In that example, the baseline wattage was adjusted from 60W to 43W. Lastly, for the purpose of calculating dual baseline lifetime savings, savings were also calculated using a code-specified baseline wattage.

Hours of Use (HOU): The hours of use utilized were the hours confirmed during the site visit or hours from DEER workpapers dependent upon space type and climate zone.

Summer Peak Coincidence Factor (CF): The summer peak coincidence factor was a ratio determined by light utilization during the peak demand period of 1pm-5pm on weekdays from July to September.

Interactive Effects, Energy Savings (IEFe): The utilized value for energy interactive effects were sourced from tables taken from DEER. The values were dependent upon space type, climate zone, and installed fixture type.

Interactive Effects, Demand Reduction (IEFd): The utilized value for energy interactive effects were sourced from tables taken from DEER. The values were dependent upon space type, climate zone, and installed fixture type.

A.1.1.4. Ex-Ante Savings Review

Table A-3 summarizes the discrepancies the Evaluator found comparing the reported ESP Ex-Ante kWh and Peak kW savings with the Ex-Ante kWh and Peak kW savings presented in the tracking data delivered by LADWP.

Table A-3 CDI Ex-Ante Savings Source Comparison

Fiscal Year	ESP Data Ex-Ante kWh Savings	Program Data Ex-Ante kWh Savings	Ex-Ante kWh Percent Change	ESP Data Ex-Ante Peak kW Savings	Program Data Ex-Ante Peak kW Savings	Ex-Ante Peak kW Percent Change
20/21	4,315,466	4,345,377	0.7%	300.56	338.41	11.2%

The tracking Ex-Ante kWh was slightly greater than the ESP Ex-Ante savings. There was a more significant deviation between ESP and tracking data for peak kW impact, totaling 11.2% for FY 20/21.

A.1.1.5. M&V Approach

In person site visits were utilized to inform the calculation of energy savings for the sample. The site visits were used to accomplish two major tasks:

- Verification of equipment installation; and
- Collection of data from site regarding operating hours, building type, HVAC systems, and other parameters that affect savings calculations.

Available documentation was reviewed for a sample of projects, with attention given to the building type, counts, location, and other parameters. All 8 of the sampled sites were visited in person.

A.1.1.6. Data Collection Activities

When projects were selected for the M&V sample, the Evaluator notified LADWP by providing the LADWP EM&V staff with a list of projects for which the Evaluator planned to schedule M&V activities. This list included the company name, the project ID, the site address or other premise identification, and the respective contact information for the customer representative that the Evaluator intended to contact to schedule an appointment.

Typically, notification was provided at least one week prior to the Evaluator contacting customers to schedule M&V visits. Upon request, ADM coordinated its scheduling and M&V activities with an LADWP Customer Service Representative.

Site visits consisted of an in-person walk-through to verify installed measures were functioning and to collect photos of installed equipment. In person interviews were conducted with site contacts regarding project details and to collect information to support Ex-Post analysis.

A.1.2. Impact Evaluation

Ex-Post kWh savings and peak kW reduction were calculated using the DEER workpapers and other proven industry techniques. Key input parameters were based on information collected during site visit verification or from available project documentation.

A.1.2.1. Engineering Review Procedures

Available project documentation was reviewed for a sample of projects, with attention given to system wattage, fixture type, building type, HVAC configuration, and space type. Analysis of lighting savings was accomplished using the Evaluator's custom-designed lighting evaluation model with system parameters (fixture wattage, operating characteristics, etc.) based on information either collected virtually, referenced in project documentation or DEER workpapers and, if appropriate, referencing industry standards.

A.1.2.2. Extrapolation of Results

Table A-4 Compares Ex-Post energy savings to Ex-Ante claimed savings from the tracking data. For FY 20/21, the program level Ex-Post energy savings realization rate was 88% when compared to Ex-Ante savings.

Table A-4 CDI Stratum Savings Summary

Stratum	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
1	459,083	363,788	79%
2	2,067,407	1,915,462	93%
3	1,066,737	1,079,303	101%

Stratum	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
4	752,150	430,615	57%
Total	4,345,377	3,789,168	88%

The program level realization rate of 88% was a result of the sampled projects seen below in Table A-5. The overall program realization rate was most affected by Projects 1,2,3, and 4.

Table A-5 CDI Sampled and Non-Sampled Savings Summary

Project	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Project 1	11,434	8,141	71%
Project 2	118,135	94,499	80%
Project 3	419,001	213,392	51%
Project 4	38,906	31,945	82%
Project 5	29,112	31,074	107%
Project 6	3,346	3,571	107%
Project 7	50,054	52,287	104%
Project 8	90,100	91,514	102%
Non-sampled Projects	3,585,289	3,262,745	91%
Total	4,345,377	3,789,168	87%

The Evaluator sample included 8 projects. The specific factors affecting the projects' realized energy savings were as follows.

- Project 1: The Evaluator's site visit found annual hours of 2,125. The Ex-Ante used annual hours of 3,612.
- Project 2: The Evaluator's site visit found annual hours of 2,991 & 2,983 for the interior fixtures. The Ex-Ante used annual hours of 3,612. Additionally, EISA 2007 baseline wattage standards were applied to some fixtures. For example, the A19 bulb baseline wattage of 60W incandescent was updated from 60W, to 43W.
- Project 3: The Evaluator's site visit found annual hours of 2,125 & 2,750 & 2,983 & 3,861 for the interior fixtures. The Ex-Ante used annual hours of 4,004. Additionally, EISA 2007 baseline wattage standards were applied to some fixtures. For example, the A19 bulb baseline wattage of 60W incandescent was updated from 60W, to 43W.
- Project 4: The Evaluator's site visit found annual hours of 1,750 for the interior fixtures. The Ex-Ante used annual hours of 3,612.

- Project 5: The Evaluator's site visit found annual hours of 4,377 for the exterior fixtures. The Ex-Ante used annual hours of 3,612.
- Project 6: The Evaluator's site visit found annual hours of 4,377 for the exterior fixtures. The Ex-Ante used annual hours of 3,612.
- Project 7: The Evaluator's site visit found annual hours of 4,377 for the exterior fixtures. The Ex-Ante used annual hours of 3,612.
- Project 8: The Evaluator's site visit found annual hours of 4,377 for the exterior fixtures. The Ex-Ante used annual hours of 3,612.

The frequency and impact of the specific factors affecting realized savings listed above are illustrated in Figure A-1 and Figure A-2 below.

Figure A-1 CDI Factors Affecting Gross Realized Savings

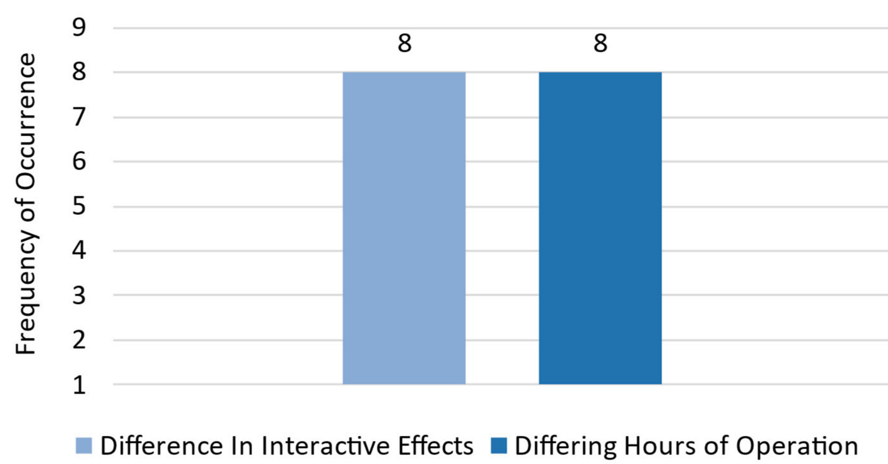
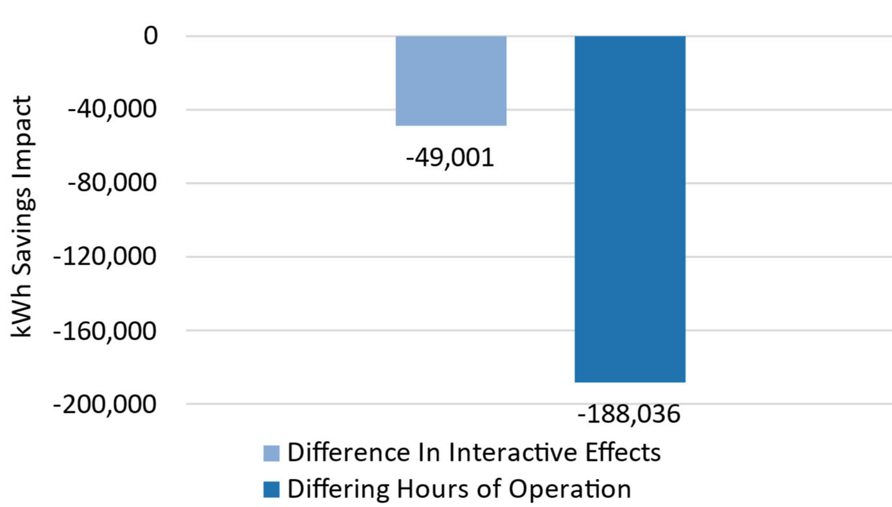


Figure A-2 CDI Impact of Factors Affecting Gross Realized Savings



A.1.3. Process Evaluation

The Evaluator completed a summary evaluation that was limited in scope as the program had limited activity due to the COVID-19 pandemic. One in-depth interview was completed with program staff in December 2020, which explored program design, customer engagement and outreach, measures offered, and participation processes.

A.1.3.1. Summary Process Evaluation Findings

The Evaluation team discussed with program staff outreach strategies and participation processes. Staff report that the program utilizes seven distinct community-based organizations (CBOs) in various parts of the greater LA area. The external vendor (Lime Energy) provides CBOs with project leads contingent upon their zip code. The following steps are then completed:

- The CBOs approach potentially qualifying small and medium businesses and solicit their participation in the program. If a business agrees to participate, one of two subcontractors are assigned to the project who will conduct an initial assessment to ascertain the qualifying measures that are applicable to the customer.
- A report is generated through the initial assessment that documents the buildings existing water and lighting measures, whether the existing measures are eligible for an upgrade, and if so, what the upgrade will be. The report also provides the potential monetary savings and corresponding annual usage of each measure.
- Upon completion of the initial assessment, a LIME Energy ESR (energy service representative) finalize the agreement with the customer and officially enrolls it in the program, as well as to answer any additional questions.
- Once the Lime Energy ESR enrolls the business in the program, the business is assigned a lighting subcontractor through the Local 11 contracting Union, and the work is completed.
- If the building is eligible for water saving measures, Lime Energy sends the report to the Plumbing Supervisor, and installation of water measures is coordinated separately and performed by LADWP employees.

Lighting measures are primarily focused on replacing exit lighting as well as inefficient T8 and T12 fixtures with high-efficiency LEDs, with additional focus on external wall packs and pole mounted parking lot lighting. The program does not offer any decorative or specialty lighting. Available water devices are contingent upon the type of business, with aerators, low-flow showerheads, and low-flow toilets available to all businesses, and high-efficiency spray valves offered only to food service businesses.

A.2. CLIP

This section details the impact evaluation for the Commercial Lighting Incentive Program (CLIP) program that LADWP offered customers during FY 20/21. The primary objective of this evaluation was to calculate energy savings and peak demand reduction attributable to the CLIP program, as well as to complete a process evaluation.

A.2.1. Evaluation Methodology

This section presents the findings of the tracking data review, the methodology used to calculate verified Ex-Post energy savings and peak demand reduction for the program, and the results of the analysis.

A.2.1.1. Tracking Data Review

LADWP provided the Evaluator with the available program tracking data for measures installed as a part of CLIP during FY 20/21. Review of the tracking data was performed to ensure that the provided data was sufficient to calculate energy savings and peak demand reduction, and to verify that projects listed were completed and had dates matching the fiscal year to which they were attributed.

A.2.1.2. M&V Sample Design

Based on a review of the program tracking data, a stratified random sampling approach was employed based on project level Ex-Ante annual energy savings (kWh). Statistical samples will be designed so as to ensure that the combined strata represent the population within ±10% precision at the 90% confidence interval by the end of FY 22/23. The number of strata, the boundaries within each stratum, and the number of sample points for each stratum will be determined through an iterative process. For FY 20/21, the sample resulted in a program level precision of ±13.74% at the 90% confidence interval using Ex-Ante estimates. The boundaries of each stratum were developed to ensure the extrapolation of impacts was appropriately distributed. Realization rates (the ratio of Ex-Post kWh savings to Ex-Ante kWh savings) for projects sampled in each stratum were only extrapolated to other projects within that stratum.

Table A-6 CLIP Population Statistics used for Sample Design

	Stratum 1	Stratum 2	Stratum 3	Stratum 4	Stratum 5	Stratum 6	Totals
Strata boundaries (Ex-Ante kWh)	0 - 12,000	12,000 - 40,000	40,000 - 115,000	115,000 - 315,000	315,000 - 1,000,000	1,000,000 - 3,500,000	
Population Size	10	20	32	42	18	3	125
Total Ex-Ante kWh savings	46,267	492,717	2,273,907	8,284,698	9,643,510	6,056,931	26,798,030
Average Ex-Ante kWh Savings	4,627	24,626	71,060	197,255	535,751	2,018,877	214,384
Standard deviation of Ex-Ante kWh savings	3,243	8,893	21,470	58,727	199,969	1,255,959	375,138
Final design sample	2	2	2	3	4	1	14

A.2.1.3. Baseline Assumptions Review

Generally, for projects involving lighting measures, savings can be determined as follows:

$$kWh_{Savings} = \frac{Watt_{Baseline} * HOU_{Baseline} * Qty_{Baseline} - Watt_{Installed} * HOU_{Installed} * Qty_{Installed}}{1000} * IEFe \quad \text{Equation A-3}$$

$$kWh_{Code} = \frac{Watt_{Code} * HOU_{Baseline} * Qty_{Baseline} - Watt_{Installed} * HOU_{Installed} * Qty_{Installed}}{1000} * IEFe \quad \text{Equation A-4}$$

$$\Delta kW = (\text{Watt}_{\text{Baseline}} - Watt_{Installed}) * CF * IEFd/1000 \qquad \textit{Equation A-5}$$

$$Dual\ Baseline\ Lifetime\ Savings = kWh_{Savings} * \frac{EUL}{3} + kWh_{Code} * (EUL - \frac{EUL}{3}) \qquad \textit{Equation A-6}$$

Equation A-3 and Equation A-5 detail the equations used to determine energy savings and demand reduction for lighting measures. Dual baseline lifetime savings were calculated as a part of the program analysis, detailed in Equation A-6. Calculation of dual baseline lifetime savings required the use of savings using code standards found using Equation A-4 Baseline assumptions made for energy savings and demand reduction are detailed below:

Baseline Wattage: For the Ex-Post savings analysis, the baseline wattage is considered as the wattage of the pre-retrofit lighting fixture. However, for the purpose of calculating dual baseline lifetime savings, savings were also calculated using a code-specified baseline wattage. For Tube LEDs, High Bay LEDs, and LED Troffer Kits, the code baseline wattage was calculated using a code efficacy value taken from the SWLG009-02, SWLG011-03, and SWLG012-01 workpapers along with the lumens of the installed fixture. For Screw-In LEDs, the code baseline wattage was determined using a wattage reduction ratio taken from DEER workpapers applied to the installed fixture wattage.

Hours of Use (HOU): The hours of use utilized were the hours confirmed during the virtual verification process. Deemed values from DEER workpapers dependent upon space type and climate zone were also used.

Summer Peak Coincidence Factor (CF): The summer peak coincidence factor is a ratio determined by light usage during the peak demand period of 1pm-5pm on weekdays from July to September.

Interactive Effects, Energy Savings (IEFe): The utilized value for energy interactive effects come from tables taken from DEER. The values are dependent upon space type, climate zone, and installed fixture type.

Interactive Effects, Demand Reduction (IEFd): The utilized value for energy interactive effects come from tables taken from DEER. The values are dependent upon space type, climate zone, and installed fixture type.

A.2.1.4. Ex-Ante Savings Review

Table A-7 summarizes the discrepancy found in comparing the reported ESP Ex-Ante kWh savings and Peak kW reduction with the Ex-Ante kWh savings and Peak kW reduction presented in the program tracking data provided by LADWP.

Table A-7 CLIP Ex-Ante Savings Source Comparison

Fiscal Year	ESP Data Ex-Ante kWh	Program Data Ex-Ante kWh	Ex-Ante kWh Percent Change	ESP Data Ex-Ante Peak kW	Program Data Ex-Ante Peak kW	Ex-Ante Peak kW Percent Change
20/21	26,663,687	26,798,030	0.5%	2,921.98	4,730.59	38.2%

The Ex-Ante kWh reported in the tracking data was slightly greater than the ESP Ex-Ante savings for FY 20/21. For Peak kW, the savings comparison differed by 38.2% when comparing the tracking Ex-Ante with ESP Ex-Ante kW impact.

A.2.1.5. M&V Approach

The Evaluator contacted site contacts for sampled projects to schedule a site visit. Due to COVID-19, a choice between in-person and virtual site visits were offered when scheduling the visit. Site visits were used to verify the installation of incentivized measures and gather information utilized for calculating project energy savings. In addition to the virtual site visits, provided project documentation (invoices, cut sheets, applications, etc.) were reviewed to supplement the information gathered during the virtual verification process in order to calculate associated project savings.

A.2.1.6. Data Collection Activities

When projects were selected for the M&V sample, the Evaluator notified LADWP by providing the LADWP EM&V staff with a list of projects for which the Evaluator planned to schedule M&V activities. This list included the company name, the project ID, the site address or other premise identification, and the respective contact information for the customer representative the Evaluator intended to contact to schedule an appointment.

Once approval of M&V activities for the sampled projects was given by LADWP, the Evaluator contacted and scheduled verification activities with the customer representative.

Site visits consisted of an in-person walk-through to verify installed measures were functioning and to collect photos of installed equipment. In person interviews with site contacts regarding project details and information to support analysis were conducted.

Virtual verification consisted of two different approaches which were used dependent upon the project, facility type, location, and customer representative availability. These methods were as follows:

- Video Call: During video calls, the Evaluator would verify the installation of claimed project measures while also conducting an interview of the site contact to gather information regarding operation of the project equipment. Multiple methods of video were employed to accommodate site contacts for various projects. The methods of video communication used were Streem, Microsoft Teams, and FaceTime.
- Phone Call: In instances where the site contact was unable to perform a video call, a phone call interview was performed, where the Evaluator would ask the project

pertinent questions and for which those answers were used to calculate savings. The Evaluator would also request photos of the installed project equipment to be provided after the call.

A.2.2. Impact Evaluation

Ex-Post kWh savings and peak kW reduction were calculated using the applicable DEER workpapers and other proven industry techniques. Key input parameters were based on information collected during virtual site verification or from the available project documentation.

A.2.2.1. Engineering Review Procedures

Documentation provided was reviewed for the projects within the program sample. The CLIP measure summary and incentive calculator along with invoices and specification sheets of installed fixtures were reviewed. Analysis of project savings were performed with typical lighting savings algorithms detailed in 2.1.3 using information gathered from the project documentation and information gathered during the virtual verification process.

A.2.2.2. Data Analysis

A full evaluation analysis was conducted on 14 of the randomly sampled projects from FY 20/21. Project-level and Measure-level results can be found in project site-level reports, which can be viewed in Appendix E. For confidential and privacy considerations of participants, Appendix E was not published with the public version of the report. Appendix E was provided only to LADWP as reference to supplement this EM&V report. Energy savings for sampled projects within each stratum were aggregated to determine a strata level realization rate used for extrapolation to the population. Sample savings impacts by strata are shown in Table 3-2.

A.2.2.3. Extrapolation of Results

Results of the Ex-Post savings of the program sample were separated by stratum to determine a realization rate for energy savings, peak demand reduction, and lifetime energy savings. The values determined from the Ex-Post analysis of the program sample were extrapolated to the other projects within the program by stratum.

Description of Factors Affecting Gross Realized Savings

The Evaluator determined 4 main factors that contributed to discrepancies in the realized savings of the sampled projects. The frequency in which these factors are relevant is skewed, with the most common factors being “Differing Hours of Operation” & “Incorrect Baseline Assumptions”. Explanations of how each factor affected realized savings are found below, along with frequency of occurrence as illustrated in Figure A-3. Figure A-4 quantifies the impact of these identified factors on the gross realized savings of the project sample.

Incorrect Baseline Assumptions: The baseline assumptions made for the Ex-Post savings calculations are detailed in Section A.2.1.3. This factor was chosen for projects in which the baseline values utilized in the Ex-Ante savings calculations differed from the Ex-Post savings calculations. The most common occurrence in the CLIP analysis was a difference in interactive effects. The Ex-Ante savings calculations were found to use a value of 1.08 for both energy savings and demand reduction, whereas the Ex-Post savings calculations used values dependent upon various project-specific factors.

Differing Hours of Operation: Hours of use utilized in the Ex-Post savings calculations were determined during the virtual verification process. In any instance where the hours of use determined differed from the hours claimed in the Ex-Ante calculations, this factor was listed as affecting the realized savings.

Clerical Errors: Clerical errors as it pertains to the analysis of the CLIP were determined to be a difference in the installed fixture wattage used in the Ex-Ante and Ex-Post savings calculations. The fixture wattages used in the Ex-Post savings calculations were taken from specification sheets for the fixtures specified in the provided project documentation.

Errors in Analytical Approach: Projects in which this factor was identified were due to the Ex-Ante calculations estimating demand reduction as the difference in the connective load of the project facility pre- and post-retrofit. The Ex-Post peak demand reduction was determined using the difference in connective load during the summer peak.

Figure A-3 CLIP Factors Affecting Gross Realized Savings

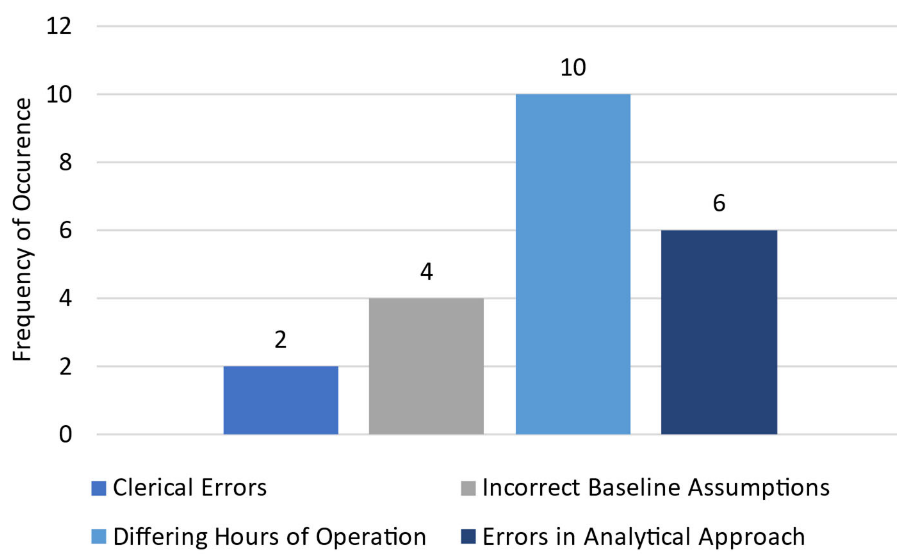
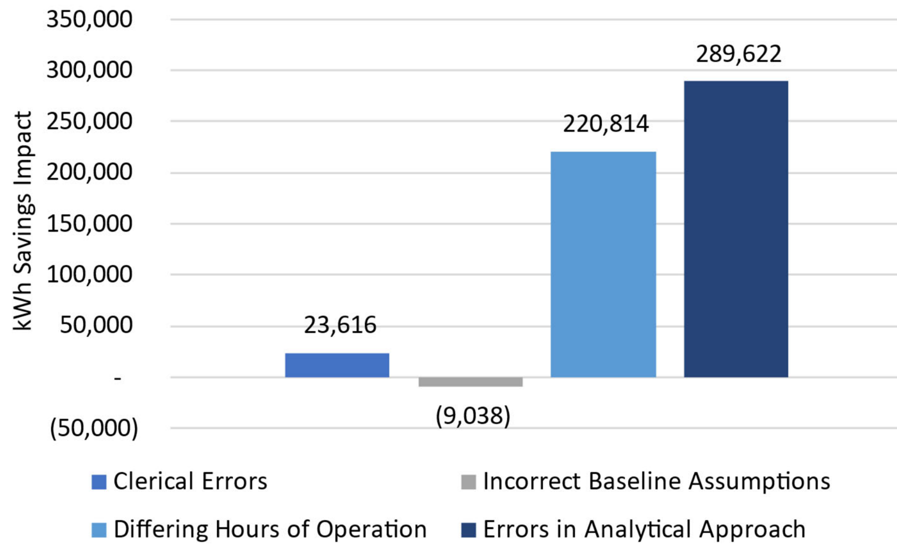


Figure A-4 CLIP Impact of Factors Affecting Gross Realized Savings



A.2.3. Process Evaluation

This section presents the process evaluation for the Commercial Lighting Incentive Program (CLIP).

A.2.3.1. Process Evaluation Approach and Methodology

The following sections describe the evaluation approach and methodology used to perform the CLIP process evaluation.

A.2.3.1.1. Document Review

The Evaluator reviewed all available program documentation for CLIP, including outreach and marketing materials, process flow charts, application forms, organization charts, and process and operations manuals. The team reviewed this information to understand how the program engages with the market, what the intended touch points are for customers and vendors, how program processes work together, and intended program outcomes. This information was used, along with findings from staff interviews, to construct the participant survey and vendor interview data collection instruments and provided context for findings by these research activities.

A.2.3.1.2. Staff Interviews

The Evaluator completed two 60-minute phone interviews with CLIP program staff. Interviews were designed to provide detail on program design and procedures, assess current progress, and identify critical research questions to be included in the program evaluation. Interviews covered topics including program design changes, program progress toward goals, impacts of the COVID-19 pandemic, marketing and outreach strategy, target audiences, relationships with recognized and unrecognized Vendors, program processes, risks to performance looking forward, and evaluation needs. This information was used, along with findings from the document review, in construction of participant survey and vendor interviews data collection instruments and provided context for findings by these research activities.

A.2.3.1.3. Participant Survey

The sample included 552 CLIP participants from January 2019 through June 2021 (399 participated in 2019, 104 participated in 2020, and 49 participated in 2021). The 2019 participants were added to supplement the small sample sizes in 2020 and 2021. In total, the team collected responses from 42 customers who participated in CLIP. The evaluation team excluded 10 respondents from the analysis because they were either screened out by the record verification questions (n=4) or they did not complete most of the survey (n=6). Accordingly, the following findings are based on the responses of 32 CLIP participants. Of these 32 participants, most participated in CLIP in 2019 (n=18) and some participated in 2020 (n=6) and in 2021 (n=8).

A.2.3.1.4. Recognized Vendor In-Depth Interviews

There were 30 Recognized Vendors and 49 unrecognized vendors who completed CLIP projects between January 2020 and June 2021. ILLUME conducted 14 in-depth interviews with LADWP CLIP Recognized Vendors from August 25 through September 10. We conducted 9 interviews with Recognized Vendors and five with unrecognized program vendors – vendors who were not part of CLIP’s Recognized Vendor program.

All interview respondents were in ownership or senior management positions, and all were the key decision makers for their businesses. Respondents’ primary customer segments include large manufacturing facilities, parking structures, hotels, large professional office buildings, and other commercial properties, and respondents reported most of their customers in these markets are repeat customers.

A.2.3.1.5. CEUS Data LED Lighting Saturation

The Evaluator leveraged data collected as part of the California End-Use Survey to present LED lighting saturations for businesses that receive service from LADWP. Data were collected from 1,050 sites via on-site visits or remote data collection, in response to COVID-19 restrictions.

A.2.3.2. Process Evaluation Findings

Overall, the program appears to be working as intended from the perspectives of customers, who are generally satisfied with the program processes. However, many Recognized Vendors expressed dissatisfaction with the recent program change requiring participating customers to have average monthly demand of 200 kW or greater. Staff interviews suggest that the inception of the Commercial Direct Install (CDI) program and the accompanying new CLIP threshold were intended to address the historical program application processing backlog by reducing the number of applications. However, from vendors’ perspectives, program processes are complicated and burdensome relative to other utility lighting programs, which they say results in a lot of back-and-forth communications with LADWP to correct errors in their applications.

In regards to the perspectives of these vendors, the Evaluator reviewed the program application materials and requirements. Based on that review, the application requirements are fairly typical for programs targeting larger lighting projects. These types of programs tend to require completion of a lighting worksheet similar to the one LADWP requires, submission of photos of baseline equipment and installed equipment, invoices, and often have pre-inspection and post-inspection requirements.

Simplifying the application process and building trusting relationships with Recognized Vendors may help to improve vendor satisfaction with the program while simultaneously easing the administrative burden on program staff. Specific suggestions are noted in the Recommendations section below. Additionally, over-communicating with vendors about the rationale for large program changes may help to address vendor mistrust and confusion about program changes. These findings and considerations are summarized in more detail below.

A.2.3.2.1. Overview of Program Processes

CLIP works with a group of lighting contractors who become Recognized Vendors to deliver the program to LADWP customers. The program employs multiple requirements for a lighting contractor to become and maintain status as a Recognized Vendor. To become a Recognized Vendor:

- The contractor must participate in an LADWP-sponsored training workshop on completing the application package.
- Complete at least one lighting project that includes a complete and accurate application package with at least two different products, passes both pre- and post-inspection (Waived inspection are ineligible), receives a minimum incentive payment of at least $1,000 through the program.
- Submit a Recognized Vendor Enrollment Form.

To maintain status as a Recognized Vendor, the lighting contractor must:

- Consistently submit complete and accurate applications and continue to meet all terms and conditions. Accurate submissions are defined as applications with an error rate of less than 5% for lighting fixture quantities, matching invoices for all installed lighting, less than 5% error for fixture types, counts, lamp types, and ballast types.
- Maintain someone who can safely open fixtures during any inspections.
- Submit fewer than 3 lighting projects with incomplete or inaccurate information within a one-month period.

Recognized Vendors perform the following functions:

- Recruiting participating customers;
- Developing and completing installation of lighting projects;
- Preparing and submitting application materials.

The participation process begins when the Recognized Vendor recruits a customer into the program and submits an application for the project. To qualify for the program, the customer must have an average monthly electrical load of 200 kW. Additionally, the project must have a minimum of 10% energy savings and the equipment must meet the program qualification standards. When submitting an application, Recognized Vendors submit:

- An Excel based workbook that captures information on the customer, the space type, the existing lighting equipment, the proposed equipment, and the operating hours.
- A program application.
- A project information sheet that includes the building operating schedule and a checklist for the items needed for a complete application.
- Photographs of existing fixtures, lamps, and ballasts, one photograph for each type of equipment to be replaced.

Upon receipt of the application the contractor enters the information into the database and verifies that the application is complete. If an application is incomplete, revisions are requested. If a pre-inspection is required, the LADWP field group completes the pre-inspection.

The next step is for the customer and Recognized Vendor to complete the installation of the lighting. After which notification of project change from the pre-application are sent to LADWP along with invoices for final review. LADWP makes a determination if a post-inspection is needed. After any required post-inspection is completed, the project undergoes final review and is submitted for payment.

LADWP estimates the savings of the program based on the project and site-specific information provided through the application. Overall, the realization rate for CLIP energy savings was high. The main contributors to the differences between the Ex-Post and Ex-Ante savings analysis were differences in analysis approach and differences in hours of operation for the site. Regarding the former, the difference was due to the Ex-Ante savings estimates consistently applying a waste heat interaction factor of 1.08 for all fixtures in areas determined to have “Mechanical Cooling” regardless of space type or cooling and heating type. To improve on this estimation of the heating and cooling interaction factor, the program could record heating conditions for the space.

Regarding the impact of differences in hours of operation, CLIP is using site specific hours in the estimation of savings for the program projects. The differences in hours are likely due to differences between posted or reported hours at the time of the evaluation from what was reported on the application form. The differences were not very significant and amounted to 3% of the Ex-Ante savings for the sampled site.

A.2.3.2.2. Vendor In-Depth Interview Findings

Vendors were generally happy with the types of measures incentivized through CLIP and high rebate amounts. Vendors reported that the $0.24/kWh rebate was the highest in the region. However, most vendors reported finding it challenging to find new participants for the program that meet the new 200 kW average monthly demand threshold. Some vendors have found success using different strategies to identify and engage customers using a combination of program and non-program incentives to encourage them to install high-efficiency lighting. Eight vendors reported focusing their attention on identifying large facilities; those facilities result in the greatest savings and related incentives, which are appealing values to larger customers. Two vendors reported offering “no cost” upgrades by combining program incentives with tax deductions to engage customers.

Most respondents (11 of 14) stated that any effort put forth in trying to identify new customers and assess remaining market opportunities, is increasingly difficult. Six respondents stated they use online resources such as Google Earth to pinpoint large facilities or have business representatives drive around industrial areas seeking out facilities that are perceived to meet the 200 kW average monthly demand threshold.

Eight respondents stated that they seek out large facilities that have lighting on for long hours every day to achieve the biggest savings and further incentivize the customer. One respondent noted that with incentives they can sometimes offer upgrades for no costs to the customer. Another respondent reported using a sales strategy of applying Section 179D tax credits to large warehouse projects to get some tax deductions for depreciation of T5s they replace.

Despite high levels of satisfaction with the incentivized measures and rebate amounts, respondents expressed significant dissatisfaction with four key program elements. These elements are listed here in order of importance to the vendors we interviewed, and summarized below:

1. Market Size Restrictions
2. LADWP Rebate Processing
3. Responsiveness to Vendor Inquiries
4. Application Process & Requirements

Market Size Restrictions

Most vendors (12 of 14) reported, unprompted, that the 200 kW threshold for eligible projects has caused significant frustration. From these vendors' perspectives, this new demand requirement has limited their market potential and made it challenging to identify eligible customers cost-effectively. This issue was exacerbated, in their view, by how this program change was communicated.

Vendors explained that there was very little forewarning (about 2 weeks) that this change would occur, and that they were notified of these changes during the holidays, while many vendor employees were on vacation. The sudden notice caused some vendors to rush to submit applications for in-progress projects at businesses that used less than 200 kW before the end of the year. Two vendors complained that they had planned and sold projects to customers with the CLIP rebates that they ended up losing due to the change and missing the deadline.

> *"We were notified through email that we had less than 2 weeks to complete all eligible applications. I was sitting in the office on New Year's Eve frantically working to finish spreadsheets. We had no forewarning this was coming, and it cost us a lot of opportunity."* Recognized Vendor

Three of the five unrecognized Vendors stated they were previously listed as Recognized Vendors with the program but left because of the complex program processes and requirements.

> *"We used to be on the recognized list, but when LADWP made a lot of changes and added the 200kW market restriction, the program was just too much and almost unworkable. It was no longer worth the effort."* Unrecognized Vendor

Rebate Processing

Recognized Vendors also noted how the rebate processing system, particularly delays, negatively affects their finances. Vendors mentioned that they could wait up to 10 months after project completion for a rebate to be processed. Delays could be due to a variety of factors, including error corrections, LADWP review timelines, and delays for the post-inspection process. As a result, this delay forces them to bear the cost of the rebate (passed onto the customer already) for months. In extreme situations, respondents described taking out "massive lines of credit" to pay their employees.

Nearly all (13 of 14) interview respondents stated that rebate processing times are too long, which created stress for the vendors. These vendors stated that rebates take an average of 6 – 8 months to receive, during which some vendors reported needing to absorb the full costs of the projects after passing the incentive along to customers. Several vendors stated they had to take out new lines of credit to cover equipment costs and salaries while waiting for rebates.

> *"The payment timeline is crippling to operations. I have had to take out loans and lines of credit to keep my doors open while waiting on LADWP."* Recognized Vendor

> *"While LADWP has the highest rebates, their rebate processing timeline is the slowest. I had to expand my services into new territories so I could maintain cash flow while waiting on them."* Recognized Vendor

> *"I had to start visiting the LADWP offices weekly to get paid in a reasonable timeframe. I repeatedly ask to come pick up the check, so I do not have to wait another week or so for snail mail. One time I went to the offices and my check was just sitting on someone's desk. No one knew why it was there or for how long it had been there."* Recognized Vendor

One vendor said they have never received a check sooner than 8-10 months after a project is completed. They also mentioned that projects can get backed up for "an extended period" in post-inspection. The respondent said that this 4–5-month delay in getting paid required them to take out "massive lines of credit" to pay their employees. Another respondent whose company works with many utility programs across the country said the time it takes to go through the CLIP program process is a barrier to participation because it is often longer than their customers are willing to wait.

> *"CLIP is probably the most complicated and time-consuming program we work with."* Recognized Vendor

Responsiveness to Vendor Inquiries

Vendor experiences with LADWP interactions varied. Just under half of the interviewed vendors (n=6) reported consistently positive interactions with LADWP staff. Four vendors had a largely neutral impression of their interactions with LADWP staff, though some wished for more responsiveness, and four vendors reported generally negative interactions with program staff. Of the six vendors who reported that they did not receive timely responses to vendor inquiries from LADWP staff, four also noted that when they did receive a response, they were not positive interactions.

> *"I understand that LADWP has probably been burned before, but they need to stop treating us like we are going to lie and steal. They need to treat us like partners because we are trying to work together."* Recognized Vendor

> *"I have been dealing with an issue at a site, and neither I, nor the actual customer, can get any help from the LADWP supervisors. We have been reaching out for over a month now."* Recognized Vendor

A characteristic response of vendors who reported positive interactions came from one vendor who said they had an issue where a fixture they were proposing was not on the approved list. They brought it into an LADWP lab, LADWP tested it, and within a week it was verified and approved. This vendor said that CLIP was much easier to work with than SoCal Edison, with generous rebates and fast payment. Another quote from a Recognized Vendor describes having positive interactions with program staff after application submission.

> *"We interact with staff through every step after application submission. They have been great, everyone from the program is knowledgeable. It works well."* Recognized Vendor

Nearly all respondents reported that interactions with inspectors during the pre- and post-inspection phases were very positive. Interviewees perceived some inspectors as more demanding than others, but the vendors we spoke with felt that the inspectors were trying to do a good job, and vendors respected the inspectors' standards.

Application Process & Requirements

Interviews revealed opportunities to improve vendors' satisfaction by refining the program's application process, which respondents found challenging. Respondents raised specific issues about the application submission process, application review time, and the process for identifying and addressing errors in the application.

Nine respondents reported being frustrated and dissatisfied with the program's application process. These respondents described the application process as time-consuming, obsolete, and costly to the vendor. Unlike other utilities in Southern California, LADWP does not have a web portal for the vendors to upload documents or update project information. Instead, project materials are sent through email attachments, which creates logistical barriers.

> *"The LADWP application submission process is archaic. We have to complete a very lengthy excel spreadsheet and then email it, along with multiple pictures, to one point of contact at LADWP. Oftentimes, the attachments are too large, so PMs have to spend time redoing and separating out attachments among multiple emails. Then, only one person at LADWP knows what is happening with the project. If you try to call and get answers, and that one person who received the email is gone or not available, no one else can help."* Recognized Vendor

Additionally, vendors expressed frustration with the application review time and rejections due to vendor errors. Respondents stated that applications can get rejected for reasons that they consider to be minor (for example, typos). Rather than allowing the vendor to make a revision, vendors we spoke with reported that if an application gets rejected, the vendor had to start over again. Vendors reported that this process was costly and often frustrates the customer – sometimes frustrating customers to the extent that customers canceled planned projects. Vendors suggested that having an application form that helps to flag small errors would reduce workload for their businesses and the LADWP application review team.

> *"Our application spreadsheets vary from 3 lines to 300 lines. And in a 300-line spreadsheet, there are going to be typos. LADWP just rejects the application and makes us redo it. And if you have 3 application submissions containing errors, you get booted from the program. There should be a percentage margin of error based on the size of the spreadsheet. But LADWP has the same error margin for 3 lines as they do for 300 lines."* Unrecognized Vendor

> *"The application process is grueling and slow."* Unrecognized Vendor

> *"The program is very costly to follow because of the extensive time requirements."* Recognized Vendor

Finally, four respondents (28%) reported that the requirements for the application process seem to change frequently and vary from vendor to vendor.

> *"Rules change overnight, with no forewarning, and seem to be different for every participant."* Recognized Vendor

Opportunities

Vendors described several areas where they saw additional opportunities for efficient lighting projects. including:

- Customers who went through DI program with plug-and-play ballast-compatible LED tubes. These customers will need ballast replacements when these tubes start failing. CLIP vendors could offer fixture replacements for tubes in troffers
- Distribution facilities, warehouses, harbor operations, and heavy industries that are hard to reach
- Smaller properties that are not aware of the program

Vendors suggested that, because their primary barrier to participation was identifying eligible customers, anything that LADWP could do to help them connect with eligible customers would be appreciated. Four Recognized Vendors suggested that LADWP could either add notices in customers' utility bills or have meet-and-greet events where eligible customers and Recognized Vendors could connect. Some vendors reported that other programs they work with share leads with them and suggested that LADWP could emulate this practice.

Customer Motivations and Barriers to Participation

Despite the process challenges summarized above, vendors agreed that the program design of CLIP is effectively influencing customer purchasing decisions. Vendors reported that customers mentioned reducing their energy costs and improving ROI as the most important factors in their decision to upgrade. CLIP incentives help improve the ROI for these projects and prompt customers to make upgrades. The importance of incentives in getting customers to invest in efficient lighting were echoed by several respondents. One said, “If the incentive program was not there, they would say why fix something if it isn’t broken?” Another offered “Even with a customer who had planned to do upgrades, they did it sooner because of the rebates.”

Vendors also noted that customers are motivated by non-incentive benefits. Examples of these non-incentive benefits include reduced maintenance costs, reduced liability for maintenance issues (including maintaining hard to reach fixtures), improved lighting quality, and improved safety and productivity.

Vendors reported that they perceived few barriers that would make it difficult for customers to participate in the program. One vendor said timing could be an issue when the customer may need to wait until next fiscal year to act. Another said the primary barrier to participation is the time it takes to wait for pre-approval, with the energy costs associated with keeping old equipment while waiting for pre-approval outweighing the value of program incentives.

A.2.3.2.3. Participant Survey Findings

Most respondents reported being highly satisfied with the program and with individual program components. Much like Recognized Vendors, respondents were most dissatisfied with long wait times for the rebate check and administrative burdens in the application process.

CLIP respondents learned about the program through their vendor, past participation, or LADWP staff. The primary motivating factor for respondents to engage in the program was to save money on utility bills and receive the rebate. Increasing the rebate incentive and how quickly applications are processed were the top two suggestions for improving participant satisfaction.

Finally, cost is the most substantive challenge affecting respondents’ decision to purchase energy efficient equipment, suggesting that the rebates through CLIP address the biggest area of concern for respondents desiring the purchase energy efficient equipment.

Participant survey findings are summarized below within the following subsections:

- Awareness and motivations
- Satisfaction with program processes
- Barriers and decision making
- Firmographics

Awareness and Motivations

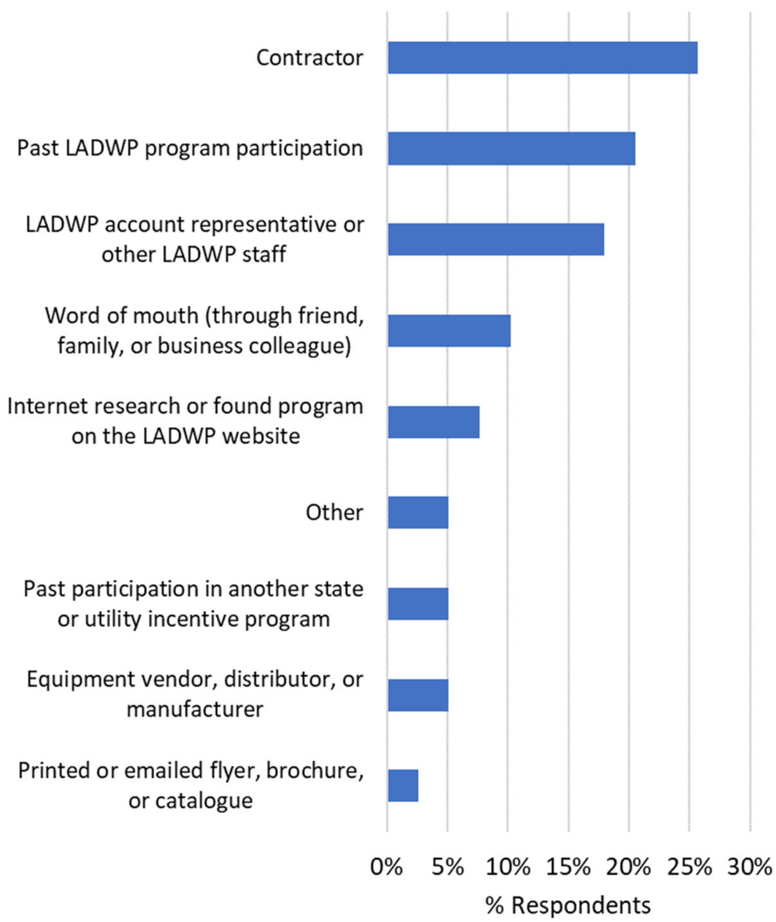
Vendors are an important sources of customer awareness for CLIP, acting as a primary source of awareness for respondents and actively contacting respondents to inform them. Just over a fifth of respondents also said they learned about the program through previous participation in an LADWP program, indicating cross-program referrals (Figure A-5).

Financial savings is the clear driver of respondents' motivation for participating in CLIP.

Recommendations by LADWP program staff are influential as well, in this case a slightly greater motivator for respondents than a recommendation by their vendor. This suggests that both vendors and LADWP staff are important players in promoting awareness and participation in CLIP.

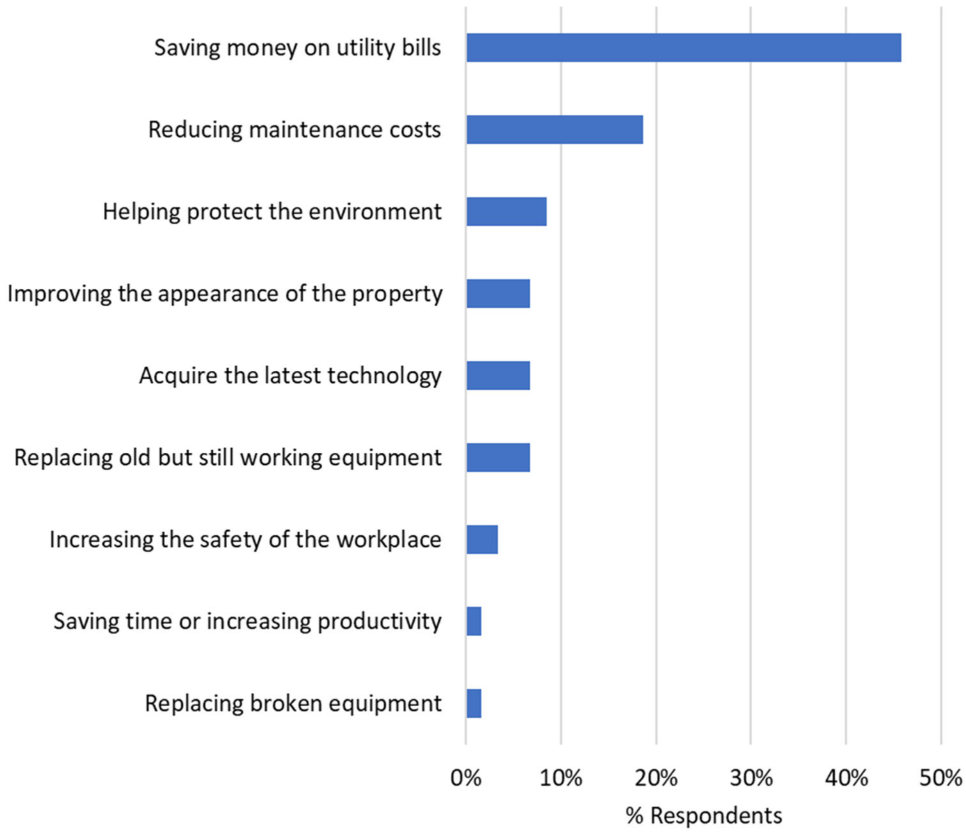
Vendors are proactively reaching out to customers, and an important sales resource for the program. Of the respondents who learned about CLIP through a vendor (n=12), the vendor always contacted them first, versus the participant contacting the vendor. Most of these respondents (9/12) reported using a Recognized Vendor.

Figure A-5 Where Respondents Learned About CLIP (n=32)



As seen in Figure A-6, respondents were primarily financially motivated to make lighting improvements. 'Saving money on utility bills' was the top reason they completed the lighting improvements (46%); the second most common reason for the upgrades was "reducing maintenance costs" (19%).

Figure A-6 Most Important Factors Motivating Respondents to Make Improvements Through CLIP (n=32)



In addition to asking about motivations, the survey also asked respondents to rank importance of various elements in their decision to participate in CLIP. The responses to this question further reinforced the importance of the financial incentive as well as recommendations by the vendor and LADWP. The rebate was the most important factor in respondents' decision to participate in the program, with an average priority rating of 4.1 on a one-to-five scale (n=32). The second most important factor in respondents' decision to participate in the program was a recommendation by a program contact at LADWP, with an average rating of 3.5 out of 5 (n=31). Interestingly, respondents ranked the importance of LADWP's recommendations higher than that of a vendor (3.5 and 2.9, respectively), suggesting that a recommendation from program staff is more important than a vendor's in influencing customers to participate in CLIP.

Satisfaction with Program Processes

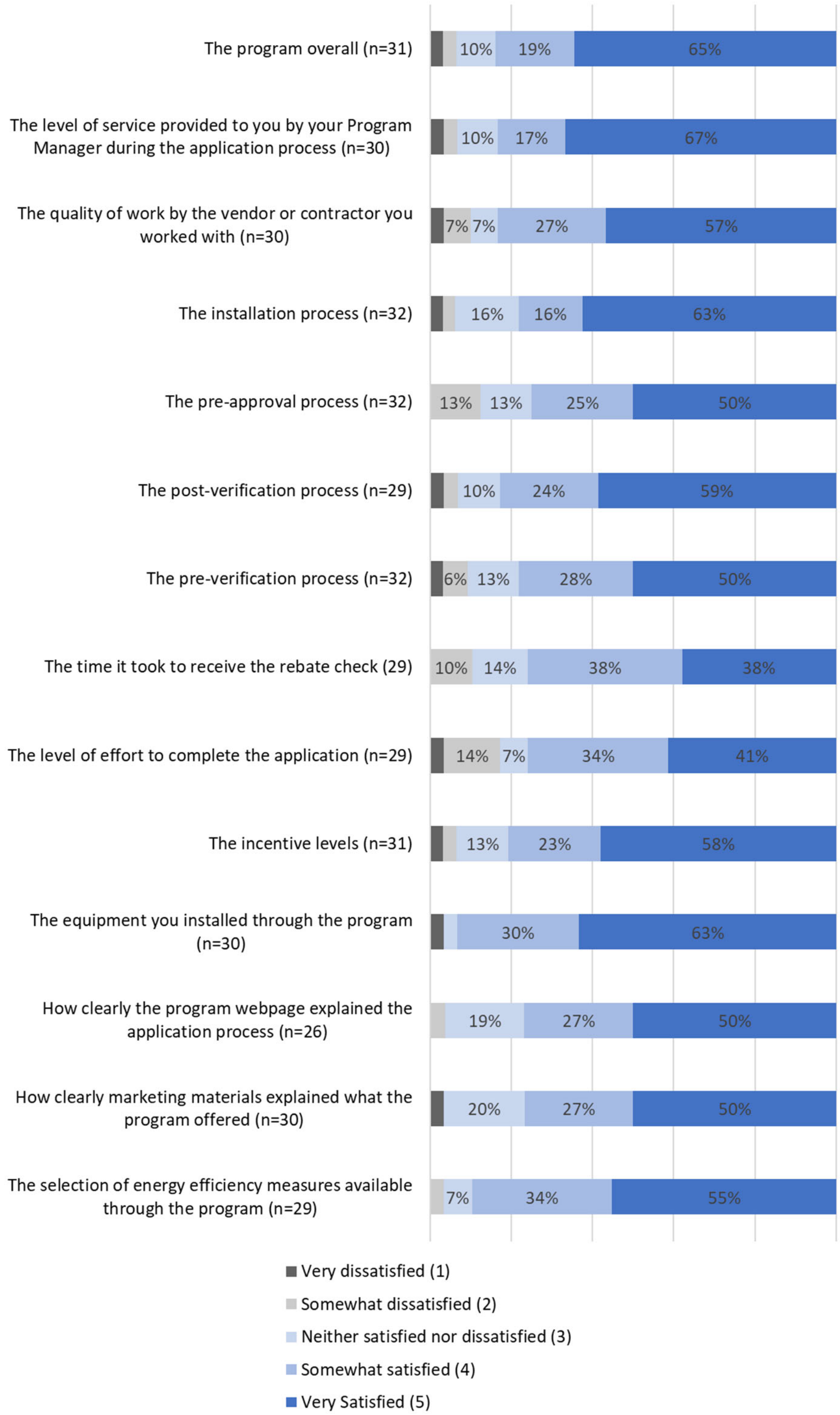
Overall, respondents were satisfied with the CLIP program process. Any dissatisfaction centers around the waiting time to receive the rebate or the administrative burden to complete the application. Nearly a fifth (18%) of respondents reported that a faster application process would improve their satisfaction with the program. Although most respondents (58%) are very satisfied with the rebate amount, 24% of respondents said that higher incentives would improve their satisfaction.

Figure A-7 shows the distribution of participant satisfaction scores on a scale of 1 to 5 where 1 is “very dissatisfied” and 5 is “very satisfied” for each program element of CLIP. Most respondents (84%) were at least somewhat satisfied with the program overall, with nearly two-thirds (65%) indicating they were very satisfied with the program. While responding participants were generally satisfied with all program elements, they were least likely to say they were “very satisfied” with “the time to receive the rebate” and “the level of effort required to complete the application,” with 38% and 41% of respondents, respectively, reporting that they were “very satisfied” with these elements.

Respondents were most satisfied with the following program elements:

- Equipment they installed through the program (average rating 4.5),
- Service provided by their Program Manager (average rating 4.4), and
- Selection of energy efficiency measures available through CLIP (average rating 4.4)

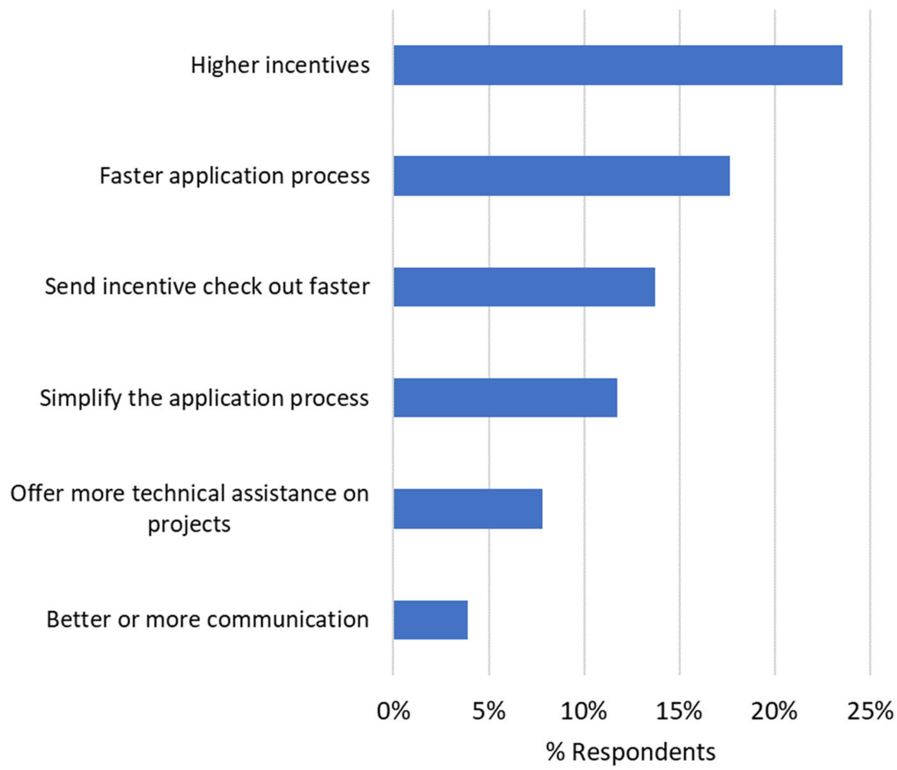
Figure A-7 Participant Satisfaction of CLIP Program Elements



Respondents were asked to explain their rating if they indicated a three or lower for any program element. Most of these respondents mentioned what they perceived to be slow or administratively burdensome program processes, citing reasons similar to what vendors described in interviews. Specifically, 4 of these 13 respondents reported being dissatisfied with the amount of time it took to complete program processes. These respondents mentioned time-consuming methods for file sharing, delays in their lighting projects due to a long wait for the rebate, multiple requests for corrections, and a vendor that took much longer to complete the project than expected. Four other respondents described administrative burdens like a steep learning curve for program paperwork and processes, overly complex marketing materials, repeated requests from LADWP to resubmit drawings, and frustration with the pre-inspection not being completed before finalizing new equipment.

Mirroring their value for finances and ease of process, when asked how CLIP could be improved higher incentives and a faster application process topped the list of responses (Figure A-8). Communication, an issue raised by vendors, was not identified as a major area of concern, and was mentioned by only a few respondents.

Figure A-8 Participant-selected Suggestions for Improving CLIP (n=32)



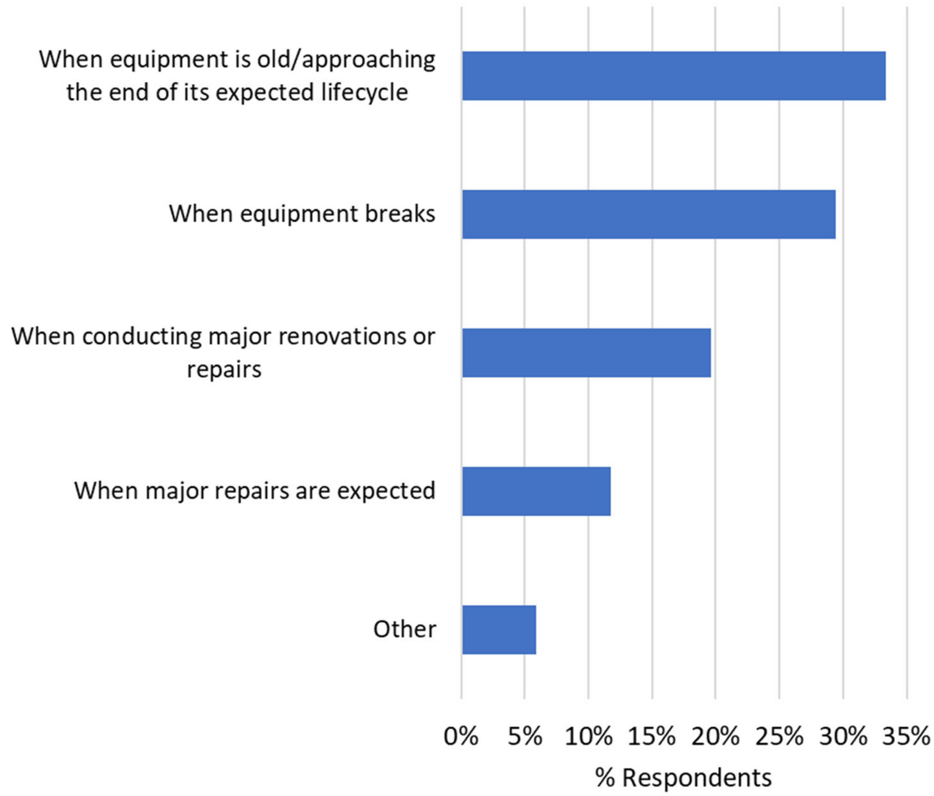
Overall, respondents generally view LADWP favorably. Specifically, out of 32 respondents, 8 reported that their opinion of LADWP is “extremely favorable” and 16 reported that their opinion is “very favorable” (about 75% of respondents).

Barriers and Decision Making

Cost is the most important factor affecting respondents’ decision on what equipment they install and cost also the biggest challenge reported by respondents to investing in energy efficient equipment. This suggests that the rebate in CLIP addresses the major challenge that respondents face. Most respondents have a formal process for making improvements, but there is variation in the presence of specific return on investment (ROI) requirements and organizational policies.

Respondents are generally replacing equipment when at, or near, failure. And somewhat contrary to vendor reports, they are not replacing equipment earlier due to the rebate. As Figure A-9 illustrates, almost two-thirds of respondents reported replacing equipment when it is old or broken. Several others or when doing major renovations or repairs (20%).

Figure A-9 CLIP - When Do Respondents Typically Replace Equipment? (n=32)



Most respondents reported that they have a formal approval process in their organizations for making capital improvements (78%). Nearly half of respondents reported that they must meet specific ROI criteria on improvements (46%), while slightly more (54%) reported that they do not. Several respondents reported that they do not have organizational policies related to the efficiency of equipment installed (52%), while several do have such policies (48%).

Just 2 of the 32 survey respondents were a part of a franchise. Of those two, one makes decisions on equipment installations at the regional level and one at the local level.

A third of participant organizations (34%) have sustainability initiatives, goals, or mandates. Just over a quarter of participant organizations (28%) have a Sustainability Coordinator. Over a quarter of participant organizations (28%) also have a dedicated Energy Manager who is responsible for seeking out and applying for incentives.

Figure A-10 shows that the most important considerations for respondents when selecting equipment were up-front cost (32%), energy usage (20%), and reliability/maintenance expectations (20%).

Figure A-10 CLIP - Respondents' Criteria for Selecting Equipment to Install (n=25)

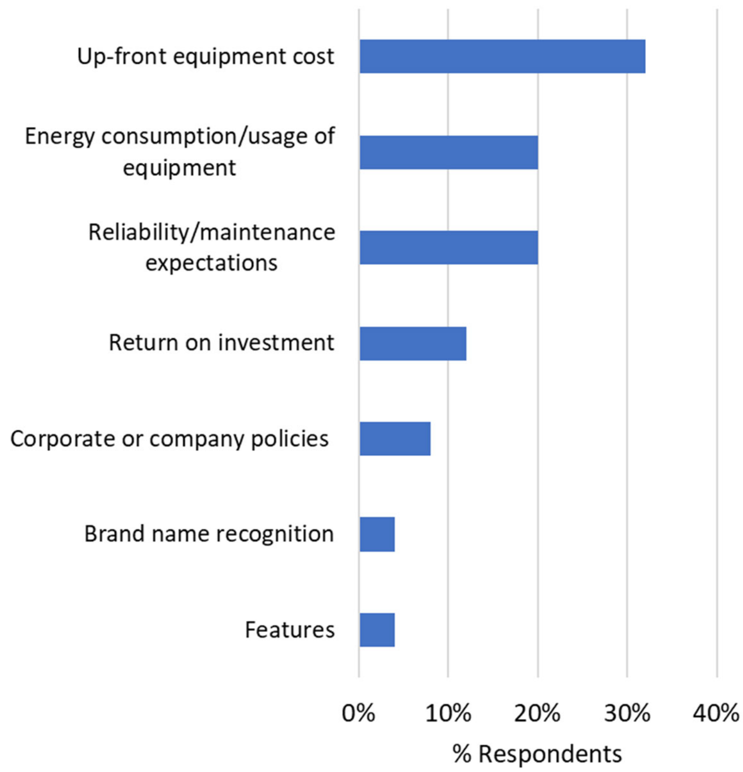
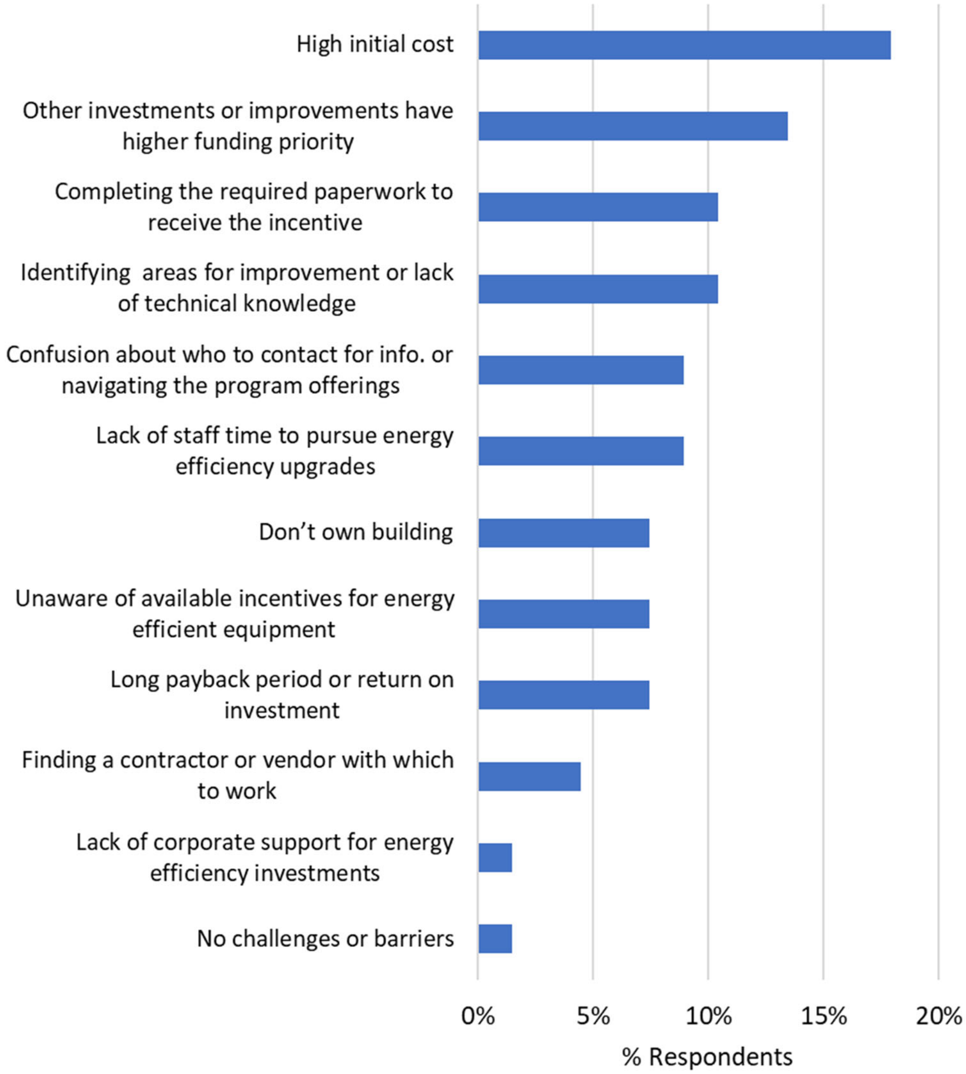


Figure A-11 displays the challenges for respondents when investing in energy efficient equipment. The most frequently selected challenges were high initial costs (18%), conflicts with other higher-priority investments (13%), program paperwork (10%), and difficulty identifying improvement needs (10%).

Figure A-11 CLIP - Barriers to Respondents' Investment in Energy Efficiency Equipment (n=31)



Firmographics

Many respondents were in the real estate and property management industry (41%), followed by 13% in the education industry. Most respondents have 49 or fewer employees (45%), followed by 28% that have 50 to 199 employees.

Several of respondents' facilities are 100,000 square feet or greater (32%), followed by 29% in the rage of 5,000 to 10,000 square feet. These responses are likely due to respondents considering the square footage of multiple buildings together.

The main fuel type that respondents use for space heating is gas (57%), while 43% use electricity. The main fuel type used for water heating is gas (83%), while 17% use electricity.

A.2.3.2.4. CEUS LED Saturations

Table A-8 summarizes LED penetrations and saturations by building type. Penetrations refer to the average percent of lamps that are LED, whereas saturations are the percent of buildings with some lighting that is LED. Figure A-12 is a plot of LED saturations against the number of buildings in the LADWP service area.

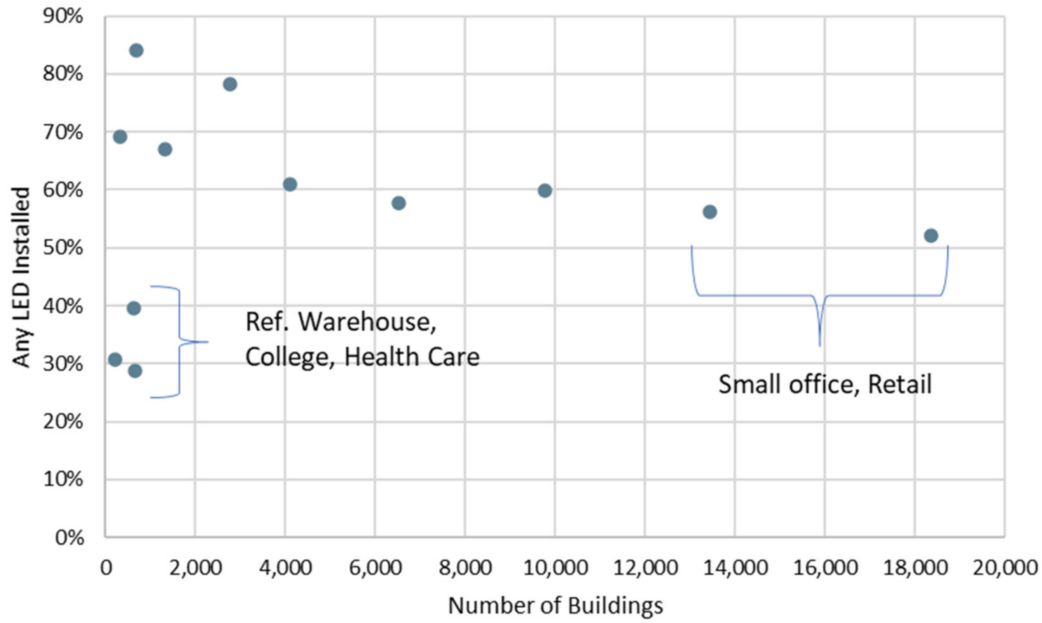
Key findings of the analysis of CEUS data are:

- **The overall situation of LEDs is relatively low with LEDs present at 57% of buildings in LADWP service area.** This suggests significant market potential remains for CLIP and CDI, as well.
- **Three building types are less common and have relatively low LED saturations.** Refrigerated warehouses, colleges and health care facilities are both less numerous building types and have relatively low LED saturations. A specific marketing focus on these building types may present an additional opportunity for the program.
- **Small offices and retail buildings have middle range LED saturations and represent a large share of commercial buildings.** These building segments are likely a good for the CDI program and this finding suggests that significant opportunity for LED upgrades remain.
- **Exterior LED saturations and penetrations are low relative to interior LED saturations.** These results suggest that a focus on exterior LED lighting presents an opportunity to reduce lighting energy use.

Table A-8 *CLIP - LED Penetrations and Saturations by Building Type*

California Energy Commission Building Type	Population Size	Penetration		Saturation		
		Interior LED	Exterior LED	Interior LED	Exterior LED	Any LED
Large Office	689	55%	52%	83%	63%	84%
Hotel	314	49%	49%	56%	50%	69%
Warehouse	4,099	59%	19%	61%	19%	61%
Misc.	9,778	54%	22%	59%	24%	60%
Food	2,781	70%	31%	78%	31%	78%
Ref. Warehouse	208	31%	18%	31%	18%	31%
School	1,315	56%	44%	65%	50%	67%
College	619	32%	19%	40%	20%	40%
Health Care	666	21%	4%	26%	5%	29%
Retail	13,436	49%	18%	55%	20%	56%
Restaurant	6,529	50%	24%	57%	24%	58%
Small Office	18,341	43%	17%	51%	19%	52%
Total Commercial Sector	**58,775**	**50%**	**21%**	**56%**	**23%**	**57%**

Figure A-12 CLIP - Any LED Saturations by Number of Buildings



A.2.4. Recommendations

- **Support vendors in identifying eligible customers.** Most vendors reported that their primary barrier to participation in the program is identifying eligible customers since the implementation of the 200 kW average monthly demand requirement. Vendors suggested that LADWP could help them identify leads using customer data and data from customers' participation in other programs, perhaps even providing vendors with a tool that would allow them to look up an address to see whether a customer qualifies for the program. Recognized Vendors suggested that LADWP could help them with directly marketing to customers via bill inserts or by facilitating meet-and-greet events to connect vendors with eligible customers.
- **Communicate with vendors early and often about upcoming program changes.** Many vendors reported that they had little forewarning about the program change that required participating customers to have 200kW or more average monthly demand. Vendors also reported feeling confused about the rationale for this program change and felt that LADWP did not provide enough support to help their businesses adapt to the change. Program changes – particularly significant changes - should be communicated to vendors as early as possible and through all available communication channels. LADWP could consider developing a Frequently Asked Questions (FAQ) document that summarizes responses to key questions that vendors might have about what the changes mean for their current and future projects.
- **Consider ways to simplify program forms and processes.** Vendors reported feeling that the application and verification process was complicated and time-consuming. Some reported that the processing times had an adverse impact on customer participation. Consider identifying ways to streamline program processes

– including automating more of the process for filling out or editing the application and finding ways to move applications and form submissions online where possible. Some vendors reported that having an online application process could reduce the inconvenience associated with submitting applications via email – especially for transferring large files (Program staff noted that they were considering an online application). Some vendors recommended having any sections of the application that require repeated information from other sections auto-populate from sections that have already been filled out. Additionally, adding flags that automatically alert vendors to potential errors in the application may help to reduce errors. Any reductions to verification and rebate processing times may also improve the vendor and customer experience. Two other suggested strategies are:

- **Integrate multiple program application materials into a single workbook**. This will have the advantage of simplifying the number of separate documents that need to be tracked and eliminate some redundancy. For example, the lighting spreadsheet and project information sheet both require hours of operation information, although in different forms, and location information.
- **Consider offering a simpler application process for small lighting projects.** Although the program targets larger customers and larger lighting projects, there are some projects with relatively small incentive and savings associated. For example, of 125 CY1 projects, 44 accounted for 80% of the project incentives and the smallest 22 projects accounted for one-percent of the incentives. A simpler form and process that did not require pre-verification may be expedite the processing of applications and improve Recognized Vendor perceptions.

- **Consider ways to build trust with vendors – particularly Recognized Vendors.** Many vendors reported feeling that LADWP's relationship with them felt punitive – with steep penalties for small application errors, limited communication between program staff and vendors, and limited support for vendor businesses. Based on staff interviews, this appears to be at least partially due to resource and staffing limitations exacerbated by the need for staff to resolve a high rate of errors in program applications. Simplifying the program applications may help to address this issue, but it may be helpful to take additional steps, including potentially having periodic meetings with a "advisory team" of Recognized Vendors to discuss program issues, or adding staff resources to support existing program staff with vendor communications.
- **Consider marketing and outreach strategies to reach segments with relatively low LED saturations.** Hospitals, colleges, and refrigerated warehouses are smaller building segments that present an opportunity for the program given the relatively low LED saturations, although opportunities for hospitals are likely limited during the pandemic. These strategies may include identification of contractors that focus on these building types and targeted outreach by CLIP implementation staff.

A.3. CP

This section presents details about the methodology and impact evaluation for the CP Program.

A.3.1. Evaluation Methodology

This section presents the findings of the tracking data review and the methodology used to calculate verified Ex-Post energy savings for the program.

A.3.1.1. Ex-Ante Savings

The total energy savings are the sum of the direct savings (due to shade only) and indirect savings (due to ambient cooling). The approaches for calculating direct and indirect savings are described below.

A.3.1.2. Ex-Ante Savings Review

Table A-9 summarizes the discrepancies the Evaluator found comparing the reported ESP Ex-Ante kWh and Peak kW savings with the Ex-Ante kWh and Peak kW savings presented in the tracking data delivered by LADWP.

Table A-9 CP Ex-Ante Savings Source Comparison

Fiscal Year	ESP Data Ex-Ante kWh Savings	Program Data Ex-Ante kWh Savings	Ex-Ante kWh Percent Change	ESP Data Ex-Ante Peak kW Savings	Program Data Ex-Ante Peak kW Savings	Ex-Ante Peak kW Percent Change
20/21	6,617,573	6,617,573	0.0%	3,018.61	0.00	NA.

The tracking Ex-Ante kWh was equal to the ESP Ex-Ante savings. However, program data did not provide Ex-Ante kW.

A.*3.1.2.1.* Direct Savings

The Ex-Ante savings have been determined by EcoLayers, Inc. using an energy model developed by the USDA Forest Service (USFS), as applied to LADWP project specific data. The energy model consists of three sub-models:

1. Tree Growth Model calculates annual tree growth (e.g., height, canopy, diameter at breast height, and other parameters) for the estimated life of the tree. Results are based on empirical research by the USDA Forest Service for over 25 years covering more than 3200 species in all climate zones across the US.
2. Shadow Model calculates the shade on each wall and roof of the building based on the number, species, and age of the selected trees, building size and orientation, the location of trees relative to the building walls (the tree planting plan), building address, local historical meteorological data, type of HVAC system currently in use, and other factors. The shadow model then quantifies hourly irradiance reductions (the reduced heat from the sun) on the building based on tree species, leaf density and season.
3. Building Model calculates the hourly energy required to cool the building based on thermostat setting, building size and address, local historical meteorological data, type of HVAC system currently in use, and other factors. Energy savings are calculated

over each hour as the difference in energy required to cool the building with and without trees for each year of tree growth over the life of the tree.

The following assumptions were used in the simulation model for calculating the Ex-Ante energy savings:

- AC thermostat setting: 75°F
- AC Distribution: AC-60%, Window/Wall Unit-15%, No AC-25%
- Distance distribution: <20 ft: 50%, 20-40 ft: 50%
- Azimuth: North: 25%, South: 25%, East:25%, West: 25%
- Floors:
    - single-story (approximately 1500 sq. ft.): 75%
    - two-stories (Approximately 2,000 sq. ft.): 25%
- Vintage:
    - Pre-1950: 37%
    - 1950-80: 53%
    - Post-1980: 10%
- Mortality Rate: 10% annually. The effect of mortality is captured by reducing the kWh instead of “killing” individual trees.

Key parameters for the different building vintage types are shown in Table A-10 below.

Table A-10 CP - EcoLayers Parameter Defaults

	Pre-1950	1950-80	Post-1980
Glazing (m2)	22.7	22.5	30.2
Floor type	Crawl	Crawl	Slab
Wall RValue	7	7	11
Ceiling RValue	7	11	25
Cooling SEER	10	10	10
Heat Duct Location	Crawl	Crawl	Attic
Cool Duct Location	Crawl	Crawl	Attic
Duct Wall RValue	2.1	2.1	4.2
Leaf On Indirect (month)	4	4	4
Leaf Off Indirect (month)	11	11	11
Window Frame Type	Metal w/ Dividers	Metal w/ Dividers	Metal w/ Dividers
Window Operation Type	sliding	sliding	sliding
Thermal Break	No	No	No
Glazing Panes	1	1	2
Wall Construction Type	1in Wood 7 rvalue	1in Stucco 7 rvalue	1in Stucco 11 rvalue
Roof Construction Type	generic 7 rvalue	generic 7 rvalue	generic 11 rvalue

The building energy use model quantifies changes in annual heating and cooling energy consumption for the shading scenarios specified in the EcoLayers interface and quantified by the shadow model. Hourly heat gains or losses are computed using the resulting shading factors and data on building structure, insulation level, window configuration, installed heating/cooling equipment, and local weather based on standard ASHRAE formulations. The Radiant Time Series Method (RTSM) is used to convert heat gains to cooling loads.

Energy savings are calculated over each hour as the difference in energy required to cool the building with and without trees. Hourly data are aggregated monthly and annually.

The kWh savings for the next year begins by “growing” the tree for the next year using the tree growth model, passing the necessary parameters to the shadow model, and running the building heat run model for each hour of the year and aggregating the results.

A.3.1.2.2. Indirect Savings

The indirect savings are calculated by applying a factor of 36% to the direct savings, discussed in the previous section. Table A-11 shows CP Program Ex-Ante savings summary for FY 20/21.

Table A-11 CP Program Ex-Ante Savings Summary

Fiscal Year	Program Data Ex-Ante Direct Savings/Shade Only (kWh)	Program Data Ex-Ante Indirect Savings/Ambient Cooling (kWh)	Program Data Ex-Ante Total Savings (kWh)	Program Data Ex-Ante Total Reported Savings (kWh)*
FY 20/21	5,406,514	1,946,345	7,352,859	6,617,573

* Includes 10% reduction based on street tree mortality rates found in Fall 2018 sampling

A.3.1.3. Ex-Post Savings

After several discussions with LADWP staff and EcoLayers, it was established that review of the existing models used to calculate Ex-Ante savings, or the development of new models based on the EcoLayers software was not possible. However, it was decided that the Evaluator would review the assumptions that were used as inputs to the models to verify the accuracy of Ex-Ante savings and benchmark EcoLayers’ savings with other sources of information.

A.3.2. Impact Evaluation

This section presents findings from the impact evaluation efforts to verify annual energy savings from EcoLayers’ software tool.

A.3.2.1. Virtual Verification

As part of validation of the EcoLayers model results, ADM performed virtual verifications of a sample of projects of planted program trees. These virtual verifications were performed using the online Google Earth application. A random sample of a small number of projects was selected to verify installation, quantities, type, height, canopy spread, region, location, and orientation of shade trees. These parameters were used in energy saving calculations. The details on virtual verification of these sampled projects are provided in Table A-12 below.

Table A-12 CP - Details on Virtually Verified Shade Tree Projects

Project	Zip Code	# Of Trees	Orientation	Species	Height (ft.)	Spread (ft.)
Project 1	91345	2	East	Purple Leaf Acacia	10	10
Project 2	90019	1	South	Magnolia	8	7
Project 3	91326	2	West	Canary Island Pine	16	6.5
Project 4	90048	1	West	Evergreen Pear	11	6.5
Project 5	90731	1	South	African Fern Pine	10	7

A.3.2.2. Benchmarking

The Evaluator used two different modeling tools to benchmark inputs, parameters, and results from EcoLayers. These methods were employed as the EcoLayers model could not be reviewed. ADM also conducted a literature review of previous evaluations and research studies to benchmark the results of EcoLayers.

A.*3.2.2.1.* i-Tree Design Models

As the Evaluator was unable to work within the EcoLayers models, other tools were employed to benchmark EcoLayers' results based on model inputs and parameters. The Evaluator chose five example measures from the FY 20/21 City Plants dataset to model using i-Tree Design software. The Evaluator used i-Tree Design software, developed by USDA, to calculate the savings for a small sample of houses to get estimates on the extent of energy savings and sensitivity to various parameters. The trees were selected from LADWP's database. Figure A-13 portrays a picture of two Purple Leaf Acacia trees planted in front of a house, under the CP Program. The house is facing East.

Figure A-13 Purple Leaf Acacia Trees Planted Through CP Program

Figure A-14 portrays the screen capture of i-Tree Design model of the same house shown from above. Two green pins on the right side mark the location of the trees. The diameters of these trees were estimated using Google Earth's "Ruler" feature, which were used as an input to the model.

Figure A-14 CP - Screen Capture of i-Tree Design Model

Table A-13 presents energy savings and benefits for the five modeled projects during the summer and winter seasons. The summer savings (kWh) are associated with the cooling energy and winter savings (Therms) with the heating energy. It is noticeable that winter savings and benefits are negative in most cases, which means there is a penalty on heating energy usage due to shade caused by the trees. The non-deciduous trees are typically responsible for this penalty because these trees don't shed their leaves in winter.

Table A-13 CP - Energy Savings and Benefits during the Summer and Winter seasons

Project	Number of Trees	Summer Energy Savings (kWh)	Winter Energy Savings (Therms)	Summer Energy Benefits	Winter Energy Benefits
Project 1	2	88.5	-2.9	20.26	-5.87
Project 2	1	84.0	2.8	16.32	4.52
Project 3	2	169.7	3.5	32.17	7.05
Project 4	1	88.3	-1	18.81	-1.99
Project 5	1	76.0	-5.8	17.39	-9.41
Average	101.3	101.3	-0.7	21.0	-1.10

Figure A-15 shows the per-tree annual summer savings (kWh) for each project, along with the average per-tree savings. The average per-tree annual summer savings is 75.5 kWh.

Figure A-15 CP - i-Tree Design Per-Tree Annual Summer Savings

Similarly, Figure A-16 shows the per tree annual winter savings (Therms) for each project along with the average per tree savings. The average per tree annual winter savings is negative 0.74 Therms. Although, the number seems relatively small, yet over the entire population, the impact could be considerable. Especially, when trees become mature and cause more shade.

Figure A-16 CP - i-Tree Design Per Tree Annual Winter Energy Savings

Figure A-17 shows the impact of orientation on the energy savings along with an average of savings for all trees. The average of annual energy savings for all trees is 75.5 kWh/yr.

per-tree. As evident from this chart, West orientation is the best for planting shade trees. East orientation is the least desired, among the simulated sample of trees.

Figure A-17 CP i-Tree Design Per-Tree Energy Savings by Orientation

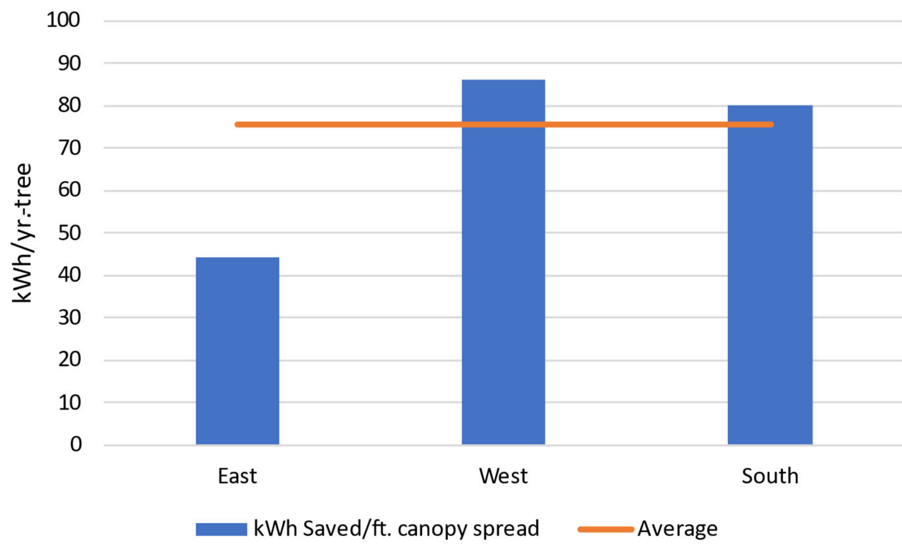
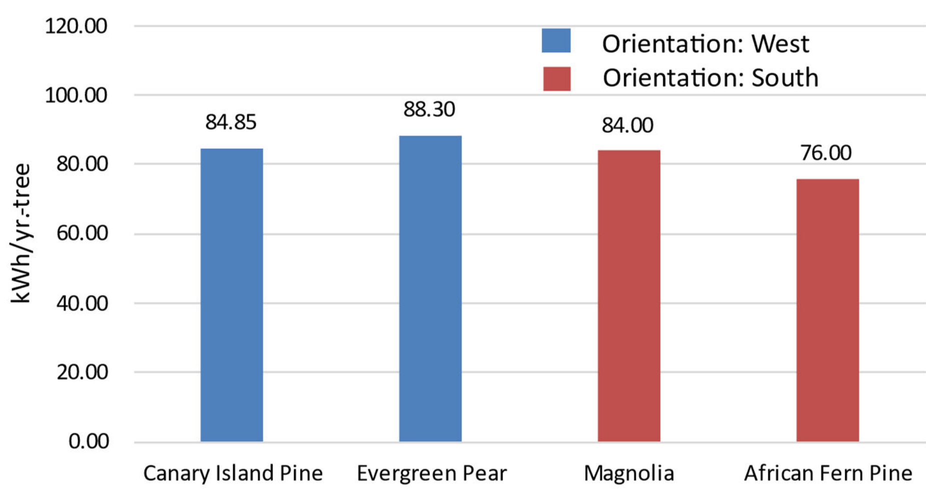


Figure A-18 shows the impact of different tree species on the energy savings. In this chart, only multiple projects with the same orientation but different species were included for comparison purpose. Trees planted in different orientations are colored distinctly.

Figure A-18 CP - i-Tree Design Per-Tree Energy Savings by Tree Specie



A.*3.2.2.2.* eQuest Simulation Models

The Evaluator also validated EcoLayers inputs and assumptions regarding modeled buildings through the use of eQuest prototypical residential models. A prototypical model of a 1,500 square foot single-story house was developed to calculate the energy savings due to tree shade. The shade tree was modeled by defining multiple layers of permanent shades with varying shade schedule for accommodating "leaves on" and "leaves off" schedules during different seasons (i.e., Leaf-on: April, Leaf-off: October), similar to what was used in EcoLayers models. The shade tree used in this model was of deciduous type, which sheds leaves during the winter season. During "leaves on" season, only 5% solar radiation is transmitted through while 95% is blocked by the shade, whereas, during "leaves off" season, 95% solar radiation is remitted through while only 5% is blocked.

The key parameters for the different vintage types are shown in above. In the current eQuest model, the parameters belonging to 1950-80 building vintage were considered, because most of the houses (53%) benefitting from shade trees under the CP Program were reported to have been categorized under this particular vintage. The models were run with and without the shade tree to calculate the difference. These simulation runs were repeated by using two weather files (Los Angeles Intl. Airport & Burbank) and by changing the orientation of the shade tree to North, East, West and South directions. Table A-14 shows eQuest results on per-tree energy savings by orientation, under the two different weather zones.

Table A-14 CP - eQuest Results on Per-Tree Energy Savings (kWh/yr.-tree) by Orientation under Two Weather Zones

Weather/ Orientation	South	East	West	North	Average
South Coast	48.3	38.7	65.0	14.3	50.7
South Valleys	40.8	79.7	120.0	36.9	80.2
Average	44.5	59.2	92.5	25.6	55.5

A.3.2.2.3. Literature Review

The Evaluator conducted an on-line search of peer reviewed relevant literature to support validation of the EcoLayers model inputs and parameters.

The last three decades have witnessed significant research and development activities in understanding urban heat islands, their environmental effects, their health impacts, development of measures to mitigate heat islands, and development of implementing policies and programs to cool urban heat islands. In 1992, Hashem Akbari *et al.*[12] conducted research, which identified that shade trees directly reduced cooling energy use in buildings and with a combination of cool roofs, cool pavements, and urban vegetation would cool the city by a few degrees. Building energy simulations in many climates quantified the potential cooling energy savings and electrical peak demand reductions in many climates in the U.S. These simulations were validated with many field experiments documenting cooling energy savings of 10–50% (depending on climate, building type and operation) for the areas under facility roofs (Synnefa et al[13]).

[12] https://www.tandfonline.com/doi/abs/10.3846/13923730.2015.1111934

[13] https://www.researchgate.net/publication/280755913_Technical_Advances_in_the_EU_Cool_Roof_Project

Akbari et al.[14] monitored peak-power and cooling-energy savings from shade trees in two houses in Sacramento, California. The collected data included air-conditioning electricity use, indoor and outdoor dry-bulb temperature and humidity, roof and ceiling surface temperatures, inside and outside wall temperatures, insulation, and wind speed and direction. The shading and microclimate effects of the trees at the two monitored houses yielded seasonal cooling energy savings of 30%, corresponding to average savings of 3.6 and 4.8 kWh/day. Peak demand savings for the same houses were 0.6 and 0.8 kW (about 27% savings in one house and 42% in the other).

Taha et al.[15] estimated the impact on ambient temperature resulting from a large-scale tree-planting program in the selected 10 cities. They used a three-dimensional meteorological model to simulate the potential impact of trees on ambient temperature for each region. The mesoscale simulations showed that, on average, trees could cool down cities by about 0.3^{o}K to 1^{o}K at 2 pm. The corresponding air-conditioning savings resulting from ambient cooling by trees in hot climates ranged from \$5 to \$10 per year per 100 m^2 of roof area of residential and commercial buildings. Indirect effects were smaller than the direct effects of shading, and, moreover, required that the entire city be planted.

Yekang Ko et al.[16] reported that in 1995, SMUD contracted with the USDA Forest Service to evaluate the cooling energy (kWh) and capacity (kW) provided by the Sacramento Shade Program. Computer simulations of tree shade and space conditioning energy use were completed for a random sample of 254 residential properties. On average, 3.1 trees per property reduced annual cooling energy use by 153 kWh (7.1%) and peak demand by 0.08 kW (2.3%) per tree. Annual heating loads were projected to increase by 0.85 GJ (1.9%) per tree. Using 1998 energy rates (\$0.10/kW hand \$6.15/MMBtu), these energy impacts converted to \$15.25 for annual cooling saving and \$5.25 for an annual heating penalty per tree.

McPherson and Simpson (2003)[17] applied tree canopy cover data from aerial photographs and building energy simulations to estimate energy savings from existing trees and new plantings in California. Tree numbers by location for each sample city were stratified into the 11 climate zones. Tree ratios, the number of trees per person or per dwelling unit, were calculated by land use and tree site (i.e., positive, neutral, or negative) for each sample city. The authors simulated annual energy saving effects of one existing tree (15 feet crown diameter) at different locations around the base case residences. Climate only trees did not shade buildings (> 40 feet). The results based on this study for South Coast and South Valleys zones (belonging to LADWP territory) are shown below in Table A-15.

[14] https://www.osti.gov/servlets/purl/860475

[15] https://www.osti.gov/servlets/purl/860475

[16] https://www.sciencedirect.com/science/article/abs/pii/S0169204615001553

[17] https://www.sciencedirect.com/science/article/abs/pii/S1618866704700254

Table A-15 CP - Secondary Research Results on Per Tree Energy Savings (kWh/yr.-tree) by Orientation under Two Weather Zones

Weather/ Orientation	South	East	West	North	Average	Climate Only
South Coast	18.0	15.0	23.0	-	18.7	16
South Valleys	32.0	36.0	60.0	-	42.7	25
Average	25.0	25.5	41.5	-	30.7	20.5

A.3.2.2.4. Comparisons of Energy Savings Results

Table A-16 presents the comparisons of energy savings (kWh per year per tree), expected from shade trees by different source. Averages of sources 2,3, and 4 were taken to compare with values from EcoLayers used in the Ex-Ante calculations. These figures provide a good benchmark between EcoLayers' calculations and values from other sources.

Table A-16 CP - Comparisons of Energy Savings due to Shade Trees by Source

Source/ Orientation	South	East (kWh/yr.-tree)	West (kWh/yr.-tree)	North	Average (Shade Only) (kWh/yr.-tree)	Climate Only (kWh/yr.-tree)
1- EcoLayers*	-	-	-	-	46.9	16.9
2- i-Tree Design	80.0	44.25	86.0	-	70.1	not calculated
3- eQuest Simulation	44.5	59.2	92.5	25.6	55.5	not calculated
4- Secondary Research[18]	25.0	25.5	41.5	-	30.7	20.5
Average (2,3,4)	49.8	43.0	73.3	25.6	52.1	20.5
* EcoLayers' results include 10% reduction based on street tree mortality rates found in Fall 2018 sampling						

A.4. CPP

This section details the impact evaluation and process evaluation for the Custom Performance Program (CPP) program that LADWP offered customers during FY 20/21. The primary objective of this evaluation was to calculate energy savings and peak demand reduction attributable to the CPP program, as well as to complete a process evaluation.

A.4.1. Evaluation Methodology

This section presents the findings of the tracking data review and the methodology used to calculate verified Ex-Post energy savings and peak demand reduction for the program.

A.4.1.1. Tracking Data Review

To begin the impact evaluation, program documentation was reviewed, and data examined on the performance of the program in previous years. Program tracking data

[18] https://www.sciencedirect.com/science/article/abs/pii/S1618866704700254

was reviewed for completeness and identification of outliers and anomalies. Projects were checked for installation and incentive dates for program year applicability.

Program tracking data (both at the measure level and the project level) was then analyzed to determine the most appropriate sampling approach. Data was reviewed for the range of measure types as well as the range of annual energy savings (kWh). While a random evaluation sample was determined, it was important to ensure that various measure types were represented for extrapolation.

Measure type categories were chosen based on the measures listed in the program tracking data (within the project description) and included Building envelope, Controls, HVAC, Lighting, Process, VFD, and Other. A summary of projects by measure type category is shown in Table A-17.

Table A-17 CPP Measure Categories

Stratum	Total Program Projects	Program Data Ex-Ante Annual kWh	Minimum Ex-Ante kWh	Maximum Ex-Ante kWh	Percent of Population
Building Envelope	4	387,888	205	311,689	1%
Controls	17	4,369,023	26,007	722,757	11%
HVAC	26	8,182,984	1,895	2,113,381	21%
Lighting	59	13,934,171	4,922	600,674	36%
Other	9	10,627,597	5,202	7,567,917	27%
Process	1	251,792	251,792	251,792	1%
VFD	11	1,407,785	547	551,400	4%
Total	127	39,161,241	205	7,567,917	100%

A.4.1.2. M&V Sample Design

Based on a review of the program tracking data, a stratified random sampling approach was employed based on project level Ex-Ante annual energy savings (kWh). Statistical samples will be designed so as to ensure that the combined strata represent the population within ±10% precision at the 90% confidence interval by the end of FY 22/23. The number of strata, the boundaries within each stratum, and the number of sample points for each stratum will be determined through an iterative process. For FY 20/21, the sample resulted in a program level precision of ±17.52% at the 90% confidence interval using Ex-Ante estimates. A summary of the sample is shown in Table A-18. The selected sample represents 30% of the CPP population. A single project contributed 19% of estimated savings. This project was provided its own sample strata.

Table A-18 CPP Population Statistics used for Sample Design

Stratum	Strata Boundaries (Ex-Ante kWh)	Projects	Sampled Projects	Standard Deviation of Ex-Ante kWh Savings	Program Data Ex-Ante Annual kWh	Sample Ex-Ante Annual kWh
1	< 97,455	47	2	30,556	1,880,215	26,842
2	103,141 – 235,296	27	1	41,738	4,385,627	120,159

Stratum	Strata Boundaries (Ex-Ante kWh)	Projects	Sampled Projects	Standard Deviation of Ex-Ante kWh Savings	Program Data Ex-Ante Annual kWh	Sample Ex-Ante Annual kWh
3	251,663 – 399,510	31	2	40,938	10,171,639	650,549
4	407,811 – 654,145	16	1	75,347	8,159,905	489,962
5	722,757 – 2,113,381	5	3	675,358	6,995,938	2,841,135
6	7,567,917	1	1	NA	7,567,917	7,567,917
Total	NA	127	10	720,015	39,161,241	11,696,565

A.4.1.3. Project Documentation Review

Documentation representing the sampled projects was requested and received from LADWP. Project documentation included a mix of energy savings calculations, invoices, specification sheets, and application materials. Further data requests were provided for projects in which insufficient documentation was available for evaluation. In addition to project documentation, billing data was reviewed (as available) within the LADWP meter data online tool.

Every sampled project underwent a detailed documentation review which was used to develop site-specific MV Plans. A review of energy savings calculations by the Evaluator focused on the key factors and assumptions used to determine energy use, including operating hours, usage patterns, and load factors. The review included the following:

- Review of energy efficiency improvements considered;
- Review of energy analysis input assumptions; and
- Review of methods used to calculate energy savings.

When applicable and feasible, a desk-review of the provided calculations was completed to prepare for primary data collection. Regenerating energy savings estimates ensured that all issues and concerns were identified prior to communicating with the site contact. Available billing data was reviewed and analyzed to identify the potential for use in either a billing regression analysis or calibration of an energy simulation.

A.4.1.4. Site Specific Measurement and Verification Plans

After a full review of program documentation, project documentation, and billing data, the Evaluator developed MV Plans which describes the project and initial impact estimation methods, identified the major sources of uncertainty in the impact estimation methods, proposed a methodology for assessing the project’s energy impacts, and specified the exact steps by which data was collected and analyzed to remove or mitigate uncertainties in energy savings estimations.

M&V Plans were developed and distributed for each project. The plans described the evaluation approach and data collection activities specific to each measure type within the project.

A.4.1.5. Virtual Data Collection Activities

Adhering to current conditions regarding COVID-19, the Evaluator utilized a mix of virtual data collection practices and on-site data collection for this evaluation. The first step was to ensure the M&V Plans provided defensible methodologies to facilitate data collection through a site contact. This included an exploration of a billing regression analysis, review of data collected through implementation, and exploration of available building automation system (BAS) data. To effectively collect information virtually, the Evaluator made sure to work collaboratively with the participant to ensure the data collection procedure was feasible and acceptable.

Data was collected virtually using software platforms that allowed for ease of verification. The Evaluator used the Streem virtual video platform, when possible, to reduce burden on the site contact. If Streem was not feasible then evaluation staff relied on Microsoft Teams, email, phone, and occasionally another platform of preference by the site contact.

Prior to virtual data collection, the Evaluator underwent a recruitment process that consisted of:

- Sharing a list of sampled projects with site contact information, M&V Plans, and data collection approach;
- Requesting support from LADWP large account managers;
- Initiating contact with the site contact (using both email and phone);
- Scheduling a virtual data collection event with the site contact; and
- Performing data collection through feasible virtual means.

A.4.1.6. Engineering Analysis

Energy savings calculation methodologies were selected based on industry standard practices adhering to IPMVP Options. Industry references included DEER, ASHRAE, and DOE UMP. DEER workpapers were reviewed by measure and checked for applicability for each sampled site. Many custom projects are typically analyzed through energy simulation software.

Energy impacts of annual energy savings (kWh), lifetime energy savings (kWh) and peak demand reduction (kW) were determined for each measure of each sampled project. Each analysis underwent a quality control process to ensure proper methodologies were employed and no calculation errors were present. Measure level energy impacts were aggregated to the project level. A site level report was developed for each project for individual review.

Lifetime energy savings were determined based on the methodologies provided in DEER workpapers or based on industry standards when necessary. Lifetime energy savings by measure are dependent on the type of replacement such that a portion of lifetime energy savings may be reliant on the remaining useful life of the baseline condition and/or the code compliant savings beyond the remaining useful life.

Peak demand reduction was determined based on the methodologies provided in DEER workpapers. For custom projects, the peak demand reduction was defined as the average hourly consumption across the peak demand window of 2 PM to 5 PM on non-holiday weekdays from June through September.

A.4.1.7. Program Analysis

Upon completion of the project-level analyses, the results were aggregated by strata for extrapolation. Sample results within strata were extrapolated to projects in the population that fell within the same strata criteria. For this sampling approach, it meant that projects of similar annual energy savings magnitude were given the overall realization rate from sampled projects within the same strata. Each project was then provided Ex-Post energy savings results that were aggregated to the program level.

A.4.1.8. COVID-19 Impacts

In addition to the determination of annual energy savings, the Evaluator explored the impact of COVID-19 on energy impacts from the installed measures. Through verification efforts, the Evaluator explored the effects on operating schedules, mechanical systems, and any other consumption effects presented by site contacts.

A.4.2. Impact Evaluation

This section describes various procedures undertaken to conduct the impact evaluation of the CPP program. These include engineering review procedures, data analysis, extrapolation of results, and description of factors affecting gross realized savings.

A.4.2.1. Program Data Review

Measure level descriptions in program tracking data indicated 29 different measure types were implemented during the program year. For reporting purposes, measure types were categorized into Building Envelope, Controls, HVAC, Lighting, Process, VFD’s, and Other. The classification of “Other” includes retro-commissioning (RCx), refrigerated display case door upgrades, and descriptions listed as other. The provided measure level tracking data was complete for the purposes of reviewing gross impacts and developing a stratified random sample.

Project documentation was delivered for each sampled project. The amount of project documentation varied depending on the project. Not all projects included clearly identified final documentation to match program tracking data. Billing data was obtained, when available through the LADWP online tool. Comprehensive billing data by project was difficult to compile as project sites may have include multiple meters. In addition, billing data must span a significant time to be useful for analysis calibration. In many cases the available billing data could not be used for analysis purposes.

A.4.2.2. Data Collection

Data collection for evaluation efforts was completed with on-site visits as well as virtual methods when applicable. The Evaluator was able to perform data collection activities during the pandemic for all sampled projects. Site specific Measurement and Verification Plans (M&V Plans) were developed to determine the appropriate information, photographs, and data to be collected. Prior to data collection, M&V Plans were shared with program staff, and customer account managers were notified when applicable. The two virtual verifications were for projects in which the site contact was able to provide trend and power consumption data. A summary of data collection activities for the sample is shown in Table A-19.

Table A-19 CPP Evaluation Data Collection by Project

Stratum	M&V Plans	On-Site Verification	Virtual Verification	Evaluated
1	2	2	0	2
2	1	1	0	1
3	2	2	0	2
4	1	1	0	1
5	3	2	1	3
6	1	0	1	1
Total	10	8	2	10

The sampled projects represented eight measure types which were the following:

- Monitoring Based Commissioning (MBCx)
- Retro-commissioning (RCx)
- HVAC (Chillers, Cooling towers, AC units)
- Lighting
- VFD
- Refrigeration Motors and Controls
- Occupancy Controls
- Transformers

A.4.2.3. Sample Results

Measurement and verification for the determination of verified energy impacts was conducted on all ten sampled projects from the 2020/2021 fiscal year. Evaluation protocols were classified using the IPMVP Options. A summary of the protocols used is shown in Table A-20.

Table A-20 CPP Evaluation Protocols by Measure

IPMVP Option	FY 20/21
Option A: Spreadsheet or Basic Bin Analysis	2
Option A-: TRM (Or other Deemed) Analysis	2
Option B: Partial Retrofit Isolation	1
Option C: Whole Building Retrofit	3
Option D: Calibrated Simulation	2
Total	10

A summary of evaluated measures by measure types selected from the population is shown in Table A-21. The sample of projects was randomly selected based on magnitude of energy savings. Samples from fiscal years 2020/2021, 2021/2022, and 2022/2023 will be combined to meet an overall precision of +/- 10% at the 90% confidence interval. Not all measure categories were randomly selected for fiscal years 2020/2021.

Table A-21 CPP Evaluated Measures by Category and Protocol

Measure Type	Option A	Option B	Option C	Option D	Total
Building Envelope	0	0	0	0	0
Controls	1	1	0	0	2
HVAC	1	0	1	2	4
Lighting	2	0	0	0	2
Process	0	0	0	0	0
VFD	0	0	0	0	0
Other	0	0	2	0	2
Total	4	1	3	2	10

Project-level and measure-level results can be found in site-level reports, which can be viewed in Appendix E. For confidential and privacy considerations of participants, Appendix E was not published with the public version of the report. Appendix E was provided only to LADWP as reference to supplement this EM&V report. Sampled measures represented 30% of the reported annual energy savings. The evaluation sample was grouped by strata based on the magnitude of annual energy savings. Energy savings for projects within each stratum were aggregated to determine a strata-level realization rate for extrapolation to the population. Sample savings impacts by strata are shown in Table A-22.

Table A-22 CPP Evaluation Sample Savings Summary

Stratum	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
1	26,842	25,908	97%
2	120,159	118,571	99%
3	650,549	776,909	119%
4	489,962	484,079	99%
5	2,841,135	4,613,760	162%
6	7,567,917	4,775,124	63%
Total	11,696,565	10,794,351	92%

Evaluation sample savings impacts by measure category are shown in Table A-23.

Table A-23 CPP Evaluation Sample Savings by Measure Category

Measure Category	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Controls	842,916	746,021	89%
HVAC	1,902,446	2,828,638	149%
Lighting	650,549	776,909	119%
Other	8,300,654	6,442,783	78%
Total	11,696,565	10,794,351	92%

The largest project in the evaluation sample is also the largest project in the population. This project consists of a long-term MBCx with a project initiation dating back to 2015. This project was placed as a single project into strata 6, with no extrapolation. This project was considered a certainty project where evaluation findings were held to the project.

Realization rate factors were categorized for reporting purposes to identify areas of program improvement related to the calculation of energy impacts. The evaluation found the factors influencing the realization rate to be differing load profiles, differences in savings methodologies, differing hours of operation, and incorrect baseline assumptions. The category of “differences in savings methodologies” included analyses using IPMVP Option C approaches in which an equal amount of post-installation consumption data was not available for Ex-Ante estimates. The impact of these realization rate factors is shown in Table A-24. The table presents differences in absolute value as well as net value. The absolute values provide a representation of the total differences between Ex-Ante and Ex-Post.

Table A-24 CPP Sample Realization Rate Factors

Realization Rate Factor	Sample Difference Absolute Value (kWh)	Sample Difference Net Change Value (kWh)
Differing Load Profiles	2,608,650	(1,302,436)
Difference in savings methodology	2,106,306	333,453
Differing hours of operation	121,305	121,305
Incorrect baseline assumptions	54,537	(54,537)
Total	4,890,798	(902,215)

The impact of these realization rate factors on the overall sample by measure category is shown in Table A-25.

Table A-25 CPP Evaluation Sample Impact from RR Factors

Realization Rate Factor	Controls	HVAC	Lighting	Other	Total
Difference in savings methodology	-0.41%	-0.01%	0.04%	3.22%	2.85%
Differing hours of operation	0.00%	0.00%	1.04%	0.00%	1.04%

Realization Rate Factor	Controls	HVAC	Lighting	Other	Total
Differing Load Profiles	0.00%	5.58%	0.00%	-16.71%	-11.14%
Incorrect baseline assumptions	-0.42%	-0.05%	0.00%	0.00%	-0.47%
Total	-0.83%	5.53%	1.08%	-13.49%	-7.71%

A.4.2.4. EETAP Projects

The largest project in the population and in the sample, an MBCx project, was an EETAP project. No other EETAP projects fell into the evaluation sample. The realization rate factors for this project included differences in savings methodology as well as differing load profiles. This was a complex analysis as the MBCx impacted the facilities energy consumption as well as distributed fuel sources of chilled water and steam. There were electrical energy implications from steam savings as the complex has on-site power generation using steam; thus, steam offset from energy efficiency measures can be used to generate electricity. The evaluation found the Ex-Ante calculations to be thorough and detailed; however, the baseline consumption estimate relied on a partial year of consumption data. This factor was found to be the main contributor to the difference in annual energy savings as compared to the Ex-Post verified savings.

A.4.3. Process Evaluation

This section presents the process evaluation for the Custom Performance Program (CPP).

A.4.3.1. Process Evaluation Approach and Methodology

The following sections describe the evaluation approach and methodology used to perform the CPP process evaluation.

A.4.3.1.1. Document Review

The Evaluator reviewed all available program documentation for CPP, including outreach and marketing materials, process flow charts, application forms, organization charts, and process and operations manuals. The team reviewed this information to understand how the program engages with the market, what the intended touch points are for customers and vendors, how program processes work together, and intended program outcomes. This information was used, along with findings from staff interviews, to provide context for research findings and to construct the participant survey and the interview guides for participants, near-participants, and contractors interviews.

A.4.3.1.2. Staff Interviews

The Evaluator completed one 60-minute phone interview with CPP staff. The interview was designed to provide detail on program design and procedures, assess current progress, and identify critical research questions to be included in the program evaluation. The interview covered topics including program design changes, program progress toward goals, impacts of the COVID-19 pandemic, marketing and outreach strategy, target audience, relationships with customers, program processes, risks to performance looking forward, and evaluation needs. This information was used, along with findings from the document review, in construction of participant survey and vendor interviews data collection instruments and provided context for findings by these research activities.

A.4.3.1.3. Participant Survey

In total, the team collected responses from 11 participants drawn from a sample frame of 108 unique and valid emails, including 48 emails from 2019-2020 participants to supplement the small 2021 sample. The analysis excluded two respondents because they did not complete most of the survey resulting in a total of nine CPP participants included in the analysis. Of the nine CPP respondents, most participated in 2021 (n=5), some in 2020 (n=3), and one in 2019 (n=1).

A.4.3.1.4. Participant, Near-Participant, and Contractor Interviews

The team interviewed one participant and one contractor to gather in-depth, qualitative feedback on their experience with the program. The evaluation was unable to include interviews with near-participants. In total, the team attempted to contact 11 near-participants, 51 participants, and 8 contractors through 3 emails and up to 4 phone contacts. This recruitment was conducted with the support of LADWP staff. The team will attempt to conduct additional contractor interviews in 2022 with newly available data.

A.4.3.2. Process Evaluation Findings

Overall, the program seems to be working as intended, although program staff noted that they have had a difficult time achieving savings goals due to businesses closing temporarily or shutting down during the COVID-19 pandemic. Even after reopening, many of the large businesses targeted by CPP have reduced budgets for making energy efficiency improvements. Despite lower than usual participation, those who did participate report a high level of satisfaction with the program, with the equipment installer, and with the equipment installed through the program. Respondents report that the program would benefit from a simplified and faster application process, suggesting that LADWP could consider continuing its existing efforts to improve these processes. Analyses of tracking data suggests that rebate processing times are shortening in recent months, suggesting that program processes are improving as intended by recent program changes – most significantly the addition of the “Express” program track that offers an expedited application process for simpler measures.

Respondents learned about CPP most commonly through past participation, internet research, and LADWP staff. Most respondent organizations replace equipment when it is old or when it breaks and most have a formal organizational approval process for the purchase of new equipment. Several respondent organizations have sustainability goals, a Sustainability Manager, or an Energy Manager. The most common barriers for investing in energy efficient equipment were high initial costs and conflicts with higher-priority investments. This suggests that the rebate offered through CPP addresses one of the primary barriers that customers face when attempting to invest in energy efficient equipment.

Based on the limited survey responses, respondents:

- Most frequently learned about the program through past participation, internet searches and LADWP staff

- Participated to save money on their energy bills followed by reduced energy cost
- Rated the importance of the rebate highly in their decision to participate (average 4.8 on a 1 to 5 scale where 5 was extremely important)
- Experienced limited vendor influence, rating vendor importance in decision to participate an average of 3.1 out of 5

These findings are described in greater detail below.

A.4.3.2.1. Program Application and Review Process

The Evaluator reviewed the CPP program application and review process. The main findings of that review are as follows.

The LADWP project evaluation and quality control process is rigorous and thorough. The key features are:

- Pre-inspection for most express track projects and all custom calculated projects.
- Post-inspection for all projects.
- Structured protocols for guiding savings estimation and project documentation for the custom calculate tracks including, development of a pre-inspection checklist to systemize data collection, documentation of an M&V plan, documentation of final project evaluation in a report.
- A well-structured process for quality control review of the savings estimation and project documentation provided by the Energy Service Providers (ESPs) that evaluate the submitted projects.
- A process for reviewing completed express track projects.

The division of the project into express and custom calculated tracks has improved the efficiency of the program. The addition of the express track for simpler measures, for which deemed savings values can be used, has simplified the program process and allowed staff to reallocate efforts to larger projects that are more impactful on overall program results.

The quality control process for reviews of custom calculated projects is rigorous but burdensome. The process for reviewing ESPs project evaluations is designed to ensure the program procedures are being followed by the service providers and provide feedback to them. The reviews do not alter project savings. A drawback of the process is that it is time consuming and burdensome for LADWP staff and it can be difficult to find staff to complete the reviews in a timely manner.

We recommend reducing the number of quality control reviews in order to reduce the program administration costs. This recommendation is based the following findings:

- The quality control reviews do not affect savings estimations and will not impact incentive payments.
- The program has several quality assurance mechanisms including working with third-party technical experts to estimate the savings for all custom calculate

projects, protocols for documenting and planning savings estimation approaches and results, as well as submitting supporting documentation and data.

- The Evaluator's evaluation of the FY 15/16 through FY 19/20 programs found a high realization rate for the Ex-Ante savings estimated (95%).
- A review of feedback provided on 21 reviews of ESP projects completed by LADWP staff during 2021 found that in most cases the issues identified involved project documentation or organization of documents. Although these are important aspects of the projects, for nearly all of the reviews, the LADWP reviewer did not find issues that indicated the estimated savings was significantly incorrect.

The Evaluator recommends that LADWP consider a protocol that would involve a review of all of the first submissions by a new ESP, with a sample of reviews after that, for example, reviewing 50% of the projects. For projects that do not receive a review, we recommend an expedited review to verify that all documentation has been submitted.

Additional details of the application and review process are discussed below.

CPP provides applicants with two tracks through which they can receive an incentive: smaller projects with conventional measures go through the express track and receive deemed savings estimates and larger (projects that are over 250,000 kWh) or projects with more complicated measures go through the custom calculated track. Projects that consist of measures that qualify for the express track and measures that require custom calculation, are routed through the custom calculation track.

Express Track

LADWP implemented the express track to reallocate staff time from performing detailed reviews of smaller projects with simpler measures, to larger projects with more complicated measures with greater uncertainty in savings impacts.

The program application form provides a list of measures that are eligible for the express track. The application includes built in calculations to estimate the expected savings and incentive amount for express track measures based on the applicant's inputs.

To receive incentive through the express track, the applicant completes the application workbook and submits the workbook to LADWP for review. LADWP reviews the application submission and determines if the project is eligible for the express track or if it should be moved to the custom calculated track. Staff reported that it is not common for a project to move from the express to custom track.

Most express track projects undergo a pre-inspection, although program staff may wave the pre-inspection on a case-by-case basis (notes in the CY1 program data indicate that 12 of 51 express projects had the pre-inspection waved). Pre-inspections consist of verifying that the baseline equipment is correctly documented and confirming all of the inputs needed to estimate the project savings. The program introduced virtual pre-inspections in response to Covid-19 and intends to keep this approach.

Once a project has passed the pre-inspection, LADWP notifies the customer who then completes the installation. Once the installation is complete, the customer submits the report and completes the installation report. The installation report documents the installation date and includes an attestation of whether or not changes have been made to the proposed measures. The applicant also submits invoices for the project.

Upon receipt of the post-installation report, program staff schedule the post inspection. Post-inspections may result in a revision to the energy savings estimates.

After passing the post-inspection and finalizing the associated energy savings, the project is submitted for incentive payment.

Custom Calculated Track

The custom calculated process begins with the submission of the program application and workbook. For custom calculated projects, applicants may submit their own estimates of the projects savings or program staff will assist them in developing these estimates. A small share (10-20%) of custom calculated submissions include a savings estimate for the project. For the remainder, LADWP works with a group of contractors, referred to as Energy Service Providers (ESPs), who will assist customers in developing the savings estimates for their planned projects.

When LADWP receives the submitted materials, it schedules a meeting with the customer. This meeting serves as an opportunity to discuss the approach and process for estimating the project savings, and to help manage the customer’s expectations. An output of the meeting is a determination as to whether a measurement and verification (M&V) approach or a modeling approach will be used to estimate the project savings.

The next step is for an ESP to complete a pre-inspection of the facility. The pre-inspection is guided by a checklist that is developed by the ESP. The checklist outlines what data should be obtained during the site visit. Pre-inspections are performed by the program ESPs. The pre-inspection serves similar purposes as the pre-inspection for the express track. The outputs of the pre-inspection are an M&V plan for projects under an M&V approach, and a baseline model and estimated savings for projects under a modeling approach.

Modeling projects require customers to provide detailed inputs on the building and equipment. For cases where inputs are incomplete, ESPs are to use values that generate conservative estimates and to communicate that this approach will be used to the applicant.

For projects under the M&V approach, pre-installation monitoring is performed for the specified duration. In some cases, it is possible to leverage customers’ monitoring capabilities (for example, data capture from an energy management system). If such data is not available, the ESP will install loggers during the pre-inspection to capture the needed information.

The next step is for the applicant to complete the installation of the measures. Upon completion of the installation, projects under the M&V approach undergo post-installation monitoring. After installation and post-installation monitoring, if needed, the customer submits the post installation reports and documentation.

A post-installation inspection is scheduled by LADWP for all projects. The ESPs complete the post-installation inspections. If necessary, the ESP assigned to the project will revise the energy savings calculations. The ESP generates an evaluation report for the project. Once the final savings are determined, the project is submitted for incentive payment.

ESP Quality Control and Assurance

LADWP has a detailed and well-organized process for reviewing the savings estimated by ESPs. In this process, all custom calculated projects undergo a QA/QC review by an LADWP staff person. The goal of the review is to verify that the ESPs are following program procedures, demonstrating technical competence in their evaluations, and to provide ongoing feedback to the ESPs to improve their work. The review does not alter the estimated savings for the projects.

Table A-26 outlines the overall structure of the review. The review divides the project into a series of pre-installation and post-installation tasks. Each task has a set of QC review criteria associated with it. The criteria focus on the organization and sufficiency of documentation, the quality of the technical approach for data collection and analysis, and the quality of the report writing and traceability. For each of the criteria, the reviewer scores each project on a one to five scale.

Table A-26 *CPP - Project Review Structure*

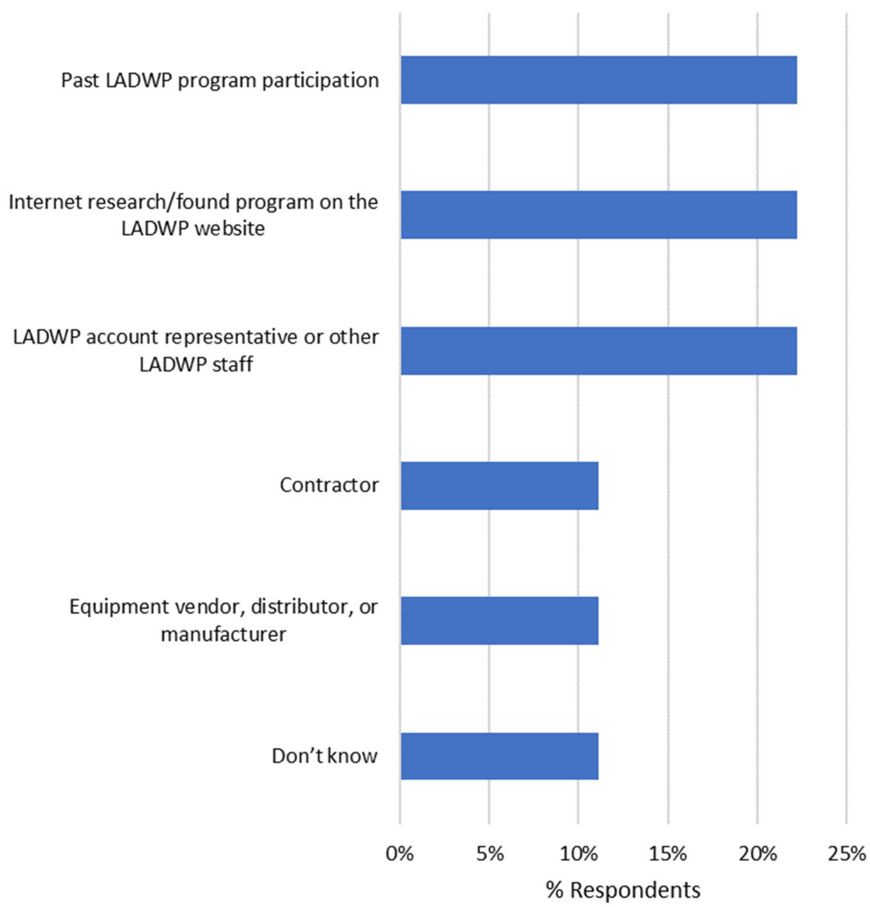
Project Phase	Project Task	Project Task Description	QC Review Criteria
Pre-installation	P1-1	Receive, Review, All Initial Project Files, RFI	Data Collection Organization of Documents Technical Approach
	P1-2	Generate Pre-Inspection Checklist, Perform Pre-Inspection	Pre-inspection checklist Inspection photos Inspection outcomes /results
	P1-3	Deploy Measurement Devices During Pre-Inspection	Deployment of pre-installation measurement device deployment Pre-installation measurement duration Pre-installation measurement parameters
	P1-4	Perform Preliminary Baseline Evaluation, Modeling, Review and Develop Calculations	Pre-installation evaluation Documentation of baseline
	P1-4a	Review and Adjust Customer Submitted Model/Calculations	Displays professional judgment and knowledge of calculation methodology Provides comprehensive description of baseline condition
Post-installation	P2-1	Notify Contractor, Owner of Any Necessary Trend Data, Information and Final Evaluation and Post-Inspection. Generate Post-Inspection Request and Equipment Checklist. Perform Post-Inspection, Take Site and Equipment Photos.	Post-inspection checklist Post-inspection photos Post-inspection outcomes/results
	P2-2	Collect Measurement Devices During Post-Inspection	Re-deploys measurement devices per M&V plan Deploys devices for period specified in M&V plan Analyzes parameters specified in M&V plan
	P2-3	Perform Final Evaluation, Modeling, Review and Develop Calculation	Displays professional judgement and knowledge of conditions and analysis Provides comprehensive documentation of approach
	P2-4	Generate Final Report for LADWP	Writing proficiency Traceability Transparency

A.4.3.2.2. Participant Survey Findings

The most common way CPP respondents learned about the program was through past program participation (n=3), followed by internet research (n=2) or through LADWP staff (n=2). This suggests that there are repeat customers that either know about LADWP programs or can get information from LADWP staff or the website. Most respondents were motivated to engage in the program for financial reasons such as saving money on utility bills or reducing maintenance costs. Unsurprisingly, the rebate was also a primary driving factor for participation in the CPP.

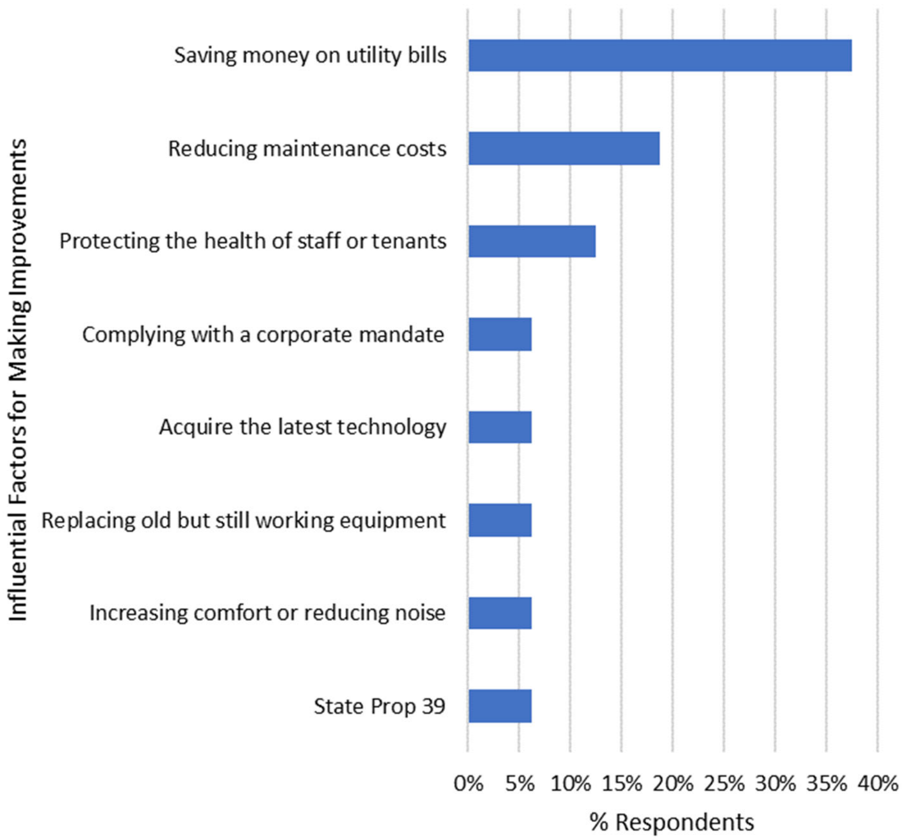
Figure A-19 below shows the common ways the respondents learned about the CPP. The most frequently selected were past LADWP program participation (n=3), followed by internet research (n=2), and LADWP staff (n=2).

Figure A-19 Where Respondents Learned About CPP (n=9; Multiple Response Question)



Respondents were asked what factors were most influential to their decision to make improvements (Figure A-20). The most frequently selected factors were saving money on utility bills (n=6) and lowering maintenance costs (n=3) suggesting that respondents' motivations to participate in CPP were primarily financial.

Figure A-20 Most Important Factors Motivating Respondents to Make Improvements Through CPP (n=9; Multiple Response Question)



Respondents rated factors that affected their decision to participate in CPP on a scale from 1 to 5, with 1 meaning "Not at all important" and 5 meaning "Extremely important". Seven respondents reported that getting the rebate was an "extremely important" factor in their decision to participate in the program and two reported that it was "very important", scoring an average rating of 4.8 out of 5 (n=9). Three respondents reported that vendor recommendations were "extremely important" while two respondents each reported that vendor recommendations are "not at all important" or only "slightly important", with an average rating of 3.1 out of 5 (n=9).

Three respondents reported that a recommendation by a program contact at LADWP was "very important" to their decision, two reported that it was "moderately important" and three reported that it was "slightly important". The average rating for a recommendation by an LADWP contact was 2.8 out of 5 (n=9). The least important factor affecting respondents' decision to participate was a recommendation by a family, friend, or colleague. Five respondents reported that this was "not at all important" to them and the average rating was a 1.9 out of 5 (n=9).

When asked about their prior knowledge of the CPP tracks, four respondents did know that there were two CPP tracks and four did not know (n=8).

Satisfaction with Program Processes

Most respondents were satisfied with the program overall and with most of the specific components. All program components scored an average satisfaction score of 3 out of 5 or higher, although there is variation in the distribution of responses. This variation shows that respondents are highly satisfied with some parts program (particularly the equipment and installation process) and more dissatisfied with other parts (particularly the effort required to complete the application).

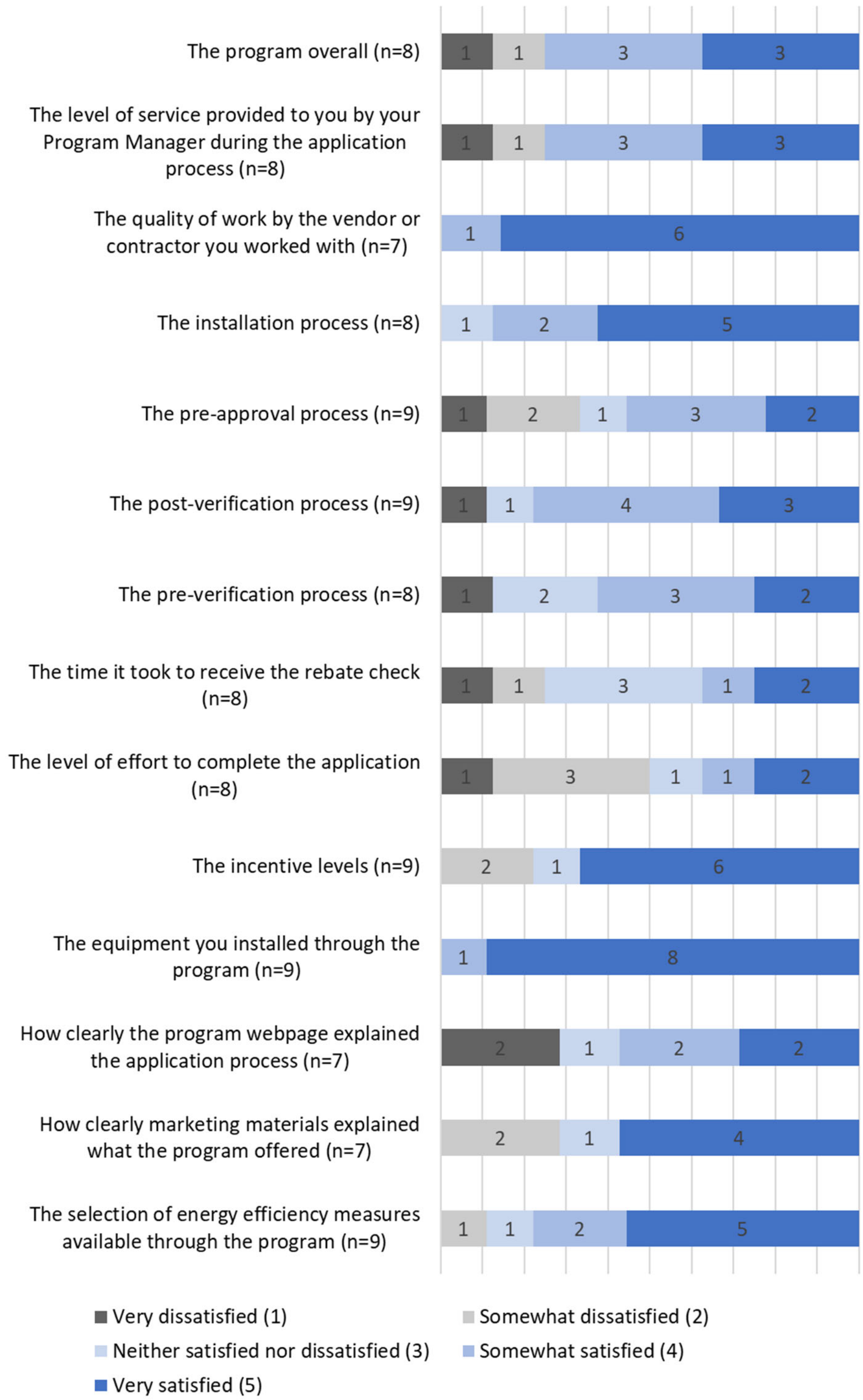
Figure A-21 below shows the distribution of participant satisfaction scores on a scale of 1 to 5 where 1 is “very dissatisfied” and 5 is “very satisfied” for each program element of CPP. Most respondents (6 of 8) were at least somewhat satisfied with the program overall. Respondents were most satisfied with the following program elements:

- Quality of work by the vendor or contractor (6 of 7 very satisfied),
- Equipment installed through the program (8 of 9 very satisfied).
- Incentive level (6 of 9 very satisfied)

Respondents were least satisfied with the following elements:

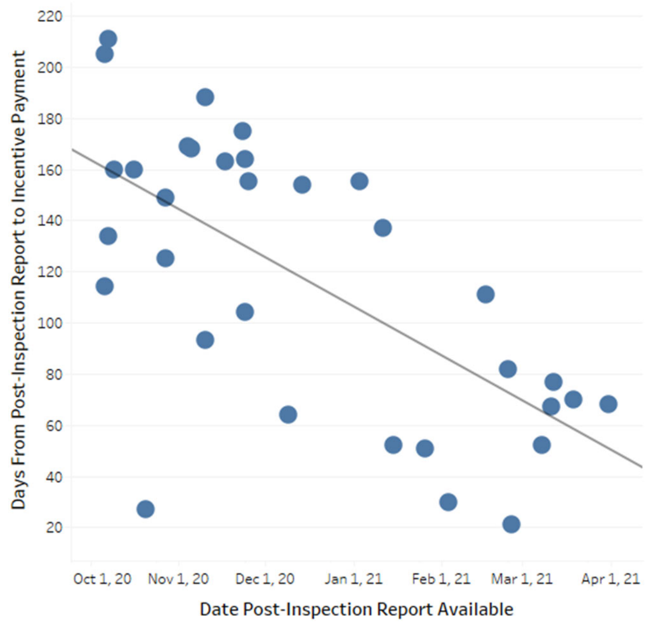
- Level of effort to complete the application (3 out of 8 satisfied or very satisfied)
- Time to receive the rebate (3 out of 8 satisfied or very satisfied)

Figure A-21 Participant Satisfaction of CPP Program Elements



Respondents who gave a satisfaction score of three or lower (7 of 9) were asked to explain their low satisfaction scores. These respondents mentioned that they perceived the program processes (particularly the application and inspection process) to be slow, confusing, or burdensome. However, three of the nine respondents submitted applications before 2020 and may have more experience with older versions of program processes. Analysis of more recent tracking data shows that the length of time taken by one key process (i.e., the time between the post-inspection report and LADWP sending a check to a participant) has been dropping rapidly. While this trend may be an artifact of only including projects that were completed in FY 2020/2021 it is suggestive of a trend that incentive processing may be getting faster (Figure A-22).

Figure A-22 CPP - Incentive Processing Time by Post-Inspection Report Date (n=33 invoices)



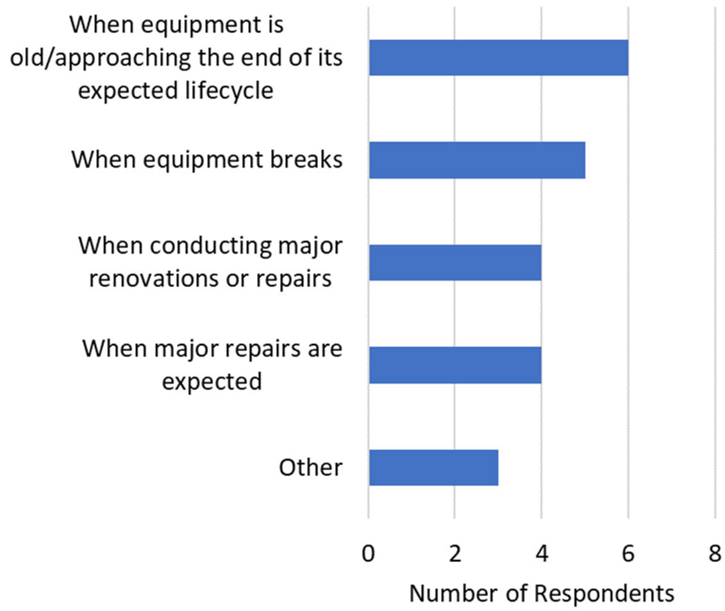
When respondents were asked what LADWP could have done to improve their experience in the program, responses not surprisingly aligned with their reasons for dissatisfaction, most commonly noting a faster application process and simplifying the application process.

When asked if they could think of anything else LADWP could have done to improve their experience with the program, respondents suggested that LADWP could provide a rebate estimate at the start of a project, increase the speed of the program processes, and allow electronic signatures for required paperwork.

Barriers and Decision Making

Most respondents replace equipment when it is old or broken. Relatedly, reliability or maintenance considerations are most important when respondents consider purchasing decisions (Figure A-23).

Figure A-23 CPP - When Do Respondents Typically Replace Equipment? (n=9; Multiple Response Question)

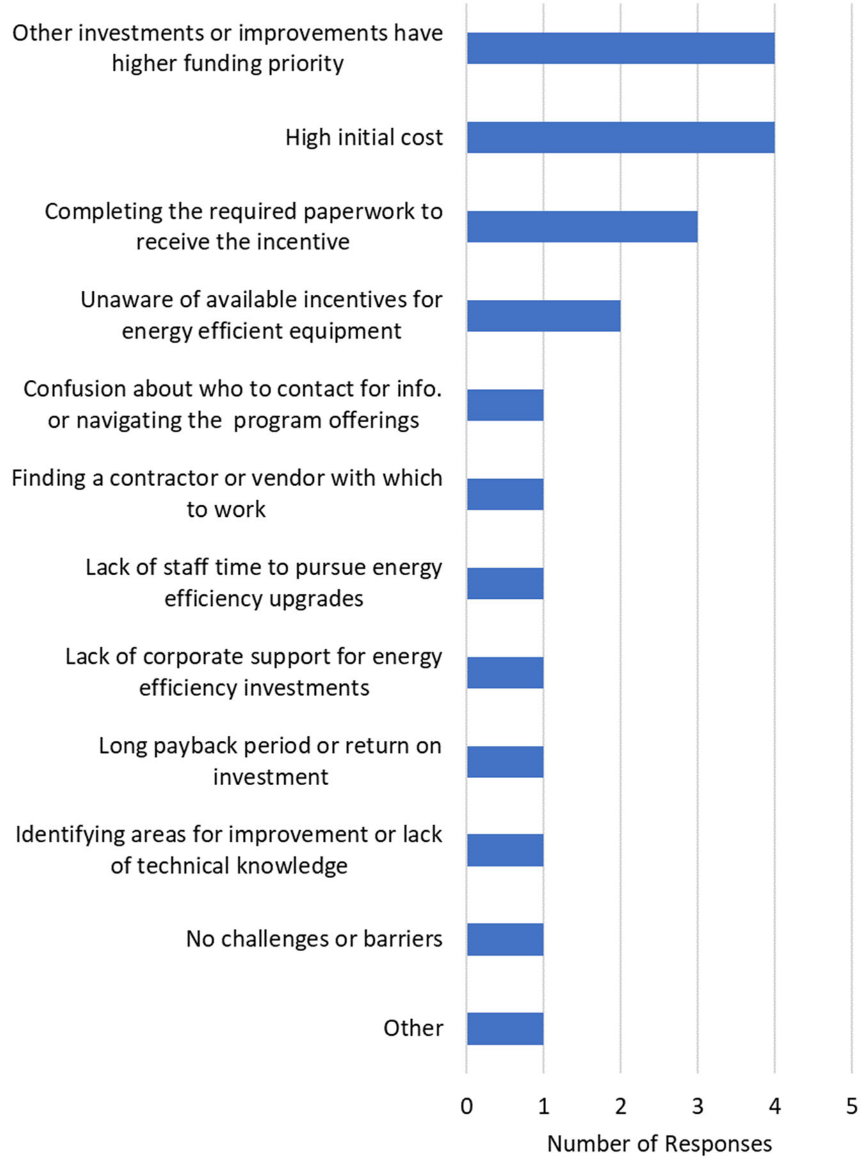


Respondents typically have a formal process for assessing capital improvements, and said they face challenges with investing in energy efficient equipment due to the cost or conflicts with other higher priority investments. With that said, sustainability is important; about half of respondent organizations have sustainability initiatives and/or a Sustainability Director. Half of respondents' organizations have a dedicated Energy Manager who is responsible for seeking out and applying for incentives. This suggests that sustainability values are important to participant organizations.

Reliability is the most important criterion for selecting equipment, cited by 4 out of 7 respondents. Other criteria such as brand name recognition, energy consumption, and up-front cost were selected by one respondent each.

Cost and competing demands are the most noted barriers to investing in energy efficient equipment (Figure A-24). There are many other barriers noted, but with singular responses.

Figure A-24 CPP - Barriers to Respondents' Investment in Energy Efficiency Equipment (n=9; Multiple Response Question)



A.4.4. Recommendations

- **Continue to track and measure rebate processing time to confirm trend toward faster processing.** LADWP appears to be making considerable progress toward their goal of improving rebate processing times by offering the Express program track. Program tracking data supports the conclusion that rebate processing times are shortening. Continue to track this trend to confirm that rebate processing times stay low.

- **Review application process to identify opportunities to streamline the process for participants.** The program application was perceived to be difficult and time-consuming. While this is not unusual for a custom program, identifying opportunities to continue streamlining the application process may increase customer satisfaction.
- **We recommend reducing the number of quality control reviews in order to reduce the program administration costs.** This recommendation is based the following findings:
    - The quality control reviews do not affect savings estimations and do not impact incentive payments.
    - The program has several quality assurance mechanisms including working with third-party technical experts to estimate the savings for all custom calculate projects, protocols for documenting and planning savings estimation approaches and results, as well as submitting supporting documentation and data.
    - The Evaluator's evaluation of the FY 15/16 through FY 19/20 programs found a high realization rate for the Ex-Ante savings estimated (95%).
    - A review of feedback provided on 21 reviews of ESP projects completed by LADWP staff during 2021 found that in most cases the issues identified involved project documentation or organization of documents. Although these are important aspects of the projects, for nearly all of the reviews, the LADWP reviewer did not find issues that indicated the estimated savings was significantly incorrect.

The Evaluator recommends that LADWP consider a QA/QC protocol that would include the following elements:

- Complete a quick review of all custom calculated projects to verify that all supporting documentation has been provided. This information is necessary for LADWP's records as well as for third-party evaluations.
- Perform a review of a subset of projects that meet one of the following criteria:
    - Criterion 1: Review the first three projects submitted by an ESP, if added, to ensure that understanding of LADWP requirements and technical competence. We recommend three projects because that number should provide sufficient opportunity for new ESPs to understand LADWP requirements and provide LADWP confidence in the ESPs technical competence. However, should the review of the three projects not demonstrate understanding of LADWP requirements or technical competence, additional project should be reviewed.
    - Criterion 2: Focus full QC reviews on projects with incentives greater than $75,000. During CY1, these projects accounted for 71% of the program incentives and 39% of the program projects. By focusing on reviews on these projects LADWP will be providing additional due diligence with the projects that utilize the most program incentive dollars.

- Criterion 3: Perform full QC reviews on projects that contain more complicated measures including controls, RCx/MBCx, VFDs, and industrial process improvements. Based on project descriptions in the CY1 tracking data, 28% of custom calculated projects included one or more of these measures. Reviews of these more complex projects will help to ensure ESPs are correctly analyzing savings and provide an opportunity for feedback from LADWP. (Criterion 2 and Criterion 3 combined accounted for 58% of the CY1 custom calculated projects.)

A.5. FSP - Comprehensive

This chapter details the impact evaluation and process evaluation for the Food Service Program – Comprehensive (FSPC) that LADWP offered customers during FY 20/21. The primary objective of this evaluation is to estimate energy and peak demand impacts attributable to the FSPC, as well as to complete a process evaluation.

A.5.1. Evaluation Methodology

This section presents the findings of the tracking data review and the methodology used to calculate verified Ex-Post energy savings and peak demand reduction for the program. As part of the impact evaluation, the Evaluator performed the following data collection activities outlined in Table A-27.

Table A-27 FSPC Data Sources for Impact Evaluation

Data	Source
Program Tracking Data	Data requested to LADWP for all data tracking program participation
Desk Review	Reviews of project documentation of a sample of customers who have participated in the program
On Site & Virtual Verification	Site visits of a sample of customers to collect data for savings calculation, to verify installation, and determine operating parameters

A.5.1.1. Tracking Data Review

Program tracking data for measures incentivized between July 2020 and June 2021 was provided by LADWP. The data was reviewed for duplicate entries and errors. Additionally, the database was reviewed to ensure that the data provided sufficient information to calculate energy savings and peak demand impacts.

A.5.1.2. M&V Sample Design

A sample was developed for site level analysis utilizing the provided tracking data. The Evaluator selected a stratified sample of projects (known as ratio estimation) to represent the population of the program. The FY 20/21 sample projects were enough to estimate the total Ex-Post savings with ±26.2% precision at a 90% confidence interval. The Evaluator’s current sample (FY 20/21) and future samples (FY 21/22, FY 22/23) will in total be enough to estimate the total achieved savings with ±10% precision at a 90% confidence interval.

Projects were categorized to each stratum by Ex-Ante kWh savings. The boundaries of each stratum were developed to ensure the extrapolation of impacts was appropriately distributed. Realization rates (the ratio of Ex-Post kWh savings to Ex-Ante kWh savings) for projects sampled in each stratum were only extrapolated to other projects within that stratum. Table A-28 presents the number of projects and tracking Ex-Ante kWh savings for the sampled projects by stratum.

Table A-28 FSPC Population Statistics used for Sample Design

	Stratum 1	Stratum 2	Stratum 3	Totals
Strata Boundaries (kWh)	<1,930	1,930 – 11,498	>11,498	
Population Size	10	5	3	18
Total Ex-Ante kWh Savings	8,105	47,072	68,812	118,989
Average Ex-Ante kWh Savings	810	9,414	21,271	
Standard deviation of Ex-Ante kWh Savings	485	3,403	5,615	
Coefficient of Variation	0.60	0.36	0.26	
Final Design Sample	2	2	2	6

The resulting sample of 6 projects consisted of 3 categories, or strata. The sample precision based on Ex-Post gross annual energy savings (kWh) was ±26.2%.

A.5.1.3. Baseline Assumptions Review

The Evaluator utilized DEER workpaper baseline assumptions (idle energy rates, production capacities, cooking efficiencies, etc.) for all measures. Workpaper approval dates were cross-checked with the FY 20/21 start dates in order to ensure the appropriate DEER workpaper was used.

A.5.1.4. M&V Approach

A combination of project desk reviews, virtual site visits, and in person site visits were utilized to estimate sample savings. Available documentation (invoices, applications, cut sheets, etc.) was reviewed for a sample of projects, with attention given to the model numbers and unit parameters. Due to ongoing COVID-19 health and safety concerns, customers were given the option for a virtual site visit in lieu of on-site visits to collect data for energy savings calculations, to verify measure installation, and to determine measure operating parameters. For the 6 sampled sites, the Evaluator completed 2 virtual visits, 3 on site visits, and one desk review.

A.5.1.5. Data Collection Activities

Due to the COVID-19 pandemic, the data collection was performed virtually or in person for a sample of projects to obtain the information needed for calculating energy savings. Site contact interviews were conducted by means of phone call, in person, and/or video walk-through to verify installed equipment.

When projects were selected for the M&V sample, the Evaluator notified LADWP by providing the LADWP EM&V staff with a list of projects for which the Evaluator planned to schedule M&V activities. This list included the company name, the project ID, the site address or other premise identification, and the respective contact information for the customer representative the Evaluator intended to contact to schedule an appointment.

Typically, notification was provided at least one week prior to the Evaluator contacting customers to schedule M&V virtual or in person verifications. Upon request, the Evaluator coordinated its scheduling and M&V activities with an LADWP Service Representative.

Site visits consisted of several different approaches depending on the project type, facility type, location, and site contact. Virtual visits included one or more of the following.

- A video walk-through to verify installed measures were functioning; several different methods of video were used including Microsoft Teams, Apple's Facetime, and Streem.
- Email communication with a site contact asking specific questions pertaining to the project, and collecting any data or applicable trend data, along with requesting photos of the newly installed equipment.
- Verbal communication (if no video), to review project details and to collect additional information to support analysis through an interview.
- An in-person walk-through to verify installed measures were functioning and to collect photos on installed equipment; conducting an in-person interview with the site contact regarding project details and information to support analysis.

A.5.2. Impact Evaluation

Ex-Post kWh savings and peak kW reduction were estimated using the appropriate DEER workpapers. Important input parameters were determined based on information collected during site verification or available project documentation.

A.5.2.1. Engineering Review Procedures

Available documentation was reviewed for a sample of projects, with attention given to model numbers, ENERGY STAR rating, invoices, and unit specifications. Analysis of FSPC energy savings was performed using the Evaluator's custom-designed food service evaluation tool with system parameters (unit efficiencies, unite size/capacity, operating characteristics, etc.) based on information either collected in person, referenced in project documentation, or DEER workpapers and specification sheets.

A.5.2.2. Extrapolation of Results

Table A-29 compares Ex-Post energy impacts to Ex-Ante claimed savings from the tracking data. For FY 20/21, the program level Ex-Post energy savings realization rate was 103% when compared to tracking data Ex-Ante savings.

Table A-29 FSPC Stratum Savings Summary

Stratum	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
1	8,105	3,315	41%
2	47,072	80,590	171%
3	63,812	38,401	60%
Total	118,989	122,307	103%

The program level realization rate of 103% was a result of the sampled projects seen below in Table A-30. Project 2 and 5 realization rates were over 100% but their program level impact was offset by the other sampled project with less than 100% realization rates.

Table A-30 FSPC Sampled and Non-Sampled Savings Summary

Project	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Project 1	25,822	22,737	88%
Project 2	11,497	20,218	176%
Project 3	808	685	85%
Project 4	22,994	6,640	29%
Project 5	8,916	14,730	165%
Project 6	1,067	82	8%
Non-sampled Projects	47,885	57,215	119%
Total	118,989	122,307	103%

The Evaluator sample included 6 projects. The specific factors affecting the projects' realization rates were as follows.

- Project 1: The less than expected realization rate was driven by the kitchen hood DCV, convection oven, and hot food holding cabinet measures at this site.
    - Kitchen Hood DCV: Source of kitchen hood DVC Ex-Ante savings value was unknown, the Evaluator used the DEER workpaper savings values;
    - Convection Oven: The site visit found that only one oven is used at time of verification, therefore the oven quantity was reduced to one in the Ex-Post analysis; and
    - Hot Food Holding Cabinet: Ex-Post utilized purchased unit's specifications such as volume and idle energy rates in lieu of default DEER work paper values used in the Ex-Ante estimate. The Ex-Ante estimate used a volume of 25 cu. ft. and idle energy rate of 11.3 W/cu. ft. The Ex-Post calculation used values from the product specification sheet of 21.5 cu. ft. for volume and 19.16 W/cu. ft. for idle energy rate.

- Project 2: Ex-Post calculation utilized purchased unit's specifications such as volume, idle energy rates, cooking efficiencies, and production capacities in lieu of default DEER work paper values used in the Ex-Ante estimate. For example, the Ex-Ante estimate used an efficient case preheat energy of 1.50 kWh while the Ex-Post calculation used an as-found efficient case preheat energy of 0.63 kWh.
- Project 3: Differing reference savings values for refrigerator/freezer savings. Source of Ex-Ante savings value was unknown; the Evaluator used the DEER workpaper savings values.
- Project 4: The site visit found that only one oven is used at time of verification, the oven quantity was reduced to one in the Ex-Post savings calculation. Additionally, the site visit found significant less hours of use (5 per day) when compared to Ex-Ante values (12 per day).
- Project 5: The less than expected realization rate was driven by the kitchen hood DVC and refrigerator/freezer measures at this site.
    - Kitchen Hood DVC: Source of kitchen hood DVC Ex-Ante savings value was unknown; the Evaluator used the DEER workpaper savings values; and
    - Refrigerator/Freezer: The site visit found that the refrigerator was not ENERGY STAR certified.
- Project 6: The Ex-Post analysis used as-found annual hours of 780 for the hot food holding cabinet, as opposed to the Ex-Ante default value of 4380. In addition, it would appear that the Ex-Ante calculations used default values of 15 W/cu. ft. as the idle rate. The Evaluator used a value of 18.25 W/cu. ft. sourced from the unit cut sheets. Adjusting these values would yield a realization rate closer to 100%. Thus, it is plausible but not confirmed that there was also a clerical error during the application process.

The frequency and impact of the specific factors affecting realized savings listed above are illustrated in Figure A-25 and Figure A-26 below.

Figure A-25 FSPC Factors Affecting Gross Realized Savings

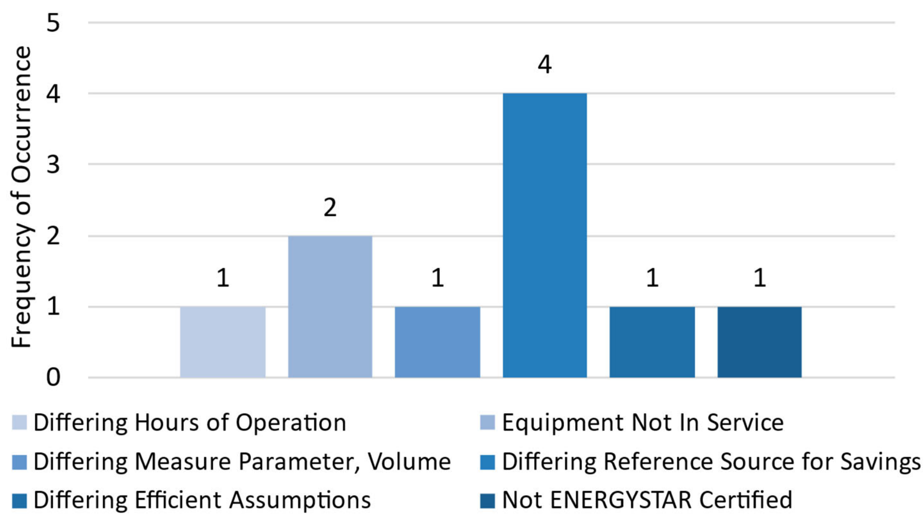


Figure A-26 FSPC Impact of Factor's Effecting Gross Realized Savings

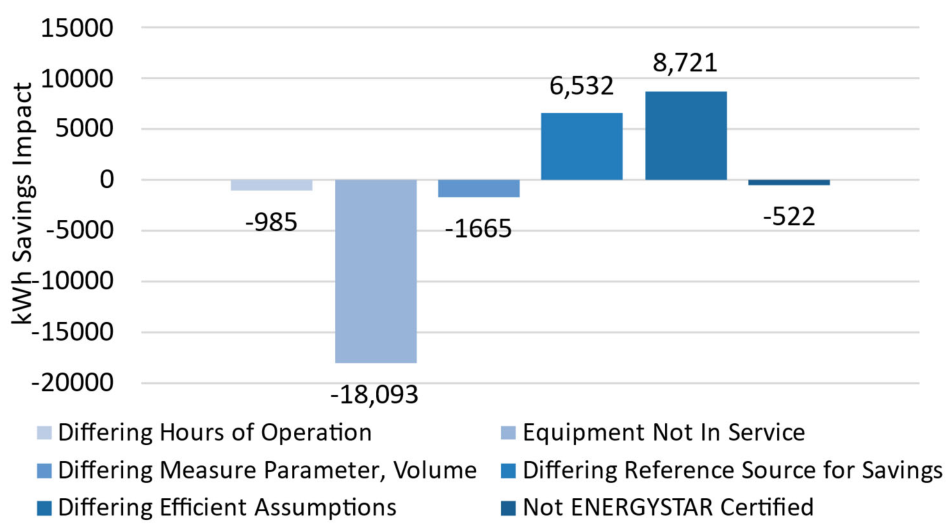


Table A-31 compares Ex-Post energy savings to Ex-Ante claimed savings from the tracking data at the measure level. For FY 20/21, the program level Ex-Post energy savings realization rate was 103% when compared to Ex-Ante savings.

Table A-31 FSPC Evaluation Savings by Measure Category

Measure	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Auto Closers - Walk-in	1,612	1,419	88%
Combination Oven	57,485	66,225	115%
Convection Oven	3,480	3,064	88%

Measure	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Hot Food Holding Cabinet	5,009	3,553	71%
Ice Machine	1,319	794	60%
Kitchen Hood DVC	37,773	36,227	96%
Refrigerator/Freezer	12,311	11,025	90%
Total	118,989	122,307	103%

A.5.3. Process Evaluation

The process evaluation for the Food Service Comprehensive and Point of Sale are combined and reported in section A.6.3.

A.6. FSP - POS

This chapter details the impact evaluation and process evaluation for the Food Service Program – Point of Sale (FSP POS) that LADWP offered customers during FY 20/21. The primary objective of this evaluation was to estimate energy and peak demand impacts attributable to the FSP POS, as well as to complete a process evaluation.

A.6.1. Evaluation Methodology

This section presents the findings of the tracking data review and the methodology used to calculate verified Ex-Post energy savings and peak demand reduction for the program. As part of the impact evaluation, the Evaluator performed the following data collection activities outlined in Table A-32.

Table A-32 FSP POS Data Sources for Impact Evaluation

Data	Source
Program Tracking Data	Data requested to LADWP for all data tracking program participation
Desk Review	Reviews of project documentation of a sample of customers who have participated in the program
On Site Verification	Site visits of a sample of customers to collect data for savings calculation, to verify installation, and determine operating parameters

A.6.1.1. Tracking Data Review

Program tracking data for measures incentivized between July 2020 and June 2021 was provided by LADWP. The data was reviewed for duplicate entries and errors. Additionally, the database was reviewed to ensure that the data provided sufficient information to calculate energy and peak demand impacts.

A.6.1.2. M&V Sample Design

A sample design was developed for site level analysis utilizing the tracking data provided. The Evaluator selected a stratified random sample of projects (known as ratio estimation) to represent the population of the program. The FY 20/21 sample projects are enough to estimate the total achieved savings with ±33.5% precision at a 90% confidence interval. The Evaluator's current sample (FY 20/21) and future samples (FY 21/22, FY 22/23) will in total be enough to estimate the total achieved savings with ±10% precision at a 90% confidence interval.

Projects were categorized to each stratum by Ex-Ante kWh savings. The boundaries of each stratum were developed to ensure the extrapolation of impacts is appropriately distributed. Realization rates (the ratio of Ex-Post kWh savings to Ex-Ante kWh savings) for projects sampled in each stratum were only extrapolated to other projects within that stratum. Table A-33 presents the number of projects and tracking Ex-Ante kWh savings for the sampled projects by stratum.

Table A-33 FSP POS Population Statistics used for Sample Design

	Stratum 1	Stratum 2	Stratum 3	Totals
Strata Boundaries (kWh)	<935	935 – 1,068	>1,068	
Population Size	71	15	6	92
Total Ex-Ante kWh Savings	29,210	23,418	43,177	95,805
Average Ex-Ante kWh Savings	411	1,561	7,196	
Standard deviation of Ex-Ante kWh Savings	177	549	6,116	
Coefficient of Variation	0.43	0.35	0.85	
Final Design Sample	2	2	4	8

The resulting sample of 8 projects consisted of 3 categories, or strata. The Ex-Post gross annual energy savings (kWh) precision was ±33.5%.

A.6.1.3. Baseline Assumptions Review

ADM utilized DEER workpaper baseline assumptions (idle energy rates, production capacities, cooking efficiencies, etc.) for all measures. Workpaper approval dates were cross-checked with the FY 20/21 start dates in order to ensure the appropriate DEER workpaper was used.

A.6.1.4. M&V Approach

A combination of project desk reviews and in person site visits were utilized to estimate sample savings. Available documentation (invoices, applications, cut sheets, etc.) was reviewed for a sample of projects, with attention given to the model numbers and unit parameters. In person on-site visits were performed to collect data for savings calculation, to verify measure installation, and to determine measure operating parameters. Of the 8 sampled sites, the Evaluator completed 5 on site verification visits and 3 desk reviews.

A.6.1.5. Data Collection Activities

Data collection was conducted in person for a sample of projects to provide the information needed for estimating savings. Interviews with site contacts by means of in person walk-throughs were used for project verification.

When projects were selected for the M&V sample, the Evaluator notified LADWP by providing the LADWP EM&V staff with a list of projects for which the Evaluator planned to schedule M&V activities. This list included the company name, the project ID, the site address or other premise identification, and the respective contact information for the customer representative the Evaluator intended to contact to schedule an appointment.

Typically, notification was provided at least one week prior to the Evaluator contacting customers to schedule M&V virtual verifications. Upon request, the Evaluator coordinated its scheduling and M&V activities with an LADWP Service Representative.

Site visits consisted of in person walk-throughs to verify installed measures were functioning and to collect photos of installed equipment. In person interview were performed with site contacts to discuss project details and to collect information to support the impact analysis.

A.6.2. Impact Evaluation

Ex-Post kWh savings and peak kW reduction were calculated using the appropriate DEER workpapers. Important input parameters were determined based on information collected during site visit verification or available project documentation.

A.6.2.1. Engineering Review Procedures

Available documentation was reviewed for a sample of projects, with attention given to model numbers, ENERGY STAR rating, invoices, and unit specifications. Analysis of FSP POS savings was accomplished using the Evaluator's custom-designed food service evaluation tool with system parameters (unit efficiencies, unite size/capacity, operating characteristics, etc.) based on information either collected in person, referenced in project documentation or DEER workpapers, and specification sheets.

A.6.2.2. Extrapolation of Results

Table A-34 compares Ex-Post energy impacts to Ex-Ante claimed savings from the tracking data. For FY 20/21, the program level Ex-Post energy savings realization rate was 56% when comparing to tracking data Ex-Ante savings.

Table A-34 FSP POS Stratum Savings Summary

Stratum	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
1	29,210	26,234	90%
2	23,418	10,521	45%
3	43,177	17,196	40%
Total	95,805	53,952	56%

The program level realization rate of 56% was a result of the sampled projects as shown below in Table A-35. Project 1 and 7 realization rates were over 100% but their program level impact was offset by the other sampled project with less than 100% realization rates.

Table A-35 FSP POS Sampled and Non-Sampled Savings Summary

Project	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Project 1	9,361	10,689	114%
Project 2	3,357	0	0%
Project 3	3,203	2,342	73%
Project 4	18,722	766	4%
Project 5	2,135	0	0%
Project 6	931	856	92%
Project 7	1,068	1,439	135%
Project 8	259	213	82%
Non-sampled Projects	56,769	37,647	66%
Total	95,805	53,952	56%

The Evaluator sample included 8 projects. The specific factors affecting the projects realization rates were as follows.

- Project 1: The Evaluator's site visit found the steamer is operated 362 days per year. The Ex-Ante used a value of 310 days per year.
- Project 2: Equipment not in service during Evaluator's site visit. The Evaluator was unable to evaluate savings and deemed the project to have zero savings since the unit was not found on-site and it could not be determined that the item was installed in LADWP territory.
- Project 3: Ex-Post calculation utilized purchased hot food holding cabinet volume in lieu of default DEER work paper values used in the Ex-Ante estimate. The Ex-Ante used a volume of 25 cu. ft. The Ex-Post used volume value from the product specification sheet of 18 cu. ft.
- Project 4: The Evaluator's site visit found significant less hours of use (4.5 per week) when compared to Ex-Ante values (64.75 per week).
- Project 5: Equipment not in service during Evaluator's site visit. The Evaluator was unable to evaluate savings and deemed the project to have zero savings since the unit was not found on-site and it could not be determined that the item was installed in LADWP territory.
- Project 6: Differing reference savings values for refrigerator/freezer savings. Source of Ex-Ante savings value unknown, the Evaluator used the DEER workpaper savings values.
- Project 7: Ex-Post calculation utilized purchased hot food holding cabinet specifications in lieu of default DEER work paper values used in the Ex-Ante. For example, the Ex-Ante used an efficient case idle energy rate of 12 W/cu. ft. while the Ex-Post used an as found efficient case idle energy rate of 0.67 W/cu. ft.

- Project 8: Differing reference savings values for refrigerator/freezer savings. Source of Ex-Ante savings value unknown, the Evaluator used the DEER workpaper savings values.

The frequency and impact of the specific factors affecting realized savings listed above are illustrated in Figure A-27 and Figure A-28 below.

Figure A-27 FSP-POS Factors Affecting Gross Realized Savings

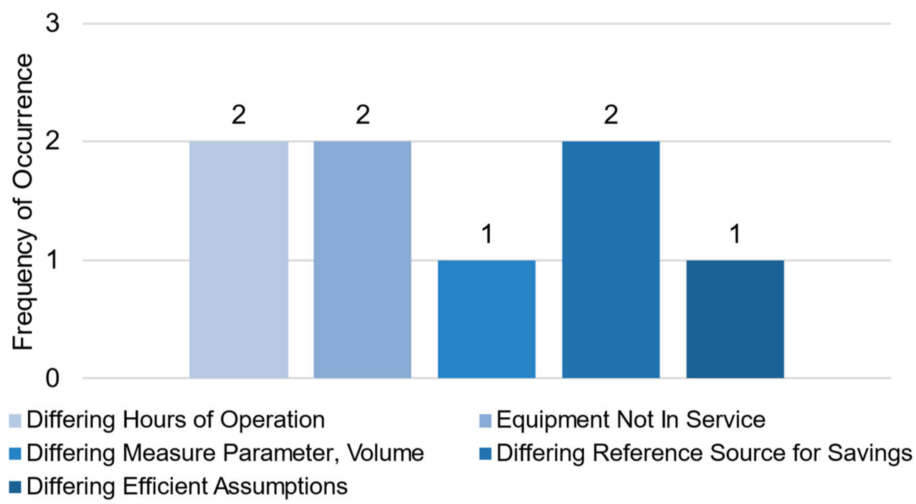


Figure A-28 FSP-POS Impact of Factor's Effecting Gross Realized Savings

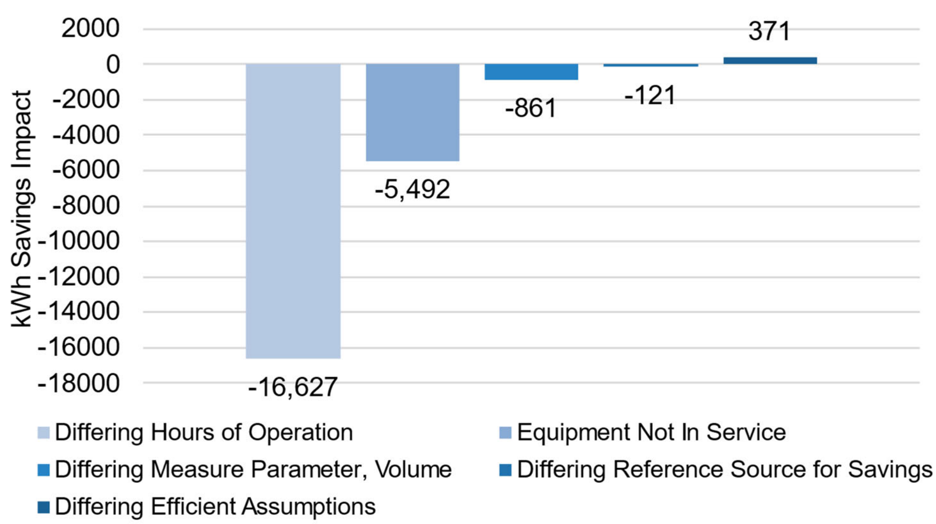


Table A-36 compares Ex-Post energy impacts to Ex-Ante claimed savings from the tracking data at the measure level. For FY 20/21, the program level Ex-Post energy savings realization rate was 56% when compared to Ex-Ante savings.

Table A-36 FSP POS Measure Summary Savings

Measure	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Convection Oven	8,393	2,091	25%
Hot Food Holding Cabinet	20,285	10,017	49%
Ice Machine	3,007	2,701	90%
Refrigerator/Freezer	36,038	27,688	77%
Steamers	28,082	11,455	41%
Total	95,805	53,952	56%

A.6.3. Process Evaluation

This section presents the process evaluation for the Food Service Program Comprehensive (FSPC) and Point-of-Sale (FSP POS).

A.6.3.1. Process Evaluation Approach and Methodology

The following sections describe the evaluation approach and methodology used to perform the FSPC and FSP POS process evaluation.

A.6.3.1.1. Document Review

The Evaluator reviewed all available program documentation for the Comprehensive and POS programs, including outreach and marketing materials, point-of-sale materials, process flow charts, application forms, organization charts, and process and operations manuals. The Evaluator reviewed this information to understand how the program engages with the food service market, what the intended touch points are for customers and qualified dealers, program processes, and intended outcomes. This information was used, along with findings from staff interviews, in construction of participant survey and dealer interviews data collection instruments and provided context for findings by these research activities.

A.6.3.1.2. Staff Interviews

The Evaluator completed two 60-minute phone interviews: one with LADWP program staff, covering both the Comprehensive and POS program, and one with Energy Solutions, covering just the FSP POS. Interviews were designed to provide detail on program design and procedures, assess current progress, and identify critical research questions to be included in the program evaluation. Interviews covered topics including program design changes, partnerships with SoCalGas and other stakeholders, program progress to goals, impacts of the COVID-19 pandemic, marketing and outreach strategy, target audience, relationships with qualified dealers, program processes, risks to performance looking forward, and evaluation needs. This information was used, along with findings from the document review, in construction of participant survey and qualified dealer interviews data collection instruments and provided context for findings by these research activities.

A.6.3.1.3. Qualified Dealer Interviews

The Evaluator conducted 30-45 minute interviews with qualified dealers participating in the POS FSP. While interviews were fielded to POS qualified dealers, many dealers serve customers participating in both programs, and therefore interview guides also included questions about the Comprehensive program. Interviews were designed to collect information on markets served by dealers, how FSP can better target and support the food service industry, impacts of the COVID-19 pandemic on the industry, effectiveness of FSP rebates and services in encouraging the adoption of energy efficient equipment, and whether the program can be modified to improve the net effects.

The Evaluator received contact information for 12 dealers, nine of whom submitted claims to the program in 2021. The Evaluator reached out to the nine participating dealers up to three times via phone and email to invite them to share their experience. The Evaluator fielded interviews from August 9, 2021, to August 19, 2021. Dealers received a $50 e-gift card to compensate them for the time spent completing the interview.

The Evaluator completed interviews with six dealers, three of whom participated in both the Comprehensive and POS FSP and three who participated in the POS FSP only.

A.6.3.1.4. Participant Survey

The Evaluator administered a 15-minute phone and web-based survey to FY 20/21 participants in the Comprehensive and POS Food Service programs. Surveys collected information on customer awareness, motivations, barriers, and satisfaction with the program, as well as to understand policies, processes, and decision making related to the installation of efficient equipment.

There were a total of 110 unique participants in FSP from FY 20/21, 18 of which participated in Comprehensive and 92 of who participated in POS. The Evaluator received a total of 94 unique phone numbers. The Evaluator distributed letters to customers explaining the purpose of the survey and letting customers know that the evaluation team would be contacting them and providing a link to the survey so that participants could choose to take the survey at their convenience. The letters were identified as from LADWP and printed on LADWP letter head and included a link to an LADWP website explaining the purpose of the EM&V surveys and an email address to contact LADWP with any questions. Contact information for ADM was also included in the letter.

Subsequent to the mailing of the letters, the Evaluator fielded the survey from September 1, 2021 to September 21, 2021. Each participant was contacted up to three times by telephone. Ultimately, only one participant completed the survey, resulting in a less than 1% response rate. Due to the low response, the evaluation team did not include survey results in this year’s evaluation. The Evaluator will field the survey again in FY21-22 to attempt to attain more participant responses.

A.6.3.1.5. Tracking Data Review

The Evaluator reviewed tracking data to characterize participation, costs, savings, and participant characteristics. The Evaluator also reviewed the database for insights into dealer engagement and opportunities for further engagement.

A.6.3.1.6. CEUS Data Supplement

The Evaluator augmented data collection performed as part of the statewide California End-Use Study (CEUS) at 110 LADWP sites. Table A-37 summarizes the number of sites for the three building types that additional data was collected from.

Table A-37 FSP Equipment Sample Sites

Building Type	Sample Site Count
Liquor/Convenience store	29
Grocery	38
Restaurant	43

Data was collected on the following food service equipment types:

- Cooking equipment;
- Refrigeration equipment;
- Freezers;
- Ice maker;
- Dishwasher;
- Hand wrap machines; and
- Demand control ventilation.[19]

Due to COVID-19 restrictions, data was primarily collected via telephone surveys. Data was collected on the presence of various equipment types and if the equipment was energy efficient (e.g., ENERGY STAR rated).

A.6.3.2. Process Evaluation Findings

Based on the interviews and document and tracking data review, the evaluation team developed the following findings related to the research questions.

A.6.3.2.1. Overview of Program Processes

The food service program has documented procedures for submitting and reviewing applications through both Comprehensive and POS programs.

Comprehensive Program

The main steps in comprehensive program are to:

- Application submission: Applicant submits an application online or by email and invoice documentation.
- Application review: Program manager validates that the customer name, address, and measures are eligible.

[19] The demand control ventilation measure was removed from the program.

- Past submission check: Application is reviewed to see if another has been previously submitted.
- Payment request is submitted: Payment issued pending approval.
- Request for field verification: Five percent of rebates are selected for field verification.

FSP POS

Participating dealers submit program applications through an online portal. The applications are submitted for customers purchases of the qualifying equipment. An application submittal requires submission of:

- Information on the customer, including business name on the account, location, and contact name and phone number.
- Equipment manufacturer and model.
- Customer signature.

Pre-approval is required for sales claiming an incentive of over $3,000.

LADWP reviews submissions made by Energy Solutions for payments to verify that all submissions contain the following:

- POS Master spreadsheet
- Customer Participation Agreement for each incentive paid
- Copies of dealer checks
- Energy Solutions cover sheet
- Energy Solutions invoice to SCPPA
- Monthly POS Food Service Report

The program staff verify that incentives were paid to LADWP Customers, that the incentive amount is correct, and that the supporting documentation is correct.

The review of each packet of submissions is guided by a review checklist.

Overall, the program application and review processes are well documented and thorough. However, while the comprehensive program has a check point to determine if a rebate has been previously claimed for submitted equipment, the Evaluator did not find documentation of a similar check for payment across the POS and Comprehensive programs. That is the POS process does not appear to include a check to determine if a downstream rebate was paid through the Comprehensive Program.

Additionally, as discussed in section A.6.3.1.2, findings from interviews with market actors and program staff indicated that two challenges with the process are obtaining the customer signature and validating the end-user is an LADWP customer.

The Food Services Comprehensive and POS Program uses partially deemed savings values from the DEER workpapers to estimate the savings of the program measures. The primary sources of discrepancy with the Ex-Post savings results were due to differences between the assumed values from the DEER workpapers and the site- and equipment-specific values utilized in the Ex-Post savings analysis. Nevertheless, the Evaluator recommends continuing to use the partially deemed savings approach because a more custom approach would 1) increase the burden on program applicants to provide additional detail on operating conditions and equipment specifications in the application form and 2) increase costs of processing program applications necessary to perform more custom calculations. However, we note that the product qualifying list is model specific. LADWP may want to explore revising the application form to capture the model specific information and utilize the equipment specifications in the application.

The Evaluator failed to verify the rebated equipment for two of the eight sampled projects in the FSP POS. We recommend incorporating a verification protocol into the FSP POS. The verification protocol should be structured by participating dealer. An example of such a protocol would be to verify the first five sales made by a distributor and performing verification of 5% of sales made after that. Failed verifications should prevent payment of the program rebate and multiple failures should lead to removal from the program.

A.6.3.2.2. Program Performance

Overall, FSP did not meet its savings goals in FY 20/21. Program staff attributed FSP performance to the challenging nature of reaching the food service market and to the significant impact of the COVID-19 pandemic on the food service industry. In a typical year, FSP faces difficulties reaching its goals, due to the high cost of food service equipment and the robust used equipment market for this sector. The pressures of the pandemic exacerbated these challenges by putting financial strain on food services customers and leading many to shift operating models, as detailed in section 6.2.1.1.1 below.

Despite these challenges, program staff indicated that FSP plays an important role in LADWP's overall portfolio. The program allows LADWP to reach the food service market, which is a large segment in LADWP's service territory, offering rebates on purchases of specialized equipment not covered by other programs. Program staff and the implementer were optimistic about the outlook of the program, indicating they believed the current budget was sufficient to meet goals and that program efficacy and efficiency would improve over time. Dealers in both the Comprehensive and POS programs had positive feedback on the program overall, with most indicating that the rebates are helpful in encouraging customers to purchase energy efficient equipment. LADWP, the implementer, and dealers noted a few challenges with the rebate paperwork process.

A.6.3.2.3. Pandemic impacts

The pandemic exacerbated challenges reaching the food service market in FY 20/21. Specifically, the pandemic limited demand for new food service equipment due to:

- General economic slowdown among food service businesses' due to pandemic-related closures and supply chain disruptions, and reduced demand for equipment
- Restaurants shifting to take-out dining models, leading to the use of smaller equipment without energy efficient models, such as toasters, panini presses, and griddles

- Larger institutions that have food service operations, such as schools and hotels, initially shutting down entirely and experiencing reduced demand for the remainder of 2020, continuing into 2021

The program implementer noted that the FSP POS was particularly impacted by 2020 shutdowns, as the program had started in mid-2019 and lost significant momentum due to the pandemic. The implementer noted that project volume through the FSP POS began to increase again starting in 2021.

Participating FSP POS dealers, some of whom also work with the Comprehensive program, said that the pandemic affected their customers in different ways. Dealers who work with many smaller independent businesses saw a slowdown in equipment sales, while others, such as a dealer that has large grocery businesses that specialize in delivery, saw no reduction in demand for equipment. One dealer saw a considerable increase in sales due to them adding a new product line of fryers (which was well received by customers), an increase in Comprehensive program rebate amounts, and the availability of small business grants through COVID stimulus programs.

When asked about the outlook for food service equipment sales, most dealers thought demand would continue to increase above 2020 levels, but that supply chain difficulties would persist over the near term. Supply chain challenges for food service equipment are causing prices to rise and delaying project timelines, which can pose a challenge for restaurants looking to reopen quickly. One dealer observed: “The supply is horrendous, and the lead time is outrageous.” However, some are optimistic. One said, “Our territory is looking good despite COVID, supply issue and labor shortage.” Another said they “expect 2022 to be a very good year.”

A.6.3.2.4. Participant Characteristics

The food service program plays a valuable role in helping LADWP serve businesses who may not be reached through LADWP’s other commercial offerings. According to program staff, the Comprehensive and POS programs help LADWP reach two distinct segments of the food service market: the comprehensive program appeals to mid-size to large customers who prefer to purchase equipment in bulk and submit applications online, while the FSP POS appeals to smaller customers who tend to be more cash constrained and prefer to receive the rebate upfront. Larger customers participating in the Comprehensive program can receive application support from LADWP account representatives, while smaller customers participating in the FSP POS receive assistance from equipment dealers.

LADWP notes that the current program faces some challenges in reaching customers who do not operate out of brick-and-mortar storefronts, including food trucks, pop-up businesses, and kitchens shared by multiple restaurants. This is due to a requirement that the rebate must go to the business associated with the utility account. The program also faces challenges in reaching quick dining establishments due to lack of energy efficient models for smaller equipment.

FSP does not currently track metrics to assess what business or customer types are being reached through the Comprehensive or POS programs. The tracking data currently includes a building type field but is populated for only 3% of projects.

A.6.3.2.5. Qualified Dealer Characteristics

Participating dealers are the primary mechanism for cost-effectively administering the FSP POS to LADWP's customer base. Overall, the FSP POS is designed to work with equipment dealers serving LADWP's service territory to provide an additional incentive for dealers to promote the program, while also offering customers the opportunity to get a line-item discount.

According to the implementer, the program's design most appeals to cash-and-carry wholesale dealers, while national chains and online sellers may be more difficult to reach due to the size of LADWP's market and the effort required to participate. The FSP POS implementer indicated that recruiting and enrolling new dealers in the FSP POS was running smoothly overall, due to dealers' existing familiarity with the statewide POS program. Additionally, efforts made by LADWP to better align their online FSP POS application system with the statewide POS application system have been positively received by dealers. The implementer noted that LADWP may be able to expand the number of participating dealers by further reducing the time required to verify projects and pay out rebates to dealers.

There were 12 participating dealers in the FSP POS in FY 20/21. Dealers varied on how active they were in the program as shown in Table A-38. The evaluation team interviewed 3 high volume dealers (submitted 5 or more claims) and 3 low volume dealers (submitted fewer than 5 claims).

Table A-38 FSP - Number of claims submitted by dealers in FY 20/21

Number of Claims Submitted	Number of Participating Dealers	Number of Dealers Interviewed
No claims submitted	3	1
1-4 claims submitted	6	2
5-10 claims submitted	1	1
10-25 claims submitted	1	1
Over 25 claims submitted	1	1
Total	12	6

Dealers served a wide variety of food service operations from smaller independent restaurants to very large national chain stores. Almost all listed schools as customers, and one also listed other large institutional customers as well such as government agencies, hospitals, and jails. Some dealers were also looking to expand the breadth of customers that they reached through the FSP. These dealers were specifically interested in reaching more large customers including schools, institutions such as hospitals and prisons, convenience and grocery stores, and other chains. The dealers expressing this interest engaged in both the Comprehensive and POS programs.

A.6.3.2.6. Equipment & Service Rebates

Dealers generally found the equipment rebates to be helpful in selling efficient equipment, although some would like electric equipment rebate amounts to be higher. Additionally, dealers noted some differences in how rebates impacted customer decision-making, which varied based on customer type.

Four of the five responding dealers who dealt directly with sales said they sold more of the energy efficient models because the rebates were available. Not all dealers stocked equipment, but of those who did, two indicated that they had increased stock of certain items due to the rebate. Several dealers also indicated they upsell customers to more-efficient models using the rebates to make their price comparable to the less efficient models. One dealer noted that they used to have to spend lots of time educating customers about paybacks on equipment, but now the rebates sometimes make the efficient equipment cheaper than the inefficient models.

Dealers directly testified to the effectiveness of the rebates in buying decisions, with one dealer saying, “[The rebates] are a pretty big deal. I have a long-time brand-loyal customer who switched brands due to the rebates.” Another dealer noted, “People come in looking to buy, energy savings and incentive are too good to pass up.”

Although dealers mostly agreed on the rebates’ effectiveness, they also noted some differences in customer types’ buying decision-making and the associated impact of rebates:

- Chain stores tend to prefer brands/models they have previously used and value consistency across locations. Also, they often purchase directly from the manufacturers and therefore may not be aware of the program.
- Very large chains tend to not know or care about rebates due to the size of their market relative to the size of LADWP’s program
- Smaller independent restaurants tend to be focused primarily on price (rather than efficiency), so availability of rebates could be influential in their buying decisions.
- Schools can be difficult to reach through the program based on their budgeting process. Dealers noted that schools often base their budgets on previous year planning, and therefore may be reluctant to receive rebates that weren’t included in the budgeting process because if they don’t spend their entire budget, they may lose funding in a future year. However, schools may also be reluctant to include rebates in the budgeting process because variations in rebate amounts by location or over time may be difficult to explain to school boards.

LADWP staff noted another limitation to current program offerings: FSP does not currently offer rebates for equipment maintenance. However, for many food service equipment items, maintenance can impact the energy use, costs, and the useful lifetime of the equipment. LADWP currently refers customers to the CA Energy Wise website for more information on equipment maintenance. The website also contains information on the statewide food service program, calculators, webinars, and resources for different types of food service businesses. LADWP could consider creating follow-up materials for FSP participants that could be shared with customers via mail, email or through dealers. These materials could remind customer of the importance of equipment maintenance and share the link to the CA Energy Wise website.

A.6.3.2.7. Marketing and Outreach

The materials provided by LADWP such as signs, stickers, and panels are welcomed by POS dealers and are perceived to be effective at steering shoppers toward more efficient equipment. All dealers with on-site sales staff said they use, or plan to use, these marketing materials. One dealer said they also use their own materials, and another said they use them on their social media site as well.

The influence of program marketing materials appears to be primarily on the showroom floor. According to dealers, most buyers are not thinking about efficiency, so the rebate on a more efficient item can be helpful influencing their buying decision.

When asked for suggestions on how LADWP might improve marketing and outreach efforts, dealers suggested that LADWP:

- Promote the program to the end users so they start asking dealers about rebates and so dealers do not have the sole responsibility of educating customers
- Promote a list of participating dealers to customers in program mail or email communications. This information is included on LADWP's website but may be difficult for customers to locate.
- Provide more "big-picture" information on the program such as what the program is trying to achieve and what LADWP gains from giving customers money to purchase efficient equipment. One dealer indicated that suspicion about the utility's motives in promoting efficient equipment may prevent some customers from participating.

A.6.3.2.8. Effectiveness of Program Processes

Table A-39 summarizes feedback from dealers participating in the FSP POS. Additional details on the feedback is provided below.

Table A-39 FSP - Summary of Dealer Feedback on Program Processes

Component	Key Findings
Dealer Enrollment	Most dealers thought the enrollment process was easy and painless.
Dealer Training	Most dealers attended the training and found the training to be valuable. One dealer did not attend the training because they did not need it.
Application Submissions	Program applications are submitted online, and Energy Solutions provides a video on how to use the system. Obtaining customer signatures is a pain point and may limit rebate submissions because of the difficulty in obtaining it. Verifying customers can be challenging because of lags in the currency of the data in the lookup tool.

Overall dealers were happy with both the Comprehensive and Point of Sale programs. Dealers particularly liked being able to offer POS rebates, noting that customers really appreciated them. As one dealer described, not having to complete rebate paperwork is “one less thing for (the customer) to have to do.” Another said the “best thing for the customer is they have no need to feel the program, they do not need to take any steps to get their rebates. As long as we do the instant rebate, they love it.”

Likewise, dealers offered positive feedback on other aspects of the program, including the enrollment process and the sales and administrative trainings. Regarding the enrollment process, most dealers said signing up for the program was “very easy,” “no problem” or “painless.” One said it was “time-consuming” but had no suggestions for improvement.

Regarding the training, five of the six respondents said they use the trainings, and the sixth said they had no need because they have no sales associates. All dealers who used the trainings found it valuable, especially when they have new hires. One respondent said the training process was well-done overall and that they valued the program staff’s responsiveness to questions. Another dealer said the trainings prompted sales staff to seek out more information on the program and rebates by following up with the implementer to ask questions. None of the dealers had suggestions for improvements, though some said they preferred the in-person training over the remote training implemented during the pandemic. The program implementer also felt in-person trainings were more effective and planned to resume them when it was safe to do so.

All dealers highlighted program paperwork as a key pain point in the overall participation process. In particular, dealers struggled to collect customer signatures, which is required to complete different application forms for both the POS and comprehensive programs. Securing a customer signature can be challenging for dealers, particularly when not interacting with customers in-person. One dealer cited these forms as the reason many eligible projects do not go through the program, estimating that over 100 projects from the Comprehensive and POS programs had not been submitted. Dealers pointed to other programs such as SoCalGas that have a more streamlined process as models LADWP should emulate. For example, dealers noted that they could use zip code to verify eligibility through the SoCalGas program and that they did not need to collect a customer signature.

LADWP program staff are aware of this challenge and have made efforts to streamline application forms but noted they are required to collect information (including the form requiring the customer signature) not required by investor-owned utilities due to their status as a public entity. FSP allows dealers to submit signatures digitally, including allowing e-signatures, pictures of the signed form taken with a mobile phone, scanned, and emailed forms. However, the implementer noted that dealers and their customers are not always tech-savvy enough to take advantage of these options and that the additional stressors of the pandemic made it more difficult to motivate customers to turn their forms in.

One dealer noted an additional challenge to confirming customer eligibility: they often needed to contact a program representative to verify whether a customer was eligible for the program and that they would prefer a way to do this that doesn’t require a phone call to a program representative. According to the implementer, there is a look-up tool dealers can use to determine whether a customer is in their service territory. However, LADWP's tool is different than the tool dealers use for the statewide program, which allows dealers to verify customer eligibility using zip code, and sometimes it can be challenging for dealers to find the correct address within the database. The implementer also noted that sometimes newer customers do not show up in the database for several months, which can make verifying customer eligibility challenging, especially in the food service industry where properties tend to change ownership more frequently. For upstream FSP programs in other regions of the country, the implementer has addressed this challenge by securing access to the utility customer database. The implementer then integrates the database into their online application form, allowing the dealer to use a single portal to verify the customer address. LADWP could consider this option if looking for ways to streamline the dealer participation experience.

Dealers' thoughts on needs for the future were shaped by their experiences with the pandemic. Many were dealing with supply chain issues and saw that as the primary constraint on increasing program activity. When asked broadly about how to improve the food service program overall, dealers also offered the following suggestions:

- Including more efficient countertop appliances for rebates;
- Targeting equipment like walk-in coolers that are on all day; and
- Getting testimonials from participating dealers to help the program recruit more smaller dealers and assure them of timely payment through the program.

A.6.3.2.9. Program Approach to Estimating Savings

The Food Services Comprehensive and POS Program uses partially deemed savings values from the DEER workpapers to estimate the savings of the program measures. The primary sources of discrepancy with the Ex-Post savings results were due to differences between the assumed values from the DEER workpapers and the site- and equipment-specific values utilized in the Ex-Post savings analysis. Nevertheless, the Evaluator recommends continuing to use the partially deemed savings approach because a more custom approach would 1) increase the burden on program applicants to provide additional detail on operating conditions and equipment specifications in the application form and 2) increase costs of processing program applications necessary to perform more custom calculations. However, we note that the product qualifying list is model specific. LADWP may want to explore revising the application form to capture the model specific information and utilize the equipment specifications in the application.

The Evaluator failed to verify the rebated equipment for two of the eight sampled projects in the FSP POS. We recommend incorporating a verification protocol into the FSP POS. The verification protocol should be structured by participating dealer. An example of such a protocol would be to verify the first five sales made by a distributor and performing verification of 5% of sales made after that. Failed verifications should prevent payment of the program rebate and multiple failures should lead to removal from the program.

A.6.3.2.10. Food Service Equipment Saturations

The main findings from the data collected on food service equipment saturations are summarized below, followed by presentation of detailed tables.

- **The share of food service equipment that is ENERGY STAR certified is relatively small.** Across various types of cooking equipment, refrigerators, freezers, ice makers, and dishwashes, the shares of equipment that are ENERGY STAR rated are low, typically less than 15% of the equipment. The finding suggests there continues to be an opportunity to provide incentives to increase sales of ENERGY STAR models. This finding also aligns with the relatively low estimate of free ridership developed from interviews with market actors (13.8%).
- **Continuous ice makers were less common than cube ice makers and more likely to be ENERGY STAR certified.** Cubed ice makers were present in five times as many groceries, eight times as many restaurants, and three times as many liquor/convenience stores as continuous ice makers. None of the cubed ice makers were ENERGY STAR certified in groceries and liquor/convenience stores, and 10% of those in restaurants were ENERGY STAR. In comparison, about a third of continuous ice makers in restaurants and liquor/convenience stores were ENERGY STAR.
- **Hand wrap machines were common in grocery buildings.** No hand wrap machines were present in restaurants or liquor/convenience stores, but they were common in groceries (82% reported them). The presence of hand wrap machines with on-demand heating elements was commonly reported (91% of machines) but may have been over estimated as respondents may be unfamiliar with the technology.
- **Kitchen ventilation equipment was common in restaurants and groceries.** Ninety-one percent of restaurants and 82% of groceries reported they had ventilation equipment. Demand control ventilation was present in 21% of restaurants and 68% of groceries with the equipment present.

Cooking Equipment, Refrigerators, Freezers, Ice Makers, and Dishwashers

Table A-40 through Table A-42 summarize information on the presence of cooking equipment, refrigerators, freezers, ice makers, and dishwashers. The tables present the following information:

- **Number of buildings with equipment present.** This is the total number of buildings in the sample with the equipment present, regardless of if that equipment was ENERGY STAR certified.
- **Percent of buildings with equipment.** This is the percent of the buildings in the sample with the equipment present, regardless of if that equipment was ENERGY STAR certified.
- **Average number of units present.** This is the average number of units in the equipment that is present in the buildings, regardless of if that equipment was ENERGY STAR certified.
- **Percent ENERGY STAR.** This is the percent of units installed in the sample that are ENERGY STAR certified.

Table A-40 FSP - Cooking Equipment, Refrigerators/Freezers/Ice Makers, and Dishwasher Saturations (Grocery)

Equipment Group	Equipment Type	Number of Buildings with Equipment	Percent of Buildings with Equipment	Average Number of Units Present	Percent ENERGY STAR
Cooking	Boiler	0	0%	-	-
	Food warmer	28	74%	2.8	0%
	Fryer	30	79%	2.7	2%
	Griddle	25	66%	1.7	7%
	Oven	32	84%	3.7	9%
	Steamer	3	8%	1.3	0%
Refrigerators	Countertop	20	53%	3.2	0%
	Deli Case	36	95%	8.5	0%
	Glass reach-in	38	100%	8.6	3%
	Glass walk-in	28	74%	3.9	0%
	Solid reach-in	26	68%	1.5	0%
	Solid walk-in	10	26%	2.7	0%
	Undercounter	1	3%	1.0	0%
	Worktop	24	63%	1.4	0%
Freezers	Blast	2	5%	1.0	0%
	Chest	30	79%	2.5	5%
	Glass reach-in	31	82%	5.0	1%
	Glass walk-in	26	68%	2.0	0%
	Solid reach-in	15	39%	2.4	0%
	Solid walk-in	8	21%	1.5	0%
	Undercounter	0	0%	-	-
	Worktop	13	34%	2.5	0%
Ice makers	Continuous	9	24%	3.7	6%
	Cube	29	76%	1.4	0%
Dishwashers	Dishwasher	3	8%	1.0	0%

Table A-41 FSP - Cooking Equipment, Refrigerators/Freezers/Ice Makers, and Dishwasher Saturations (Restaurant)

Equipment Group	Equipment Type	Number of Buildings with Equipment	Percent of Buildings with Equipment	Average Number of Units Present	Percent ENERGY STAR
Cooking	Boiler	11	26%	1.0	9%
	Food warmer	25	58%	2.5	0%
	Fryer	28	65%	2.1	14%
	Griddle	27	63%	1.4	11%
	Oven	36	84%	3.0	6%
	Steamer	5	12%	1.4	14%
Refrigerators	Countertop	5	12%	1.6	0%
	Deli Case	9	21%	1.0	11%
	Glass reach-in	28	65%	1.8	14%
	Glass walk-in	0	0%	-	-
	Solid reach-in	25	58%	2.1	13%
	Solid walk-in	38	88%	1.1	0%
	Undercounter	19	44%	3.1	12%
	Worktop	27	63%	1.2	0%
Freezers	Blast	0	0%	-	-
	Chest	4	9%	1.5	17%
	Glass reach-in	5	12%	1.2	17%
	Glass walk-in	0	0%	-	-
	Solid reach-in	32	74%	1.1	6%
	Solid walk-in	20	47%	1.1	0%
	Undercounter	1	2%	1.0	0%
	Worktop	2	5%	1.0	0%
Ice makers	Continuous	7	16%	1.1	38%
	Cube	36	84%	1.2	10%
Dishwashers	Dishwasher	23	53%	1.1	16%

Table A-42 FSP - Cooking Equipment, Refrigerators/Freezers/Ice Makers, and Dishwasher Saturations (Liquor /Convenience Store)

Equipment Group	Equipment Type	Number of Buildings with Equipment	Percent of Buildings with Equipment	Average Number of Units Present	Percent ENERGY STAR
Cooking	Boiler	0	0%	-	-
	Food warmer	11	38%	1.0	0%
	Fryer	0	0%	-	-
	Griddle	5	17%	1.0	0%
	Oven	12	41%	1.0	0%
	Steamer	0	0%	-	-
Refrigerators	Countertop	0	0%	-	-
	Deli Case	11	38%	1.3	7%
	Glass reach-in	25	86%	3.1	4%
	Glass walk-in	20	69%	1.0	0%
	Solid reach-in	2	7%	1.0	0%
	Solid walk-in	5	17%	1.0	0%
	Undercounter	0	0%	-	-
	Worktop	0	0%	-	-
Freezers	Blast	0	0%	-	-
	Chest	25	86%	1.4	0%
	Glass reach-in	23	79%	1.8	5%
	Glass walk-in	0	0%	-	-
	Solid reach-in	2	7%	1.5	0%
	Solid walk-in	1	3%	1.0	0%
	Undercounter	0	0%	-	-
	Worktop	0	0%	-	-
Ice makers	Continuous	3	10%	1.0	33%
	Cube	24	83%	1.0	0%
Dishwashers	Dishwasher	0	0%	-	-

Hand Wrap Machines

Groceries were the only building type with installed hand wrap machines. Table A-43 presents the share of buildings with hand warp machines, the average number of units in buildings with the machines, and the share of those machines with on-demand heat elements.

Table A-43 FSP - Hand Wrap Machines (Grocery)

Number of Buildings with Equipment	Percent of Buildings with Equipment	Average Number of Units Present	On-Demand Heat Elements Saturation
31	82%	2.1	91%

Note: The data presented in this table was collected by telephone and the presence of hand wrappers with on-demand heating elements may be inflated.

Kitchen Ventilation Equipment

Table A-44 presents the share of buildings with kitchen ventilation equipment and the share of equipment with demand control ventilation.

Table A-44 FSP - Kitchen Ventilation Equipment

Building Type	Number of Buildings with Equipment	Percent of Buildings with Equipment	Demand Control Ventilation Saturation
Restaurant	39	91%	21%
Grocery	31	82%	68%
Liquor / Convenience	2	7%	0%

A.6.4. Recommendations

- **Given the lasting impacts of the pandemic, particularly supply chain issues, consider targeted marketing to boost participation to achieve program goals.** Dealer feedback indicated that small, independent customers are most likely to be influenced POS rebates, while larger chain stores and institutional customers are more influenced by corporate policy, using consistent equipment across locations, and operating costs. Targeted marketing could both help direct customers to the program they are most likely to participate in (Comprehensive vs. POS) and include messaging that most appeals to each customer type. For example, while POS materials promoting upfront cost savings appear to be effective for the small and independent restaurants that tend to participate in that program offering, comprehensive marketing materials could emphasize how efficient equipment may help reduce operating costs, which may appeal to institutional customers with tight operating budgets. Collecting and leveraging dealer insight may also help LADWP identify and target customers with emerging market needs, such as restaurants or large institutional customers seeking to reopen following pandemic. Dealers can speak to the unique needs of customers within this segment. For example, dealers noted that warehouse operations favor refrigeration equipment with efficient recovery, due to the large number of staff entering and exiting these areas. For large brands, reliability, longevity, and support for maintenance and repairs may be more valuable. Dealers can provide ongoing and up-to-date information on the needs of these customer segments that can be incorporated into program marketing and outreach.

- **Seek ways to expand the number of dealers participating in the FSP POS, including collecting and sharing testimonials from participating dealers and reducing rebate payout times.** Feedback from the implementer and participating dealers indicated that these techniques may be effective in increasing the number of dealers participating in the overall FSP. Recruiting additional dealers to the program may help increase the projects submitted to the program, which may help FSP reach its annual savings goals.
- **Continue working to identify opportunities to address the signature requirement, which directly affects participation.** All dealers interviewed indicated this requirement was a key pain point in the participation process. One dealer indicated that a large number of projects were not submitted to the program due to this requirement.
- **Track metrics to assess the building types and organization size of businesses participating in the FSP.** Building type and organization size could be collected through the program application or a post-participation survey. This field is already included in the Comprehensive program application and could be included on the POS application as well. These metrics could help LADWP better understand customers served through the program and work to address any gaps and hard-to-reach customers.
- **Ensure contact name, contact email, and phone number is tracked for all participants in the FSP.** Currently phone contact information is tracked for 96% of participants and emails are tracked 17% of participants. Contact name is tracked for nearly all Comprehensive program participants but is largely complete for Point-of-Sale participants. Tracking more complete information will make it easier to reach customers to assess their experience with FSP and identify potential improvements.
- **Create materials to educate customers about why LADWP promotes energy efficiency.** One dealer indicated that suspicion about the utility's motives in promoting efficient equipment may prevent some customers from participating. Educational materials that raise customer awareness on the importance of energy efficiency and lend further credibility to LADWP's programs. This information could also be used by dealers to better field questions about the program from customers.
- **Consider creating follow-up materials on the importance of maintenance for continued efficient operation of equipment that could be shared with customers via mail, email or through dealers.** These materials could remind customers of the importance of equipment maintenance and share the link to the CA Energy Wise website. This may help improve the energy and bill savings customers realize through the program and their experience with their new food service equipment, leading to greater satisfaction with the Food Service Program and higher potential for repeat participation or recommending the program to others.
- **Results from the net savings analysis and data collected on equipment saturations support continuation of all incentives.** ENERGY STAR food

service equipment saturations were low and the estimate of free ridership from interviews with dealers support the continuation of incentives for all equipment types.

- **Consider adding a verification process to the program.** During the Ex-Post analysis of savings, the Evaluator failed to confirm the installation of the equipment for two projects.

A.7. LADWP Facilities Program

This section details the impact evaluation and process evaluation for the LADWP Facilities Program that LADWP offered customers during FY 20/21. The primary objective of this evaluation is to calculate energy savings and peak demand impacts attributable to the Program, as well as complete a process evaluation.

A.7.1. Evaluation Methodology

This section presents the findings of the tracking data review and the methodology used to calculate verified Ex-Post energy savings and peak demand reduction for the program.

A.7.1.1. Tracking Data Review

LADWP provided the Evaluator with the available program tracking data for measures installed as a part of LADWP Facilities Upgrades between July 01, 2020, and June 30, 2021. Review of the tracking data was performed to ensure that the provided data was sufficient to calculate energy savings and peak demand reduction, and to verify that projects listed were completed and had dates matching the fiscal year to which they were attributed.

A.7.1.2. M&V Sample Design

A total of three projects participated in the LADWP Facilities Program during FY 20/21. With this small population, there was no need for further sampling and therefore, all three sites were evaluated.

A.7.1.3. Baseline Assumptions Review

The projects completed under the LADWP Facilities program during FY 20/21 were found to consist of lighting measures only. Generally, for projects involving lighting measures, savings can be calculated as follows:

$$kWh_{Savings} = \frac{Watt_{Baseline} * HOU_{Baseline} * Qty_{Baseline} - Watt_{Installed} * HOU_{Installed} * Qty_{Installed}}{1000} * IEFe \quad \textit{Equation A-7}$$

$$kWh_{Code} = \frac{Watt_{Code} * HOU_{Baseline} * Qty_{Baseline} - Watt_{Installed} * HOU_{Installed} * Qty_{Installed}}{1000} * IEFe \quad \textit{Equation A-8}$$

$$\Delta kW = (\mathrm{Watt}_{\mathrm{Baseline}} - Watt_{Installed}) * CF * IEFd/1000 \quad \textit{Equation A-9}$$

$$Dual\ Baseline\ Lifetime\ Savings = kWh_{Savings} * \frac{EUL}{3} + kWh_{Code} * (EUL - \frac{EUL}{3}) \quad \textit{Equation A-10}$$

Equation A-7 and Equation A-9 detail the equations used to determine energy savings and peak demand reduction for lighting measures. Dual baseline lifetime savings were calculated as a part of the program analysis, detailed in Equation A-10. Calculation of dual baseline lifetime savings required the use of savings using code standards found using Equation A-9. The baseline assumptions made for energy savings and demand reduction are detailed below:

Baseline Wattage: For the Ex-Post savings analysis, the baseline wattage is considered as the wattage of the pre-retrofit lighting fixture. However, for the purpose of calculating dual baseline lifetime savings, savings were also calculated using a code-specified baseline wattage. For Tube LEDs, High Bay LEDs, and LED Troffer Kits, the code baseline wattage was calculated using a code efficacy value taken from the CA eTRM along with the lumens of the installed fixture. For Screw-In LEDs, the code baseline wattage was determined using a wattage reduction ratio taken from DEER workpapers applied to the installed fixture wattage.

Hours of Use (HOU): The hours of use utilized were the hours confirmed during the on-site verification process. Deemed values from DEER workpapers dependent upon space type and climate zone were also used.

Summer Peak Coincidence Factor (CF): The summer peak coincidence factor is a ratio determined by light usage during the peak demand period of 1pm-6pm on weekdays from June to September.

Interactive Effects, Energy Savings (IEFe): The values utilized for energy interactive effects come from tables taken from DEER workpapers. The values are dependent upon space type, climate zone, and installed fixture type.

A.7.1.4. Ex-Ante Savings Review

Table A-45 summarizes the discrepancies the Evaluator found comparing the reported ESP Ex-Ante kWh and Peak kW savings with the Ex-Ante kWh and Peak kW savings presented in the tracking data delivered by LADWP.

Table A-45 LADWP Facilities Ex-Ante Savings Source Comparison

Fiscal Year	ESP Data Ex-Ante kWh Savings	Program Data Ex-Ante kWh Savings	Ex-Ante kWh Percent Change	ESP Data Ex-Ante Peak kW Savings	Program Data Ex-Ante Peak kW Savings	Ex-Ante Peak kW Percent Change
20/21	4,315,466	4,345,377	0.7%	300.56	338.41	11.2%

The tracking Ex-Ante kWh was slightly greater than the ESP Ex-Ante savings. There was a more significant deviation between ESP and tracking data for peak kW impact, totaling 11.2% for FY 20/21.

A.7.1.5. M&V Approach

In-person site visits were used to gather information utilized in project savings estimates. In addition to the site visits, LADWP provided project documentation (measure level project tracking data) supplementing the information gathered during the on-site verification process to determine associated project savings. The on-site visit/verification involved the visual inspection and photography of the installed equipment, an interview with the site contact person to gather information pertinent to the installed measures and their operation and obtaining answers to some specific questions listed in the M&V plan for each site. No virtual data collection activities were performed for the LADWP Facilities program.

A.7.1.6. Data Collection Activities

In-person site visits were used to gather information utilized for calculating project savings. All three projects underwent M&V Plan development, which included a desk review. The depth of the desk review was dependent on evaluation approach as well as available information from project documentation. A summary of the progression of the projects is shown in Table A-46.

Table A-46 LADWP Facilities Evaluation Data Collection Progression

Fiscal Year	M&V Plans	Contact Attempted	Virtual Verification	On-Site Verification	Evaluated
FY 20/21	3	3	0	3	3

The Evaluator conducted on-site power meter monitoring on two of the three LADWP Facilities projects. The third project involved outdoor lighting in which logger installation was not viable and monitoring was not performed.

A.7.2. Impact Evaluation

This section describes various procedures undertaken to conduct the impact evaluation of the LADWP Facilities program. These activities include engineering review procedures, data analysis, extrapolation of results, and description of factors affecting gross realized savings.

A.7.2.1. Engineering Review Procedures

Provided documentation was reviewed for the projects within the population. The LADWP Facilities program measure summary and savings calculator was also reviewed. Analysis of project savings were done using typical lighting savings algorithms using information gathered from the project documentation and data gathered during the on-site verification process.

A.7.2.2. Data Analysis

A full evaluation analysis was conducted on all three projects from FY 20/21. Project-level and measure-level results can be found in site-level reports, which can be viewed in Appendix E. For confidential and privacy considerations of participants, Appendix E was not published with the public version of the report. Appendix E was provided only to LADWP as reference to supplement this EM&V report.

Table A-47 LADWP Facilities Evaluation Savings by Project

Project	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	Program Data Ex-Ante kW Savings	Program Data Ex-Post kW Savings	Gross kWh Realization Rate
Project 1	438,382	353,466.00	81%	37.50	40.35	108%
Project 2	329,280	245,392.00	75%	46.70	46.62	100%

Project	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	Program Data Ex-Ante kW Savings	Program Data Ex-Post kW Savings	Gross kWh Realization Rate
Project 3	74,278	69,351.00	93%	17.22	0.00	0%
Total	841,940	668,209.00	79%	101.42	86.97	86%

A.7.2.3. Extrapolation of Results

All three projects were evaluated, and a measure sample was drawn on lighting fixtures. Therefore, project-level extrapolation of results was not necessary.

A.7.3. Process Evaluation

This section presents the process evaluation for the LADWP Facilities Program.

A.7.3.1. Process Evaluation Approach and Methodology

The process evaluation for the Facilities Upgrade Program consisted of an interview with the acting Program Supervisor ("Program Supervisor"), on October 27, 2021. The interview covered the Program Supervisor's role and responsibilities; the program's objectives, management, and implementation; project tracking; and perceived challenges for the program going forward.

The Evaluator applied a deemed net-to-gross ratio of 1.0 to the LADWP program because the LADWP is using program dollars to fund improvements in the facilities and would not likely have access to other funds to make these improvements.

A.7.3.1.1. Roles and Responsibilities

The interviewee had been the most senior member of the Program team, reporting directly to the Program Manager, and was made acting Program Supervisor when the prior Program Manager recently retired, while another Senior Supervisor became acting Program Manager. The Program Supervisor reported that his primary role is to oversee some of the Program's larger lighting projects.

A.7.3.1.2. Program Objectives

The objective of the program is to provide high-quality energy efficient space lighting, to bring lighting to at least code, generate energy savings, and improve the comfort and safety of the work environment. The Program Supervisor noted that LADWP has many older facilities that are not very energy efficient.

The Program aims for 3-year payback period with minimum 30% savings, keeping with IES recommended space lighting, emergency lighting requirements, and California Title 24 and Title 20. The Program Supervisor further clarified, however, that the Program seeks to provide the most efficient lighting possible that is appropriate to the space. The "most appropriate" replacement may not be the most efficient lighting that achieves the existing lighting level, as that existing level may have been too dim, which could create safety concerns. In some cases, the most efficient lighting may be too bright or the wrong color temperature for the work being performed. For example, in one case, they initially installed lighting at a sheet metal shop that was too "cold," resulting in too much glare on metal surfaces. As a result, workers could not see pencil marks on the metal. The workers thought the lighting was not bright enough, but the Program staff realized it was the wrong color temperature and installed lighting that was a correct color temperature.

A.7.3.1.3. Program Management and Implementation

The Program Supervisor explained that the Program is organized within the Efficiency Solutions Engineering (ESE) Group but works with the Power Construction Maintenance (PCM) and Facilities Operation and Maintenance (O&M) groups to implement projects. ESE staff manage project engineering design and savings estimates, while PCM and O&M staff implement a lot of projects. The latter may include installing sensors, programming them according to ESE specifications, adjusting ES drawings to give as-built drawings. The Program also works with outside vendors – “boots on the ground” electrical construction and maintenance workers – to install projects, and with facility supervisors, managers, and LADWP’s contracts & administration group as well as equipment suppliers, including lighting manufacturers and their technical support staff.

In terms of how a project will unfold, the Program Supervisor explained that, typically, an LADWP facility comes to the Program with a request for help. Program staff will schedule a site visit to do an audit, in which they will go room to room to determine what lighting is needed and to assess factors that affect lighting use, such as occupancy and hours of operation. They then will perform a cost analysis to determine whether it meets the 3-year payback and 30% savings. If so, they will let the facility manager or lead know what they can do through the Program. If an agreement is reached, the Program staff determine whether Program staff or PCM will lead the installation work. They will then document the facility’s existing lighting, create sketches, and carry out the item procurements. If it is determined that PCM will lead the work, Program staff will submit construction work packages with engineering drawings, labor hour estimate, and a request for drafting support if needed and will request an implementation schedule.

According to the Program Supervisor, dealing with manufacturers and vendors normally is nonproblematic. The Program works with a network of vendors they deal with, who usually can get the equipment they need. Program staff try to standardize the equipment they use to facilitate this process. Sometimes, however, the supply chain process can be “a pressure point” when it is necessary to go through multiple steps (contracts group to vendor to manufacturer) to get the equipment needed. This occurs when searching for equipment that is not handled by their network of vendors, which usually happens when the project requires something that is uncommon. In such cases it is necessary to develop specifications and get bids, which can take a long time.

A.7.3.1.4. Project Tracking

The Program Supervisor noted that the project documentation is largely pen and paper. However, the system is “in flux,” with efforts to move toward more electronic, online documentation since the previous Program Manager retired.

A.7.3.1.5. Program Challenges

When asked about opportunities for continued savings through LADWP facilities upgrades, the Program Supervisor indicated that there are “a lot of facilities yet to get to.” Further, the Program Supervisor indicated there were no challenges relating to the type of facilities that might be upgraded. The main challenge is the diminishing savings that come from lamp replacements. As LEDs continue to become the norm, there will be fewer savings from lamp replacements, and additional energy savings will need to be realized from implementing building controls to integrate lighting with other energy systems.

The Program Supervisor did note other challenges for the Program implementation. One challenge is that other groups or individuals – whose involvement is needed – may not prioritize a lighting upgrade at a particular facility. For example, PCM may prioritize safety-related projects over lighting upgrades, which results in additional lag time between when the Program accepts a project and when it can be completed. Similarly, a facility manager may not be able to get approval from their boss because another matter (e.g., a power outage) is taking priority. The Program Supervisor indicated that it would be very beneficial to have a permanent Program Manager in place to assist in getting lighting projects prioritized.

Related to the above, the Program Supervisor also noted that equipment cost increases must be approved by a different department and the Program staff are not “in the loop” of the cost communication, which can be an issue.

A final challenge is lags in the supply chain – specifically, in deliveries from China – because of the Coronavirus pandemic.

A.7.3.1.6. Recommendations

LADWP should identify a permanent Program Manager as soon as can be done practically. A permanent Program Manager is needed to advocate for greater prioritization of lighting projects and facilitate communication between the Program and other LADWP administrative units.

LADWP should assess decision-making within, and communication across, administrative units to determine whether changes can be made to facilitate implementation of energy efficiency projects, and then should implement changes that can be feasibly carried out. Lack of prioritization of lighting upgrades may prevent or delay energy savings as well as create safety concerns. As an energy efficiency program administrator, LADWP should set an example by maintaining a high standard of energy efficiency in its facilities, and as a public entity, it should set the example of prioritizing worker safety and comfort.

A.8. LAUSD DI Program

This section details the impact and process evaluation for the LAUSD Direct Install Program that LADWP offered customers during FY 20/21. The primary objective of this evaluation is to calculate energy savings and peak demand impacts attributable to the Program, as well as complete a process evaluation.

A.8.1. Evaluation Methodology

This section presents the findings of the tracking data review, the methodology used to calculate verified Ex-Post energy savings and peak demand reduction for the program.

A.8.1.1. Tracking Data Review

LADWP provided the Evaluator with the available program tracking data for measures installed as a part of LAUSD DI Program between July 01, 2020 and June 30, 2021.

Review of the tracking data was performed to ensure that the provided data was sufficient to calculate energy savings and peak demand reduction, and to verify that projects listed were completed and had installation dates during FY 20/21.

A.8.1.2. M&V Sample Design

Based on the tracking data provided by LADWP, a sample design was developed for site-level analysis. A sample was developed that provided savings estimation with ±10% statistical precision at the 90% confidence level. To represent the population of projects, the Evaluator selected a stratified sample (known as ratio estimation) with enough projects to estimate the total achieved savings with 10% precision at a 90% confidence level. Projects were categorized by Ex-Ante kWh savings. The boundaries of each stratum were developed to ensure the extrapolation of impacts is appropriately distributed. Realization rates (the ratio of Ex-Post kWh savings to Ex-Ante kWh savings) for projects sampled in each stratum were only extrapolated to other projects within that stratum. Table A-48 provides program population and sample statistics.

Table A-48 *LAUSD DI Population Statistics Used for Sample Design*

	Stratum 1	Stratum 2	Stratum 3	Stratum 4	Stratum 5	Totals
Strata boundaries (Ex-Ante kWh)	<70,000	70,000 - 160,000	160,000 - 200,000	200,000 - 450,000	> 450,000	
Population Size	10	10	12	3	2	37
Total Ex-Ante kWh savings	227,887	1,192,926	2,150,728	751,138	965,387	5,288,066
Average Ex-Ante kWh Savings	22,789	119,293	179,227	250,379	482,693	
Standard deviation of Ex-Ante kWh savings	26,138	26,532	13,092	55,220	33,123	
Coefficient of variation	1.03	0.22	0.09	0.22	0.07	
Final design sample	1	1	1	1	1	5

A.8.1.3. Baseline Assumptions Review

The projects completed under the LAUSD DI Program during FY 20/21 were found to consist of lighting measures only. Generally, for projects involving lighting measures, savings were determined as follows:

$$kWh_{Savings} = \frac{Watt_{Baseline} * HOU_{Baseline} * Qty_{Baseline} - Watt_{Installed} * HOU_{Installed} * Qty_{Installed}}{1000} * IEFe$$ *Equation A-11*

$$kWh_{Code} = \frac{Watt_{Code} * HOU_{Baseline} * Qty_{Baseline} - Watt_{Installed} * HOU_{Installed} * Qty_{Installed}}{1000} * IEFe$$ *Equation A-12*

$$\Delta kW = (\mathrm{Watt_{Baseline}} - Watt_{Installed}) * CF * IEFd/1000$$ *Equation A-13*

$$Dual\ Baseline\ Lifetime\ Savings = kWh_{Savings} * \frac{EUL}{3} + kWh_{Code} * (EUL - \frac{EUL}{3})$$ *Equation A-14*

Equation A-11 and Equation A-13 detail the equations used to determine energy savings and demand reduction for lighting measures. Dual baseline lifetime savings were calculated as a part of the program analysis, detailed in Equation A-14. Calculation of dual baseline lifetime savings required the use of savings using code standards found using Equation A-12. Baseline assumptions made for energy savings and demand reduction are detailed below:

Baseline Wattage: For the Ex-Post savings analysis, the baseline wattage is considered as the wattage of the pre-retrofit lighting fixture. However, for the purpose of calculating dual baseline lifetime savings, savings were also calculated using a code-specified baseline wattage. For Tube LEDs, High Bay LEDs, and LED Troffer Kits, the code baseline wattage was calculated using a code efficacy value taken from the CA eTRM along with the lumens of the installed fixture. For Screw-In LEDs, the code baseline wattage was determined using a wattage reduction ratio taken from DEER workpapers applied to the installed fixture wattage.

Hours of Use (HOU): The hours of use utilized were the hours confirmed during the on-site verification process. Deemed values were also used from DEER workpapers dependent upon space type and climate zone.

Summer Peak Coincidence Factor (CF): The summer peak coincidence factor is a ratio determined by lighting usage during the peak demand period of 1pm-6pm on weekdays from June to September.

Interactive Effects, Energy Savings (IEFe): Energy interactive effects used in the analysis were obtained from DEER. The values are dependent upon space type, climate zone, and installed fixture type.

A.8.2. Ex-Ante Savings Review

The following table compares the reported ESP Ex-Ante kWh and Peak kW savings with the Ex-Ante kWh savings and Peak kW reduction presented in the tracking data delivered by LADWP.

Table A-49 *LAUSD DI Ex-Ante Savings Summary*

Measure	ESP Data Ex-Ante kWh	Program Data Ex-Ante kWh	Ex-Ante kWh Percentage Change	ESP Data Ex-Ante kW	Program Data Ex-Ante kW	Ex-Ante Peak kW Percentage Change
Lighting	5,348,832	5,288,066	-1.1%	560.17	1,538.78	174.7%

A.8.2.1. M&V Approach

In-person site visits were used to gather information utilized in project savings estimates. In addition to the site visits, LADWP provided project documentation (measure level project tracking data), supplementing the information gathered during the on-site verification process to determine associated project savings. The on-site visit and verification involved the visual inspection and photos of the installed equipment, an interview with the site contact person to gather information pertinent to the installed measures and their operation, and to obtain answers to some specific questions listed under M&V plan for each site. No virtual data collection activities were performed under the LAUSD DI program.

A.8.2.2. Data Collection Activities

In-person site visits were used to gather information utilized in project savings estimates. All projects selected underwent M&V Plan development, which included a desk review. The extent of the desk review was dependent on evaluation approach as well as available information from project documentation. A summary of the progression of the randomly sampled projects is shown in Table A-50.

Table A-50 LAUSD DI Evaluation Data Collection Progression

Stratum	MV Plans	Contact Attempted	Virtual Verification	On-Site Verification	Evaluated
1	1	1	0	1	1
2	1	1	0	1	1
3	1	1	0	1	1
4	1	1	0	1	1
5	1	1	0	1	1
Total	5	5	0	5	5

Due to the on-going COVID-19 pandemic, the Evaluator was not able to conduct any on-site power monitoring for LAUSD DI projects.

A.8.3. Impact Evaluation

This section describes various procedures undertaken to conduct the Impact Evaluation of the LAUSD DI program. These include engineering review procedures, data analysis, extrapolation of results, and description of factors affecting gross realized savings.

A.8.3.1. Engineering Review Procedures

The documentation provided by LADWP along with the LAUSD DI Program measure summary and savings calculator was reviewed for the projects within the program M&V sample. Analysis of project savings were performed with typical lighting savings algorithms using information gathered from the project documentation and during the on-site verification process.

A.8.3.2. Data Analysis

A full evaluation analysis was conducted on 5 of the 37 randomly sampled projects from FY 20/21. Project-level and measure-level results can be found in site-level reports, which can be viewed in Appendix E. For confidential and privacy considerations of participants, Appendix E was not published with the public version of the report. Appendix E was provided only to LADWP as reference to supplement this EM&V report. Energy savings for sampled projects within each stratum were aggregated to determine a strata level realization rate used for extrapolation to the population. Summary of LAUSD DI Program savings by strata is shown in Table A-51.

Table A-51 LAUSD DI Evaluation Savings by Strata

Stratum	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
1	227,887	268,513	118%
2	1,192,926	1,249,574	105%
3	2,150,728	2,351,231	109%
4	751,138	808,010	108%
5	965,387	994,579	103%
Total	5,288,066	5,671,907	106%

The overall realization rates varied for all strata categories. The most common cause of discrepancy in the sampled projects were the lighting hours of use utilized in Ex-Post savings calculations compared to the Ex-Ante estimates. Generally, discrepancies in peak kW savings occurred due to a difference in calculation methodology described in A.8.1.3.

A.8.3.3. Extrapolation of Results

Results of the Ex-Post savings of the program sample were separated by stratum to determine a realization rate for energy savings, demand reduction, and EUL. The values determined from the Ex-Post analysis of the program sample were extrapolated to the other projects in the population within the same stratum. The gross realization rates of sampled projects within the M&V sample are shown below in Figure A-29 and the gross realization distribution of all projects is shown in Figure A-30.

Figure A-29 LAUSD DI Gross Realization Rate by Sample Stratum

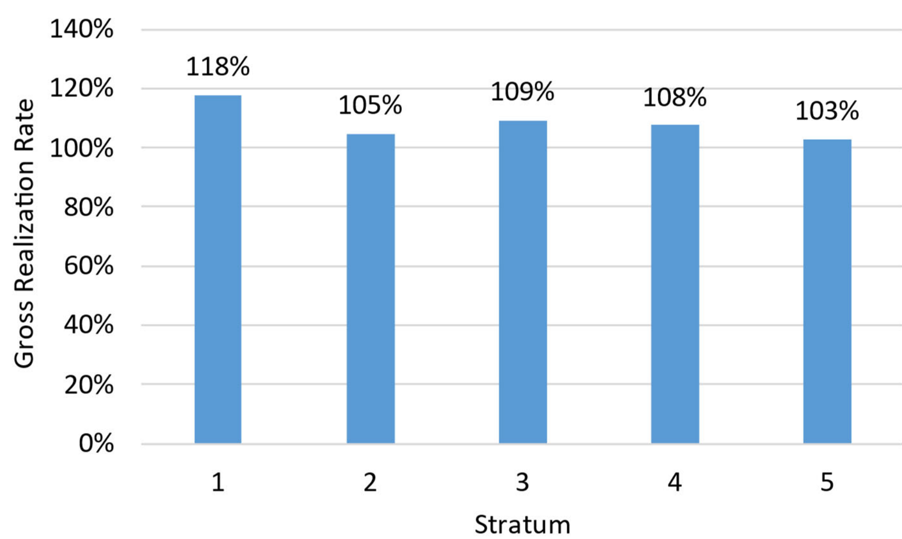
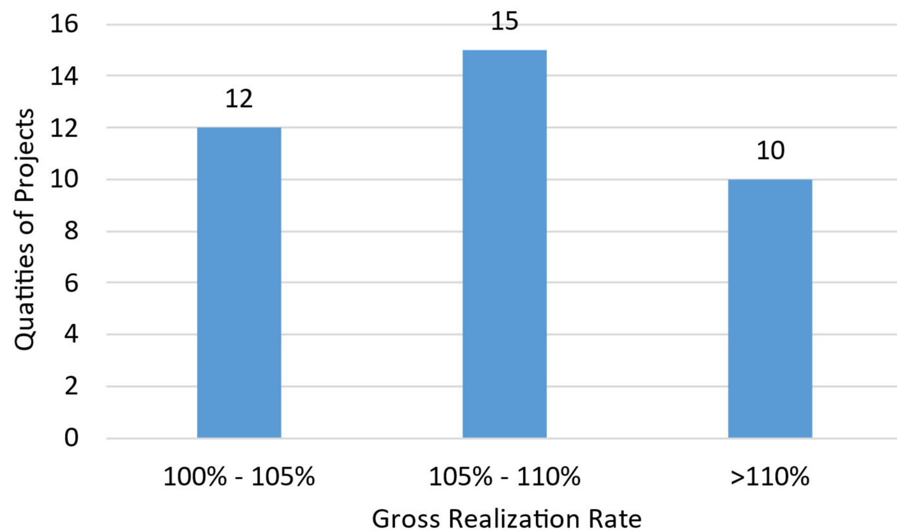


Figure A-30 LAUSD DI Gross Realization Rate Distribution for Population of Projects



A.8.4. Process Evaluation

This section presents the process evaluation for the LAUSD DI Program.

A.8.4.1. Process Evaluation Approach and Methodology

The process evaluation for the LAUSD Direct Install (DI) Program consisted of an interview with the acting Program Supervisor (“Program Supervisor”), on September 21, 2021, and a Senior Project Manager for LAUSD on November 18, 2021.

The interviews covered the respondents’ role and responsibilities; the program’s objectives, management, and implementation; communication; the school district’s experience with and perception of the program; project tracking; and perceived challenges for the program going forward.

A.8.4.1.1. Roles and Responsibilities

The acting Program Supervisor replaced the previous Program Supervisor, who retired June 1, 2021. She has worked for LADWP for 30 years and with the LAUSD DI Program since 2018. She reports directly to the manager for all energy efficiency programs and coordinates with the LADWP contracts administrator for efficiency programs, LAUSD staff, and the implementation contractor. She is assisted by a program “lead.”

The LAUSD Senior Project Manager manages facility projects, both retrofit as well as new construction. He has been involved in facility retrofits for eight years and has been involved with the Program since the start of the second MOU, in March 2021. In his role, he interacts with Program staff and the implementation contractor and its subcontractors who do implementation work.

A.8.4.1.2. Program Design and Objectives

The Program Supervisor provided information on the program’s history, design, and objectives. The LAUSD DI Program is one of four energy efficiency strategies covered in the MOU between LADWP and LAUSD. The other three – energy efficiency outreach and education, design and project management assistance, and energy use monitoring and assessment – are done by other LADWP units. The Program's objectives are to generate energy savings and reduce energy costs for the LAUSD; the Program Supervisor was not aware of any specific savings goals.

The initial 3-year MOU went into effect in October 2015 and was to expire in October 2018 but was extended to October 2020. A new MOU was put in place in January of 2021.

Under the current MOU, a contractor performs the DI work. LAUSD pays the contractor's labor costs, while the Program pays equipment costs. The Program has an annual budget of $12M per year, which is sufficient to treat about 12 schools per year.

A.8.4.1.3. Program Communication

The Acting Supervisor, together with her program lead, holds weekly meetings with Willdan staff and the LAUSD Senior Project Manager. During these meetings, attendees discuss: 1) the status of ongoing implementation activities; 2) what schools are coming up next and whether school staff (i.e., school principal or designee, custodial staff) have been alerted to let them know the project will be starting, what the details are, what the impact is, so they have expectations for the project); 3) project wrap-up activities; 4) administrative (i.e., cost) issues; and, at the end of the year, 5) the next phase of the program.

The Acting Supervisor reported that the meetings keep her "up to speed" on projects; the LAUSD Senior Project Manager said that the meetings are "very good." The Senior Project Manager also reported that he can talk to program staff outside the weekly meeting as needed.

A.8.4.1.4. Project Selection, Scheduling, and Implementation

Each year, the Program Supervisor asks LAUSD to provide a list of 14 to 15 schools that need the most retrofit in terms of lighting. The list allows the Program to select and plan retrofits for 12 schools, with a mix of high schools, middle schools, and elementary schools, while providing some extras to be substituted in the event that a selected one cannot be scheduled.

After ensuring the selected schools are in LADWP territory, the Program Supervisor provides the list of schools to the implementation contractor, Willdan, which schedules audits of the identified schools over a two-to-three-week period. After conducting the audits, Willdan determines the scope and estimated cost of each retrofit. Willdan uses an automated tracking system to record measures identified and installed. Contractor staff use a hand-held pad to record measure counts, and the system then uses applies prescriptive savings values per measure to generate a total per school. Willdan sends the Program Supervisor a spreadsheet with the scope for each school, listing each measure and cost.

The Program Supervisor then reviews the cost and cost-effectiveness, approving anything that costs $3/kWh saved or less. Willdan then determines the scheduling for retrofitting then schools, based on its estimate of how long each one it will take and carries out the retrofits, working with two subcontractors, Herzog and On Target.

According to the LAUSD Senior Project Manager, a LAUSD field electrician will "walk the site" during the installation phase to confirm the need for the installed equipment.

A.8.4.1.5. Project Review and Tracking

Upon completion of measure installation at a school, Willdan creates a "completion form," which is an itemized list of all the measures installed. The LAUSD onsite staff and the installation subcontractor foreman then do a walk-through at the school to ensure that all identified measures were installed and working. They create a punch list of any uncompleted measures or unworking measures, and the contractor will then go and complete those measures. Once the LAUSD project manager signs off on the completion form, Willdan sends it to LADWP.

According to the Program Supervisor, the results of the walk-through inspections are discussed during the weekly meetings. Reports of missed measures are infrequent and usually minor – for example, a small closet was missed.

The Program Supervisor reported that LADWP does not have direct access to Willdan's tracking system but indicated satisfaction with the project tracking system, saying that she can request anything she needs and Willdan will provide it within minutes. She did note, however, that for the LADWP Commercial DI program, the implementer provides LADWP with direct access to its tracking system. She indicated that it might be good to ask Willdan for such access, but the current system works.

A.8.4.1.6. Perceptions of the Implementer

The Program Supervisor reported that the Program "runs pretty smoothly" as "Willdan does the heavy lifting" and that Willdan is "very thorough" as a project manager. The LAUSD Senior Project Manager reported being "very satisfied" with Willdan. He further noted that Willdan has always been good about replacing occupancy sensors that stopped working after the inspection.

A.8.4.1.7. LAUSD Program Satisfaction

The LAUSD Senior Project Manager reported satisfaction with the installed measures and said that the Program has "been a very good program – very beneficial for the district [because] we have been able to achieve something we wouldn't have done on our own."

A.8.4.1.8. Challenges

When asked whether any challenges exist to current Program implementation or achievement of goals, the only potential improvement she could identify was in invoicing. Specifically, it often takes three to four weeks, and sometimes up to five weeks, for Willdan's subcontractors to submit invoices to Willdan. Willdan invoices LADWP on an ongoing basis rather than once at the end of each project, and so a given project may generate invoices every two weeks. Based on feedback received during weekly meetings, the Program Supervisor indicated that part of the reason for delays may the fact that LAUSD has only two staff who do post-installation inspections, and they can "cover only so much ground." Since subcontractors do not submit invoices until after LAUSD has signed off on the completion of the work, having more resources to complete inspections might result in fewer or shorter delays in invoicing. The Program Supervisor noted, however, that subcontractors may delay submitting invoices even when inspections are done. The Program Supervisor did not know the reason for such delays but noted that the delays (whether the result of limited inspection resources or other factors) do not delay program operations or installations, just the expense tracking.

Apart from the above, the COVID-19 pandemic also has created challenges by increasing the installation costs. This is for two reasons: 1) contractors must do installations during the evenings so they are not in the schools during regular class times, and they must then be paid higher rates for overtime work; and 2) the contractors have to sanitize the classrooms before entering and leaving, which adds time to the process.

A.8.4.1.9. Recommendations

- **LADWP may consider asking the implementer to provide the Program Supervisor with direct access to project tracking data.**
    - The Program runs smoothly, and the implementer promptly provides the Program Supervisor with any requested information. It may be useful, however, for the Program Supervisor to have direct access to the implementer’s project tracking system. This may allow the Program Supervisor to download information more frequently and provide broader QC opportunities.
- **If possible, LADWP may consider conducting some onsite inspections with its own staff to speed up that process. This may reduce delays in expense tracking, which may reduce the overall management load for the project.**
    - Limited school resources for onsite post-installation inspections create delays in contractor invoicing. This does not appear to affect program operations or installations but does delay expense tracking.
- **LADWP may consider adding a requirement that contractors submit invoices within a specified time after the completion of onsite inspections, with penalties for delay. This may reduce delays in expense tracking, which may reduce the overall management load for the project.**
    - Subcontractor delays in invoicing may occur for reasons other than limited school resources for onsite post-installation inspections. This does not appear to affect program operations or installations but does delay expense tracking.

A.9. SBD/LADWP ZBD Program

This section details the impact evaluation for the Saving by Design (SBD) Program that LADWP offered customers during FY 20/21. The primary objective of this evaluation is to calculate energy savings and peak demand impacts attributable to the Program, as well as complete a limited process evaluation for the LADWP Zero by Design Program.

A.9.1. Evaluation Methodology

This section presents the findings of the tracking data review and the methodology used to calculate verified Ex-Post energy savings and peak demand reduction for the program.

A.9.1.1. Tracking Data Review

To begin the impact evaluation, the Evaluator reviewed program documentation. Program tracking data was reviewed for completeness and identification of outliers and issues. Projects were checked for installation and incentive dates for program year applicability.

Project level tracking data was then analyzed to determine the most appropriate sampling approach. Data was reviewed for the range of annual energy savings and whether projects were New Construction or Modernization. While a census was determined, it was important to ensure that each project type was represented for extrapolation.

A.9.1.2. M&V Sample Design

Due to the completion of four projects in the fiscal year, an engineering review of all projects was determined to be the most appropriate course of action. Thus, verified savings are held to each project, with each project undergoing evaluation.

A.9.1.3. Project Documentation Review

Documentation representing each project was requested and received from LADWP. Project documentation included design team and owner incentive agreements, design team and owner letters of interest, utility incentive worksheets (UTIL-1), energy simulation models, and inspection reports. Energy simulation models used a variety of energy simulation software including EnergyPro, CBECC, and IES-VE. In addition to project documentation, billing data was sought for all electric meters associated with sampled projects.

Every project underwent a detailed documentation review which was used to develop the most appropriate evaluation approach. Our review of energy savings calculations focused on the verification of installed equipment and specification against inputs to the energy simulation models used to determine Ex-Ante energy savings. The review included the following:

- Review of energy savings by end-use
- Review of energy simulation model inputs
- Review of project scope and equipment based on verification reports

A.9.1.4. Site Specific Measurement and Verification Plans

After a full review of program documentation, project documentation, and billing data, ADM developed MV Plans as needed which describes the project and initial impact estimation methods, identifies the major sources of uncertainty in the impact estimation methods, proposes a methodology for assessing the project’s energy impacts, and specifies the exact steps by which we collect and analyze data to remove or mitigate uncertainties in energy savings estimations.

A.9.1.5. Data Collection Activities

Adhering to current conditions regarding COVID-19, the Evaluator planned to use virtual data collection practices for this evaluation. The first step was to ensure the MV Plans provided defensible methodologies to mitigate data collection through a site contact. This included an exploration of available or provided billing data, review of data collected through implementation, and review of the energy simulation models.

Based on the provided documentation, ADM sought an interview with only one site contact, without any need for virtual observation. The post inspection reports were detailed and based on prior evaluation efforts had been found to accurately represent the post installation conditions. Large, complex new construction projects are difficult to visually verify and often involve in-depth understanding of the facility and its operation. Therefore, ADM relied on available data and analysis techniques to both benchmark and calibrate provided simulations.

A.9.1.6. Engineering Analysis

Energy Savings calculation methodologies were selected based on industry standard practices adhering to IPMVP options. Industry references include DEER, ASHRAE, and California’s Title-24.

Energy impacts of annual energy savings (kWh), lifetime energy savings (kWh) and peak demand reduction (kW) were determined for each project. Each analysis underwent a quality control process to ensure proper methodologies were employed and no calculation errors are present. A site level report was developed for each project for individual review.

Lifetime energy savings were determined based on the methodologies provided in DEER workpapers or based on industry standards when necessary. Lifetime energy savings by measure are dependent on the type of installed equipment.

Peak demand reduction has been determined on a project-level basis using the methodologies provided in DEER workpapers. The peak demand reduction has been defined as the average hourly consumption across the peak demand window of 2 PM to 5 PM on non-holiday weekdays from June through September. Program-level peak demand reduction is to be presented as annual energy savings applied to an appropriate load shape for consistency with reporting methodologies.

A.9.1.7. COVID-19 Impacts

In addition to the determination of annual energy savings, ADM explored the impact of COVID-19 on energy impacts from the installed measures. Through data analysis efforts ADM explored the effects on operating schedules, mechanical systems, and any other consumption effects.

A.9.2. Impact Evaluation

This section describes various procedures undertaken to conduct the impact evaluation of the SBD program. These include engineering review procedures, data analysis, extrapolation of results, and description of factors affecting gross realized savings.

A.9.2.1. Program Data Review

Project level descriptions in program tracking data indicated that two projects were classified as New Construction and two as modernization. The provided project level tracking data was complete for the purpose of reviewing gross impacts and developing a stratified sample.

Project documentation was received for each project. The documentation consisted of design team and owner incentive agreements, drawings, design team and owner letters of interest, utility incentive worksheets (UTIL-1), inspection reports, and energy simulation models, with various programs used for the energy simulation models. While project documentation was complete, it did not always match with results in the program tracking data. In some instances, additional simulation versions were provided. Details of project documentation for each project can be found in the site level evaluation reports.

Billing data was sought for each site using MV-WEB. However, the Evaluator was unable to obtain billing data for every project. Comprehensive billing data by project is difficult as project sites may include multiple meters or share a meter with other buildings on a campus. In addition, billing data must span a significant time to be useful. In most cases the provided or obtained billing data could not be used for analysis purposes.

A.9.2.2. Data Collection

ADM sought data collection from site contacts for only one of the four projects. The remaining three projects were treated as desk reviews using project documentation and billing data. ADM did not conduct any on-site monitoring. Data collection activities are shown in Table A-52.

Table A-52 SBD Evaluation Data Collection Progression

Stratum	MV Plans	Desk Reviews	Virtual Verification	Evaluated
SBD	2	4	1	4

A.9.2.3. Project Level Results

Evaluation analysis was conducted on all four completed SBD program projects in fiscal year 2020-2021. Two projects were considered to be new construction and two projects modernization. All projects were evaluated against California code Title 24. Each project utilized an energy simulation, thus falling into the classification of IPMVP Option D: Calibrated Simulation. However, trusted billing data was available for one project in which a billing data regression analysis was performed to develop Ex-Post results (Option C: Whole Building Retrofit).

In addition, benchmarking and calibration were performed to update energy simulations or results by end-use. Data from running eQuest prototypical simulations and the Energy Information Administration Commercial Building Energy Consumption Survey (CBECS) were used. eQuest prototypical models from ADM's library based on facility type were adjusted for mechanical system type and local weather impacts. A summary of results based on IPMVP Option are shown in Table A-53.

Independent lighting analyses based on lighting power densities better than Title 24 requirements were performed for projects with detailed as-built lighting schematics. Energy simulations can often overlook detailed lighting configurations within space types.

Table A-53 SBD Evaluation Savings by IPMVP Option

IPMVP Option	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Option C	40,352	195,242	484%
Option D	192,657	180,149	94%
Total	233,009	375,391	161%

Evaluation results differed from Ex-Ante results because of differing load profiles. Some of the provided energy simulations did not match reported Ex-Ante estimates, but alternate approaches determined that differences in energy savings were the result of load profiles varying in the post implementation period. Load profiles identified as varying include mechanical system fan consumption, lighting operation, domestic hot water consumption, and overall facility consumption. The largest discrepancy was found in the project in which Option C was used for evaluation. Differences by end use could not be determined due to the variance in billing data from the efficient condition energy simulation consumption profile. The magnitude of energy savings differences by end use from Ex-Ante energy simulations is shown in Table A-54.

Table A-54 SBD Savings Variance by End Use

End Use	Savings Variance (kWh)
Whole Facility	-142,382

A.9.3. Summary Process Evaluation Findings

The LADWP ZBD program is relatively new, launching in 2021. At the time when the team completed the interview with the program team in mid-June, the LADWP ZBD program had only one project in process. Given the limited participation to-date, a full process evaluation would not be valuable. Therefore, the Evaluator completed a summary evaluation that was limited in scope. The team understands that there has been additional participation in subsequent months and anticipates conducting a full process evaluation of this program in FY 21/22.

To complete the summary process evaluation, the Evaluator reviewed the business plans and other relevant program materials and completed two interviews with LADWP program staff which provided background information on the program design and processes involved in the LADWP ZBD program.

With the sunsetting of the SBD program, LADWP staff were able to integrate solutions into the program design that addressed challenges and lessons learned from SBD.

A.9.3.1. Key differences between LADWP ZBD and SBD

- LADWP ZBD provides additional flexibility in participation requirements. SBD required applications to be submitted early, during the design phase, to allow for review and recommendations by the program administrator. Alternately, LADWP

ZBD allows new construction projects to enter the program at much later stages of the design and building process. Design assistance continues to be an important component of SBD and LADWP ZBD. It is valuable for customers, especially smaller builders, who do not have expertise in sustainable building and design.

- LADWP ZBD also provides energy modeling assistance. Whereas SBD required participants to complete their own energy model to participate, LADWP ZBD allows applicants to forfeit their project's design team incentive should LADWP complete their energy model for them, if they are unable to provide an energy model themselves. In addition, LADWP ZBD split the Design Team incentive into two payments – one payable upon receipt of an approved pre-construction energy model and the other paid at the end of the project once the post-construction energy model is reviewed and approved. As construction projects take many years to complete, this allows the Design Team to receive a small portion of its incentive early on rather than waiting until construction is complete as had been done in SBD. Also, if the applicant was not able to retain its Design Team to complete the post-construction energy model, the applicant would be able to forfeit the remainder of the Design Team incentive in lieu of LADWP completing the post-construction energy model for the applicant.
- LADWP ZBD will be more cost-effective to administer. LADWP administers LADWP ZBD internally versus working through IOU contractors, which allows the Department to eliminate additional administration fees that were impacting the cost effectiveness of the SBD program. Other changes that increase efficiency include a streamlined procurement process; marketing and outreach that is managed internally, and a single dedicated technical evaluator to conduct review of applications.
- The LADWP ZBD program offers express and whole building tracks for customers. Applicants may receive incentives for installation of specific high efficiency equipment through the express track. While options are currently limited, additional measures, including electrification, will be added in the future. The whole building performance track encourages peak performance through analysis of building systems and their interactivity.
- LADWP ZBD is a more streamlined process. The SBD program could take several years from initial discussions to application submission. This is in part due to the extensive administrative requirements under SBD, as well as the required design process. LADWP's internal administration and more flexible requirements hope to reduce the time from a customer entering the program to completing the process.

A.9.3.2. *Third-party Verification as an Added Benefit*

LADWP staff note that as construction costs are very high, program incentives do very little to bring down costs and are a small motivator in encouraging participation in the program. LADWP ZBD staff explained that they constantly seek out other non-monetary benefits of the program to promote. As many participants also seek outside green building certification for their facilities, LADWP ZBD staff reported that third party verification of their building's performance and efficiency can be very valuable to customers and is, often, promoted as part of the program's benefits. Program staff will continue to research other motivators to develop other incentives to increase participation in the program.

A.10. Upstream HVAC Program

This section details the impact evaluation and process evaluation for the Upstream HVAC (UHVAC) Program that LADWP offered customers during FY 20/21. The primary objective of this evaluation was to calculate energy savings and peak demand impacts attributable to the Program, as well as complete a process evaluation.

A.10.1. Evaluation Methodology

This section presents the findings of the tracking data review and the methodology used to calculate verified Ex-Post energy savings and peak demand reduction for the program.

A.10.1.1. Tracking Data Review

The Evaluator used the provided program tracking data for the fiscal year to identify and develop an understanding of expected savings, base savings estimates, and the methods used to develop these estimates. The provided program tracking data, which included equipment information, end-user information, and service provider information, allowed for a review of evaluation impacts based on end-user business types, service provider, and equipment type.

A.10.1.2. M&V Sample Design

The Evaluator selected a sample of line items to estimate evaluated energy savings of the program, with the number of sampled line items meeting 90/25 confidence/precision. Samples will be combined over FY 20/21, FY 21/22, and FY 22/23 to meet a program level precision of 90/10. Precision will be met through stratification of projects based on annual energy savings (kWh). A random sample was developed using stratification by equipment type (AC, HP, VRF) and aggregated annual energy savings by line item. A summary of sample statistics is shown in Table A-55. Strata identification is based on equipment category (AC, HP, VRF) and numerical by tracking data line-item total Ex-Ante annual energy savings (kWh).

Table A-55 UHVAC Evaluation Sample

Strata	Strata Boundaries	Sample Measures	Program Data Ex-Ante kWh	Sample Size	Sample kWh
AC 1	(17,367)-14,435	14	1,539,928	6	31,497
AC 2	15,172-27,119	7	663,321	2	34,960
AC 3	30,048-300,051	4	1,558,145	2	123,996
HP 1	1,213-2,983	2	20,547	2	4,324
HP 2	3,385-13,934	23	189,485	6	49,781
HP 3	16,256-24,525	16	136,003	2	37,157
HP 4	44,745-80,540	71	388,108	4	230,010
VRF 1	4,271-19,421	14	425,611	8	90,000
VRF 2	20,079-49,927	15	1,416,386	6	159,647
VRF 3	50,335-83,629	19	723,053	4	282,204

VRF 4	86,808-238,009	49	1,905,146	5	710,872
Total	NA	234	8,965,732	47	1,754,449

The evaluation sample design resulted in a precision of 18.73% at the 90% confidence interval. Ex-Ante annual energy savings were used to determine sample size, but upon completing the evaluation, Ex-Post annual energy savings were then used to determine the verified precision to meet statistical requirements.

Applicable program documentation was reviewed for these sampled measures, including application information, invoices, specification sheets, billing data, and analysis assumptions. Information was collected from the implementation team to support program documentation and provide an understanding of ex-ante energy impact estimates.

Annual energy savings extrapolation was achieved by projecting a realization rate by stratum to population measure level line items that fell within each strata's criteria. The annual energy savings, or kWh, realization rate was determined by dividing the aggregated Ex-Post kWh by the aggregated Ex-Ante kWh for each stratum. The same function was performed to extrapolate peak demand reduction results.

Lifetime energy savings extrapolation was achieved by projecting a stratum level effective useful life from the evaluation sample to the population. Lifetime energy savings were determined for each sampled measure line item. Ex-Post stratum level aggregated lifetime energy savings were divided by stratum level aggregated Ex-Post annual energy savings (kWh) to determine a strata effective useful life to be applied to measure line items in the population.

A.10.1.3. Sample Customer and Specification Review

Additional research was conducted for impact verification on sampled measures. Facility information was collected through an online review using the provided site address. Measure specifications were verified through a review of available manufacturer and Air Conditioning, Heating and Refrigeration Institute (AHRI) data.

A.10.1.4. DEER Workpaper Review and Analysis

As the program included various mechanical system types, the Evaluator considered various methodologies to calculate Ex-Post energy savings. Where content was available from DEER workpapers, the Evaluator reviewed and incorporated Ex-Post savings impact estimates based on the associated work paper. Many DEER workpapers provide savings rates of kWh/ton and kW/ton based on a measures facility type, location, and efficient specifications. When available, the Evaluator performed a review of the DEER workpaper algorithms as provided in embedded documentation within the workpaper. In some instances, this involved the collection and review of energy simulations.

A.10.1.5. Industry Standard Analysis

In support of the DEER workpaper assumptions, the Evaluator determined Ex-Post savings estimates using industry standard guidelines following the methodologies from the International Performance Measurement and Verification Protocol (IPMVP) and Uniform Methods Project (UMP). As part of the provided documentation included a Major Measure Database (MMDB) from the implementation team, the Evaluator calculated energy savings based on a desk review of the provided energy savings algorithm inputs, using the equation below.

$$Annual\ kWh = CAP * EFLH * \left(\left(\frac{1}{Effbase}\right) - \left(\frac{1}{Effinstall}\right)\right) \qquad \textit{Equation A-15}$$

Where:

- CAP = Full Load capacity (kBTU/hr) of all equipment (heating or cooling)
- EFLH = Equivalent Full Load Hours (heating or cooling)
- Eff = Energy Efficiency Ratio or Seasonal Energy Efficiency Ratio (baseline from Title 24, efficient from as-found installed).

Operating hours of mechanical equipment was a driver of energy savings and therefore an EFLH study was conducted based on the equipment type, facility type, and climate zone of the sampled measures.

A.10.1.6. Billing Analysis

The Evaluator reviewed customer billing data for sampled measures to ascertain the applicability of performing a billing data regression analysis for the determination of Ex-Post energy savings. Applicability of billing data was tested for:

- Completeness (review of missing readings);
- Reasonableness (review of outliers, fluctuations, and meter arrangements);
- Duration (review of sufficient pre-installation and post-installation readings); and
- Magnitude (is the magnitude Ex-Ante savings estimates discernable from total consumption).

Billing data was reviewed for the address associated with each measure line item in the program tracking data. Each address would be reviewed and modeled individually based on a comparison of billing data prior to the equipment installation to billing data after equipment installation. Reliance on a commercial billing data regression analysis is dependent on adherence to the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) Guide 14 stipulations and IMPVP protocols.

A.10.1.7. COVID-19 Impacts

The impact of COVID-19 was meant to be assessed based on findings from the billing analysis. The Evaluator was to use the billing analysis results to decipher the influence on set point changes that may have occurred during the COVID-19 pandemic. Commercial facilities were generally encouraged to increase ventilation which could cause an increase in consumption by fans in the system as well as increased cooling system compressor run-time with ambient temperature above cooling set points.

A.10.2. Impact Evaluation

This section describes various procedures undertaken to conduct the impact evaluation of the UHVAC program. These include engineering review procedures, data analysis, extrapolation of results, and description of factors affecting gross realized savings.

A.10.2.1. Ex-Ante Savings Review and Sampling

The Evaluator acquired program tracking data and implementation documents that provided Ex-Ante data. The provided program tracking data was sufficient to determine a random stratified sample to represent the population. Project documentation was provided for all sampled measures that included application information, equipment specifications, invoices, Ex-Ante savings tools, incentive tables, and referenced workpapers.

The Evaluator found in the project tracking data that some of the line item descriptions were incorrect based on the provided specifications of the equipment. This does not appear to have had an impact on energy savings. In addition, many model numbers were found to only represent the condensing unit. When verifying capacities and efficiencies in AHRI, this meant several options of equipment were available. Project documentation included efficiencies and capacities such that they could be matched, as well as serial numbers which can sometimes be used in online searches.

A.10.2.2. DEER Workpaper Analysis

The Evaluator sourced applicable work papers by equipment type and revision to perform a desk review analysis adhering to DEER specifications. Energy savings based on DEER workpapers are reliant on a selection of energy savings rates (kWh/ton and kW/ton) from a database for each equipment type. Selection of the energy savings rate is based on installed equipment type, installed equipment specifications, facility type, and climate zone. All measures in the program sample relied on energy savings rates provided in workpapers associated with water sourced heat pumps, unitary air-cooled AC, air cooled packaged chillers, and VRF commercial HP and heat recovery systems.

The associated workpapers used in this evaluation include:

- SCE13HC033.2 – MiniSplit Heat Pumps
- SCE13HC036 - VRF
- SCE13HC048.4 – Water Source Heat Pumps
- SCE17HC012/SCE13HC035 – Unitary AC/HP
- SCE17HC030 – Air Cooled Chillers

Annual energy savings and peak demand reduction were calculated using the workpapers for each measure in the sample. The sampled line items selected for the sample represent 234 installed measures. Energy savings for each of the sampled line items were aggregated into the strata used for extrapolation based on equipment type (AC, HP, VRF) and magnitude of annual energy savings. Sample level Ex-Post results and realization rates by strata are shown in Table A-56.

Table A-56 UHVAC Evaluation Sample Results (Workpaper) by Strata

Stratum	Count of Measures	Program Data Ex-Ante kWh	Program Data Ex-Post kWh	Gross kWh Realization Rate
AC 1	14	31,497	3,626	20%
AC 2	7	34,960	33,806	27%
AC 3	4	123,996	5,199	54%
HP 1	2	4,324	20,063	40%
HP 2	23	49,781	15,183	28%
HP 3	16	37,157	86,789	38%
HP 4	71	230,010	78,954	88%
VRF 1	14	90,000	147,329	92%
VRF 2	15	159,647	246,589	87%
VRF 3	19	282,204	464,191	65%
VRF 4	49	710,872	6,706	26%
Total	234	1,754,449	1,108,435	63%

Sample results aggregated by equipment type (AC, HP, VRF) are shown in Table A-57.

Table A-57 UHVAC Evaluation Sample Results by Equipment Type

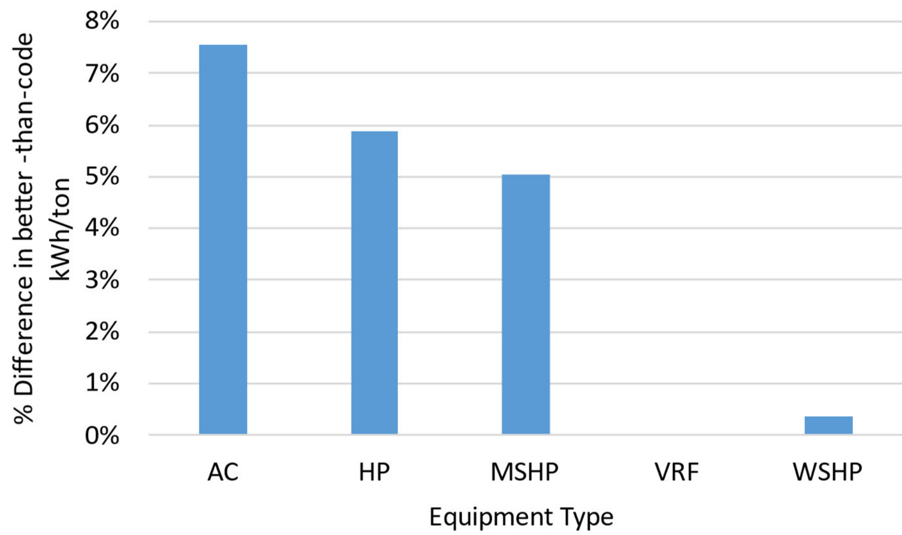
Equipment Type	Count of Measures	Program Data Ex-Ante kWh	Program Data Ex-Post kWh	Gross kWh Realization Rate
AC	19	187,881	44,138	26%
HP	118	323,845	127,234	37%
VRF	97	1,242,724	937,063	75%
Total	234	1,754,449	1,108,435	63%

Discrepancies were found in energy savings across the three classifications of equipment type (AC, HP, VRF) within the sample. Differences can be attributed to the selection of appropriate work papers, and selection of savings rates by measure within a workpaper. Selection of savings rates in a workpaper are based on the equipment type, climate zone, replacement scenario, facility type, and equipment specifications.

The savings discrepancy due to selection of energy savings rate could have been influenced by selection of facility type and equipment type (replace on burnout versus early retirement). Through verification of efficient equipment, the Evaluator found minor discrepancies in equipment capacity, and efficiency ratings. The Evaluator used internet searches and mapping software to determine of facility type. Differences in facility type were only observed for heat pump projects where the DEER workpapers provided more granularity in energy savings rates.

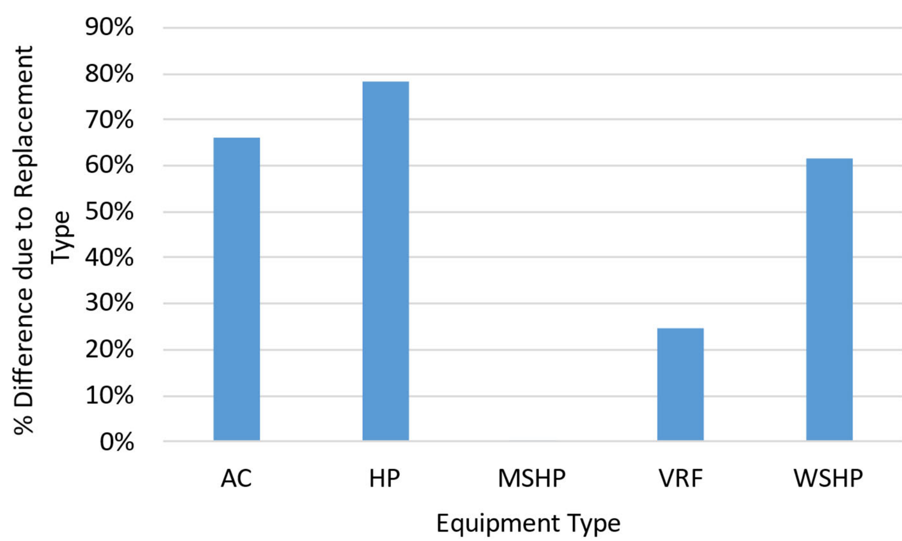
Project documentation included Ex-Ante savings rates both to code and better-than-code. When comparing the Ex-Ante better than code savings rates to Ex-Post above code savings rates, the overall sample difference is only 1%. This difference can be attributed to the difference in equipment specifications, selection of facility type and/or difference in workpaper selection. Results by equipment type are shown in Figure A-31. Granularity was added for this comparison to be consistent with workpaper selection. Heat pumps have been split out into air source heat pumps (HP), mini-split heat pumps (MSHP) and water source heat pumps (WSHP).

Figure A-31 UHVAC Impact of Better-than-Code Realization Rate Factors



The remaining difference in energy savings can be attributed to the selection of replacement type. Ex-Post savings include only above code impacts. Results by equipment type are shown in Figure A-32.

Figure A-32 UHVAC Impact of Replacement Type



A.10.2.3. Industry Standard Analysis

To further address the implications of the DEER workpaper based energy savings rates, an analysis was performed using industry standard algorithms. Energy savings were determined for the sampled measures based on the algorithm presented in this chapter's methodology section. For this analysis, capacity and efficiency ratings were determined through desk review verification efforts. EFLH's were based on workpaper inputs. EFLH for VRF systems used heat pump EFLH, based on the availability of information from the VRF workpaper (SCE13HC036). Evaluation sample results are shown in Table A-58.

Table A-58 UHVAC Evaluation Sample Results (Industry Standard) by Strata

Stratum	Count of Measures	Program Data Ex-Ante kWh	Program Data Ex-Post kWh	Gross kWh Realization Rate
AC 1	14	31,497	30,913	169%
AC 2	7	34,960	173,432	140%
AC 3	4	123,996	12,436	129%
HP 1	2	4,324	54,982	110%
HP 2	23	49,781	78,018	145%
HP 3	16	37,157	472,770	206%
HP 4	71	230,010	148,584	165%
VRF 1	14	90,000	199,803	125%
VRF 2	15	159,647	269,382	95%
VRF 3	19	282,204	918,853	129%
VRF 4	49	710,872	30,112	115%
Total	234	1,754,449	2,389,285	136%

Industry standard analysis sample results aggregated by equipment type (AC, HP, VRF) are shown in Table A-59.

Table A-59 UHVAC Evaluation Sample Results (Industry Standard) by Equipment Type

Equipment Type	Count of Measures	Program Data Ex-Ante kWh	Program Data Ex-Post kWh	Gross kWh Realization Rate
AC	19	187,881	234,457	139%
HP	118	323,845	618,206	180%
VRF	97	1,242,724	1,536,622	124%
Total	234	1,754,449	2,389,285	136%

The large variance in savings between DEER workpaper savings rates and an industry standard analysis cannot be fully determined. For the industry standard analysis, baseline efficiencies were gathered from the 2016 California Title 24. Equivalent full load hours were pulled out of DEER workpapers where possible. EFLH for VRF used HP EFLH.

An advantage to using the industry standard analysis is that each measure does not require the categorical binning to determine a savings rate as does with the workpaper. For this analysis, The Evaluator used AHRI efficiencies and capacities to accurately represent the efficient condition.

A.10.2.4. Billing Data Analysis

Billing data was made available to the Evaluator through an online portal (MV-Web). Billing data was reviewed for all sampled measures. Two locations had sufficient billing data for a portion of the meters but not all. Two locations had sufficient data for all meters associated with the address. The remaining addresses had insufficient billing data to perform a pre/post billing regression analysis.

For the two locations with sufficient billing data, Site #1 and Site #2 did not adhere to the statistical ASHRAE requirements for r^2 when considering the parameters of CDD, Pre/Post (binary), HDD, Interactive effects, day type, and a binary value representing the start of the pandemic. The analysis for Site #1 indicated a non-routine event causing an increase in consumption in the post period that could not be identified without primary data collection. The analysis for Site # 2 did indicate a reduction in consumption equating to approximately 3% of baseline usage and therefore could not be considered statistically significant when considering the regression statistics.

A.10.3. Process Evaluation

The following sections detail the process evaluation of the UHVAC Program.

A.10.3.1. Process Evaluation Approach and Methodology

The following sections describe the evaluation approach and methodology used to perform the UHVAC Program process evaluation.

A.10.3.1.1. Document Review

The evaluation team reviewed program documents which included information on program staffing and internal organization, program process, marketing, distributors, and applications.

The staffing materials include an Upstream HVAC Program staffing and organizational chart, including position descriptions, as well as a chart for the relevant Energy Solutions team and contact information for the team.

The documents reviewed included:

- Diagrams of application processing,
- Payable invoicing,
- Receivable invoicing,
- Downstream check,
- Monthly invoice timeline,
- Proposed upstream verification,
- Replace on burnout implementation,

- and new construction process.

The participating distributor and manufacturer list included:

- Contact information with business type,
- Level of engagement,
- and other information.

The team reviewed copies of the FY 20/21 UHVAC applications that market actors submit to the program as well as marketing and outreach materials that are provided to distributors.

A.10.3.1.2. Staff Interviews

The evaluation team completed 3 staff interviews with the LADWP Efficiency Solutions team and the Energy Solutions team that implements the program. The interviews with the LADWP program and an initial interview with the Energy Solutions team took place in April and June 2021. The evaluation team conducted an additional interview with the Energy Solutions team prior to conducting market actor interviews in August 2021.

A.10.3.1.3. Market Actor In-Depth Interviews

The evaluation team completed 9 interviews with 10 staff from 9 companies, including manufacturers and distributors participating in the upstream HVAC program. These interviews took place in August and September 2021. The interviews addressed the following research questions:

- Are there opportunities to streamline processes with participating market actors? What resources, information, and/or other points of engagement could support market actors' activities?
- Is the upstream model meeting the intended objectives and outcomes per the program theory? What market changes does the program anticipate, and how will the program theory need to adapt to those changes?
- Are incentives comparable with other similar programs? Do differences impact participation or lead to leakage?
- Are incentives and program-related services sufficient to encourage market actors to promote and push qualifying equipment?
- Has the availability of the program – statewide and/or specific to LADWP – changed their manufacturing / distribution processes?
- What markets is the program reaching and serving? Are there the opportunity and/or need to expand the program reach into other commercial sectors?
- What are the characteristics of current participating market actors, and is the existing pool of market actors sufficient enough to drive participation in future years?

We spoke with 3 representatives from 2 companies that have participated in more than 100 projects per year in the 2019-2020 FY year, 2 representatives from 2 companies that participate in 10-99 projects in the 2019-2020 FY, and 5 representatives who support 7 total companies (1 representative supports 3 companies) that have participated in 0-9 projects per year. Our interviewees included 3 manufacturers' representatives, 4 distributors, 1 manufacturer, and 1 distributors representative. We spoke with 2 local companies, 4 regional companies, 2 national companies, and 1 international company.

A.10.3.2. Process Evaluation Findings

Based on the staff, implementation team, and market actor interviews, the evaluation team developed the following findings related to the research questions.

A.10.3.2.1. Overview of Program Processes

Participating distributors submit claims through the online application tool. The tool captures information on:

- The unit type and model information.
- The number of units installed and the serial numbers.
- Installation site information (location and business name).

The onsite tool allows the user to look up the equipment model and specifications, or alternatively the user can add a new model.

Additionally, feedback from participating distributors indicated that the online tool now also requires them to enter the building type.

The next step is approval of the customer and equipment for the project. For this step, Distributors use the intended installation address to verify with Energy Solutions and the project site is within LADWP's service area. LADWP staff verifies that the purchased equipment is not receiving an incentive from a downstream rebate program, but noted that because of the nature of the program, verification of the equipment installation at the site is challenging. Energy Solutions also reviews the equipment to verify that it qualifies for the program.

Once the approval is complete, the application is added to the invoice for payment. Once approved, the distributor receives payment for the unit(s). The invoice is also submitted to LADWP for review and approval.

Program staff noted that they have considered adding onsite verifications to the process but mentioned that reach customers is difficult because customers may not be aware that they participated in the program.

The program references DEER workpapers to estimate the savings of the program measures. In performing the Ex-Post analysis of the UHVAC program savings, the Evaluator found that the difference between the Ex-Ante and Ex-Post analysis were primarily due to three factors:

- Incorrect equipment specifications and replacement type
- Differences in facility type and replacement type
- Difference in workpaper applied to assess savings.

Regarding the replacement type, the Evaluator found instances where the savings estimate appears to be based on an early replacement estimate. Given the upstream design of the program, the Evaluator recommends estimating replace on burnout savings for each unit as this is a more conservative replacement scenario and establishing early replacement would be challenging.

The program had been applying effective full-load hours based on the DEER workpapers and sometimes using a weighted average representing general commercial applications by climate zone. However, the program is now collecting the project building type and we recommend applying a building type specific full-load hour estimate based on the DEER workpapers in the future.

The program implementation process incudes a step for verifying the equipment installed, however, additional attention should be paid to the equipment efficiency ratings as the Evaluator found discrepancies between the reported specifications reported specifications and the AHRI database. It is unclear if the differences are due to incorrect information in the model lookup tool on the online application or if they are due to incorrect entries made when a new model is added.

A.10.3.2.2. Market Actor Participation and Satisfaction

Among participating or affiliated market actors, the level of participation in the program varies, most predominantly due to the extent to which the program is incorporated into the distributor's business model, scope of the distributor territory, and the project type.

Factors that influence participation include:

- **Customer and project type:** Across interviews, we heard that the program worked best, and/or participation was easiest, for plan-and-spec jobs. In these situations, the distributor/manufacturer has the time to confirm the address and establish site eligibility as well as confirming equipment eligibility and incentive amount. Situations where there was an emergency replacement were more challenging as the distributor might not have the address of the install or might not have a viable unit in stock or have the time to upsell a more efficient unit.
- **Level of incorporation into business model:** Some participants relied on the incentive dollars when bidding projects and were actively coordinating with the program team to ensure that projects were eligible. Other, often less-active participants would rely on the program incentives as a 'bonus' to offer their customers and to get a sale. In one instance, the market actor shared the challenge that the time to complete and submit the application was oftentimes not worth the incentive value. This individual's key performance indicators were based on sales and incorporating the program into her practices could have the effect of reducing sales.
- **Experience:** For some participants with relatively few projects in the LADWP territory, the program participation process was more challenging because it was less familiar to them. In some cases, their sales reflected the broader needs of the territory they served, even if that meant stocking or selling equipment that was not eligible for the LADWP program.

  "These programs are a nice way to highlight the things we do that the competition does not, but at the end of the day, I don't get paid any more or less for participating in these programs. Just an added sell feature to our customers."

Program experience varies widely, and those who participate more expressed higher satisfaction with the program.

Interviews revealed a relationship between support, communication, satisfaction, and level of activity in the program. Those market actors who were more active in the program expressed high satisfaction as well as receiving the support they received from the implementation team, comparing them favorably to other utility program implementers. Conversely, distributors and manufacturers who participated less frequently were less satisfied with the program, including support provided by the implementation team, and specifically noted an absence in communication. It is hard to know the causation; whether lower satisfaction affected level of participation, or if those less active market actors are not as visible and do not receive the same level of support as those more active. Regardless, this finding indicates a segment of the market actor group where it could be beneficial to target for enhanced support and communication.

> *"I don't have any communications from LADWP. We operate around the country, so if we have a program like this, where there's no communication from the PM, there might be another program that seeks a little bit more participation. There is the unfortunate ability for it to be kind of out of sight, out of mind." – Rep of a company that did few projects in FY 2020-2021.*

A.10.3.2.3. Communication with LADWP

Market actors wanted more communication with the Department in terms of measure mix and incentive amounts and prospective changes to either.

Several market actors we spoke with expressed a desire to communicate more directly with the department about the incentive amount or measure mix. In some cases, these distributors and manufacturers described new equipment they offered that they hoped to see incorporated into the program; in other cases, they asked for more explanation or rationale around why the measure mix had changed or what the incentive amounts were. Although we heard this sentiment from several market actors, it was more strongly articulated by those who were less well-connected with Energy Solutions. That is, in some cases, the market actors had a close relationship with Energy Solutions and felt they were well supported on a "two-way" street where they were able to share their feedback on the program as well as get insight into program changes from the implementation team. The desire for more communication often came from those who had less of a strong relationship with the Energy Solutions team.

Participants also noted that project timelines could extend over multiple years due to the nature of the large commercial jobs they worked on. The estimated time between design to installation for a commercial HVAC project is months to years. This meant that distributors might wait years between initially submitting a proposal with a specific price attached, and then being able to submit for the application. Several market actors described situations where the rebate amount or product eligibility had changed between when they scoped a project and when they were able to submit the rebate application. In these cases, they had to absorb the cost of the lost rebate. In some cases, this sense of risk left distributors unable to rely on incentive consistency, resulting in some hesitance around the program. Additional communication around potential changes to incentive amounts or eligible measures could support these participants.

> *"The longer timeline projects are the larger projects, which are the most rebate-intensive as far as overall total dollar amount, so we can find ourselves in a bind. The problem we have with the rebate programs is they're changing the rebates regularly, so we can get approval for a rebate at the beginning, and by the time we actually apply for the rebate again several years later, sometimes the whole program could have changed and that's a problem. It's a real gamble. We're also facing equipment class cost increases so we get hit from both sides, we expected this equipment cost and we expected this rebate and all of a sudden, the equipment cost is higher and the rebates lower and we're the ones caught holding the bag."*

> *"Why are certain products available and others aren't in the program? I guess I don't fully understand why they took away some and kept some in there. I don't understand where the dollar amounts come from either, I understand that they get reduced every year, but I don't know what's the determining factor in that."*

A.10.3.2.4. Program Incentives

The LADWP incentives are higher than the statewide incentives but do not affect stocking decisions.

The LADWP program is one of several similar upstream programs in the region, and market actors compare these programs. The higher incentive amounts and additional eligible measures in LADWP's program ensure that where possible, distributors/manufacturers will apply for a rebate through that program. However, when making stocking decisions, they may not use the LADWP product list as a basis for their decisions, instead using the statewide programs measure list to make stocking decisions.

Participants appreciated that the LADWP incentives were higher than the statewide program incentives, however, in some cases, the participant would price and stock units according to the eligibility criteria and incentive amounts of the statewide program, with the higher incentives for projects within the LADWP territory being seen as a "bonus." At least one participant, however, noted that when they thought a project might be eligible for the LADWP program, they would apply for the rebate, but, if they found out it wasn't in LADWP territory, they said it "wasn't worth it" to go through the process of participating in the statewide program because the incentives were so low. This suggests that the LADWP program is having an impact in driving the sales of efficient commercial HVAC equipment within their territory.

> *"LADWP incentive amounts are higher, so I will always submit to LADWP and then if it somehow gets rejected because it's outside that LADWP zip code line, then I go back and submit it to the statewide program so at least we get something. But I did a comparison between the two, and there can be huge differences, like more than 50% differences in dollar amounts."*

> *"The big problem with the statewide program structure right now is that the product mix is not as beneficial for commercial based programs and driving drastic market transformation. It's built for transformation over a factor of 5-10 years because of the measures, but it's not going to see the instant kind of response that LADWP should have given the product mix."*

The LADWP incentives support VRF installations in the region, which are not covered under the statewide program.

Additionally, participants expressed appreciation that the LADWP program continues to provide incentives for VRF systems, which are often a good option for commercial properties and are no longer eligible in the statewide program.

> *"I'd say the program is really important with certain products. For example, VRF is on the expensive side compared to other products, but with the rebate, it helps us to minimize that difference and to help us push the technology further along."*

Participating distributors and manufacturers are generally satisfied with the program and incentive amounts.

Participating distributors and manufacturers reported satisfaction with the program, the incentive amounts, and the list of eligible equipment. However, participants noted several factors that limit the impact of the program including:

- Incentive amounts have declined in recent years, which has impacted the ability for distributors and manufacturers to recommend the most efficient equipment at a comparable price to code minimum equipment. Many of the distributors and manufacturers we spoke with described situations where customers were looking for the lowest cost unit. Although generally the feedback on the rebate levels of the LADWP program was very positive, the incentives are not adequate to substantially off-set the incremental cost above code minimum equipment.
- One distributor noted that another barrier to participation was the requirement to submit the building address where the equipment would be installed. He acknowledged that this was unlikely to change and understood the requirement but did note that some contractors purchasing package units declined to provide the install address, thus precluding them from submitting the incentive.

> *"The incentive has gone down. Even though LADWP is still robust, it is not robust enough to sell a high efficiency unit for the same price as a standard efficiency – the gap is too far."*

> *"The rebates have changed over the past few years, quite significantly. They do help offset the initial increasing costs for customers. Using the rebates to help offset those first costs is definitely beneficial."*

A.10.3.2.5. COVID-19 Impacts

The COVID-19 pandemic impacted program participation and the commercial HVAC market in general.

Participants consistently noted that the COVID-19 pandemic impacted their participation in the program in 2020, primarily because they noted slow-downs in large construction projects and subsequent demand for commercial HVAC equipment. In several cases, they noted that projects already financed and underway continued (which contributed to the program meeting its goals in 2020), but that there was a halt on new construction projects for several months, which led to a slower 2021 in terms of program project completion. Several market actors noted that 2021 had been a substantially better year for their business, but that prices were higher due to a steel shortage, and that wait times were longer. Distributors and manufacturers noted that their customer's budgets were often tighter as customers were managing with shortfalls and lockdown combined with the increased cost (due to steel shortages and other supply chain issues). As a result, they were seeing less interest in higher-priced efficient equipment and a preference for equipment with a lower first cost.

The supply chain shortages also impacted stocking. In at least one case, the person said that they kept no stock on hand because of these shortages. We heard that that some segments were more hard-hit by the COVID shutdowns, particularly the hospitality sector, which impacted their sales and program participation.

> *"The pandemic has affected our work. We've been doing a lot of service work and maintenance work and repairing work, but not delivering new equipment. COVID has hurt business, that's for sure. Not specifically incentive type stuff, but incentive stuff is down because business is down."*

> *"Before COVID, people were really open to looking at options, especially if I was going to give them a discount. But now everyone just wants to get the cheapest piece of equipment as possible. There's a huge drop in the commercial market to begin with, because businesses have been closed."*

A.10.3.2.6. Other Observations

Participants apply the incentive in a variety of ways and are not consistently passing on the incentive to end customers, which is consistent with the program design. Relatedly, the gap between design to installation for commercial HVAC projects presents a barrier for market actors relying on the incentive when bidding.

Across the participants we spoke with, we heard some say that they used the incentive to lower the cost to the contractor or the end customer and typically passed on the full amount of the incentive to their customers. Others passed on some of the cost, while holding some to cover additional administrative costs affiliated with the program. Still others did not integrate the incentive into their pricing at the project level, using it instead to cover training, marketing, and other activities that enabled them to sell higher efficiency equipment at a competitive price.

Views on participation logistics vary. While the timing of the program onboarding and rebate processing were viewed positively, the online application was viewed from positively to challenging.

We heard generally positive experiences about the program onboarding process. Customers noted that the rebate processing time was adequate once an application was submitted. One market actor had experienced a decrease in the time it took for ES to process the incentive, which they viewed positively. Some market actors shared their challenges with the online portal or other application submission experience. The experience for participants does not appear to be consistent, nor does the support that participants receive from the Energy Solutions team. One person noted that the ES team would provide them a clear list of what products were eligible for the rebates, while another distributor noted that they had to put it in the systems and check manually to see if a particular product was eligible. One participant noted that the new online portal was slightly more cumbersome than the previous, because it required more clicks to identify where an application was in the submittal process and/or to identify why an application had been rejected. The portal now requires additional information about building type which this respondent found laborious and, in some cases, challenging to identify (they noted that “food store” and “grocery” are different categories). However, this same person noted that the incentive processing time seemed to have shortened, which they appreciated.

> *“The process of the incentive program is so streamlined and makes so much sense. Once the submission is done, you can go back and see which applications were submitted, rejected, approved, or pending. It shows the dollar amount for each one, you can export it to Excel for the check number, you can look up application by a number, it's easy to make changes or corrections. The team is so attentive, they usually process payment quickly. I don't know if it's just because the team is so great that makes the program one of my favorite programs, or maybe because I've worked with that program the longest, so it just everything seems so simple to me for that program.”*

A.10.3.2.7. Recommendations

- **Create additional opportunities for connection with market actors.** We heard from market actors that they are interested in additional conversation and support from the program and the implementation team. Several market actors requested more two-way communication to understand the rationale for why incentives change, or measures were dropped and/or to be able to provide recommendations around measure mix. While the evaluation team understands that the decisions around measure eligibility and incentive amount have to do with broader portfolio planning and cost-effectiveness, the upstream program relies on the participating market actors as partners, and this feedback suggests that there is opportunity to cultivate an experience of partnership across participating market actors.
  - For example, customers expressed a desire for additional communication around incentive values and any upcoming changes to incentives.
  - Several market actors shared experiences where they bid on a project with the expectation of an incentive for a given piece of equipment, but by the time the equipment was installed, the incentive amount had decreased, or the equipment was no longer eligible for a program incentive. The program may consider providing a larger window of notice around upcoming changes to the incentive amount or measure mix.
- **Assess program process to ensure that the experience is similar for high and low participating market actors.** The interviews with market actors suggest that there are significant differences in the level of support and interaction market actors experience from the program administration team. In our interviews, these differences were correlated with level of participation, where more highly participating market actors expressed greater support and interaction from the ES team than did less frequent participating market actors.

A.11. CRP

This section details the impact evaluation and process evaluation for the Consumer Rebate Program (CRP) that LADWP offered customers during FY 20/21. The primary objective of this evaluation was to calculate energy savings and peak demand impacts attributable to the Program, as well as complete a process evaluation.

A.11.1. Evaluation Methodology

The Evaluator completed the following types of data collection for the impact evaluation:

Table A-60 CRP Program Data Collection

Data	Source
Program tracking data	Data requests to LADWP for all measure level program tracking data
Program participant surveys	Survey administered to a sample of program participants via email contact information
Recipient and control group billing data	Data requests to LADWP for all relevant billing data in the study period
Participation in other LADWP programs	Data requests to LADWP for all residential program participation in the study period
Recipient and control group customer data	Data requests to LADWP for other customer information (e.g., demographics, contact permissions)
Participant site visits	Site visit to verify equipment installation

A.11.1.1. Tracking Data Review

Program data aggregated at the measure level was obtained from the ESP database platform, the cloud based IT platform hosted by the Energy Savings Platform, Inc. (ESP) provider. The ESP data was formatted as aggregated measure level data. Also, program participant tracking data was sourced from spreadsheet data in Excel files provided securely by LADWP.

Table A-61 CRP Program Tracking Data Sources

Workbook File Name	Participant Records
Energy Savings Platform (ESP) export	NA
CRP_07.2020-05.2021 with Equity Metrics.xlsx	NA
CRP_07.2020-05.2021.xlsx	23,023
CRP_Jun 2021 with Equity Metrics.xlsx	2,375
Dashboard CRP_Jun 2021 Equity Metrics.xlsx	NA

A.11.1.2. M&V Sample Design

Field data collection consisted of online participant surveys and in-home data collection. Savings were evaluated via billing analysis and engineering desk reviews for the program measures. The approach the Evaluator used to determine Ex-Post kWh savings and Ex-Post peak kW reduction for the CRP was based on statistical analysis of billing data for the weather sensitive measures of cool roofs, central air conditioners, central heat pumps, and variable speed swimming pool pumps with motors. Engineering desk reviews were completed for whole house fans and dual pane windows.

Participant information from the tracking data was cross referenced to LADWP account data to determine which account holders were willing to be contacted. The email address for those that did not have a "no contact" flag was aggregated by their installed measure from the CRP tracking data.

Table A-62 CRP Sampling Method by Measure

Strata	Sampling	Sample
Attic Insulation	Billing analysis	Qualified census*
Central Heat Pump	Billing analysis	Qualified census*
Cool Roof	Billing analysis	Qualified census*
Dual Pane Windows	Desk review	Census
Pool Pump Replacement	Billing analysis	Qualified census*
Whole House Fan	Desk review	Census

*Census qualification for billing analysis Section A.11.1.6

A.11.1.3. Baseline Assumptions Review

The following sections detail the baseline assumptions review for each measure offering in CRP.

A.11.1.3.1. Attic Insulation

The Ex-Ante savings method binned the baseline to insulated and uninsulated spaces by building type and climate zone with corresponding deemed savings values per square feet of insulation. The Ex-Post baseline was indifferent to individual baseline conditions by aggregating all samples by building type and climate zone in the billing analysis.

A.11.1.3.2. Central Air Conditioner, Central Heat Pump

The Ex-Ante savings method binned the baseline to building type and climate zone with corresponding deemed savings value. The Ex-Post baseline was indifferent to individual baseline conditions by aggregating all samples by building type and climate zone in the billing analysis.

A.11.1.3.3. Cool Roofs

The Ex-Ante savings method binned the baseline to building type and climate zone with corresponding deemed savings values per square feet of roof area. The Ex-Post baseline was indifferent to individual baseline conditions by aggregating all samples by building type and climate zone in the billing analysis.

A.11.1.3.4. Dual Pane Windows

The Ex-Ante savings method was indifferent to the baseline, with measures binned to climate zone. The Ex-Post savings method considered the baseline as single pane window, typical window properties, and savings by climate zone.

A.11.1.3.5. Pool Pumps

The baseline pool pump and motor were a two speed motor as directed by CA Title 20, but recently the Federal Standard also changed as of July 2021, requiring pool pump and motors to meet a minimum weighted energy factor (WEF). In most applications, this WEF can only be met with a variable speed drive. The Evaluator assumed the sell through period would approach a duration of one year, so the two speed baseline was maintained for the FY 20/21 program year, but will advance to the minimum WEF value for evaluation of the FY 21/22 program year.

A.11.1.3.6. Whole House Fan

Both the Ex-Ante and Ex-Post baseline was a home without a whole house fan.

A.11.1.4. Ex-Ante Savings Review

The Ex-Ante data review had three objectives. The first was to compare the tracking data energy savings to the aggregate measure level energy savings in ESP. Then, to compare the number of units and incentive cost to the ESP data to determine inclusion in the impact analysis. Finally, to review the available measure data fields used by the program to estimate energy savings and peak demand reduction.

The comparison of energy, demand, and quantity values between the Ex-Ante data from ESP and tracking data is summarized in Table A-63. The incentive dollars were equal for all measures. The energy savings were equal for three measures and less than 1% difference for the remaining measures.

Table A-63 CRP ESP to Program Tracking – Savings Comparison

Measure	Energy (kWh)		Incentive ($)		Quantity	
	ESP Data Ex-Ante	Program Data Ex-Ante	ESP Data Ex-Ante	Program Data Ex-Ante	ESP Data Ex-Ante	Program Data Ex-Ante
Attic Insulation*	3,869,182	3,892,794	25,592,327	25,592,327	25,592,327	25,753,228
Central AC	92,123	92,368	103,210	103,210	250	251
Central Heat Pump	11,448	11,448	8,600	8,600	27	27
Cool Roof*	624,801	625,475	301,095	301,095	1,420,002	1,421,535
Dual Pane Windows*	4,373	4,373	19,876	19,876	9,938	9,938
Pool Pump/Motor	3,952,326	3,952,712	2,360,000	2,360,000	4,720	4,720
Whole House Fan	848	848	400	400	2	2
Total	8,555,100	8,580,018	28,385,508	28,385,508	27,027,266	27,189,701

Quantities of installed equipment measured in square feet

A.11.1.5. M&V Approach: Engineering Analysis

The Evaluator used engineering-based equations to calculate energy savings and peak demand reduction for dual pane skylights and windows and whole house fans. The following sections provide calculation details for each type of equipment.

A.11.1.5.1. Dual Pane Skylights and Windows

For the Ex-Post savings, the Evaluator utilized a deemed per square foot savings value, by climate zone, and the product of the installed square feet of windows and the ISR, see Equation A-16 and Table A-64.

$$\text{kWh} = \frac{kWh_{CZ}}{sf}\ x\ SF\ x\ ISR \qquad \textit{Equation A-16}$$

Table A-64 *CRP Dual Pane Skylights and Windows Savings Algorithm Inputs*

Variable Name	Input	Source	Value Range
kWh, kW	Measure savings per home	Algorithm	348-479 kWh
kWh_{cz}/sf	Measure savings per square feet of window, skylight	Workpaper table	2.4-5.0 kWh/SF 0.003-0.006 kW/SF
SF	Square feet	Tracking data	48 – 980 SF
ISR	In Service Rate	Participant Survey, 2021	100%

A.11.1.5.2. Whole House Fan

For the Ex-Post savings, the Evaluator utilized a deemed savings per unit value based on the type of efficient motor, the number of air changes by the whole house fan and the climate zone. Public LA Open Data records were sourced for the home square feet and model product data for the type of fan and the maximum CFM per fan, see Equation A-17 and Table A-65.

$$\text{kWh} = \frac{kWhsavings}{CFM} x\ CFM\ x\ \frac{1}{Home\ SF} x\ ISR \qquad \textit{Equation A-17}$$

Table A-65 *CRP Whole House Fan Savings Algorithm Inputs*

Variable Name	Input	Source	Value Range
kWh, kW	Measure savings per home	Algorithm	348-479 kWh 0.134-0.810 kW
kWhsavings/CFM	kWh savings/CFM, home size and climate zone	Manufacturer Spec Sheet-Motor Type & CFM; Climate Zone; LA Open Data Portal-Home SF	0.8-4.2 CFM/SF
CFM	Fan rated air flow	Mfg. specification sheet	2000-7000 cfm
Home SF	SF of home	LA Assessor Data Open Portal	1064 – 4063 SF
ISR	In Service Rate	Participant Survey, 2021	100%

A.11.1.6. M&V Approach: Billing Analysis

The Evaluator performed a billing analysis to evaluate the energy savings for the attic insulation, central air conditioner, central heat pump, cool roof, pool pump and motors, and certified-install pool pump and motor measures. The pool pump and motor measures used a pooled billing data regression while the HVAC-related measures (attic insulation, central air conditioner, central heat pump, and cool roof) were evaluated using a billing data retrofit isolation approach.

A.11.1.6.1. Billing Data Regression

This section describes the pooled billing data regression approach with a propensity score matched (PSM) comparison group used to evaluate the pool pump and motor and certified-install pool pump and motor measures.

Billing Data Preparation

LADWP provided both participant and non-participant bi-monthly billing data. Because billing periods varied across participants and did not correspond to the start and end of calendar months, all billing data was calendarized. To accomplish this, the Evaluator first calculated an average daily kWh for each customer bill as represented by Equation A-18.

$$Average\ Daily\ kWh = \frac{Total\ kWh}{Number\ of\ Days} \qquad \text{Equation A-18}$$

The average daily kWh was then multiplied by the number of days in each respective calendar month of the respective bill. For example, for a bill starting on January 15th and ending on March 14th, the average daily kWh would be multiplied by 17 to calculate the bill's January consumption, 28 for February, and 14 to calculate consumption in March. The portions corresponding to each given period in a calendar year would then be summed across for each participant to ascertain that customer's total monthly kWh.

It should be noted that, given billing data is measured at a monthly or lower resolution, there are customer bills which contain both pre and post data. These customer bills and any months that contain calendarized data from these bills were removed from the analysis to prevent savings suppression.

After calendarizing the data set, data was then filtered for the following criteria:

- Participants must have a populated installation date. The Evaluator noted that of the 2,429 participants across both measures, only 650 participants had installation dates reported in the tracking data.
- A simple outlier filter of the mean participant average daily kWh plus or minus three times the standard deviation of the participant average daily kWh was applied to both participant and non-participant data.
- To have a consistent pre-treatment period for PSM, participants and non-participants must have 12 months of pre-treatment data. For pool pump and motors, this period was set to between July 2018 to June 2019. For certified pool pump and motors, this period was set to between April 2018 and March 2019.
- Participants and non-participants must not have participated in any other energy efficiency programs administered by LADWP from the date of their measure installation date and beyond and must not have installed any additional measures via the CRP program.

- Non-participants must have a pool, as reported in the LA County Assessor database.

The number of qualified participants remaining in the data set after filtering for the above criteria are provided in Table A-66.

Table A-66 CRP Pool Pump and Motor Participant Count

Measure	All Participants	Qualified Participants	All Non-participants with Billing Data	Qualified Non-participants
Pool Pump and Motor	465	84	358,577	15,834
Certified-Install Pool Pump and Motor	1,964	424	358,577	16,084

For all remaining participants in the participant and non-participant pool, the zip code for each customer's service address was geolocated to an approximate latitude and longitude and historical weather data was obtained through NOAA for the nearest weather station.

Propensity Score Matching (PSM)

The Evaluator utilized PSM to develop a comparison group from the non-participant pool. The Evaluator developed five pre-treatment variables for use in the PSM:

- The average daily kWh annually,
- The average daily kWh for winter (December through February),
- The average daily kWh for spring (March through May),
- The average daily kWh for summer (June through September), and
- The average daily kWh for fall (October through November).

Because the non-participant pool does not have established treatment start dates, the Evaluator reviewed the billing data to determine an optimal pre-treatment period for PSM. For pool pump and motors, this period was set to between July 2018 to June 2019. For certified pool pump and motors, this period was set to between April 2018 and March 2019

Using the five pre-treatment variables, latitude, and longitude; the Evaluator executed a nearest neighbor PSM using the “MatchIt 4.1.0” package in the software “R 3.6.3.” The Evaluator selected a one-to-one participant-to-comparison match due to lack of equivalence when attempting a one-to-multiple matching. After executing the PSM, the Evaluator compared the participant group and the comparison group on several metrics to ensure a good match.

The Evaluator performed a MANOVA in “R 3.6.3” using default settings (Pillai’s trace) on the five pre-treatment variables to ensure similar distributions on all five variables. The results are presented in Table A-67. The distributions did not significantly differ between the participant group and the comparison group, suggesting a good PSM.

Table A-67 CRP Pool Pump and Motor Pre-Treatment MANOVA

Measure	Pillai's Trace	F-statistic	Num DF	Den DF	P-value
Pool Pump and Motor	0.008	0.254	5	162	0.937
Certified-Install Pool Pump and Motor	0.006	0.953	5	842	0.446

After reviewing the results of the MANOVA, the Evaluator then performed a series of T-tests on the average daily kWh in the pre-treatment period by month. Because nearest neighbor matching pairs participants with their respective nearest comparison group match, the Evaluator established pseudo-treatment start dates for all comparison group customers based on their participant matches. Thus, the Evaluator used the 12 months prior to the treatment start date as the pre-treatment period for this comparison.

The results of the T-tests are presented in Figure A-33. The Evaluator considered matching successful if the number of months that were significantly different between the participant and comparison groups did not exceed two at the 95% confidence level. The Evaluator established a two-month tolerance band to account for the probability that repeated T-testing on panel data may result in any given month resulting in a significant difference-40% for two out of 12 months. The PSM did not exceed this tolerance band for any of the fiscal years.

Figure A-33 CRP Pool Pump and Motor Pre-Treatment Equivalency

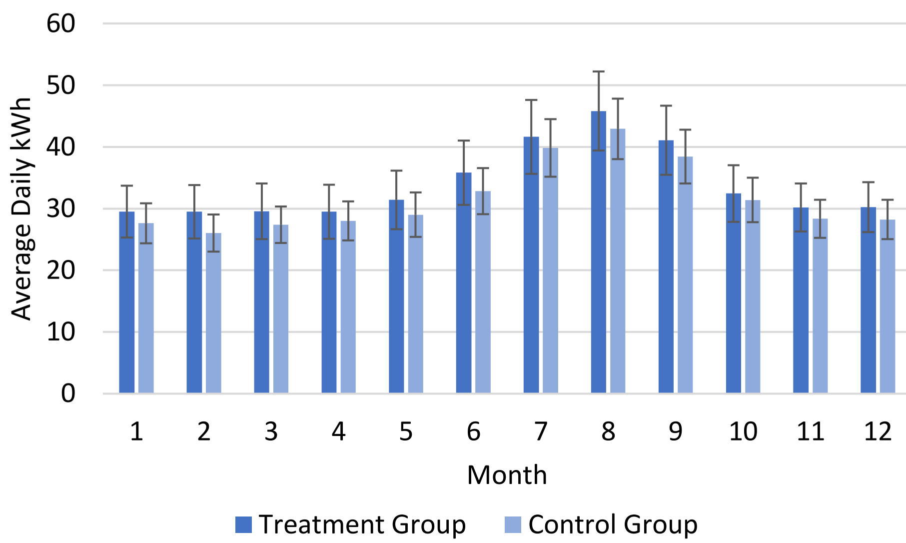


Table A-68 CRP Pool Pump and Motor Pre-Treatment T-test

Month	Participant Group (Average Daily kWh)	Non-Participant Group (Average Daily kWh)	T-value	P-value
1	29.505	27.635	-0.694	0.488
2	29.488	26.034	-1.286	0.201
3	29.566	27.396	-0.792	0.430
4	29.502	28.012	-0.543	0.588
5	31.410	29.000	-0.799	0.425
6	35.819	32.837	-0.918	0.360
7	41.630	39.848	-0.462	0.645
8	45.827	42.941	-0.704	0.483
9	41.078	38.445	-0.732	0.465
10	32.446	31.400	-0.354	0.724
11	30.171	28.365	-0.717	0.474
12	30.215	28.241	-0.754	0.452

Figure A-34 CRP Certified Pool Pump and Motor Pre-Treatment Equivalency

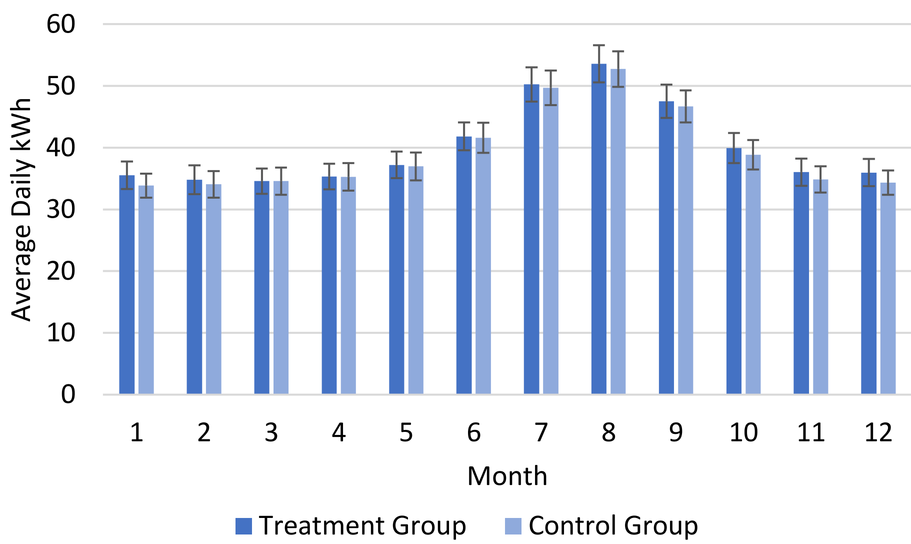


Table A-69 CRP Pool Pump and Motor Pre-Treatment T-test

Month	Participant Group (Average Daily kWh)	Non-Participant Group (Average Daily kWh)	T-value	P-value
1	35.508	33.858	-1.095	0.274
2	34.810	34.067	-0.459	0.646
3	34.589	34.577	-0.008	0.994
4	35.329	35.269	-0.039	0.969
5	37.208	36.963	-0.154	0.878
6	41.829	41.602	-0.135	0.893
7	50.247	49.692	-0.276	0.782
8	53.585	52.741	-0.399	0.690
9	47.520	46.697	-0.431	0.666
10	39.944	38.864	-0.620	0.536
11	36.034	34.848	-0.764	0.445
12	35.968	34.324	-1.093	0.275

The final participant count for the participant and comparison groups are presented in Table A-70.

Table A-70 CRP Pool Pump and Motor Final Sample Size

Measure	Participant Group Size	Non-participant Group Size
Pool Pump and Motor	84	84
Certified-Install Pool Pump and Motor	424	420

Degree Day Base Optimization

After developing the participant and non-participant group, the Evaluator used historical weather data to optimize the heating degree day (HDD) and cooling degree day (CDD) bases for each customer. HDDs were calculated using 50-, 55-, 60-, and 65-degree bases. CDDs were calculated at 65-, 70-, 75-, and 80-degree bases.

The regression equation to determine CDD/HDD fit is specified by Equation A-19:

$$Average\ Daily\ kWh_i = \alpha + \beta_1 \cdot post + \beta_2 \cdot CDD_{i,n} + \beta_3 \cdot HDD_{i,n} + \beta_4 \cdot CDD_{i,n} \cdot post + \beta_5 \cdot HDD_{i,n} \cdot post + \varepsilon$$

Equation A-19

Where:

- i represents each individual customer for each month,
- n represents each iteration of base pairs,

- $post$ is an indicator variable indicating whether the period is in the post or pre period,
- $CDD_{i,n}$ is the CDD calculated for iteration *n* for customer *i,*
- $HDD_{i,n}$ is the HDD calculated for iteration *n* for customer *i,*
- α is the intercept term,
- β_1 is the main effect of the post period,
- β_2 is the main effect of CDD,
- β_3 is the main effect of HDD,
- β_4 is the additional effect of CDD on the post period,
- β_5 is the additional effect of HDD on the post period, and
- ε is the error term.

For each customer, all 16 combinations were tested to determine which combination provided the best fit. The pair of CDD and HDD bases that provided the highest adjusted R-squared for each customer was selected as that customer's respective CDD and HDD base.

Regression Model

To estimate participant savings, the Evaluator used a post-period regression with pre-period control variables. This model isolates the post-treatment period and uses customer-specific variables generated from the pre-treatment period to control for individual variation. The Evaluator developed four pre-treatment variables for use in the regression:

- The average daily kWh for winter (December through February),
- The average daily kWh for spring (March through May),
- The average daily kWh for summer (June through September), and
- The average daily kWh for fall (October through November).

The regression equation is specified by Equation A-20.

$$\begin{aligned} Average\ Daily\ kWh_i &= \alpha + \beta_1 \cdot treatment + \beta_2 \cdot CDD_i + \beta_3 \cdot HDD_i + \beta_4 \\ &\cdot CDD_i \cdot treatment + \beta_5 \cdot HDD_i \cdot treatment + \beta_6 \\ &\cdot pre\ usage\ winter_i + \beta_7 \cdot pre\ usage\ spring_i + \beta_8 \\ &\cdot pre\ usage\ summer_i + \beta_9 \cdot pre\ usage\ fall_i + \beta_{10} \\ &\cdot month_1 + \cdots + \beta_n \cdot month_{12} + \beta_{n+1} \cdot month_1 \\ &\cdot pre\ usage\ winter_i + \cdots + \beta_{n+x} \cdot month_{12} \\ &\cdot pre\ usage\ fall_i + \varepsilon \end{aligned} \quad \textit{Equation A-20}$$

Where:

- i represents each individual customer for each month,

- $treatment$ is an indicator variable indicating whether the customer is in the participant or comparison group,
- CDD_i is the CDD calculated for iteration *n* for customer *i,*
- HDD_i is the HDD calculated for iteration *n* for customer *i,*
- $pre\ usage\ winter_i$, $pre\ usage\ spring_i$, $pre\ usage\ summer_i$, and $pre\ usage\ fall_i$ are the customer-specific pre-treatment control variables,
- $month_1$ through $month_{12}$ are indicator variables indicating if the month is January through December,
- α is the intercept term,
- β_1 is the main effect of the program participation,
- β_2 is the main effect of CDD,
- β_3 is the main effect of HDD,
- β_4 is the CDD-dependent effect of program participation,
- β_5 is the HDD-dependent effect of program participation,
- β_6 through β_9 are the main effects of pre-treatment consumption,
- β_{10} through β_n are the main effects of month,
- β_{n+1} through β_{n+x} are the interactive effects of month and pre-treatment consumption, and
- ε is the error term.

The regression coefficients of interest for estimating savings are β_1, β_4, and β_5. Table A-71 through Table A-72 provide information regarding the regression coefficients for each model and the overall model fit.

Table A-71 CRP Pool Pump and Motor Regression Coefficients

Term	Regression Coefficient	Standard Error	T-value	P-value	Adjusted R-squared
Treatment	-3.078	1.971	-1.562	0.118	0.666
Treatment x HDD	0.093	0.323	0.289	0.772	0.666
Treatment x CDD	-0.003	0.354	-0.007	0.994	0.666

Table A-72 CRP Certified Pool Pump and Motor Regression Coefficients

Term	Regression Coefficient	Standard Error	T-value	P-value	Adjusted R-squared
Treatment	-2.139	1.121	-1.909	0.056	0.710
Treatment x HDD	-0.070	0.193	-0.361	0.718	0.710
Treatment x CDD	-0.017	0.135	-0.124	0.902	0.710

The savings for each fiscal year were then calculated using the formula presented in Equation A-21.

$$
\begin{aligned}
&Annual\ Savings \\
&\qquad = [Treatment\ Coefficient \\
&\qquad + (Treatment\ x\ CDD\ Coefficient\ \cdot \overline{CDD}) \\
&\qquad + (Treatment\ x\ HDD\ Coefficient\ \cdot \overline{HDD})] \cdot -1 \\
&\qquad \cdot 365.25
\end{aligned}
\qquad \textit{Equation A-21}
$$

Where:

- $\overline{CDD}$ is the average daily CDD for a typical weather year, and
- $\overline{HDD}$ is the average daily CDD for a typical weather year.

HDDs and CDDs were weighted relative to the nearest weather stations for the participants in each program year using TMY3. These weighted values are presented in Table A-73.

Table A-73 CRP Pool Pump and Motor Weighted Average TMY3 HDD and CDD

Measure	Average Daily HDD	Average Daily CDD
Pool Pump and Motor	2.208	1.569
Certified Pool Pump and Motor	2.519	1.926

Savings per household with 90% confidence intervals and relative precision at the 90% confidence level are presented in Table A-74.

Table A-74 CRP Pool Pump and Motor Weighted Average Savings per Household

Measure	Annual kWh Savings	90% Confidence Interval		Relative Precision (90% CL)
		Lower Bound	Upper Bound	
Pool Pump and Motor	1,050	298	1,802	72%
Certified Pool Pump and Motor	857	424	1,291	51%

A.11.1.6.2. Billing Data Retrofit Isolation

To evaluate HVAC-related strata (attic insulation, central air conditioner, central heat pump, and cool roof), the Evaluator used a billing data retrofit isolation approach. Several considerations were made prior to selecting the retrofit approach over a PSM regression analysis. Results from the 2019 Residential Appliance Saturation Survey (RASS) suggest a volatile saturation of central HVAC equipment in LADWP service territory (only 10.2% to 37.8% of residential customers have electric space heating depending on building type; only 20.4% to 69.3% of residential customers have central space cooling depending on building type). This renders a PSM inappropriate as there is a high probability that comparison customers selected via PSM may not have comparable equipment installed despite being matched based on energy consumption.

Despite the advantages of using the PSM method to measure savings for HVAC-related strata, one inherent disadvantage stems from the increased variability associated with the arithmetic transformations to the billing data necessary to perform this analysis. Therefore, for measures in which a statistically significant impact could not be calculated using FY 20/21 data alone, data from FY 15/16 through FY 19/20 was used to supplement the retrofit isolation approach.

Billing Data Preparation

LADWP provided participant bi-monthly billing data. As with the procedure described with the billing data regression analysis, customer billing data was first calendarized from billing periods to calendar years. After calendarization, customer billing data was filtered for the following criteria:

- The Evaluator reviewed the post-installation data for each measure to determine the optimal post-installation period for each measure. For Attic Insulation and Central Heat Pump, the optimal post-installation period was determined to be October 2020 through September 2021. For Central Air Conditioner and Cool Roof, the optimal post-installation period was determined to be September 2020 through August 2021. In all cases, participants were filtered for those participants that had a full 12 months of post-installation data.
- For Attic Insulation and Cool Roof, pre-installation data was reviewed to determine the optimal pre-installation period for each measure. For Attic Insulation, the optimal pre-installation period was determined to be January 2019 through December 2019. For Cool Roof, the optimal pre-installation period was determined to be December 2018 through November 2019. In all cases, participants were filtered for those participants that had a full 12 months of pre-installation data.
- Participants must not have taken part in any other energy efficiency programs administered by LADWP during the five-year Retrospective Period (FY 15/16- FY 19/20).
- Participants must not have taken part in the CRP program across multiple program years.
- Participants must not have installed multiple types of CRP program measures.
- Participants with apparent photovoltaic generation, as noted by the appearance of negative billing data, were excluded from analysis.
- Central Heat Pump did not have enough participants in FY 20/21 to perform an independent billing analysis (26 participants). Therefore, Retrospective data from FY 15/16 through FY 19/20 was appended to the FY 20/21 data set to evaluate the savings of the measure.

The number of participants remaining in the data set after filtering for the above criteria is provided in the following table:

Table A-75 CRP Attic Insulation, CAC, CHP, and Cool Roof Participant Count

Strata	Number of Participants	Final Sample Size
Attic Insulation – MF	922	263
Attic Insulation – SF	18,925	7,268
Central Air Conditioner	217	77
Central Heat Pump	169	73
Cool Roof	462	137

The zip code for each customer's service address was geolocated to an approximate latitude and longitude and historical weather data was obtained through NOAA for the nearest weather station.

Weather Normalization

After preparing the billing data, the Evaluator proceeded to normalize the billing data. From the candidate HDD and CDD bases, the base pair that provided the best adjusted R-squared was selected as the HDD and CDD base for that individual customer based on the equation provided in Equation A-22. It should be noted that for Central Air Conditioner and Central Heat Pump, the weather normalization regression model excluded the post-interactive terms as the regression was only run on post-installation billing data.

$$Average\ Daily\ kWh_i = \alpha + \beta_1 \cdot post + \beta_2 \cdot CDD_{i,n} + \beta_3 \cdot HDD_{i,n} + \beta_4 \cdot CDD_{i,n} \cdot post + \beta_5 \cdot HDD_{i,n} \cdot post + \varepsilon$$

Equation A-22

Where:

- i represents each individual customer for each month,
- n represents each iteration of base pairs,
- $post$ is an indicator variable indicating whether the period is in the post or pre period,
- $CDD_{i,n}$ is the CDD calculated for iteration *n* for customer *i,*
- $HDD_{i,n}$ is the HDD calculated for iteration *n* for customer *i,*
- α is the intercept term,
- β_1 is the main effect of the post period,
- β_2 is the main effect of CDD,
- β_3 is the main effect of HDD,
- β_4 is the additional effect of CDD on the post period,
- β_5 is the additional effect of HDD on the post period, and
- ε is the error term.

Isolation of Weather-Dependent Load

After normalizing the billing data to TMY3, the Evaluator proceeded to extract the weather-dependent load for each customer for the pre and post periods under the assumption that most weather-dependent loads for residential homes is attributable to HVAC. To accomplish this, the Evaluator first detected a month with minimal HVAC load by selecting, for each customer in each period, the month with the lowest average daily kWh. The Evaluator deemed this value as "baseload," representing the typical household consumption in absence of HVAC. The weather-dependent load for each customer in each month of each period could then be determined by subtracting the baseload from that month's normalized average daily consumption.

For the purposes of this analysis, weather-dependent load between the months of May through October were treated as cooling load while weather-dependent load between November through April were treated as heating load.

CAC and CHP Savings Calculation

After calculating the post period weather-dependent load, the cooling load and heating load were then used to estimate the approximate effective full load hours (EFLHs) for cooling and heating for each customer. The equations for estimating the EFLHs are presented in Equation A-23 and Equation A-24. Equipment efficiency information including SEER and equipment capacity was obtained via the tracking data. Average HSPF values for central heat pumps were estimated using the AHRI database relative to the reported SEER and equipment capacity.

$$EFLH_{cool} = \frac{kWh_{cool,e} \cdot SEER_e \cdot 1000}{CAPY_{cool}}$$ *Equation A-23*

$$EFLH_{heat} = \frac{kWh_{heat,e} \cdot HSPF_e \cdot 1000}{CAPY_{heat}}$$ *Equation A-24*

The EFLHs obtained using the post period data were then applied to the equation presented in Equation A-25 and Equation A-26 to estimate baseline equipment consumption. EFLHs were filtered for outlier values by using the median plus or minus four times the mean-adjusted deviation (MAD) to correct for outliers in a skewed (non-normal) distribution.

$$kWh_{cool} = \frac{EFLH_{cool} \cdot CAPY_{cool}}{1000 \cdot SEER_b}$$ *Equation A-25*

$$kWh_{heat} = \frac{EFLH_{heat} \cdot CAPY_{heat}}{1000 \cdot HSPF_b}$$ *Equation A-26*

The Evaluator estimated baseline consumption for both an early replacement (ER) and replace on burnout (ROB) scenario. DEER standard baseline equipment efficiencies for the ER scenario were obtained from the DEER resources workpapers and mapped appropriately back to customers based on vintage. Vintage information could not be obtained for all customers due to gaps in county assessor data. Federal standard baseline values were used for the new construction or replace on burnout scenario.

Savings were then estimated by taking the difference in consumption between the baseline scenario and efficient equipment consumption. Savings for central air conditioners was limited to the difference between baseline and efficient cooling only. ER and ROB savings per unit are presented in Table A-76 with the 90% confidence interval of the savings estimate.

Table A-76 CRP CAC and CHP Participant-Level Savings

Measure	Scenario	Annual kWh Savings	90% Confidence Interval		Relative Precision (90% CL)
			Lower Bound	Upper Bound	
Central Air Conditioner	ER	535.89	598.89	472.89	12%
Central Air Conditioner	ROB	178.60	206.68	150.52	16%
Central Heat Pump	ER	1280.02	1056.04	1503.99	17%
Central Heat Pump	ROB	414.26	323.42	505.10	22%

Attic Insulation and Cool Roof Savings Calculation

For the Attic Insulation and Cool Roof programs, the difference in pre and post weather-dependent load was treated as the savings for each customer, as represented in Equation A-27.

$$\Delta kWh_{HVAC} = kWh_{HVAC\ Pre} - kWh_{HVAC\ Post} \qquad \text{Equation A-27}$$

Individual savings were then filtered by using the median plus or minus four times the mean-adjusted deviation (MAD) to correct for outliers in a skewed (non-normal) distribution. The individual savings were then aggregated to create an average per household savings, as represented in Table A-77.

Table A-77 CRP Attic Insulation and Cool Roof Participant-Level Savings

Strata	Annual kWh Savings	90% Confidence Interval		Relative Precision (90% CL)
		Lower Bound	Upper Bound	
Attic Insulation – MF	154.17	78.54	229.79	49%
Attic Insulation – SF	233.80	210.40	257.20	10%
Cool Roof	562.60	295.42	829.78	47%

A.11.1.6.3. Adjustment for COVID-19

It is important to note that the savings calculated as part of the residential billing analysis may be impacted by the ongoing COVID-19 pandemic. Therefore, both the residential energy consumption observed in the billing data and the observed savings for FY 20/21 may inadvertently be impacted by changes due to the COVID-19 pandemic. To account for this impact, the Evaluator created a series of adjustment factors for each measure by leveraging the non-participant billing data received from LADWP.

The creation of these adjustment factors largely followed the logic of the billing data retrofit isolation analysis in the following manner:

- For the HVAC measures (Attic Insulation, Central Air Conditioner, Central Heat Pump, and Cool Roof), the non-participant data was separated into a typical period (January 2019 through December 2019) and COVID-19-impacted period reflective of that measures' post-installation analysis period (either September 2020 through August 2021 or October 2020 through September 2021 depending on the measure).
- The non-participant billing data was weather-normalized by optimizing the CDD and HDD bases per participant and normalizing the billing data to TMY3.
- The non-weather dependent load was identified for each customer for the typical year and COVID-19-impacted year (i.e., the month with the lowest normalized average daily consumption).
- Heating-dependent load (November through April) and cooling-dependent load (May through October) was identified for each customer for the typical year and COVID-19-impacted year.
- An adjustment factor was calculated by dividing the COVID-19-impacted load by the typical year load for the non-weather dependent load, the heating-dependent load, and cooling-dependent load, creating a series of adjustment factors.

The adjustment factors were then applied to the COVID-19-impacted post-installation data for the HVAC measures evaluated via billing analysis in the following way:

- The COVID-19-impacted post-installation billing data was normalized for the impacts of COVID-19 by dividing the total post-installation cooling load and heating load by their respective COVID-19 adjustment factors prior to calculating typical year savings.
- The typical year pre-installation billing data was adjusted for COVID-19 equivalency by multiplying the total pre-installation cooling load and heating load by their respective COVID-19 adjustment factors prior to calculating COVID-19-impacted savings.

For residential measures that were not evaluated by residential billing analysis, COVID-19 adjustment factors were generated in a similar manner however the COVID-19-impacted period was fixed to July 2020 through June 2021. This adjustment factor was then applied to estimated savings rather than pre/post billing data depending on whether the measure was deemed as likely to have been impacted by COVID-19. Measures such as CRP Pool Pump and Motor and CRP Certified Pool Pump and Motor were not adjusted for COVID-19 due to being unlikely to have changed due to the COVID-19 pandemic.

A.11.1.7. Online Survey Data Collection

The Evaluator administered an online survey of FY 20/21 program participants to collect data for three purposes:

- Verify that the rebated equipment was in-place and operating (as applicable);
- Estimate the net impacts of the program; and
- Assess customer experiences with the program.

A total of 4,597 program participants received up to three emails from LADWP inviting them to complete the survey – 284 completed the survey, yielding a response rate of 6.2%.

Table A-78 *CRP Summary of Survey Sample Measure Coverage*

Measure	Quantity of Measures	Percent of Population	Quantity of Responses	Percent of Response
Attic Insulation	17,931	86%	136	48%
Pool Pump and Motor	2,251	11%	97	34%
Cool Roof	433	2%	37	13%
Central Air Conditioner	203	1%	12	4%
Dual Pane Windows	38	0%	1	0%
Central Heat Pump	20	0%	1	0%
Whole House Fan	2	0%	0	0%
Total	20,878	100%	284	100%

A.11.2. Impact Evaluation

This section presents the findings of the impact evaluation of the CRP during the FY 20/21 period. Ex-post gross energy savings and peak demand reduction are presented at the measure level.

A.11.2.1. Description of Factors Affecting Gross Realized Savings

The following sections describe factors affecting realized savings for each of the CRP offerings.

A.11.2.1.1. Attic Insulation

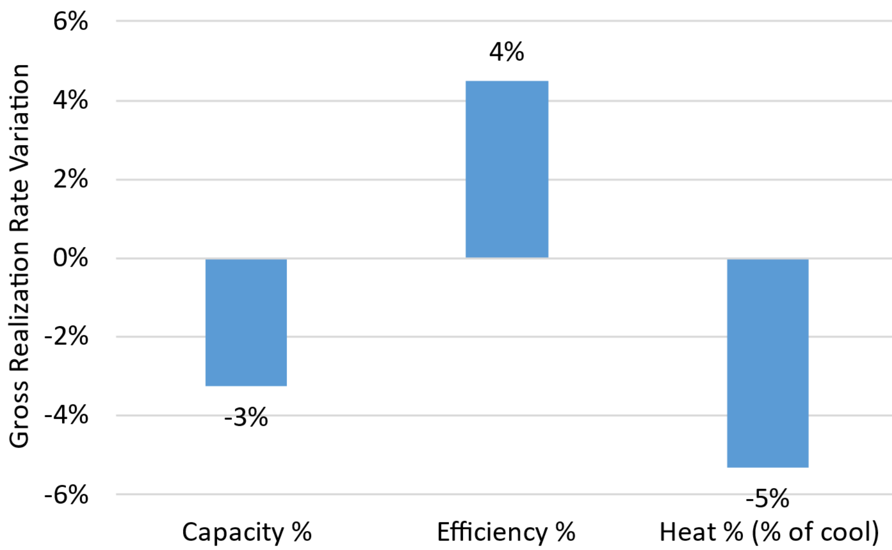
Attic Insulation has an energy savings realization rate of 118% for first year savings, and 92% for post COVID-19 Era years. The savings align closely with the Ex-Ante expected energy savings.

A.11.2.1.2. Central Air Conditioner

The Ex-Post savings for central air conditioners were calculated through a billing analysis and produced a realization rate of 64%. The Evaluator also researched the AHRI reference numbers when they were provided in the tracking data (60%). Figure A-35 summarizes the data collection from the AHRIdirectory.org database for equipment by cross referencing the AHRI equipment number provided by the applicant. Of those, the AHRI capacity was 3% less than the lowest value of the measure bin. The Ex-Ante measure bins were in ½ ton increments. The AHRI SEER efficiency was 4% higher. The Ex-Ante measure bins were either SEER 15 or SEER 16. Some (7%) participants installed CAC with SEER 17 and up to SEER 22.5.

The last bar in the figure, labeled “Heat %”, expressed as a percentage of the cooling capacity of all units, is included as the measure description for central air conditioner, but 7% (weighted capacity) were actually heat pumps. Of those heat pumps, all were ductless mini split units. They were indirectly considered in the billing analysis, as the two month bins for billing data may not have discerned heating degree days and cooling degree days in the shoulder months when both occurred.

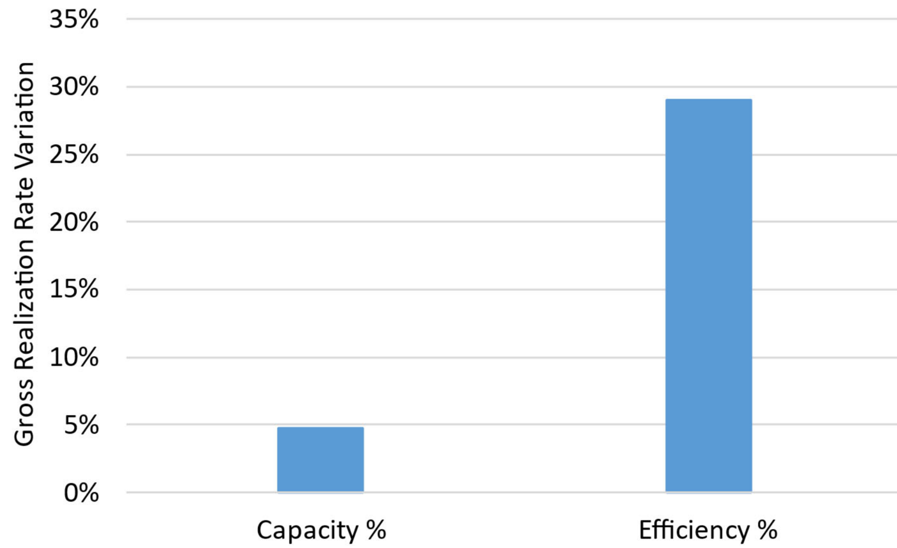
Figure A-35 CRP Central AC Variable Differences



A.11.2.1.3. Central Heat Pump

The Ex-Post savings for central heat pumps were calculated through a billing analysis and produced a realization rate of 129% for first year savings, and 85% for the remaining life in the post COVID-19 Era. The evaluation team also researched the AHRI reference numbers, when provided in the tracking data (62%). Figure A-36 summarizes the data collection from the AHRIdirectory.org database for equipment by cross referencing the AHRI equipment number provided by the applicant. Of those, the AHRI capacity was 5% more than the lowest value of the measure bin. The Ex-Ante measure bins were in ½ ton increments. The AHRI SEER efficiency was 29% higher. The Ex-Ante measure binned all heat pumps to SEER 15. Most (88%) participants installed units with SEER 16 and up to SEER 23

Figure A-36 CRP Central HP Variable Differences



A.11.2.1.4. Cool Roof

The Cool Roof measure had a low realization rate for energy savings and peak demand reduction as determined by the billing analysis, indicating the Ex-Ante deemed savings per square foot of roof area may be overestimating the energy reduction impact.

The billing analysis considered the existing roof as the baseline, but most of the LADWP customers resided in the city limits of Los Angeles, and since 2014 have been under the building code regulation with a Cool Roof SRI requirement. All of the cool roof participant survey responses (100%), replaced 90% or more of the roof, which is beyond the threshold for partial roof replacements for code required cool roof material. The participant survey also indicated that 40% of the responses installed attic insulation at the same time which is a tradeoff exemption for the state of California under CA Title 24, but the City of Los Angeles has a mandatory requirement for cool roofs that meets the requirements for replaced roof and are not eligible for the tradeoff.

Lastly, the participant tracking data indicated that 85% of the roof material installed was just equal to code requirements, while 15% of the roof material exceeded code by at least 10 SRI. Table A-79 summarizes the survey responses for the portion of the roof replaced and reason for replacement of the roof. All (32) responses replaced 90% or more of the roof.

Table A-79 CRP Cool Roof Participant Survey – Base Case

Base Case	Responses	Percent Responses	Percent of Roof Area Replaced	Percent Responses
Older roof replaced, not cool roof	31	97%	90-100	100%
Storm damage replacement	1	3%	90-100	100%
Total	32	100%		100%

Asphalt shingles are the predominate base case at 82% as indicated in the participant survey responses, see Table A-80.

Table A-80 CRP Cool Roof Participant Survey – Base Case Material

Base Case	Responses	Percent Responses
Asphalt shingles	27	82%
Membrane	2	6%
Other material	2	6%
Metal roofing	1	3%
Roof coating	1	3%
Total	33	100%

Attic Insulation is a CA Title 24 tradeoff for Cool Roofs when permitted with accompaniment of an appropriate energy study; however, this does not apply to the City of Los Angeles, where the Cool Roof is a mandatory requirement for a replacement of more than 50% of the surface area. Fifty-eight percent of survey respondents that added additional attic insulation achieved additional energy savings but would not have qualified for a CA Title 24 tradeoff from using cool roof products, when replacing the roof surface; see Table A-81.

Table A-81 CRP Cool Roof Participant Survey – Base Case Insulation

Base Case	Responses	Percent Responses
Added attic insulation same time	21	58%
Did not add attic insulation	15	42%
Total	36	100%

The majority (79%) of the cool roof measures in the category of Steep Slope 16 SRI are in the above code baseline group, with a smaller percentage of measures are in the category that indicated significantly exceeding code.

Table A-82 CRP Cool Roof Tracking Data – Code and Exceeding Code Installed Square Feet

Cool Roof Measure	Installed (square feet)	Percent Area
Steep Slope 16 SRI	1,120,264	79%
Steep Slope 35 SRI	11,293	1%
Low Slope 75 SRI	128,791	9%
Low Slope 85 SRI	159,653	11%
Total	1,420,002	100%

The average SRI of the “above code” is significantly above the code threshold of Steep Slope 16 SRI, with an average value of 21.8. The tracking data has some Steep Slope measures with SRI values exceeding 35 in the Steep Slope 16 SRI measure and some less than code in the Steep Slope 35 SRI measure category; therefore, there appears to be improper alignment in these measures.

A.11.2.1.5. Dual Pane Windows

There was not adequate tracking data for the window products to determine the installed U-factor. The survey responses for the dual panel window were low with only one response who replaced a double pane insulated window, whereas the baseline is a single pane window.

The CMUA TRM Measure 222 was the best fit for the impact analysis of dual pane windows. The measure requirement with an efficient case U-factor less than or equal to 0.35, along with the survey response indicating a base case of single pane window, aligned best with the CMUA TRM measure that’s modeled with a base case of single pane windows and efficient case of a window with a U-factor of 0.32.

The Ex-Ante energy savings estimate was based on 0.44 kWh/square feet of window installed. The CMUA TRM deemed savings value for CZ09 is 4.2 kWh/square feet. The climate CZ09 is appropriate for this comparison, as 80% of the total installed window area was located in climate zone 9.

A.11.2.1.6. VSD Pool Pump and Motor

The certified pool pump measure does not occur as a stand-alone measure but is paired with the CRP pool pump measure for a combined Ex-Ante energy savings of 1,686 kWh. The billing analysis for just the VSD pool pump and motor, without a certified installer was 1,050 kWh energy savings per unit. The VSD measure accompanied by the certified installer measure, resulted in lower savings at 857 kWh per unit.

Site visits performed for program participants who installed this measure found both certified and not certified installations with programming in the VSD pump to operate during peak hours, contrary to the certified installed directions to operate during non-peak periods.

A.11.2.1.7. Whole House Fan

The energy savings realization rate is 114%. The actual home size and manufacturer specifications for fan air flow capacity were used in the Ex-Post savings.

A.11.3. Process Evaluation

The CRP program is a rebate program designed to promote specific energy efficiency solutions within the residential market sector. By encouraging adoption of economically viable energy efficiency measures, the residential portfolio strives to overcome market barriers and to deliver programs and services aligned to support LADWP’s energy efficiency objectives. CRP is a contractor-driven program (i.e., contractors use their own marketing and outreach to find and provide program participants). The program is mainly for residential owners, which make up 37% of housing unit occupants in Los Angeles. Renters typically do not purchase the type of measures included in CRP.[20]

From June 2020 to July 2021 (the program year), CRP offered rebates for seven measures covering the building envelope, HVAC, and pool pumps. Over 25,000 rebates were paid for measures within CRP. Measure rebate amounts varied with the majority of rebates paid for attic insulation.

Table A-83 CRP Population of Measures

Category	Measure	Rebate Amounts	Number of measures	Percent of total
Building envelope	Attic Insulation (counted as one measure per home)	$1/sq. ft.	19,897	87%
Pool Pump	Pool Pump and Motor	$500 each + $500 for certified installation	2,251	10%
Building envelope	Cool Roof	Up to $0.30 per square foot	433	2%
HVAC	Central Air Conditioner	$100-$120 per ton	203	1%
Building envelope	Dual Pane Windows	$2.00 per square foot	38	<1%
HVAC	Central Heat Pump	$100 per ton	26	<1%
HVAC	Whole House Fan	$200 each	2	<1%

Source: Count of Rebate IDs within program tracking database. Note that 20,739 unique rebate IDs had a single measure, 59 rebate IDs included 2 measures and another 7 included 3 measures. Rebate amounts from the CRP Fact Sheet accessed on the LADWP website. Attic Insulation was suspended at the time of this evaluation and rebate levels were not online.

A.11.3.1. Process Evaluation Approach and Methodology

The following sections detail the process evaluation of the CRP.

A.11.3.1.1. Document Review

The Evaluator reviewed the program tracking database, the fact sheet about the program from the website, LADWP Rates and Equity Metrics Semi-Annual Report (August 3. 2021)[21], Los Angeles Housing Element 2021-2029 (Adopted November 2021)[22], Appendix

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[20] Los Angeles Housing Element 2021-2029, Adopted November 2021, p 62 (https://planning.lacity.org/plans-policies/housing-element)

[21] https://www.ladwp.com/ladwp/faces/ladwp/aboutus/a-financesandreports/au-fr-corporateperformance/au-fr-corporateperformance-emdi?_adf.ctrl-state=3mkapxmkn_87&_afrLoop=1443106048009335

[22] https://planning.lacity.org/plans-policies/housing-element

1.1 Housing Element Assessment of Fair Housing[23], Appendix K of the Housing Element[24], census data, and a document detailing the LADWP process for handling applications and payments provided by CRP staff.

A.11.3.1.2. Staff Interviews

Over a one-hour period in May 2021, the evaluation team interviewed four (4) CRP staff as a group. This wide-ranging interview covered roles, goals, benefits, challenges, COVID-19 effects, measure specific information, equity, impacts, communication between groups involved with CRP, and cost effectiveness.

A.11.3.1.3. Participant Survey

The Evaluator administered a participant survey that had several uses, but for the process evaluation, the evaluation team wrote survey questions help CRP staff learn from customers. Specifically, questions in the online survey were to determine:

- **Satisfaction** – The level of customer satisfaction with application materials, rebate payment time, and the rebated measure.

  This includes how contractors represented themselves with participants. Contractors who install pool pumps and attic insulation through the program do not represent LADWP. However, staff had anecdotal information that some contractors indicated they work for LADWP and were unsure if customers were dissatisfied with these contractors, thus potentially being dissatisfied with LADWP. The online survey obtained information more systematically on this subject

- **Purchase Drivers** – What customers said were most influential in their purchase of measures.
- **Customer Demographics** – A description of key participants characteristics. This was included to explore how well CRP participation represented the population of Los Angeles homeowners and whether target marketing by demographics may be beneficial.

A.11.3.2. Process Evaluation Findings

CRP products can substantially affect a household's energy use (and utility bills) which directly supports Los Angeles as it seeks to improve the quality of housing and reduce household burden.[25] Overall, CRP is doing a good job based on the thousands of products being rebated and level of satisfaction determined from survey respondents. However, the program could improve the time it takes for customers to receive rebates. CRP staff may also want to explore different marketing messages for different products

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[23] Ibid

[24] Ibid

[25] The Los Angeles Housing Element 2021-2029 indicates, on page 23, that part of their Goal 2 (Housing Preservation and Housing Stability) is "conserving and improving the quality of housing". Additionally, page 89 of the same document indicates that 39% of owner occupied households (the main participants in CRP) are cost burdened (i.e., they pay more than 30% of their income for housing costs).

as well as talking with participating contractors to understand why certain ethnicities are underserved. (See details below as well as the Recommendations section.)

A.11.3.2.1. Incentive Process Steps and Time to Receive a Rebate

During the past program year, the CRP program struggled with challenges related to rebate processing. The average length of time for customers to receive a rebate was 152 days (much longer than desired) due to challenges related to COVID and a surge in rebates for attic insulation.[26] During this period, LADWP put messages on the phone tree about the longer rebate time, updated their webpage to set customer expectations that rebates would take longer than normal to receive, and formalized an escalation process for how to deal with customers who complained.

Even with the adjustments noted above, a few respondents described communication issues with one customer stating that online tracking could help "solve the mystery of status."[27] Specifically, one customer indicated that it was "Impossible to reach anyone from customer service regarding this rebate. Calls and emails [were] never returned." Another indicated "At least acknowledge that you have received it and are processing. I changed the pump in May, I chased down acknowledgement which they could not even confirm receipt until Sept. They did not actually process the paperwork until end of the year, and I did not receive the actual rebate until almost a year later." And a third indicated "There was almost no communication and it took so much longer to receive than I was told it would that I literally thought you forgot about me."

The program's messaging choices had mixed results as the length of time to receive a rebate had the lowest satisfaction level among all program areas (at 66%) and the highest level of dissatisfaction (at 18% of respondents). However, as mentioned above, overall satisfaction with the program remained high.

The rebate payment system, while robust, is currently hampered by restrictions in place due to COVID-19 and the program requirement to perform certain necessary payment activities within the LADWP building. Additionally, the surge of rebates from attic insulation appeared to exacerbate delays in paying rebates.

For rebates under $10,000 (covering all CRP rebates), there are three distinct times that information is reviewed and approved.[28] The process is a mix of sending data electronically (which could possibly occur outside of the office with proper security arrangements) and performing actions by hand (which have to be performed in person). For safety reasons, during the pandemic, LADWP staff were working outside of the office and there were restrictions on when and how many could access the LADWP buildings.

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[26] In the last program year, LADWP paid an average of ~1,800 CRP rebates per month The program manager indicated that the processing time had been down to under 30 days, but the increased volume of attic insulation projects and a high level of Electric Vehicle rebates (both are processed by the same mass market team) caused the processing time to move much higher.

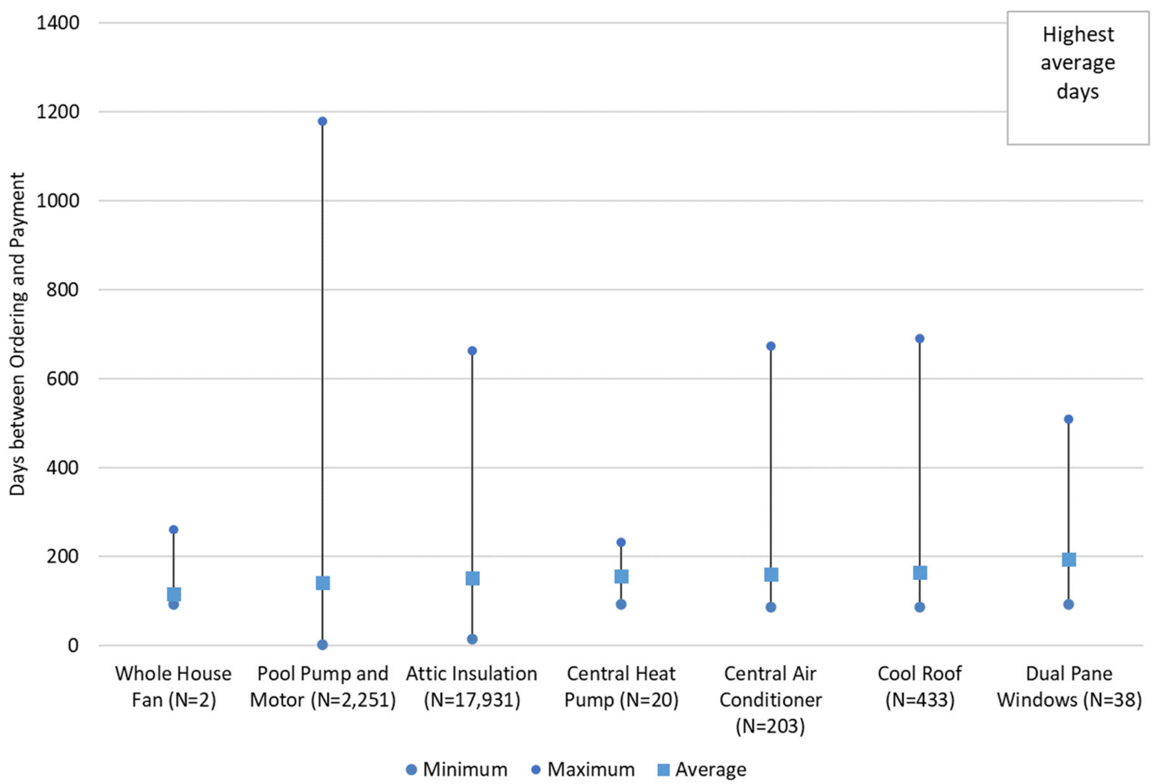
[27] CRP program managers highlighted this issue in the most recent semi-annual update to LADWP commission, and noted they have limitations to implementing an automated customer notification system because of a lack of resources to do so. (CRP Issues within LADWP Rates and Equity Metrics Semi-Annual Report, August 2021)

[28] CRP review and approval occurs prior to printing out checks, signing checks, and sending checks out.

However, for security reasons, checks had to be printed in the LADWP buildings and so required someone to actively go into the building.

According to program managers, for this program year (FY 20/21), customers were receiving their rebates about six months after the application was finalized. This is generally supported by program data, which indicates that on average, it took four to six months between ordering and payment (see Figure A-37, where the light blue squares show that the average time between ordering and payment.) As shown below by the outliers, there were some rebates that took an extremely long time to pay – up to and over a year. However, there were very few outliers as they pulled the average time between ordering and payment up minimally compared to the median time (i.e., median is the time when half of the payments were above the value and half were below).[29] Thus, even without the outliers, processing time for rebates was much longer than desired by program staff.

Figure A-37 CRP Days Between Order and Payment (minimum, maximum, and average)

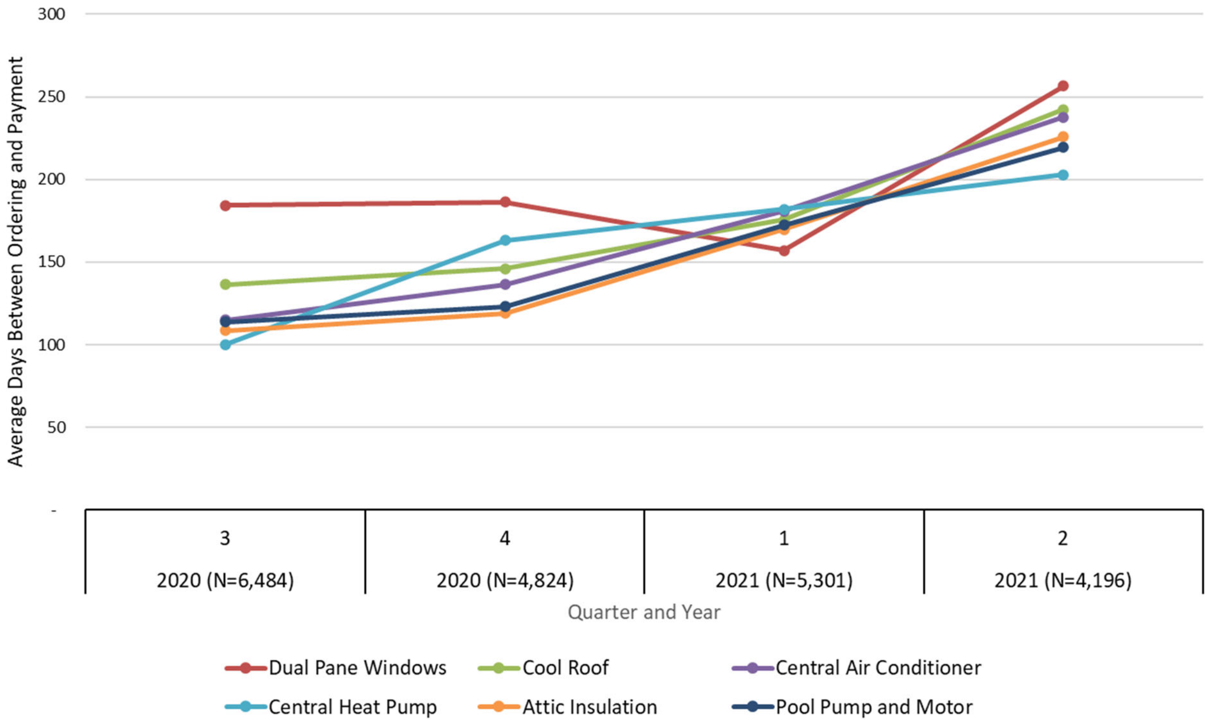


Source: Program tracking database and Evaluator analysis. Data from Q3 2020 through Q2 2021.

The time to pay for all measures increased over the program year (with dual pane windows typically taking longer to pay than other measures). The average time increased by 70% in the second half of the program year (from 113 days to 195 days),see Figure A-38.

[29] If there are a large number of values with a long time to be paid, the average time would be much higher than the median time. As it was, the average is only from 6 to 21 days higher than the median.

Figure A-38 CRP Average Days Between Order and Payment by Product and Quarter



Source: Program tracking database and Evaluator analysis. The N's are the number of rebates paid in the quarter.

Part of the issue for longer times as noted by the program managers, was the unexpected volume of attic rebates each quarter. The product was popular among customers and brought in a substantial number of rebates. Specifically, attic rebates accounted for more of paid rebates as the program progressed through the year (81%, 87%, 89% and 89% of rebates from Q3 2020 through Q2 2021, respectively).

Additionally, program managers noted challenges with having the right number of staff to move all these rebates through the payment process. These difficulties were not just ensuring the adequate number of staff, but the challenge in finding the time to train new staff to correctly move through the payment processes.[30]

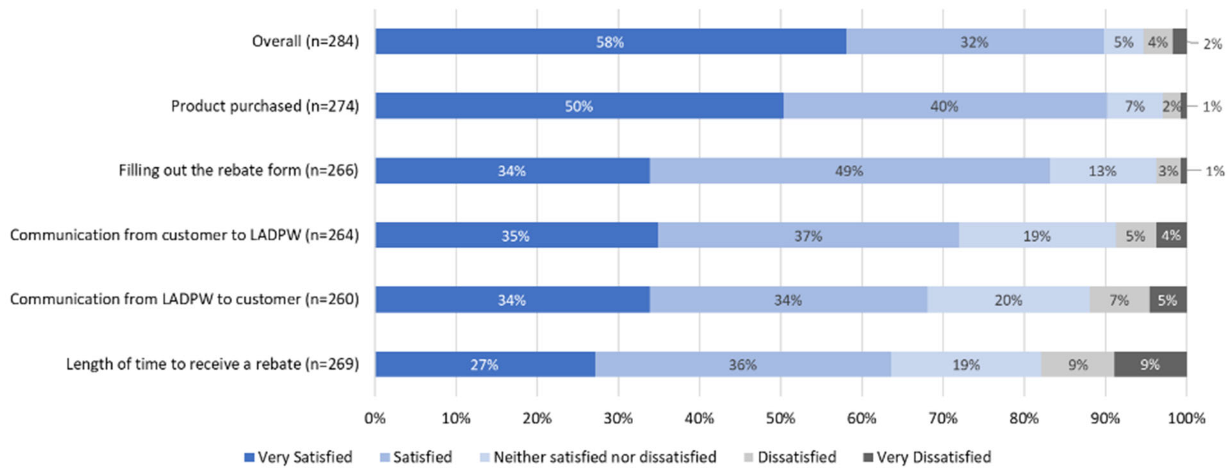
It is possible that the trajectory of time for CRP rebates may trend downwards as either the number of rebates goes back down to more typical levels or as additional staff are sufficiently trained to handle the high level of rebates. CRP program managers noted that this time had been under 30 days in the past, but this timing should be closely monitored and additional changes made in either the process for sending out checks (if there continues to be pandemic-related precautions) or the process for training up those who process the rebates.

[30] As described above, the rebate payment process has many approvals and people need to input electronic data as well as approve, sign, and deliver checks and back-up packages. Training to rigorously follow all the steps and understand what to do when approvals are denied can take time.

A.11.3.2.2. CRP Customer Satisfaction

Overall, customers were satisfied with the CRP program (90% very satisfied or satisfied). Customers were similarly satisfied with their purchased products and less satisfied with program processes (See Figure A-39, where the level of satisfaction is somewhat lower for specific program processes).

Figure A-39 CRP Overall Program Satisfaction and for Different Program Areas



Note: Based on chi-square testing, satisfaction with products purchased and filling out rebate forms is significantly higher than satisfaction with communication to and from the program, and responses about communication are significantly higher than length of time to receive a rebate.

As shown above, from 3% to 18% of customers were dissatisfied with some part of the program. Most of these customers complained about the long time to receive the rebates, a difficulty that program managers were aware of and sought to ameliorate. We describe the incentive processing steps and time to receive a rebate more in the next section.

Application forms also caused problems for some customers. While the program has definite needs for application data, a person not familiar with the program may not understand exactly what is required, misinterpret certain areas of the form, and therefore provide no or incorrect data. One pool pump customer wrote that “Completing the form was confusing - it is not simple or intuitive.” Another pool pump customer gave very detailed information on the application form when they wrote “I had a hard time differentiating between your request for pool motor information. Were you asking me to confirm the old motor make model and specifications or the new replacement motor. I had to read and reread your extensive list of requirements and technical information to get a complete understanding.” A cool roof participant indicated “…confusing, cumbersome form with so-so online instruction.” A fresh set of non-program eyes could help improve the application forms (not necessarily change the information needed, but perhaps adjusting location of the information or including additional language).

While there were a small number of pool pump or attic contractors who indicated they were LADWP staff to participants (4%), this incorrect representation of who they worked for did not adversely affect satisfaction with the program. All participants who were told by their contractor that the contractor was LADWP were satisfied with the program.

As noted above, most customers are satisfied with the CRP program, but the few dissatisfied customers provide ideas that the program managers can consider for improving the program (see the Recommendations section below).

A.11.3.2.3. Drivers of CRP Purchases

Customers buy equipment for different reasons. The CRP Fact Sheet (located on the LADWP website and last updated in 2017) is useful to provide customers with "just the facts" and includes broad benefits that give reasons to purchase. However, expanding the benefits message and tailoring it to the different measures may help customers, who are not quite ready to purchase an item, decide to move forward. Additionally, contractors may benefit from knowing a few specific tailored messages that they could use as they seek to sell CRP products.

Marketing for the different CRP measures could differ to stress distinct influences for purchase as the drivers of new efficient purchases vary by measure (Figure A-40). Unsurprisingly, rebates and utility cost savings are the most prominent reasons. The rebate was the top driver for efficient pool pumps, while saving on utility costs tends to be the most important driver for decisions about installing insulation or HVAC. Notably, for cool roofs, customers are usually replacing the roof because they need a new roof and environmental considerations are an important driver – even more important than the rebate.

Figure A-40 CRP - Most Influential Reasons for Purchases

Reasons	Attic Insulation	Pool Pump	Cool Roof	HVAC
1st	 (Save on utility costs)	 (The rebate)	 (Needed new roof)	
2nd			 (Good for the environment)	
3rd	 (Comfort)			Needed AC / purification capabilities (for health)

Note: The one window respondent indicated that comfort was most important, followed by savings on utility costs and rebates (in that order). Also, cool roof and HVAC data is from a low number of respondents (37 and 13 respectively).

A.11.3.2.4. CRP Participant Demographics

In the past program year CRP provided rebates for attic insulation for tens of thousands of homes and pool pump rebates for thousands of homes. Hundreds of homes received new cool roofs or air conditioners. These products were provided mainly to White and Latinx homeowners. Of those who provided income, many CRP participants (43%) were low or moderate income, Table A-84.

Table A-84 *CRP - Demographics of Customers Obtaining a Rebate*

Demographic Parameter	CRP Survey	Population for City of Los Angeles (census data)	Notes
Home Ownership	(n=244)	Households	
Owner - Single Family	88%	37%	As expected, participant homeowners disproportionately obtained more rebates through CRP than renters
Owner - Multi Family	2%		
Renter- Single Family	10%	63%	
Renter - Multi Family	0%		
Income	(n=284)	Owner Households*	
Low or Moderate	43%	44%	Of those who provided the Evaluator with income data, many CRP participants are considered to be low or moderate income (based on number of people in the household and self-reported income)
Above Moderate	24%	56%	
Declined to Say	33%	--	
Age	(n=272)	Owner Householder**	
25-34	2%	6%	The age of CRP participants aligns with the age of owner households in the population.
35-54	32%	36%	
55-64	27%	25%	
65+	39%	33%	
Self-Identified Ethnicity	(n=257)	Owner Householder***	
Caucasian (White)	53%	47%	CRP participation in the past program year is aligned with level of homeownership rates within Los Angeles for Whites and Latinx and significantly under the percent of homeowners who identify as Asian or Black ***
Hispanic (Latinx)[31]	23%	28%	
Asian	13%	37%	
Black	5%	29%	
Other	6%	--%	

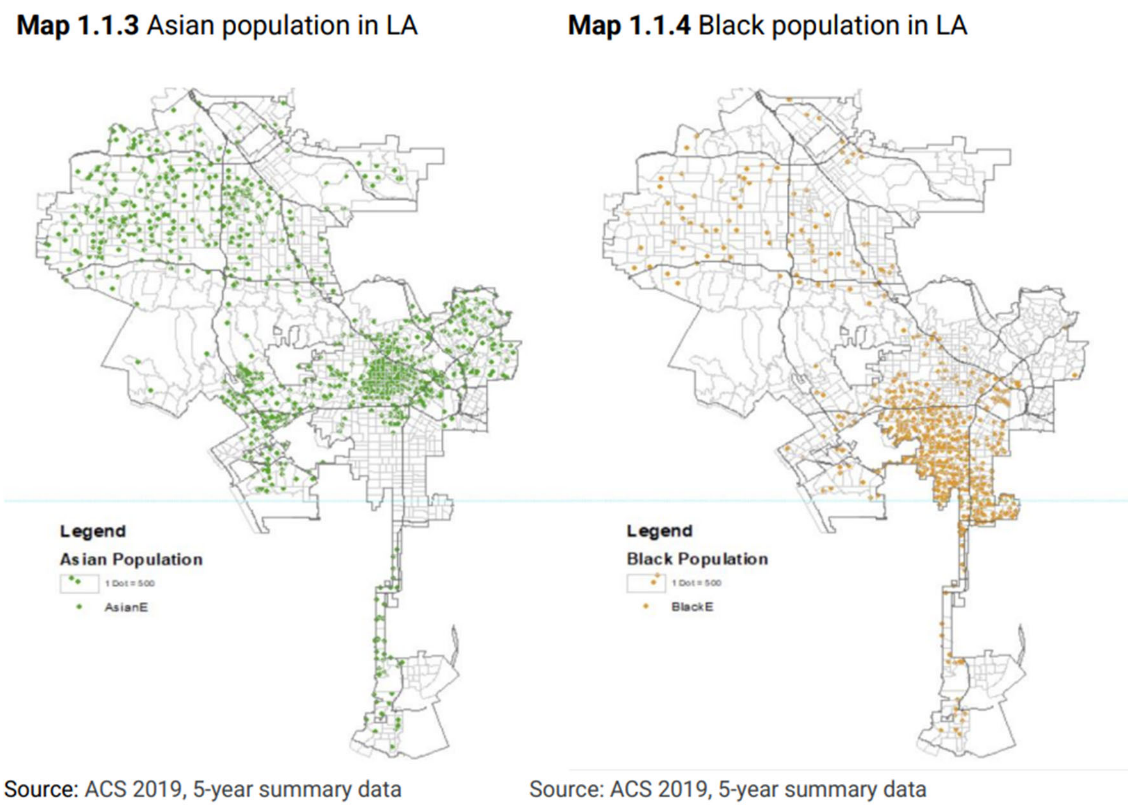
**Chart 1.1.28 Income Categories for Renters and Owners in LA City. Appendix 1.1 2021-2029 Housing Element Assessment of Fair Housing*
***2019 ACS, Table S2502 with data for Los Angeles – Long Beach-Anaheim, CA Metro Area*
**** Chart 1.1.11 Homeownership Rates by Race/ Ethnicity in Appendix 1.1 2021-2029 Housing Element Assessment of Fair Housing*

As shown above, 37% of Asian households and 29% of Black households are homeowners, yet this year's program served only 18% across both groups. As a contractor driven program, the lack of Asian or Black households participating in CRP could be indicative of a need to target contractors who provide services in areas most populated by these households (Figure A-41). CRP may want to talk to their contractors

[31] The Evaluator follows the lead of Los Angeles staff and applies the term Latinx rather than Hispanic (Housing Element 2021-2029, page 41).

to determine why the program is underserving these communities and take mitigating actions as possible.

Figure A-41 CRP - Asian and Black populations in Los Angeles

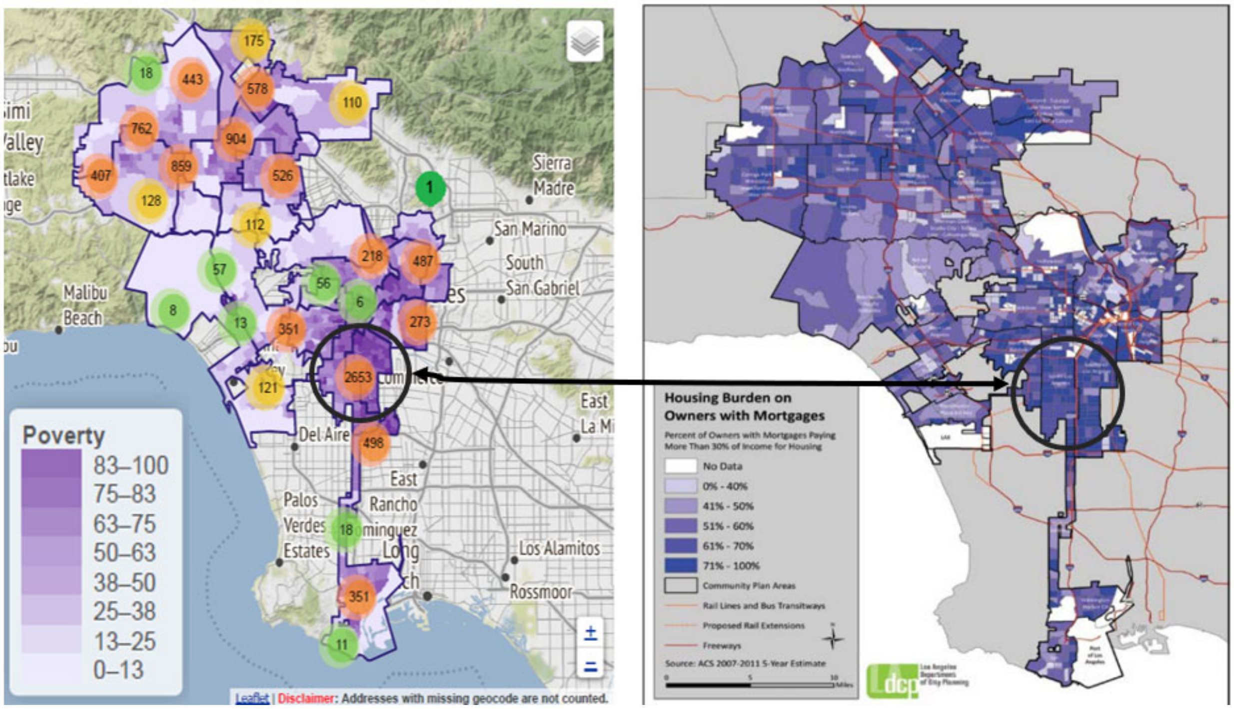


Source: Appendix 1.1 Housing Element Assessment of Fair Housing (Adopted)

CRP is assisting customers most in need and supporting the City's objective to "…improve the performance of customers' homes and given them additional control over their energy expenses..."[32] While CRP staff noted a relatively low percent of CRP participants as low income/lifeline customers (16%) within the August 2021 LADWP Rates and Equity Metrics Semi-Annual report, this metric does not tell the whole story as there were high levels of program participation (and so reduced utility costs) within areas that Los Angeles designates as high housing burden for homeowners with mortgages Figure A-42.

[32] 2021-2029 Housing Element, Adopted November 2021, page 308.

Figure A-42 CRP - Participation Areas and Owner Housing Burden (poverty levels in purple in left graphic; right graphic has housing burden on homeowners with mortgages)



Source: Figure on left is CRP participation (Nov 2020 - Apr 2021) from LADWP Rates and Equity Metrics Semi-Annual Report (August 3,2021). Figure on right from 2021-2029 Housing Element, Adopted November 2021, Appendix K.

A.11.4. Recommendations

Review all application forms and update based on feedback from people not associated with the program. Customers complained about the application forms and updating these forms based on feedback from a focus group held with customers or from LADWP staff LADWP staff not familiar with the efficiency programs, would enable CRP to take advantage of how non-program people perceive the form and make useful changes.

Provide a way for a customer to track their rebate online. Many customers expressed dissatisfaction with knowing if LADWP had received their application and difficulty reaching a customer service person to figure it out. Enabling an online tracking system could reduce the stress levels of customers and increase satisfaction around rebate timing.

Review payment process for all measures and especially for Dual Pane Windows. LADWP needs to determine how to best reduce the time for processing rebates when there is a surge in rebates (as occurred this program year).While there were few dual pane windows paid through the program (N=38), they had the highest average time between ordering and payment (194 days or about 6 months). Additionally, dual pane windows had higher average payment times for three of the four quarters of the fiscal year (almost double the time for a similar number of central heat pumps with rebates).

Consider tailoring the CRP Fact Sheet to address measure-specific messages around saving utility costs, comfort, etc. Additionally, consider providing contractors with similar tailored messages that they could use.

Talk to participating CRP contractors to determine why the program is underserving Asian and Black communities. The 2021-2029 Housing Element indicates that 39% of Asian households and 29% of Black households are homeowners. This year's program served only 18% across both groups.

If the reason for lack of participation in these areas is a lack of contractors, CRP may want to work with other agencies within Los Angeles to help bring in additional contractors who will serve these communities.

A.12. EPM

This section details the impact evaluation and process evaluation for the Efficient Product Marketplace (EPM) that LADWP offered customers during FY 20/21. The primary objective of this evaluation was to calculate energy savings and peak demand impacts attributable to the Program, as well as complete a process evaluation.

A.12.1. Evaluation Methodology

This section presents the methodology used to establish program participation, obtain product data not available in the tracking data, the findings of the tracking data review, and the methods used to calculate energy savings for the EPM Program.

The table below shows the data collection activities and sources of data for the EPM Program.

Table A-85 EPM Program Evaluation Data Collection

Data	Source
Program Tracking Data	Data requests to LADWP for all measure level program tracking data
Program Participant Surveys	Survey administered to a sample of program participants via email contact information
Recipient and control group billing data	Data requests to LADWP for all relevant billing data in the study period
Participation in other LADWP programs	Data requests to LADWP for all residential program participation in the study period
Recipient and control group customer data	Data requests to LADWP for other customer information (e.g., demographics, contact permissions)

A.12.1.1. Tracking Data Review

Program data aggregated at the measure level was obtained from the ESP database platform. Participant data (tracking data) was sourced from spreadsheet data in Excel format and was provided securely by LADWP.

Table A-86 lists the workbooks referenced to aggregate the participant data and which was then compared to ESP measure level report data.

Table A-86 EPM Program Tracking Data Sources

Workbook File Name	Participant Records
EPM Program Participation Data 2016-2020.xlsx	4,162
EPM January 2021.xlsx	499
EPM February 2021.xlsx	527
EPM March 2021.xlsx	424
EPM April 2021.xlsx	1,072
EPM May 2021.xlsx	435
EPM 06.2021.xlsx	749
Total	7,868

The Evaluator was not provided Ex-Ante peak kW reduction by measure and was unable to estimate program tracking data peak demand reduction.

A.12.1.2. M&V Sample Design

The participant sample and responses from the survey are detailed in Section A.12.3.1.3. The survey questions included both installation rate verification questions as well as decision making process questions. The analysis method and sample are summarized in Table A-87.

Table A-87 EPM Sample Design

Strata	Analysis Method	Sample
Advanced Power Strips	Engineering Analysis	Census
ENERGY STAR Lighting	Engineering Analysis	Census
ENERGY STAR Refrigerator	Engineering Analysis	Census
ENERGY STAR Room AC	Engineering Analysis	Census
ENERGY STAR Television	Engineering Analysis	Census
Smart & Web Thermostats	Billing Analysis	Eligible Census

A.12.1.3. Baseline Assumptions Review

Measures evaluated by billing analysis assumed baselines of working equipment with replacement, retrofit, or upgrade deemed as early replacement. Measures evaluated by engineering analysis utilized participant survey data to develop factors to determine the conditions of normal versus early replacement.

A.12.1.4. Ex-Ante Savings Review

Table A-88 compares ESP and program tracking Ex-Ante kWh, Incentive costs, and measures costs. The values align very closely across both databases.

Table A-88 EPM ESP to Program Tracking - Savings Comparison

Measure	Energy (kWh)		Incentive ($)		Measure Cost	
	ESP Data Ex-Ante	Program Data Ex-Ante	ESP Data Ex-Ante	Program Data Ex-Ante	ESP Data Ex-Ante	Program Data Ex-Ante
Air Conditioner	9,790	9,790	19,625	19,625	142,174	142,174
Light Bulb	2,244	2,244	2,914	2,914	10,317	10,317
Power Strip	22,260	22,260	2,017	2,017	4,197	4,197
Refrigerator	119,592	119,556	160,045	160,045	4,356,197	4,356,197
Television	1,176	1,176	185	185	4,661	4,661
Thermostat	1,096,003	1,101,710	443,425	443,350	1,148,539	1,148,639
Total	1,251,065	1,256,736	628,211	628,136	5,666,085	5,666,185

Lighting measures had two details that were inconsistent in the ESP and tracking data. First, the tracking data indicated 1.92 kWh savings for each record, regardless of the number ordered, in the field “Annual kWh Savings.” However, the ESP data did consider the order quantity. The Evaluator assumed the data was lacking another data field and reported the adjusted value in Table A-89, as Annual kWh Savings is equal to Quantity multiplied by 1.92 kWh/unit.

The second observation for lighting was that the number of lamps in a multi pack were not considered in either the ESP database or in the program tracking data; see Table A-89.

Table A-89 EPM Lighting Package Quantity

Lighting Model	Lamps per Package
Sunco Lighting SCBR3032PK3K	32
Feit BR40DM/927CA/12	12
Feit OM100DM/930CA/12	12
Feit OM60DM/927CA/12	12
Sunco Lighting SCG2510PK3K	10
Sunco Lighting SCG2510PK5K	10
Feit BPCECFC/927/6 (N)	6
Feit BPCFC40927CAFIL	6
Feit BPCFF40927CAFIL	6
Feit CEOM60/27/6(N)	6
Feit CEOM60/927/6 (N)	6
Feit CFC60/927CA/FIL/6	6
Sunco Lighting BR40-17W-3K-#PK	5
Feit A1960/950CA/FIL/4	4
Feit OM40DM950CA4	4
Feit OM60DM/927CA/4	4

Lighting Model	Lamps per Package
Feit OM60DM/930CA/4	4
Feit OM60DM/950CA/4	4
Feit BR30DM/927CA/3	3
Feit BR30DM/930CA/3	3
Feit BR30DM950CA6	3
Feit G2540/927CA/FIL	3
Feit OM60DM/927CA/3	3
Feit R20DM/930CA/3	3
GE Lighting 47952	3
Feit BPA1540C/927CA/2	2
Feit BPA1940CL927CAFIL2RP	2
Feit BPA1940CL950CAFIL2RP	2
Feit BPA1960CL927CAFIL2RP	2
Feit BPA800/RGBW/AG/2	2
Feit BPCTC40927CA/FIL2/RP	2
Feit BPCTC60927CAFIL/2/RP	2
Feit BPLVBAB/24	2
Feit BR30DM/927CA/2	2
Feit BR40DM/930CA/2	2
Feit OM100DM/950CA/2	2
Feit OM100DM927CA2	2
Feit OM60DM/950CA/2	2
Feit OM75DM/927CA/2	2
Feit OM75DM/930CA/2	2
Feit PAR30LDM930CA2	2
GE 67572	2
Globe Electric 37737	2

A.12.1.5. M&V Approach

The Evaluator used engineering-based equations to calculate energy savings and peak demand reduction for advance power strips, Energy Star refrigerators, room air conditioners, televisions, and lighting. The following sections provide calculation details for each type of equipment.

A.12.1.5.1. Advanced Power Strips Tier 2

Advanced Power Strips Tier 2 (APS Tier 2) also reduce idle phantom power and have “Smart” capabilities that control the peripherals plugged into the power strip. The Ex-Post savings were estimated by referencing the Smart Power Strips workpaper from SCE, which reported savings based on a monitoring study conducted in California. The workpaper expressed savings as percentage of the plugged-in load and provided an average energy savings per power strip, see Equation A-28 and Table A-90.

$$kWh = 240 \frac{kWh}{strip} x\ ISR\ x\ IE$$ *Equation A-28*

Table A-90 EPM Advanced Power Strips Tier 2 Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
EES_kWh	Energy savings per program year	Smart Power Strips, SCE17CS014	
EES_kW	Peak demand reduction per program year	Smart Power Strips, SCE17CS014	
ISR	In Service Rate	Participant Survey, 2021	100%
IE	Interactive Effects Factor by climate zone	DEER Interior Lighting	1.22 to 1.30

A.12.1.5.2. Energy Star Refrigerator

The energy savings for the purchase of new ENERGY STAR refrigerators and the ENERGY STAR most efficient refrigerators were determined by the efficiency of the new unit compared to the same type with the federal standard energy usage. This is the same method used by the DEER database and workpapers and is compliant with CA Title 20. The manufacturer and model number from the tracking data were cross-referenced to the ENERGY STAR online database to obtain the unit energy consumption (UEC), see Equation A-29 and Table A-91.

$$kWh = (UEC_{fed\_base} - UEC_{efficient})x\ ISR$$ *Equation A-29*

Table A-91 EPM Energy Star Refrigerator Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
kWh, kW	Measure savings per program year		
UEC_{fed_base}	Unit Energy Consumption – Federal and CA state baseline	US DOE Federal Refrigerator Standards, CA Title 20	Varies by freezer & refrigerator volume, defrost, door configuration, icemaker
$UEC_{efficient}$	United Energy Consumption - efficient	US DOE Federal Refrigerator Standards, CA Title 20	193 to 855 kWh
ISR	In Service Rate	Participant Survey, 2021	100%
IE	Interactive Effects Factor by climate zone	DEER Interior Lighting	1.22 to 1.48

A.12.1.5.3. Energy Star Room Air Conditioner

The energy savings for the purchase of new Energy Star room air conditioners were determined by the efficiency of the new unit compared to the same type with the federal standard energy usage. This is the same method used by the DEER database and workpapers and is compliant with CA Title 20. The manufacturer and model number from the tracking were cross-referenced to the Energy Star online database to obtain the unit combined energy efficiency rating (CEER). The DEER workpapers listed aggregated savings, but sourced savings from the "Residential Retrofit High Impact Measure Evaluation Report (The Cadmus Group)." From this monitoring study, the Evaluator obtained the effective full load hours (EFLH) by climate zone, see Equation A-30 and Table A-92.

$$kWh = EFLH\ x\ Capacity\ x\ \frac{\frac{1}{CEER_{base}} - \frac{1}{CEER_{eff}}}{1000}\ x\ ISR$$

Equation A-30

Table A-92 EPM Energy Star Room Air Conditioner Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
kWh, kW	Measure savings per program year		
EFLH	Effective Full Load Hours	Residential Retrofit High Impact Measure Evaluation Report (The Cadmus Group, Inc.)	225 to 631 hours
Capacity	Capacity of new unit, BTUh	Tracking Data Model and Energy Star Database	5,000 to 25,000
$CEER_{base}$	CEER – federal baseline	US DOE Federal Regulations	Varies by capacity, louver, reverse cycle
$CEER_{eff}$	CEER - efficient	Tracking Data Model and Energy Star Database	9.7 to 14.7
ISR	In Service Rate	Participant Survey, 2021	100%

A.12.1.5.4. Energy Star Television

The energy savings for the purchase of Energy Star televisions were determined by the UES of the new unit compared to the same size of a non-Energy Star television. The method listed in the TV Disposition Work Paper for determination of the base case UES was built on televisions with screen sizes from 10" to >=50". The Evaluator obtained current data from the FTC television certification database to obtain data for non-Energy Star televisions. The relationship of screen size to UES was developed for Energy Star version 8, see Equation A-31 and Table A-93.

$$kWh = \left(UES_{base} - UES_{eff}\right)\ x\ IE\ x\ ISR$$

Equation A-31

Table A-93 EPM Energy Star Television Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
kWh, kW	Measure savings per program year		
UES_{base}	UES for baseline television	Television UES Baseline	Following table
UES_{eff}	UES for Energy Star television	Model data and Energy Star Database	28 to 305 kWh
ISR	In Service Rate	Participant Survey, 2021	100%
IE	Interactive Effects Factor by climate zone	DEER Interior Lighting	0.92 to 1.08 kWh 1.01 to 1.30 kW

Table A-94 was built with data from the FTC database that generates the Energy Guide label required on all new televisions. The minimum Energy Star on-power rating is listed for the midpoint of each screen size bin along with baseline UES. The population for each UES group was the average of all non-Energy Star televisions.

Table A-94 EPM Television UES Baseline

Screen Size (diag. inch)	Samples	UES
10 to 25.5	151	45.4
25.5 to 35	157	57.2
35 to 40	65	78.4
401 to 43	168	101.7
43 to 49	105	113.6
49 to 50	260	141.6
50 to 55.5	431	155.4
55.5 to 60	114	147.4
60 to 70	518	202.5
70 to 80	243	258.0
80 to 90	126	321.6
90 to 200	6	660.0

A.12.1.5.5. Energy Star Lighting

The program offered many types of LED lamps, including general service A-lamp, reflectors, BR, PAR, and candelabra lamps. The market had been moving to a more efficient lighting baseline after the Energy Independence and Security Act of 2007 (EISA), but was accelerated with the California Appliance Regulation, Title 20. The Evaluator utilized the “2018 Screw in Lamp Disposition” memo for the baseline WRR factor for directional, globe and candelabra products. The LED A-lamp baseline also changed in 2018 and follows the “Approved LED A-Lamp Measure Definitions” with delta watts for EISA wattage bins and lumen per watt output. The algorithm for lighting energy savings is:

$$kWh = HOU\ x\ \frac{(Watts_{base} - Watts_{efficient})}{1000}\ x\ IE\ x\ ISR$$ *Equation A-32*

The variables for the lighting equations are listed in Table A-95.

Table A-95 EPM Energy Star Lighting Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
kWh, kW	Measure savings	NA.	NA.
$watts_{base}$	$Watts_{efficient}$ x WRR Delta Watts + $Watts_{efficient}$	2018 Screw in Lamp Disposition Approved LED A-Lamp Measure Definitions	25 – 150W
$watts_{efficient}$	Watts per lamp	Model data and Energy Star Database	2.2 - 23 W
ISR	In Service Rate	Participant Survey, 2021	100%
IE	Interactive Effects Factor by climate zone	DEER Interior Lighting	0.92 to 1.08 kWh 1.01 to 1.30 kW

A.12.1.6. Billing Analysis Approach

The Evaluator performed a billing analysis to evaluate the energy savings for Smart Thermostats and Web-Enabled Thermostats. As with the CRP Attic Insulation and CRP Cool Roof described in Appendix A.11.1.6.2, the Evaluator used a billing data retrofit isolation approach to evaluate EPM Smart Thermostats and EPM Web-Enabled Thermostats.

A.12.1.6.1. Billing Data Retrofit Isolation

To evaluate EPM Smart Thermostats and EPM Web-Enabled Thermostats, the Evaluator used a billing data retrofit isolation approach. As mentioned in the CRP portion of this appendix, this was done specifically to avoid some of the disadvantages of PSM-based analysis in cases where the HVAC-equipment type is unknown for a population. However, statistically viable results could not be isolated for FY 20/21 alone for EPM Smart Thermostats and EPM Web-Enabled Thermostats. Therefore, data from FY 15/16 through FY 19/20 was used to supplement the analysis. Furthermore, EPM Web-Enabled Thermostats could not produce statistically viable results independently and were aggregated with EPM Smart Thermostats for analysis.

Billing Data Preparation

LADWP provided participant bi-monthly billing data. As with the procedure described with the billing data regression analysis, customer billing data was first calendarized from billing periods to calendar years. After calendarization, customer billing data was filtered for the following criteria:

- The Evaluator reviewed the pre-installation data and post-installation data for each measure to determine the optimal pre-installation and post-installation period for each measure. Most customers did not have a full year’s worth of post-installation data. Therefore, the Evaluator used a pre-installation period of March 2019 through

September 2019 and a post-installation period of March 2021 through September 2021.

- Participants must not have taken part in any other energy efficiency programs administered by LADWP during the five-year Retrospective Period.
- Participants must not have taken part in the EPM program across multiple program years.
- Participants must not have installed multiple types of EPM program measures.
- Participants with apparent photovoltaic generation, as noted by the appearance of negative billing data, were excluded from analysis.
- The results of the analysis were not statistically significant when performed on FY 20/21 data for EPM Smart Thermostat and EPM Web-Enabled Thermostat. Thus, data was supplemented using FY 15/16 through FY 19/20 data. Furthermore, EPM Web-Enabled Thermostats could not produce statistically viable results independently and were aggregated with EPM Smart Thermostats for analysis, creating the EPM Smart + Web-Enabled Thermostats measure.

The number of participants remaining in the data set after filtering for the above criteria is provided in the following table:

Table A-96 EPM Smart & Web-Enabled Thermostat Participant Count

Measure	Number of Participants	Final Sample Size
Smart Thermostat	12,992	2,118
Smart + Web-Enabled Thermostat	13,472	2,205

The zip code for each customer's service address was geolocated to an approximate latitude and longitude and historical weather data was obtained through NOAA for the nearest weather station.

Weather Normalization

After preparing the billing data, the Evaluator proceeded to normalize the billing data. From the candidate HDD and CDD bases, the base pair that provided the best adjusted R-squared was selected as the HDD and CDD base for that individual customer based on the equation provided in Equation A-33.

$$Average\ Daily\ kWh_i = \alpha + \beta_1 \cdot post + \beta_2 \cdot CDD_{i,n} + \beta_3 \cdot HDD_{i,n} + \beta_4 \cdot CDD_{i,n} \cdot post + \beta_5 \cdot HDD_{i,n} \cdot post + \varepsilon \qquad \text{Equation A-33}$$

Where:

- i represents each individual customer for each month,
- n represents each iteration of base pairs,

- $post$ is an indicator variable indicating whether the period is in the post or pre period,
- $CDD_{i,n}$ is the CDD calculated for iteration *n* for customer *i,*
- $HDD_{i,n}$ is the HDD calculated for iteration *n* for customer *i,*
- α is the intercept term,
- β_1 is the main effect of the post period,
- β_2 is the main effect of CDD,
- β_3 is the main effect of HDD,
- β_4 is the additional effect of CDD on the post period,
- β_5 is the additional effect of HDD on the post period, and
- ε is the error term.

Isolation of Weather-Dependent Load

After normalizing the billing data to TMY3, the Evaluator proceeded to extract the weather-dependent load for each customer for the pre and post periods under the assumption that most weather-dependent loads for residential homes is attributable to HVAC. To accomplish this, the Evaluator first detected a month with minimal HVAC load by selecting, for each customer in each period, the month with the lowest average daily kWh. The Evaluator deemed this value as "baseload," representing the typical household consumption in absence of HVAC. The weather-dependent load for each customer in each month of each period could then be determined by subtracting the baseload from that month's normalized average daily consumption.

For the purposes of this analysis, weather-dependent load between the months of May through October were treated as cooling load while weather-dependent load between November through April were treated as heating load.

Savings Calculation

For the EPM Smart Thermostat and EPM Smart + Web-Enabled Thermostat, the difference in pre and post weather-dependent load was treated as the savings for each customer, as represented in Equation A-34.

$$\Delta kWh_{HVAC} = kWh_{HVAC\ Pre} - kWh_{HVAC\ Post} \qquad \textit{Equation A-34}$$

Because the FY 20/21 billing data was truncated to the period of March through September, residential load shapes taken from the California Energy Commission's 2018 Investor-Owned Utility California Load Shapes project were used to estimate the heating and cooling savings for the missing months of October through February.

Individual savings were then filtered by using the median plus or minus four times the mean-adjusted deviation (MAD) to correct for outliers in a skewed (non-normal) distribution. The individual savings were then aggregated to create an average per household savings, as represented in.

Table A-97 EPM Smart & Web-Enabled Thermostat Participant-Level Savings

Measure	Annual kWh Savings	90% Confidence Interval		Relative Precision (90% CL)
		Lower Bound	Upper Bound	
Smart Thermostat	180.34	116.33	244.36	35%
Smart + Web-Enabled Thermostat	165.95	103.33	228.57	38%

A.12.1.6.2. Adjustment for COVID-19

As mentioned in Appendix A.11.1.6.3, it is important to note that the savings calculated as part of the residential billing analysis may be impacted by the ongoing COVID-19 pandemic. Therefore, both the residential energy consumption observed in the billing data and the observed savings for FY 20/21 may inadvertently be impacted by changes due to the COVID-19 pandemic. To account for this impact, the Evaluator created a series of adjustment factors for each measure by leveraging the non-participant billing data received from LADWP.

The creation of these adjustment factors largely followed the logic of the billing data retrofit isolation analysis in the following manner:

- The non-participant data was separated into a typical period (January 2019 through December 2019) and COVID-19-impacted period reflective of that measures' post-installation analysis period (October 2020 through September 2021 depending on the measure).
- The non-participant billing data was weather-normalized by optimizing the CDD and HDD bases per participant and normalizing the billing data to TMY3.
- The non-weather dependent load was identified for each customer for the typical year and COVID-19-impacted year (i.e., the month with the lowest normalized average daily consumption).
- Heating-dependent load (November through April) and cooling-dependent load (May through October) was identified for each customer for the typical year and COVID-19-impacted year.
- An adjustment factor was calculated by dividing the COVID-19-impacted load by the typical year load for the non-weather dependent load, the heating-dependent load, and cooling-dependent load, creating a series of adjustment factors.

The adjustment factors were then applied to the COVID-19-impacted post-installation data for the HVAC measures evaluated via billing analysis in the following way:

- The COVID-19-impacted post-installation billing data was normalized for the impacts of COVID-19 by dividing the total post-installation cooling load and heating load by their respective COVID-19 adjustment factors prior to calculating typical year savings.
- The typical year pre-installation billing data was adjusted for COVID-19 equivalency by multiplying the total pre-installation cooling load and heating load

by their respective COVID-19 adjustment factors prior to calculating COVID-19-impacted savings.

For residential measures that were not evaluated by residential billing analysis, COVID-19 adjustment factors were generated in a similar manner however the COVID-19-impacted period was fixed to July 2020 through June 2021. This adjustment factor was then applied to estimated savings rather than pre/post billing data depending on whether the measure was deemed as likely to have been impacted by COVID-19.

A.12.1.7. Online Survey Data Collection

The Evaluator administered an online survey of customers who purchased a product for which LADWP claimed savings.

- Verify that the rebated equipment was in-place and operating (as applicable);
- Estimate the net impacts of the program; and
- Assess customer experiences with the program.

A total of 1,814 program participants received up to three emails from LADWP inviting them to complete the survey – 240 completed the survey, yielding an overall response rate of 13.2%.

Table A-98 EPM Summary of Survey Sample Measure Coverage

Measure	# of Customers	% of Customers	% of Measures	# of Responses	% of Responses
Smart thermostat	3,988	62%	58%	98	41%
Refrigerator	1,942	30%	25%	96	40%
Window Air Conditioner	256	4%	3%	20	8%
Light Bulb	156	2%	12%	16	7%
Power Strip	51	1%	1%	9	4%
Television	6	0%	0%	1	0%

A.12.2. Impact Evaluation

This section presents the findings of the impact evaluation of the EPM during the FY 20/21 period. Ex-post gross energy savings and peak demand reduction are presented at the measure level.

A.12.2.1. Description of Factors Affecting Gross Realized Savings

The following sections describe factors affecting realized savings for each of the EPM offerings.

A.12.2.1.1. Energy Star Lighting

The lighting realization rate for energy savings was greater than 100%. All types and wattages of ENERGY STAR lighting received the same Ex-Ante deemed energy savings value of 1.92 kWh/lamp.

The number of lamps in a package ranged from 1 to 32, listed previously in Table A-89. The Ex-Ante deemed savings considered the number of products per order, but not the quantity of lamps per retail package. The Evaluator researched product model numbers with the letters “PK” and a forward slash in the nomenclature to extract the lamp quantity per package and to inform the Ex-Post savings calculation.

A.12.2.1.2. Energy Room Air Conditioner

The Room Air Conditioner energy realization rate was greater than 100%. It appears that the deemed per unit savings value was 29 kWh FY 20/21. The Ex-Post savings per unit method was the same for all four years, as the latest US DOE Federal Code change was in 2014 and the minor ENERGY STAR revision from 4.0 to 4.1 during this period did not change the CEER values. The Ex-Post savings varied with Capacity, Base Case CEER, Installed CEER, EFLH Hours. There are many factors involved that are affecting the realization rate and it is likely that Ex-Ante per-unit savings are greatly underestimated.

A.12.2.1.3. Advanced Power Strip

The power strip energy savings realization rate was 98%. For the APS Tier 2, the Ex-Post savings referenced from the workpaper “SCE Tier 2 Advanced Smart Power Strips” was closely aligned with the Ex-Ante value of 212 kWh.

A.12.2.1.4. Smart and Web Thermostat

The smart and web thermostat energy realization rate was 92%. To obtain statistical significance in the billing analysis, FY 20/21 data was aggregated with prior program years’ data. The COVID-19 era contributes to variation in the pre and post billing analysis periods.

A.12.2.1.5. Refrigerator

The refrigerator realization rate was 117%. The Ex-Ante savings were deemed based on one of two Energy Star rating levels. The Ex-Post savings determined the minimum Federal Applicant Standard energy rating for each refrigerator and compared to the manufacturer refrigerator specifications.

A.12.2.1.6. Television

The television energy realization rate was 29%. The participation was low with a total of 17 rebated Energy Star televisions, which is reflective of the low number of manufactured Energy Star certified televisions. The Ex-Post savings were based on the difference of the manufacturer rating for annual energy use based on FTC Energy Guide data, using the Energy Star television Version 8 method.

A.12.3. Process Evaluation

The EPM program is designed to simplify shopping for energy efficient products and streamline obtaining a rebate. EPM’s website (https://marketplace.ladwp.com/) provides an easy-to-use platform for customers to find energy efficient products and locate stores and online retailers. The website provides users with lists of products, product features, product costs, products ratings and reviews from other websites, energy savings estimates, Enervee scores[33], rebate information (for certain products), and ENERGY STAR rating (where applicable). Additionally, the website includes links to Electrum, a third party that provides online information about solar.

As of October 2021, EPM included 19 different products. Of these products, customers could purchase three directly from the website and seven included LADWP rebates.

Figure A-43 EPM Products Offered

Source: Copied from website on 10/11/21

A.12.3.1. Process Evaluation Approach and Methodology

The following sections describe the evaluation approach and methodology used to perform the EPM Program process evaluation.

A.12.3.1.1. Document Review

The Evaluator reviewed the EPM website, LADWP Rates and Equity Metrics Semi-Annual Report (August 3. 2021)[34], Los Angeles Housing Element 2021-2029 (Adopted November 2021)[35], Appendix 1.1 Housing Element Assessment of Fair Housing[36], and census data.

A.12.3.1.2. Staffing Interviews

Over a one-hour period, the Evaluator interviewed three (3) EPM staff in May 2021. Additionally, the evaluation team held a 45 minute interview with two (2) Enervee staff in June 2021 (with another two LADWP staff also in attendance).

A.12.3.1.3. Participant Survey

The participant survey had several uses, but for the process evaluation, the evaluation team wrote survey questions to determine:

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[33] The Enervee score is a value from 0 to 100 representing product performance and energy use. The higher the Enervee score, the more energy efficient. The Enervee Score is calculated based on how much more or less energy a product uses compared to all others of the same size/capacity/performance and is updated daily for all products based on the range of products currently available in the market.

[34] https://www.ladwp.com/ladwp/faces/ladwp/aboutus/a-financesandreports/au-fr-corporateperformance/au-fr-corporateperformance-emdi?_adf.ctrl-state=3mkapxmkn_87&_afrLoop=1443106048009335

[35] https://planning.lacity.org/plans-policies/housing-element

[36] Ibid

- **Customer Satisfaction** - The level of customer satisfaction with the overall website.
- **Customer Wants** – Whether the platform is serving what customers want.
    - This includes the ease or difficulty of navigating the site as well as certain areas that customer's expressed interest in having more information
    - This also includes refrigerator financing – whether customers were interested in the ability to finance a new refrigerator from the site (a topic of interest to the LADWP program manager).
- **Customer Decision Making** – How the program offering affected customers decisions to purchase efficient products.
- **Customer Demographics** – Included to explore how well EPM participation represented the population of Los Angeles and whether target marketing by demographics may be beneficial.

A.12.3.1.4. Tracking Data Review

The Evaluator reviewed the program tracking database to determine the number of products with energy savings claimed by LADWP as well as the cost effectiveness of the program as implemented.

A.12.3.2. Process Evaluation Findings

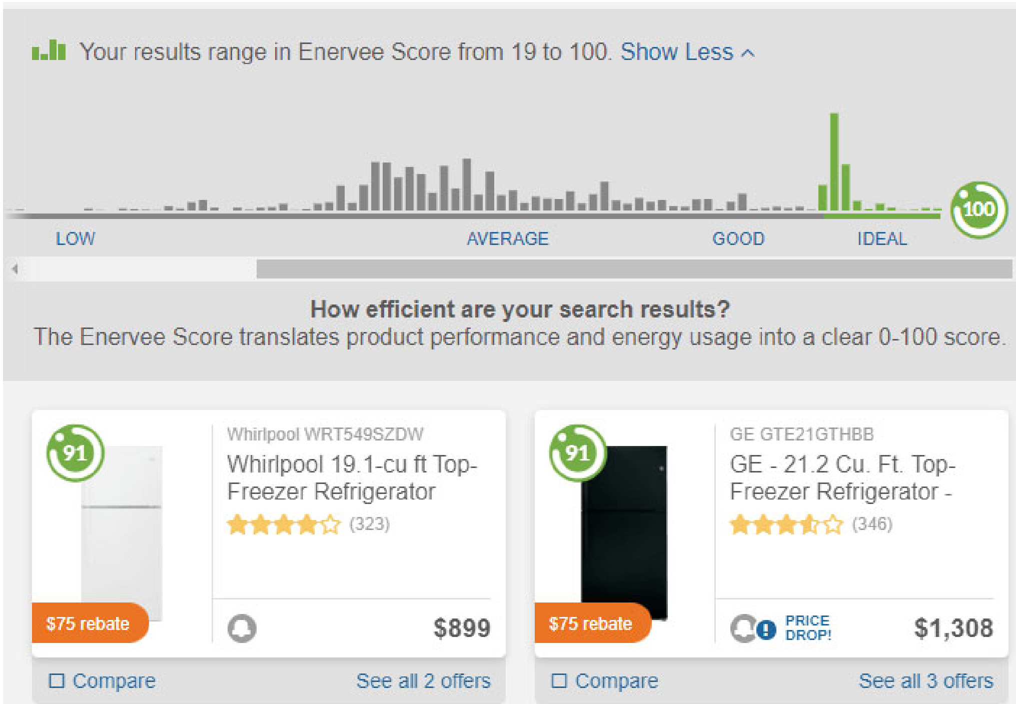
The Evaluator's analysis of EPM is focused on data obtained from customers who received a rebate through the EPM website via an online survey. This subset of customers includes a good set of email addresses to enable a survey, but limits understanding of the EPM website experience for customers who visit the site but do not obtain a rebate.

The survey respondents provide a good (albeit not exact) representation of the population of customers receiving a rebate through EPM and the Evaluator is comfortable using this data to discuss EPM (with the above caveat). (see Table A-98)

A.12.3.2.1. EPM Site and Rebate/Discount Process

The EPM website provides instant discounts and rebates for a selection of efficient products. The program website is designed to influence customers to purchase more energy efficient products. To do this, the website provides an "Enervee Score" for the products viewed. This score is a metric for the products energy efficiency, relative to other products of different make and model. The score is a simple metric that uses the products annual kWh and normalizes for product characteristics that affect energy use, such as product size and capacity. The score is presented on a 0-100 scale to allow for easy comparisons. Figure A-44 shows how the information is presented to a product purchaser. The score is presented on a 0-100 scale to allow for easy comparisons.

Figure A-44 EPM - Screenshot of LADWP Marketplace



In addition to presenting information on the product energy use, the website advertises the available rebates and compares pricing from multiple retailers.

Through the marketplace website, LADWP offers instant discounts on smart thermostats, light bulbs, and power strips. The customer receives the instant discount at the time of purchase when they add the product to their cart, complete the information necessary to verify that they are an LADWP customer, and complete their purchase.

Rebates are offered for a broader list of products: light bulbs, powers trips, washers, televisions, air conditioners, refrigerators, and thermostats. The customer can use the website to shop for the rebated product and apply for a rebate, or they can purchase the product and apply for a rebate within 12 months of the purchase time. To receive a rebate, the customer searches for the make and model information to validate the product. The website provides a tool that assists the customer by auto-populating the form with model names as the user types in the information. Once the model is entered, the customer completes a form to verify that they are an LADWP customer.

The website also provides information on a variety of other products that are not rebated or discounted by LADWP.

Online submissions for rebates are sent directly to LADWP's partner, Enervee, for processing. Paper submissions are submitted to LADWP who reviews the paperwork and verifies the customer, and the forwards it to Enervee for payment. Program staff report that rebate processing is completing rebate processing in 15 days with most being provided in 2 to 3 days.

LADWP customers can purchase an efficient product and apply for a rebate through the program website, or if they prefer, mail in a rebate application. Rebates submitted online receive an electronic Visa gift card, mailed applications receive a physical Visa card. The program website also allows provides an instant discount to customers who purchase the product through the websites' online store. The instant discount is applied at checkout.

A.12.3.2.2. EPM Customer Satisfaction and Wants

Ninety-four percent (94%) of EPM survey respondents were satisfied with the site. Additionally, most respondents (73%) felt that the website helped them decide about what to purchase and over half (56%) said it gave information that they had not seen elsewhere.

While the satisfaction rate is very high, some EPM customers want a slightly improved navigation experience (especially when looking at model numbers) and more information.

EPM Navigation

Most respondents (90%) said it was easy to find what they wanted on the site. Thirty percent (30%) chose to purchase online through EPM rather than at a store because EPM made it easy to find and buy energy efficiency products and 23% chose EPM over a store because it allowed them to compare prices from multiple stores. One satisfied respondent who provided comments noted that they liked seeing "the exact model that is compatible since they all look similar sometimes." One dissatisfied customer said that it "was very difficult to match model number up with what's listed on the website since the models were truncated in the drop-down menus. Different sub-models had different rebate amounts with no explanation. Was overall a very difficult and inefficient process."

More Information

The site provides some information about other programs, but customers are looking for more information. For example, the EPM website already includes a prominent banner on the thermostat page regarding the Power Savers program (a program that rewards customers for allowing LADWP to control their thermostat during times of grid stress). EPM also has solar information on the website (a statement about Solar Marketplace from Electrum is front and center when landing on the home page) but customers want more information on solar. While there is information about solar, figuring out how to get to the Solar Marketplace is not straightforward. (In the recommendations section, the Evaluator suggests a slight website change to make it easier to get to the Solar Marketplace.)

Last year, EPM also included many refrigerator purchases and customers generally tend to remove their old refrigerator when they purchase a new one. The EPM program manager indicated that a link to the Refrigerator Recycling program is not yet available on the EPM website but was being implemented at the time of the interview.

Forty-two percent (42%) of customers who obtain a rebate on the website wanted to see information on other products not on the website. Among those who do want to see more information, more than half expressed interest in water saving fixtures. Other products not currently on the site that these customers wanted to know about include battery storage, cars (including electric vehicles and home EV chargers), and electric lawn and garden equipment, including leaf blowers. Note that respondents were also interested in pool pumps and LADWP already provides rebates for pool pumps through the Consumer Rebate Program.

Additionally, regardless of whether they purchased a refrigerator from the website (i.e., by using a website link to purchase online from a retailer), about half of all respondents were interested in paying no money down and a small monthly amount to buy their next energy efficient refrigerator. (This option is not currently available on the LADWP Marketplace.) Income levels made no difference in the interest for this option.

A.12.3.2.3. Demographics of Customers Obtaining a Rebate through EPM

Customers who use the EPM website to obtain a rebate are mainly White or Asian, single family, and homeowners. One-third (34%) are low or moderate income, and the majority (72%) are under 55, Table A-99.

Table A-99 EPM Demographics of Customers Obtaining a Rebate through EPM

Demographic Parameter	EPM Survey	Population for City of Los Angeles (census data)	Notes
Home Ownership	(n=231)	Households	
Owner - Single Family	64%	37%	Both homeowners and renters are using the site as well – just not in proportion to their numbers in the population. Homeowners disproportionately obtain more rebates through EPM than renters
Owner - Multi Family	6%		
Renter- Single Family	12%	63%	
Renter - Multi Family	18%		
Income	(n=221)	Households*	
Low or Moderate	34%	64%	One third are low or moderate income (based on number of people in the household and self-reported income). Note, however, that many did not provide this information.
Above Moderate	40%	36%	
Declined to Say	26%	--	
Age	(n=216)	Householder**	
25-34	24%	17%	EPM is being used by all ages, but households headed up by those under 55 are obtaining more rebates through EPM compared to the population of households headed up by those under 55.
35-54	48%	39%	
55-64	14%	19%	
65+	14%	24%	
Self-Identified Ethnicity	(n=187)	Householder**	
Caucasian (White)	49%	35%	Whites and Asians disproportionately obtain more rebates through EPM than Latinx or Other ethnicities
Asian	24%	15%	
Hispanic (Latinx)[37]	19%	31%	
African descent	4%	7%	
Other	4%	13%	

**Appendix 1.1 City of Los Angeles Housing Element 2021-2029. Chart 1.1.28 Income Categories for Renters and Owners in LA City*
***Census data, ACS 2019, Table S2502*

[37] The Evaluator follows the lead of LADWP staff and applies the term Latinx rather than Hispanic (Housing Element 2021-2029, page 41).

LADWP has additional opportunities to help renters become more efficient. As shown Figure A-43, the EPM website includes products like kitchen or laundry equipment that are of interest to households who own a house as well as products of interest to households who rent like window air conditioners, televisions or air purifiers. Additionally, home ownership does not matter for certain safety and preparedness products. However, 63% of households in Los Angeles rent, but only 30% are taking advantage of rebates through EPM.

Similarly, EPM appears to be underserving the Latinx population as there are 31% of Latinx households, but only 19% are taking advantage of rebates through EPM.

A.12.4. Recommendations

Below are four recommendations from the process evaluation of EPM.

- **Consider adding more information on products of interest to customers, such as water saving equipment, back-up batteries, and lawn equipment, as well as financing for efficient refrigerators.**
- **Consider targeted marketing to begin to draw in renters and Hispanic (Latinx) customers.** While the survey did not ask questions to shed light on language capabilities, staff may want to determine if it is worthwhile to apply a language translation capability to the site so that people with English as a second language may be more comfortable using the site.
- **Cross-link programs to raise awareness of other LADWP customer opportunities.** While it may not be feasible to put in specific links to all LADWP programs onto the EPM website, it may be good to have a single link that makes a person on the website want to go explore other LADWP programs. Specific options may include the following.
    - About three quarters of EPM survey respondents are homeowners (70%) who might be able to benefit from Consumer Rebates Program (CRP) rebates, yet half to two-thirds of homeowner respondents were unaware of products available through CRP.[38] As such, the EPM website may be a good location to add a link specifically to the CRP landing page.[39]
    - Close to a third of EPM respondents (who provided their income) are low-income and may be able to participate in the Home Energy Improvement Program or appreciate knowing they could obtain free water conservation measures (through the Free Water Conservation items).
    - Over half of EPM respondents are single family homeowners who may be grateful to know that there are ways to reduce their water bills through the Turf Replacement Program.

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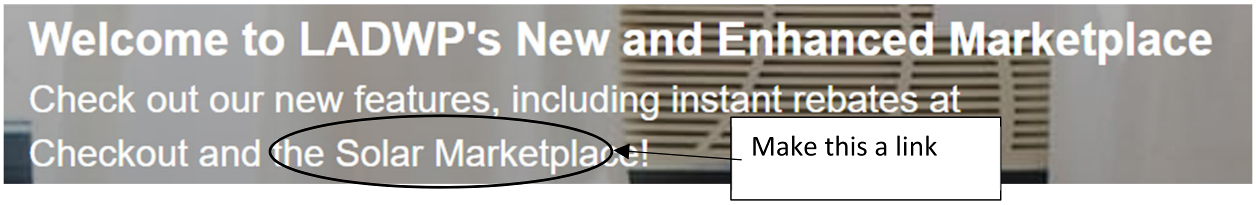
[38] CRP offers rebates for products that are typically more expensive than those on the EPM website and items that homeowners purchase more often than renters. (i.e., CRP has rebates for windows, attic insulation, variable speed pool pumps, cool roofs, HVAC, and whole house fans).

[39] The website does have a link to the general LADWP home page, but it is hard to find and a link directly to the energy efficiency page or CRP site would make it easier for residential customers to explore these rebate options.

- **Create a link directly to the Solar Marketplace that is easily followed,** see Figure A-45.

Figure A-45 EPM - Suggested Addition to Website



Source: Screen shot of website on 10/13/22

A.13. ESAP

This chapter presents an evaluation of the Energy Savings Assistance Program (ESAP) that LADWP offered customers during fiscal year 20/21 (Concurrent Period).

The primary objective of this evaluation was to estimate energy and peak demand impacts attributable to ESAP.

A.13.1. Evaluation Methodology

This section presents the findings of the tracking data review and the methodology used to calculate verified Ex-Post energy savings and peak demand reduction for the program. The evaluation methodology activities were the following:

- Tracking data review;
- Ex-Ante savings review;
- M&V approach; and
- Billing analysis approach.

A.13.1.1. Tracking Data Review

LADWP provided the Evaluator the available program tracking data for measures installed between July 1, 2020, through December 15, 2020. LADWP provided the following datasets:

- Quarterly billable amounts by measure;
- Measure-level tracking data including customer accounts, premise address, measures installed, quantity of measures installed, contractor name, measure cost, and install date; and
- Monthly measure count summaries with associated measure-level Ex-Ante kWh savings.

The Evaluator reviewed available program data and counted the total number of unique households that participated in each fiscal year. These household counts were used to extrapolate household-level regression analysis to program-level savings for FY 20/21.

The Evaluator was not provided Ex-Ante peak kW reduction by measure and was unable to estimate program tracking data demand reduction. The Evaluator found the monthly measure count and savings summaries difficult to match with the measure-level tracking data. In many cases, the measure names in one data source did not match the measure names in another data source; therefore, measure-level counts were unable to be recreated using the available tracking data.

A.13.1.2. Baseline Assumptions Review

No baseline assumptions reviews were conducted for ESAP, as a billing analysis was used to estimate Ex-Post savings for the program.

A.13.1.3. Ex-Ante Savings Review

The following table summarizes the discrepancy the Evaluator found comparing the reported ESP Ex-Ante kWh savings and peak kW reduction with the Ex-Ante kWh and peak kW impacts presented in the tracking data, delivered by LADWP.

Table A-100 ESAP Ex-Ante Savings Source Comparison

Fiscal Year	ESP Data Ex-Ante kWh	Program Data Ex-Ante kWh	ESP Data Ex-Ante Peak kW	Program Data Ex-Ante Peak kW
FY 20/21	2,745,787	2,747,700	331.02	N/A

The Evaluator was provided with tracking data that was nearly equal in terms of savings to the reported ESP Ex-Ante kWh savings. In addition, the program tracking data did not provide estimated peak kW reduction for the measures in the program, whereas the reported ESP Ex-Ante values reported peak kW impacts for FY 20/21.

A.13.1.4. M&V Approach

Table A-101 summarizes the data sources used in the ESAP impact evaluation.

Table A-101 ESAP Data Sources

Data	Source
Program tracking data	Data requested for all data tracking program participation, rebate applications, and measure details
Recipient billing data	Monthly billing data provided by LADWP for customers that have participated in ESAP in the study periods
Non-participant billing data	Monthly billing data provided by LADWP for customers that have not participated in ESAP in the study periods
Participation in other LADWP programs	Data provided by LADWP for all residential program participation in the study periods

The database review process started with a review of tracking data to ensure that sufficient information was provided to calculate energy savings and peak demand reduction.

Field data collection was not completed for ESAP. Savings were evaluated via billing analysis for the program. In addition, no sampling plan was required for this program, as savings were evaluated via billing analysis with a census of participants.

The approach the Evaluator used to determine Ex-Post kWh savings and peak kW reduction for ESAP was based on statistical analysis of billing data. The Evaluator took the following steps during the evaluation approach:

- First, the Evaluator conducted an exploratory data analysis that made use of all provided participant billing data;
- Second, the Evaluator used regression models to make longitudinal and cross-sectional comparisons of energy consumption before and after installation of energy efficiency measures to determine how electricity use changed after a measure was installed at a household; and
- Third, the Evaluator quantified whole home savings by extrapolating regression model outputs with weather and number of participants for FY 20/21.

Ex-Post savings were determined using the regression coefficients. Further details of the billing analysis approach are summarized in the following section.

A.13.2. Billing Analysis

The following sections describe the billing analysis procedures used for ESAP.

A.13.2.1. Billing Analysis Approach

The Evaluator performed a billing analysis to evaluate the energy savings for ESAP. As with the CRP Pool Pump and Motor and CRP Certified Pool Pump and Motor measures described in Appendix A.11.1.6.1, the Evaluator used a billing data regression approach to evaluate the Program.

A.13.2.1.1. Billing Data Regression

This section describes the pooled billing data regression approach with a propensity score matched (PSM) comparison group used to evaluate ESAP.

Billing Data Preparation

LADWP provided both participant and non-participant bi-monthly billing data. Because billing periods varied across participants and did not correspond to the start and end of calendar months, all billing data was calendarized. To accomplish this, the Evaluator first calculated an average daily kWh for each customer bill as represented by Equation A-35.

$$Average\ Daily\ kWh = \frac{Total\ kWh}{Number\ of\ Days} \qquad \text{Equation A-35}$$

The average daily kWh was then multiplied by the number of days in each respective calendar month of the respective bill. For example, for a bill starting on January 15th and ending on March 14th, the average daily kWh would be multiplied by 17 to calculate the bill's January consumption, 28 for February, and 14 to calculate March's consumption. The portions corresponding to each given period in a calendar year would then be summed across for each participant to ascertain that customer's total monthly kWh.

It should be noted that, given billing data is measured at a monthly or lower resolution, there are customer bills which contain both pre and post data. These customer bills and any months that contain calendarized data from these bills were removed from the analysis to prevent savings suppression.

After calendarizing the data set, data was then filtered for the following criteria:

- A simple outlier filter of the mean participant average daily kWh plus or minus three times the standard deviation of the participant average daily kWh was applied to both participant and non-participant data.
- For the sake of having a consistent pre-treatment period for PSM, participants and non-participants must have 12 months of pre-treatment data. This period was set to between May 2019 to April 2020.
- Participants and non-participants must not have participated in any other energy efficiency programs administered by LADWP from the date of their measure installation date and beyond and must not have installed any additional measures via the ESAP program beyond their initial installation date.

The number of qualified participants remaining in the data set after filtering for the above criteria are provided in Table A-102.

Table A-102 ESAP Participant Count

Measure	All Participants	Qualified Participants	All Non-participants with Billing Data	Qualified Non-participants
ESAP	5,171	3,539	358,577	147,315

For all remaining participants in the participant and non-participant pool, the zip code for each customer's service address was geolocated to an approximate latitude and longitude and historical weather data was obtained through NOAA for the nearest weather station.

Propensity Score Matching (PSM)

The Evaluator utilized PSM to develop a comparison group from the non-participant pool. The Evaluator developed five pre-treatment variables for use in the PSM:

- The average daily kWh annually,
- The average daily kWh for winter (December through February),
- The average daily kWh for spring (March through May),
- The average daily kWh for summer (June through September), and
- The average daily kWh for fall (October through November).

Because the non-participant pool does not have established treatment start dates, the Evaluator reviewed the billing data to determine an optimal pre-treatment period for PSM. This period was set to between May 2019 to April 2020.

Using the five pre-treatment variables, latitude, and longitude; the Evaluator executed a nearest neighbor PSM using the “MatchIt 4.1.0” package in the software “R 3.6.3.” The Evaluator selected a one-to-one participant-to-comparison match due to lack of equivalence when attempting a one-to-multiple matching. After executing the PSM, the Evaluator compared the participant group and the comparison group on several metrics to ensure a good match.

The Evaluator performed a MANOVA in “R 3.6.3” using default settings (Pillai’s trace) on the five pre-treatment variables to ensure similar distributions on all five variables. The results are presented in Table A-103. The distributions did not significantly differ between the participant group and the comparison group, suggesting a good PSM.

Table A-103 ESAP Pre-Treatment MANOVA

Measure	Pillai’s Trace	F-statistic	Num DF	Den DF	P-value
ESAP	0.000	0.192	5	7,072	0.966

After reviewing the results of the MANOVA, the Evaluator then performed a series of T-tests on the average daily kWh in the pre-treatment period by month. Because nearest neighbor matching pairs participants with their respective nearest comparison group match, the Evaluator established pseudo-treatment start dates for all comparison group customers based on their participant matches. Thus, the Evaluator used the 12 months prior to the treatment start date as the pre-treatment period for this comparison.

The results of the T-tests are presented in Figure A-46. The Evaluator considered matching successful if the number of months that were significantly different between the participant and comparison groups did not exceed two at the 95% confidence level. The Evaluator established a two-month tolerance band to account for the probability that repeated T-testing on panel data may result in any given month resulting in a significant difference-40% for two out of 12 months. The PSM did not exceed this tolerance band for any of the fiscal years.

Figure A-46 ESAP Pre-Treatment Equivalency

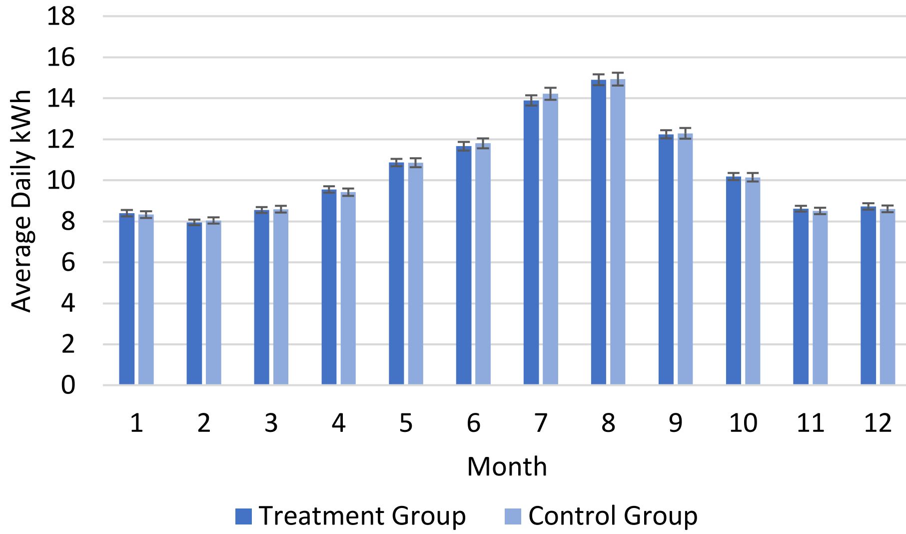


Table A-104 ESAP Pre-Treatment T-Test

Month	Participant Group (Average Daily kWh)	Non-Participant Group (Average Daily kWh)	T-value	P-value
1	8.404	8.329	-0.647	0.518
2	7.947	8.036	0.809	0.419
3	8.552	8.590	0.350	0.726
4	9.553	9.420	-1.097	0.273
5	10.867	10.857	-0.069	0.945
6	11.665	11.801	0.830	0.407
7	13.893	14.223	1.670	0.095
8	14.906	14.936	0.147	0.883
9	12.245	12.292	0.277	0.781
10	10.188	10.144	-0.316	0.752
11	8.620	8.508	-1.031	0.303
12	8.719	8.604	-0.997	0.319

The final participant count for the participant and comparison groups are presented in Table A-105.

Table A-105 ESAP Pre-Treatment T-Test

Measure	Participant Group Size	Non-participant Group Size
ESAP	3,539	3,539

Degree Day Base Optimization

After developing the participant and non-participant group, the Evaluator used historical weather data to optimize the heating degree day (HDD) and cooling degree day (CDD) bases for each customer. HDDs were calculated using 50-, 55-, 60-, and 65-degree bases. CDDs were calculated at 65-, 70-, 75-, and 80-degree bases.

The regression equation to determine CDD/HDD fit is specified by Equation A-36:

$$Average\ Daily\ kWh_i = \alpha + \beta_1 \cdot post + \beta_2 \cdot CDD_{i,n} + \beta_3 \cdot HDD_{i,n} + \beta_4 \cdot CDD_{i,n} \cdot post + \beta_5 \cdot HDD_{i,n} \cdot post + \varepsilon \qquad \text{Equation A-36}$$

Where:

- i represents each individual customer for each month,
- n represents each iteration of base pairs,
- $post$ is an indicator variable indicating whether the period is in the post or pre period,
- $CDD_{i,n}$ is the CDD calculated for iteration *n* for customer *i,*
- $HDD_{i,n}$ is the HDD calculated for iteration *n* for customer *i,*
- α is the intercept term,
- β_1 is the main effect of the post period,
- β_2 is the main effect of CDD,
- β_3 is the main effect of HDD,
- β_4 is the additional effect of CDD on the post period,
- β_5 is the additional effect of HDD on the post period, and
- ε is the error term.

For each customer, all 16 combinations were tested to determine which combination provided the best fit. The pair of CDD and HDD bases that provided the highest adjusted R-squared for each customer was selected as that customer's respective CDD and HDD base.

Regression Model

To estimate participant savings, the Evaluator used a post-period regression with pre-period control variables. This model isolates the post-treatment period and uses customer-specific variables generated from the pre-treatment period to control for individual variation. The Evaluator developed four pre-treatment variables for use in the regression:

- The average daily kWh for winter (December through February),
- The average daily kWh for spring (March through May),

- The average daily kWh for summer (June through September), and
- The average daily kWh for fall (October through November).

The regression equation is specified by Equation A-37.

$$Average\ Daily\ kWh_i = \alpha + \beta_1 \cdot treatment + \beta_2 \cdot CDD_i + \beta_3 \cdot HDD_i + \beta_4 \cdot CDD_i \cdot treatment + \beta_5 \cdot HDD_i \cdot treatment + \beta_6 \cdot pre\ usage\ winter_i + \beta_7 \cdot pre\ usage\ spring_i + \beta_8 \cdot pre\ usage\ summer_i + \beta_9 \cdot pre\ usage\ fall_i + \beta_{10} \cdot month_1 + \cdots + \beta_n \cdot month_{12} + \beta_{n+1} \cdot month_1 \cdot pre\ usage\ winter_i + \cdots + \beta_{n+x} \cdot month_{12} \cdot pre\ usage\ fall_i + \varepsilon$$

Equation A-37

Where:

- i represents each individual customer for each month,
- $treatment$ is an indicator variable indicating whether the customer is in the participant or comparison group,
- CDD_i is the CDD calculated for iteration *n* for customer *i,*
- HDD_i is the HDD calculated for iteration *n* for customer *i,*
- $pre\ usage\ winter_i$, $pre\ usage\ spring_i$, $pre\ usage\ summer_i$, and $pre\ usage\ fall_i$ are the customer-specific pre-treatment control variables,
- $month_1$ through $month_{12}$ are indicator variables indicating if the month is January through December,
- α is the intercept term,
- β_1 is the main effect of the program participation,
- β_2 is the main effect of CDD,
- β_3 is the main effect of HDD,
- β_4 is the CDD-dependent effect of program participation,
- β_5 is the HDD-dependent effect of program participation,
- β_6 through β_9 are the main effects of pre-treatment consumption,
- β_{10} through β_n are the main effects of month,
- β_{n+1} through β_{n+x} are the interactive effects of month and pre-treatment consumption, and
- ε is the error term.

The regression coefficients of interest for estimating savings are β_1, β_4, and β_5. Table A-106 provides information regarding the regression coefficients for each model and the overall model fit.

Table A-106 ESAP Regression Coefficients

Term	Regression Coefficient	Standard Error	T-value	P-value	Adjusted R-squared
Treatment	-0.557	0.134	-4.153	0.000	0.617
Treatment x HDD	0.025	0.021	1.238	0.216	0.617
Treatment x CDD	-0.016	0.020	-0.786	0.432	0.617

The savings for each fiscal year were then calculated using the formula presented in Equation A-38.

$$\begin{aligned} \mathit{Annual\ Savings} &= [\mathit{Treatment\ Coefficient} \\ &+ (\mathit{Treatment\ x\ CDD\ Coefficient}\ \cdot \overline{CDD}) \\ &+ \ (\mathit{Treatment\ x\ HDD\ Coefficient}\ \cdot \overline{HDD})] \cdot -1 \\ &\cdot 365.25 \end{aligned}$$

Equation A-38

Where:

- $\overline{CDD}$ is the average daily CDD for a typical weather year, and
- $\overline{HDD}$ is the average daily CDD for a typical weather year.

HDDs and CDDs were weighted relative to the nearest weather stations for the participants in each program year using TMY3. These weighted values are presented in Table A-107.

Table A-107 ESAP Weighted Average TMY3 HDD and CDD

Measure	Average Daily HDD	Average Daily CDD
ESAP	2.617	1.909

Savings per household, 90% confidence intervals, and relative precision at the 90% confidence level are presented in Table A-108.

Table A-108 ESAP Average Savings per Household

Measure	Annual kWh Savings	90% Confidence Interval		Relative Precision (90% CL)
		Lower Bound	Upper Bound	
ESAP	170	117	222	31%

A.13.2.1.2. Adjustment for COVID-19

It is important to note that the savings calculated as part of the residential billing analysis may be impacted by the ongoing COVID-19 pandemic. For ESAP, a COVID-19 adjustment factor was created by leveraging the matching non-participant group. This adjustment factor was created in the following manner:

- For ESAP non-participants that were matched to ESAP participants via PSM, a pseudo-installation date was assigned, and COVID-19-impacted data was restricted to the period after this date.
- Typical year data was restricted to January 2019 through December 2019.
- A simple pre/post linear model was used to determine the impact of COVID-19 on the non-participant data. Because ESAP includes a host of energy savings measures that vary between weather-sensitive and non-weather sensitive measures, the adjustment factor was generated at a whole-house level.

The COVID-19-impacted savings generated by the regression analysis was then divided by the COVID-19 adjustment factor to generate typical year savings.

A.14. LIREP

This section presents details about the evaluation methodology and impact evaluation for the REP.

A.14.1. Evaluation Methodology

This section provides a description of the evaluation methodology used by the Evaluator for the REP during FY 20/21.

A.14.1.1. Tracking Data Review

LADWP provided the Evaluator with reports from ESP summarizing the program activity for FY 20/21. These reports provided summary records of the number of new refrigerators installed during the fiscal year. Additionally, the spreadsheets contained summary Ex-Ante estimates of energy and peak demand impacts.

LADWP provided additional program tracking data administered by ARCA with details including participant contact information, appliance characteristics and other information collected at the time of pick-up. The ARCA tracking data was provided in the form of spreadsheet extracts from the ARCA program tracking database. The Evaluator asked LADWP which per-unit savings values were used for refrigerators delivered through the REP Program. LADWP provided the following Ex-Ante values via email communication:

- 822 kWh for 18 cu. ft. units;
- 692 kWh for 15 cu. ft. units; and
- 0.122 kW.

The Evaluator used the per-unit savings calculated from the ESP and ARCA tracking data for the evaluation of the program. There was a total of 152 refrigerator units recycled and installed during FY 20/21. The low participation rate was affected by ongoing COVID-19 safety precautions.

A.14.1.2. Ex-Ante Savings Review

Table A-109 shows a comparison of ESP savings and Program Tracking savings. The ESP and program tracking Ex-Ante kWh savings were closely aligned.

Table A-109 REP ESP and Program Tracking Saving Comparison

Measure	ESP Data Ex-Ante kWh	Program Data Ex-Ante kWh	ESP Data Ex-Ante Peak kW	Program Data Ex-Ante Peak kW
Refrigerator	121,954	105,184	34.30	18.54

A.14.1.3. M&V Approach

The Evaluator leveraged the program-level realization rate from FY 19/20 to calculate the energy savings in FY 20/21. The content that follows recounts the process that was performed in FY 19/20 to calculate energy savings impacts for the REP.

The Evaluator estimated gross energy and demand impacts for REP through a deemed savings calculation. To determine the appropriate baseline for REP, the Evaluator assumed that the average full year unit energy consumption (UEC) was equal to the UEC of the pre-existing refrigerator. The reason for this assumption was that participants in REP were expected to exchange their primary refrigerator and therefore the refrigerator being exchanged would be considered a primary unit for the evaluation. The full year UEC was calculated according to the method outlined in Section A.15.1.3.5 based on the RETIRE Program impact evaluation.

Then, the ENERGY STAR UEC[40] (ES UEC) for the efficient refrigerator was calculated using Equation A-39.

$$ES\ UEC = 7.26 * AV + 210.3 \qquad \textit{Equation A-39}$$

Where, AV is equal to the cu. ft. capacity of the new refrigerator.

The cu. ft. capacity was obtained by reviewing the ARCA tracking data and looking up the correct actual cu. ft. capacity value by referencing the new refrigerator model number.

Gross per-unit Ex-Post energy savings were then calculated by subtracting the ES UEC from the Average Full Year UEC for each unit exchanged in the program using Equation A-40:

$$Gross\ Ex\ Post\ kWh\ = Full\ Year\ UEC - ES\ UEC \qquad \textit{Equation A-40}$$

Gross peak demand savings were calculated based on the critical peak demand definition provided by LADWP. Measure specific normalized 8,760 hour load shapes were used to identify the average demand during this on-peak period. These load shapes assign a portion of estimated gross kWh energy savings to each hour of the year. After identifying the total kWh savings that fall into the defined on-peak hours, dividing by the total number of hours in the peak period results in the average gross peak demand reduction. The specific appliance load shapes that were used were originally developed as part of the

[40] https://www.energystar.gov/sites/default/files/specs//ENERGY%20STAR%20Final%20Version%205.0%20Residential%20Refrigerators%20and%20Freezers%20Specification.pdf

End-Use Load and Consumer Assessment Program (ELCAP) – a major end-use data collection program undertaken by the Bonneville Power Administration.[41]

A.14.2. Impact Evaluation

The Evaluator leveraged the program-level realization rate from FY 19/20 for the REP to calculate the energy savings in FY 20/21. The content that follows recounts the process that was performed in FY 19/20 to calculate energy savings impacts and the realization rate which was subsequently used to inform FY 20/21 energy savings impacts.

A.14.2.1. Full Year UEC Calculation

The calculation of full year UEC is the same as the method described in Section A.15.2.2, based on the RETIRE Program impact evaluation. Table A-110 summarizes the full year UEC estimate for refrigerators during FY 19/20.

Table A-110 FY 19/20 REP Full Year Average UEC Estimates

Fiscal Year	Appliance Type	Average Full Year UEC (kWh)
19/20	Refrigerator	1,153

A.14.2.2. Per-unit Gross Peak Demand Reduction

Appliance load shapes for refrigerators and freezers were used to estimate the average kW reduction occurring during LADWP's defined on-peak period. These load shapes were normalized versions of load shapes originally developed as part of the End-Use Load and Consumer Assessment program (ELCAP). Using these normalized ELCAP load shapes, the Evaluation Team determined that approximately 3.8% of the annual gross kWh savings attributable to a recycled refrigerator occurs during the on-peak period. Per-unit gross peak demand reduction for refrigerators for FY 19/20 is presented in Table A-111.

Table A-111 FY 19/20 REP Per-Unit kW Reduction

Fiscal Year	Appliance Type	Per-unit kW Reduction
19/20	Refrigerator	0.096

A.14.2.3. Description of Factors Affecting Gross Realized Savings

The primary factor affecting REP savings was the M&V approach that was used, with the net M&V impact resulting in -15,966 kWh. The Evaluator leveraged the FY 19/20 LIREP realization rate which was approximately 101%. However, ESP Data kWh savings were

[41] Pratt RG, CC Conner, EE Richman, KG Ritland, WF Sandusky, and ME Taylor. 1989. Description of Electric Energy Use in Single-Family Residences in the Pacific Northwest. (End-Use Load and Consumer Assessment Program [ELCAP]). DOE/BP-13795-21, prepared for Bonneville Power Administration by Pacific Northwest Laboratory, Richland, Washington.

overstated by a factor of 1.15 compared to Program Data savings, and it caused the program realization rate to be less than expected (87%).

A.15. RETIRE Program

This section presents details about the evaluation methodology and impact evaluation for the RETIRE Program.

A.15.1. Evaluation Methodology

This section provides a description of the evaluation methodology used by the Evaluator for the RETIRE Program during FY 20/21.

A.15.1.1. Tracking Data Review

LADWP provided the Evaluator with reports from ESP summarizing the program activity for FY 20/21. These reports provided summary records of the number of refrigerators and freezers collected for recycling. Additionally, the spreadsheets contained summary Ex-Ante estimates of energy and peak demand impacts.

LADWP provided additional program tracking data administered by ARCA with details including participant contact information, appliance characteristics and other information collected at the time of pick-up. The ARCA tracking data was provided in the form of spreadsheet extracts from the ARCA program tracking database. The ARCA tracking data could not be easily tied to the LADWP ESP summary report to verify that both sources represented the same number of refrigerators and freezers collected during FY 20/21. The Evaluator asked LADWP which per-unit savings values were used for refrigerators and freezers recycled through the RETIRE Program. LADWP provided the following Ex-Ante values via email communication:

- 1,946 kWh; and
- 0.3 kW.

The Evaluator used the per-unit savings calculated from the ESP and ARCA tracking data for the evaluation of the program. There was a total of only 6 refrigerator units recycled during FY 20/21. The low participation rate was affected by ongoing COVID-19 safety precautions.

A.15.1.2. Ex-Ante Savings Review

The following section presents a comparison of ESP savings and program tracking savings. Program tracking data was provided by ARCA without per-unit energy savings, and LADWP provided per-unit energy savings. ESP summary savings were combined with the ARCA tracking data to develop per-unit energy savings by measure and by fiscal year as discussed in Section A.15.1.1. Table A-112 shows a comparison of ESP savings and Program Tracking savings.

Table A-112 RETIRE ESP and Program Tracking Saving Comparison

Measure	ESP Data Ex-Ante kWh	Program Data Ex-Ante kWh	ESP Data Ex-Ante Peak kW	Program Data Ex-Ante kW
Refrigerator	11,676	11,676	3.28	1.80

A.15.1.3. M&V Approach

The Evaluator leveraged the program-level realization rate from FY 19/20 to calculate the energy savings in FY 20/21. The content that follows recounts the process that was performed in FY 19/20 to calculate energy savings impacts for the RETIRE.

A.15.1.3.1. Gross Energy Savings

Previous evaluations of utility sponsored appliance recycling programs have typically defined gross savings as equal to the unit energy consumption (UEC) of a given program appliance, usually with a part use factor applied to account for units that are not plugged in year-around. Issues such as free-ridership (units that would have been removed from the grid even in the absence of the program) and secondary market effects have typically been accounted for in the determination of net savings. This is the approach recommended and detailed in the U.S. Department of Energy's (DOE) Uniform Methods Project (UMP) Refrigerator Recycling Evaluation Protocol.[42] The UMP is a set of protocols developed through DOE funding that provides straightforward methods for evaluating energy savings for common energy efficiency measures offered through utility sponsored programs.

Gross savings are estimated in this evaluation using the 2010-2012 California Statewide Appliance Recycling Program (CA ARP) evaluation[43]. The CA ARP approach defines gross savings as the difference in energy consumption with and without the program. Because the program goal is removal of units from the grid, gross savings are defined in terms of consumption changes at the grid level. This requires some estimation of participant actions in the absence of the program. Table A-113 shows a simplified calculation of gross savings using the CA ARP definition.

Table A-113 RETIRE - CA ARP Simplified Gross Savings Calculation[44]

Unit Disposition	Location	Consumption without Program (A)	Consumption with Program (B)	Gross Savings (A-B)
Kept in Use	Participant Household	UEC as secondary unit	No consumption	UEC as secondary unit
Kept Unused	Participant Household	No consumption	No consumption	No Savings
Transferred from Participant Household	Transferee Household	UEC as primary or secondary unit	UEC as primary or secondary unit, given removal of program units	UECa - UECb

A.15.1.3.2. Verification of Units Recycled

The first aspect of conducting measurements of program activity was to verify the number of refrigerators and freezers collected and recycled through the program. When a customer schedules a pick-up, either online or over the phone, they are screened to

[42] http://energy.gov/sites/prod/files/2013/11/f5/53827-7.pdf

[43] http://www.calmac.org/publications/2010-2012_ARP_Impact_Evaluation_Final_Report.pdf

[44] This table is taken directly from the 2010-2012 CA ARP evaluation report.

ensure the scheduled unit(s) is operational and will be plugged in at the time of pick-up. At the time of pick-up, implementation crews are instructed to check that the unit powers on and produces air before permanently disabling the unit by cutting the power cord and damaging the appliance shell. However, it is not unreasonable to suspect that a small percentage of non-operational appliances may enter the program despite these screening efforts. If a non-operational unit is beyond reasonable repair, it offers no savings opportunity.

To account for this possibility, the Evaluator employed the following verification steps:

- Validating program tracking data provided by LADWP and ARCA by checking for duplicate or erroneous entries; and
- Conducting telephone surveys with a sample of program participants. The surveys were used to verify that customers listed in the program tracking database did indeed participate and that the number of appliances claimed to be recycled was accurate. Additionally, survey respondents were asked a series of questions to verify the working condition of their recycled appliances.

However, due to the extremely limited participation during FY 20/21, the Evaluator assumed a 100% verification rate for recycled refrigerators.

A.15.1.3.3. Short-Term In Situ Metering

Past evaluations of appliance recycling programs have generally taken one of two approaches to estimating UECs. The first, and perhaps more dated, approach involves metering program refrigerators and freezers using DOE testing protocols (DOE 2008) after they are collected for recycling (or using DOE based UECs that are published at the time of manufacture). The DOE protocols specify certain test conditions that are meant to provide general UEC ratings for new appliances. However, more recent evaluations have indicated that the DOE test protocols may not reflect actual usage conditions for appliances in utility customer homes (e.g., no door openings, empty cabinets, and a 90°F test chamber).

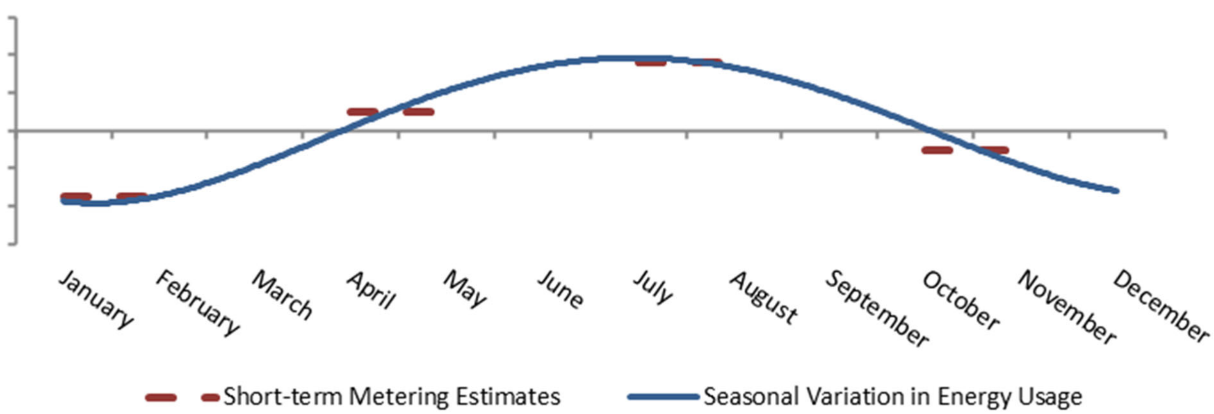
The second approach involves utilizing metered data that is collected from utility customer homes before an appliance is collected for recycling. The CA ARP protocol recommends using this in-situ (meaning “in its original place”) metering data to estimate a regression model because it accounts for environmental and usage patterns within program participating homes that might not be accurately reflected through DOE testing based metering. ADM utilized short-term in situ metering performed in the Sacramento Municipal Utility District (SMUD) service territory for this evaluation. An existing database of appliances metered in the SMUD service territory in 2006, 2011, 2014, and 2015 was used for the LADWP evaluation.

A.15.1.3.4. Annualization of Short-Term Metering Data

The data collected in 2006, 2011, 2014, and 2015 represents a small window of time between when a customer schedules a pick-up and when the pick-up actually occurs. The average length of time the metering equipment was installed in customer homes was 11 days. This timeframe is sufficient for capturing multiple appliances defrost cycles as well as weekend/weekday usage differences. However, the ideal metering study would record data from program appliances in customer homes for a full year to capture seasonal effects. This approach is not feasible because participating customers have usually enrolled in the program because they intend to dispose of the unit quickly.

As a result, the data collected from short-term metering requires some process of extrapolation to a full year UEC. The most straightforward approach to extrapolation is to simply multiply the average hourly kW readings from the monitoring period by 8,760 hours. However, this method of extrapolation does not consider that energy use for an appliance varies with outdoor temperature (albeit mediated by changes in indoor temperature and indoor-internal cabinet temperatures). Figure A-47 below illustrates the challenge presented by this simple approach to annualization. The blue line shows the typical seasonal variation in appliance energy use over one year. The dotted red line shows the energy usage during four hypothetical monitoring periods. A simple extrapolation of average energy usage during these metering periods would misrepresent the annual usage because it does not account for this seasonality. Units metered in the summer months would extrapolate to annual UECs that are likely overestimated, while the opposite is true of units metered in the wintertime.

Figure A-47 RETIRE - Bias of Simple Extrapolation due to Seasonality



To account for seasonality in extrapolating the short term metering data to full year UECs, ADM used a model developed in an evaluation of the 2004-2005 California Statewide Appliance Recycling Program.[45] The 2004-2005 evaluation utilized long term appliance metering data collected in California in the 1990's to develop models of the relationship between hourly consumption and hourly outdoor temperature.[46] The result of these models were equations that have been used to develop appliance and weather specific load shapes of refrigerator and freezer energy usage. Monthly expansion factors were then used to adjust short-term metering measurements to full year UEC based on the appliance type and month in which the metering occurred. The 2004-2005 evaluation estimated separate models for freezers, secondary refrigerators, primary top-freezer

[45] http://www.calmac.org/publications/EM&V_Study_for_2004-2005_Statewide_RARP_-_Final_Report.pdf

[46] These models are based on relatively old appliance metering data that might not accurately reflect the refrigerators and freezer recycled through the 2011-2013 program. However, the models were recently tested against newly developed models based on metering data from the 2010-2012 CA ARP study and performed reasonably well.

refrigerators, and primary side-by-side refrigerators. Table A-114 provides the model for primary refrigerators with top freezers.

Table A-114 RETIRE - Top Freezer Extrapolation Model from 2004-2005 ARP Evaluation (Dependent Variable = watthour per hour)

Operating Condition	Coefficient	Standard Error
Intercept	-98.3825	1.1320
Mean Watt Hours	0.9815	0.0005
January Dummy	3.8639	0.9129
February Dummy	-0.1099	0.9076
March Dummy	5.6952	0.9017
April Dummy	12.9591	0.9349
May Dummy	7.6151	0.9584
June Dummy	9.6176	1.0150
July Dummy	16.1311	1.0329
August Dummy	6.4387	1.0690
September Dummy	6.8108	1.0193
October Dummy	15.1539	1.1215
November Dummy	4.4912	0.9349
December Dummy	Suppressed	
Ambient Temperature (F)	1.4172	0.0186
Appliance Volume (cubic feet)	3.0881	0.0578
January Dummy * App Volume	-0.5238	0.0524
February Dummy * App Volume	-0.4686	0.0559
March Dummy * App Volume	-0.8596	0.0588
April Dummy * App Volume	-1.6752	0.0583
May Dummy * App Volume	-1.7853	0.0608
June Dummy * App Volume	-1.6470	0.0610
July Dummy * App Volume	-1.7913	0.0625
August Dummy * App Volume	-1.2161	0.0643
September Dummy * App Volume	-0.9315	0.0623
October Dummy * App Volume	-2.1263	0.0768
November Dummy * App Volume	-0.8015	0.0571
December Dummy * App Volume	Suppressed	
Ambient Temperature * App Volume	-0.0488	0.0010
January Dummy * App Volume * Ambient Temperature	0.0079	0.0007
February Dummy * App Volume * Ambient Temperature	0.0096	0.0008
March Dummy * App Volume * Ambient Temperature	0.0145	0.0007

Operating Condition	Coefficient	Standard Error
April Dummy * App Volume * Ambient Temperature	0.0228	0.0007
May Dummy * App Volume * Ambient Temperature	0.0307	0.0007
June Dummy * App Volume * Ambient Temperature	0.0309	0.0006
July Dummy * App Volume * Ambient Temperature	0.0301	0.0006
August Dummy * App Volume * Ambient Temperature	0.0279	0.0007
September Dummy * App Volume * Ambient Temperature	0.0209	0.0007
October Dummy * App Volume * Ambient Temperature	0.0264	0.0009
November Dummy * App Volume * Ambient Temperature	0.0118	0.0008
December Dummy * App Volume * Ambient Temperature	Suppressed	
	R-square	0.5189

A.15.1.3.5. Full-Year Unit Energy Consumption (UEC) Calculation

After establishing estimates of annual in situ UEC for the sample of appliances that received short term metering, the next step was to estimate unit level annual consumption for non-metered program units recycled during 2011-2013, 2014, and 2015. This was accomplished through the use of multiple linear regression analysis to model end-of-life UEC of the recycled refrigerators and freezers based on characteristics recorded in the program tracking data. In analytical terms, the regression analysis involved estimating the parameters of a regression model:

UEC = function of (V1,V2,V3,…,Vn) *Equation A-41*

Where UEC is a measure of the annual energy use of a refrigerator and the Vi are independent variables (e.g., age, size, configuration, etc.) used to explain the amount of energy consumption. This approach to estimating refrigerator and freezer energy use is fairly standard, and is the recommended method described in the UMP Protocol.

Applying the regression equations to the program tracking data for FY 20/21 provides the final full year per-unit UEC estimates.

A.15.1.3.6. Part-Use and Counterfactual Action Factors

The full-year UEC estimates must be adjusted to account for the fact that not all appliances are in continuous operation year round. The part-use factor reflects the percentage of the year that an appliance is plugged in and operational. For primary refrigerators, the part-use factor is assumed to be 100%, as it is unlikely a customer goes without any food refrigeration. For secondary refrigerators and freezers, the possibility of part-use becomes more likely.

The participant survey was used to estimate part-use factors for secondary refrigerators and freezers, separately. Respondents were asked to indicate whether the appliance they recycled was in full use, part use, or disuse during the 12 months prior to collection. If a respondent indicated part use, they were asked to estimate the number of months the unit was in operation (out of the prior 12 months). Gross baseline consumption of recycled appliances was calculated as the full year UEC estimates multiplied by the part-use factors.

Next, the part-use factors, which are based on historical usage of the recycled appliances, are combined with participants' self-reported actions had the program not been available. Specifically, whether they would have kept or discarded the unit. This information is important because it informs what type of part-use profile the unit would have had in the absence of the program (for example, if a respondent indicates that they would have kept a primary refrigerator and continued to use it as a primary unit, a part-use factor of 1 is appropriate).

A.15.1.3.7. Gross Peak Demand Reduction

Gross peak demand savings were calculated based on the critical peak demand definition provided by LADWP. Measure specific normalized 8,760 hour load shapes were used to identify the average demand during this on-peak period. These load shapes assign a portion of estimated gross kWh energy savings to each hour of the year. After identifying the total kWh savings that fall into the defined on-peak hours, dividing by the total number of hours in the peak period results in the average gross peak demand reduction. The specific appliance load shapes that were used were originally developed as part of the End-Use Load and Consumer Assessment Program (ELCAP) – a major end-use data collection program undertaken by the Bonneville Power Administration.[47]

A.15.2. Impact Evaluation

The Evaluator leveraged the program-level realization rate from FY 19/20 for RETIRE to calculate the energy savings in FY 20/21. The content that follows recounts the process that was performed in FY 19/20 to calculate energy savings impacts and the realization rate which was subsequently used to inform FY 20/21 energy savings impacts.

A.15.2.1. Verification of Units Recycled

In FY 19/20, participant responses indicated a verification rate of 96.7% for working refrigerators, prior to being recycled. However, due to the extremely limited participation during FY 20/21, with only 6 units participating, the Evaluator instead assumed a 100% verification rate for recycled refrigerators.

A.15.2.2. Full Year UEC Calculation

Full year UEC estimates were derived using the regression modeling of in situ data from 103 appliances that were metered just before decommissioning in the SMUD service territory. The short-term metering data was first extrapolated to full year UEC estimates as described in Section A.15.1.3.5. Next, the full year UECs for metered units were used as the dependent variable in a regression relating unit characteristics to annual energy usage.

[47] Pratt RG, CC Conner, EE Richman, KG Ritland, WF Sandusky, and ME Taylor. 1989. Description of Electric Energy Use in Single-Family Residences in the Pacific Northwest. (End-Use Load and Consumer Assessment Program [ELCAP]). DOE/BP-13795-21, prepared for Bonneville Power Administration by Pacific Northwest Laboratory, Richland, Washington.

In selecting variables for this model, a number of considerations were taken. The independent variables needed to be readily available in the program tracking data to ensure successful application of the model to the program population. Based on data availability and modeling recommendations from the UMP protocol, the following variables were considered:

- Appliance age/vintage at the time of metering;
- Appliance size (cubic feet);
- Appliance type and configuration (refrigerator, freezer; side-by-side, top freezer, bottom freezer, single door, upright, chest);
- Primary or secondary usage;
- Metering cohort (2006, 2011, 2014);
- Label Amps; and
- Weather variables (CDD, HDD).

The final model specification did not include weather variables, as there was limited variability in temperature data across zip codes within the SMUD service territory. Label amps were also excluded from the final model specification as they explained little variation in the overall model after accounting for the other variables. The specification and parameter estimate of the selected model are shown in Table A-115.

Table A-115 RETIRE - UEC Regression Model Estimates

Independent Variable	Coefficient	t-ratio
Intercept	-190.28	-0.548
Appliance Age ***	25.11	2.854
Dummy: Manufactured Pre-1990	66.52	0.443
Appliance Size (cubic feet) *	25.41	1.662
Dummy: Freezer	6.91	0.058
Dummy: Refrigerator	Suppressed – base variable	
Dummy: Side-by-Side Configuration	224.84	1.634
Dummy: All Other Refrigerator Configurations	Suppressed – base variable	
Dummy: Primary Usage Type	61.49	0.467
Dummy: Secondary Usage Type	Suppressed – base variable	
Dummy: 2006 Metering Cohort **	269.64	2.217
Dummy: 2011 Metering Cohort **	309.99	2.575
Dummy: 2014 Metering Cohort	Suppressed – base variable	
* Significant at the 0.10 level ** Significant at the 0.05 level *** Significant at the 0.01 level	R – Square = 0.35	

The program tracking database included information regarding appliance type, configuration, size, age, and correct pickup address for units collected during the FY 19/20. These units were used to calculate average program characteristics for calculating program UECs. Table A-116 show the average program values by appliance type.

Table A-116 FY 19/20 RETIRE Average Program Appliance Characteristics

Measure	Refrigerators (n =2,533)	Freezers (n = 114)
Average Age (Years)	18.4	20.6
Percentage of Units Manufactured before 1990	6.2%	17.5%
Average Size (Cubic Feet)	19.7	17.4
Percentage Side-by-Side	18.8%	0%
Percentage Primary Usage*	69.9%	0%
2011 Cohort Dummy Percentage**	0.5	0.5
** ADM relied on estimates from the participant survey in determining the percentage of primary refrigerators used to extrapolate program UECs. All freezers are considered secondary appliances.* ***This estimate assumes that appliances recycled during the 2011-2013 program cycle are similar to units metered in both 2011 and 2014.*		

The appliance characteristics shown in Table A-116 were used in conjunction with the parameter estimates in Table A-115 to calculate annual UEC estimates for program participating refrigerators and freezers. Table A-117 summarizes the full year UEC estimates for refrigerators and freezers.

Table A-117 FY 19/20 RETIRE Full Year Average UEC Estimates

Fiscal Year	Appliance Type	Number of Units	Average Full Year UEC (kWh)
19/20	Refrigerator	2,420	1,153
	Freezer	114	1,064

The values above do not yet represent final gross consumption or energy savings. To determine gross savings under the UMP definition, they must first be adjusted for part-use. Under the CA ARP definition, they must also be adjusted for certain appliance dispositions in the absence of the program.

A.15.2.3. Part-Use Factors and Counterfactual Actions

One final adjustment to the full year UECs was made to account for the fact that not all refrigerators and freezers are plugged in year-round. This part-use adjustment assigns different part-use factors based on three categories into which recycled appliances fall:

1) Some units that were recycled are not likely to operate at all in the absence of the program. The part-use factor for such units therefore would be zero.

2) Other units are likely to have operated part-time in the absence of the program. For these units, the part-use factor is calculated by dividing the number of months in the past

year that the unit had been plugged in and running by the number of months in the year (i.e., 12).

3) Units used all of the time have a use factor of one (1). It is assumed that all primary refrigerators operate year round.

The overall part-use factor and the corresponding part-use adjusted UECs are calculated as a weighted average across the three categories, where the weights are determined by the percentages of units falling into the three categories. The participant survey is used to determine the percentage of refrigerators that are primary units, and the part-use estimates for secondary refrigerators and freezers. Table A-118 shows the calculation of the part-use adjusted UECs for refrigerators and freezers when partial use is considered.

Table A-118 FY 19/20 RETIRE Part-Use Factors

Operating Status of Unit	Percentage of Recycled Units in Category	Use Factor	Calculation of UEC to Adjust for Part Use
Refrigerators – Secondary (n=233*)			
Not running	5.5%	0.000	0
Running part time	18.0%	0.208	240
Running all time	76.5%	1.000	1,153
Weighted Average for Secondary Refrigerators		**0.803**	**925**
Refrigerators – All (n=123)			
Not running	1.6%	0.000	0
Running part time	3.3%	0.333	384
Running all time	95.1%	1.000	1,153
Weighted Average for Refrigerators		**0.962**	**1,109**
Freezers (n=37*)			
Not running	5.4%	0.000	0
Running part time	10.8%	0.500	532
Running all time	83.8%	1.000	1,064
Weighted Average for Freezers		**0.892**	**949**
***Includes all secondary units from FY 15/16 to FY 19/20.**			

Finally, the part-use factors developed from participant responses about how the appliances were used in the past is combined with responses regarding what they would have done with the unit in the absence of the program. Depending on whether the unit would have been kept or discarded and how it would have been used if it had been kept, different part-use factors are appropriate. Table A-119 shows the final, prospective part-use factors that are used to adjust full-year UECs for refrigerators. Table A-120 shows the final, prospective part-use factors that are used to adjust full-year UECs for freezers.

Table A-119 FY 19/20 RETIRE Refrigerator Counterfactual Action[48]

Counterfactual Action					Statewide Proportions (%)*	Program Unit Consumption under the Counterfactual			Alternative Unit Consumption under the Counterfactual			Gross Unit Energy Savings, kWh
						Full UEC	Usage	Adj. UEC	Full UEC	Usage	Adj. UEC	
					(A)	(B)	(C)	(D=(B*C))	(E)	(F)	(G=(E*F))	(H=(D-G))
Keep in Use by Participant					13.7%	1,153	0.80	925	1,153	0.00	0	925
Keep Unused by Participant					2.3%	1,153	0.00	0	1,153	0.00	0	0
Transferred	Destroyed by Discarder				18.2%	1,153	0.80	925	469	0.96	451	474
Transferred	Peer-to-Peer	Primary Unit	Replaced by similar free unit		1.2%	1,153	0.96	1,109	887	0.96	853	256
Transferred	Peer-to-Peer	Primary Unit	Replaced by similar purchased unit		9.9%	1,153	0.96	1,109	764	0.96	735	374
Transferred	Peer-to-Peer	Primary Unit	Replaced by new unit		8.4%	1,153	0.96	1,109	452	0.96	435	674
Transferred	Peer-to-Peer	Primary Unit	Keep Existing Unit	Replacing Existing	5.2%	1,153	0.96	1,109	887	0.96	853	256
Transferred	Peer-to-Peer	Primary Unit	Keep Existing Unit	Add a new unit	1.4%	1,153	0.80	925	0	0.80	0	925
Transferred	Peer-to-Peer	Secondary Unit	Replaced by similar free unit		0.4%	1,153	0.80	925	887	0.80	712	213
Transferred	Peer-to-Peer	Secondary Unit	Replaced by similar purchased unit		2.0%	1,153	0.80	925	764	0.80	613	312
Transferred	Peer-to-Peer	Secondary Unit	Replaced by new unit		1.2%	1,153	0.80	925	452	0.80	363	562
Transferred	Peer-to-Peer	Secondary Unit	Not replaced		3.6%	1,153	0.80	925	0	0.80	0	925
Transferred	Retail	Individual	Primary Unit	Replaced by similar purchased unit	7.4%	1,153	0.96	1,109	764	0.96	735	374
Transferred	Retail	Individual	Primary Unit	Replaced by new unit	5.7%	1,153	0.96	1,109	452	0.96	435	674
Transferred	Retail	Individual	Primary Unit	Kept Existing Unit – Replacing Existing	3.3%	1,153	0.96	1,109	887	0.96	853	256
Transferred	Retail	Individual	Primary Unit	Kept Existing Unit – Add a new unit	0.3%	1,153	0.80	925	0	0.80	0	925
Transferred	Retail	Individual	Secondary Unit	Replaced by similar purchased unit	0.9%	1,153	0.80	925	764	0.80	613	312
Transferred	Retail	Individual	Secondary Unit	Replaced by new unit	0.5%	1,153	0.80	925	452	0.80	363	562
Transferred	Retail	Individual	Secondary Unit	Not replaced	0.1%	1,153	0.80	925	0	0.80	0	925
Transferred	Retail	Primary Unit	Units purchased to install in rental units		1.1%	1,153	0.96	1,109	764	0.96	735	374
Transferred	Retail	Primary Unit	Commercial spaces		0.6%	1,153	0.96	1,109	764	0.96	735	374
Transferred	Retail	Primary Unit	Other		0.7%	1,153	0.96	1,109	764	0.96	735	374
Transferred	Retail	Destroyed by secondary market actors			11.3%	1,153	0.80	925	469	0.80	377	548
Totals**					99.4%	1,153	0.85	978	657	0.77	440	538
* Statewide proportion values sourced from 2010-2012 CA ARP evaluation.												
** Totals are a sum of the product of statewide proportion percentages and values in each row.												

48 Table formatting taken directly from the 2010-2012 CA ARP evaluation report.

Table A-120 FY 19/20 RETIRE Freezer Counterfactual Action[49]

Counterfactual Action				Statewide Proportions (%)*	Program Unit Consumption under the Counterfactual			Alternative Unit Consumption under the Counterfactual			Gross Unit Energy Savings, kWh
					Full UEC	Usage	Adj. UEC	Full UEC	Usage	Adj. UEC	
				(A)	(B)	(C)	(D=(B*C))	(E)	(F)	(G=(E*F))	(H=(D-G))
Keep in Use by Participant				14.2%	1,064	0.89	949	1,064	0.00	0	949
Keep Unused Used by Participant				1.8%	1,064	0.00	0	1,064	0.00	0	0
Transferred	Destroyed by Discarder			12.6%	1,064	0.89	949	405	0.89	361	588
Transferred	Peer-to-Peer		Replaced by similar free unit	0.0%	1,064	0.89	949	806	0.89	719	230
Transferred	Peer-to-Peer		Replaced by similar purchased unit	5.6%	1,064	0.89	949	767	0.89	684	265
Transferred	Peer-to-Peer		Replaced by new unit	4.5%	1,064	0.89	949	443	0.89	395	554
Transferred	Peer-to-Peer		Not replaced	24.0%	1,064	0.89	949	0	0.89	0	949
Transferred	Retail	Individual	Replaced by similar purchased unit	5.2%	1,064	0.89	949	767	0.89	684	265
Transferred	Retail	Individual	Replaced by new unit	3.6%	1,064	0.89	949	443	0.89	395	554
Transferred	Retail	Individual	Not replaced	12.5%	1,064	0.89	949	0	0.89	0	949
Transferred	Retail	Primary Unit	Units purchased to install in rental units	1.3%	1,064	0.89	949	767	0.89	684	265
Transferred	Retail	Primary Unit	Commercial spaces	0.7%	1,064	0.89	949	767	0.89	684	265
Transferred	Retail	Primary Unit	Other	0.8%	1,064	0.89	949	767	0.89	684	265
Transferred	Retail	Destroyed by secondary market actors		13.2%	1,064	0.89	949	405	0.89	361	588
Totals**				100.0%	1,064	0.88	932	415	0.75	218	714

* Statewide proportion values sourced from 2010-2012 CA ARP evaluation.

** Totals are a sum of the product of statewide proportion percentages and values in each row.

Based on the full year UEC estimation and part-use estimation, the part-use adjusted UEC values for refrigerators and freezers recycled through the program are presented below in Table A-121.

Table A-121 FY 19/20 RETIRE Part-use Adjusted UEC Estimates

Fiscal Year	Appliance Type	Number of Units	Part-use Adjusted UEC
19/20	Freezer	114	714
	Refrigerator	2,533	538

A.15.2.4. Per-Unit Gross Peak Demand Reduction

Appliance load shapes for refrigerators and freezers were used to estimate the average kW reduction occurring during LADWP's defined on-peak period. These load shapes were normalized versions of load shapes originally developed as part of the End-Use Load and Consumer Assessment program (ELCAP). Using these normalized ELCAP load shapes, the Evaluator determined that approximately 3.8% of the annual gross kWh

[49] Table formatting taken directly from the 2010-2012 CA ARP evaluation report.

savings attributable to a recycled refrigerator occurs during the on-peak period. Per-unit gross peak demand reduction for refrigerators and freezers for FY 19/20 is presented in Table A-122.

Table A-122 FY 19/20 RETIRE Per-Unit kW Reduction

Fiscal Year	Appliance Type	Number of Units	Per-unit kW Reduction
19/20	Freezer	114	0.083
	Refrigerator	2,533	0.063

A.15.2.5. Description of Factors Affecting Gross Realized Savings

The primary factor affecting RETIRE savings was the M&V approach that was used, with the net M&V impact resulting in -8,483 kWh. The reason for the negative savings impact is because the estimated per-unit Ex-Ante kWh value is much higher than the verified Ex-Post kWh value.

A.16. RLEP

This section presents details about the evaluation methodology and impact evaluation for the RLEP.

A.16.1. Evaluation Methodology

The Evaluator completed the following types of data collection:

Table A-123 RLEP Program Evaluation Data Collection

Source	Data Types
Program tracking data	Distribution channel and quantity
General population survey	Survey from Retrospective period leveraged for FY 20/21
DEER Workpapers	Determination of baseline lamp wattage by lamp type
LA Assessor Data	Housing types – single family, multifamily by climate zone

Program tracking data was reviewed to ensure that the data provided sufficient information to verify program participation and to calculate energy and peak demand impacts.

The General Population Survey administered from January to February 2021 was leveraged to inform the ISR and lighting hours of use. Savings were evaluated via the efficient product specifications, referenced workpapers for base case wattages, interactive factors, and survey response data for lamp usage in the household.

A.16.1.1. Tracking Data Review

Tracking data for RLEP was sourced from the files listed in Table A-124.

Table A-124 RLEP Tracking Data Document List

File Name	LED Kits Distributed
Energy Savings Portfolio data export	NA
RLEP 06.2021 Updated.xlsx	777

The energy savings from the tracking data aligned with the ESP reported program energy savings. A heating-cooling interactive factor was not included as a factor in the Ex-Ante energy savings estimate. The Ex-Ante savings included an installation rate of 66% to determine the gross energy savings in the tracking data.

A.16.1.2. M&V Sample Design

The general population survey from the Retrospective Period informed the FY 20/21 analysis, and therefore no additional field data was collected. The General Population Survey included 14,716 email addresses randomly sampled as shown in Table A-125.

Table A-125 RLEP General Population Survey from Retrospective Period

Strata	Number of LED Kits	Gen Pop Survey Sample Deployed
FY 17/18-FY 19/20 General Population Survey	4,102,476	14,716
FY 20/21 Participants	777	0
Total	4,103,253	14,716

A.16.1.3. Baseline Assumptions Review

The Ex-Ante savings assumed a baseline lamp of 36 watts. The Ex-Post savings referenced the 2019 California Statewide Residential Appliance Saturation Study and aggregated the LADWP service area data. The proportion of each lamp type and the equivalent wattage to a 1175 lumen lamp determined the weighted baseline wattage.

Table A-126 RLEP Baseline Developed from RASS Survey

Variable	CFL	Incandescent	LED
Proportion	32%	23%	44%
Equivalent Watts to 1175 lumen LED	18	75	14.7
Weighted baseline watts	29.9		

A.16.1.4. Ex-Ante Savings Review

The Ex-Ante data review had three objectives. The first was to compare the tracking data energy savings to the aggregate measure level energy savings in ESP. Second, to compare the number of units and incentive cost to the ESP data. Finally, to review the available measure data used by the program to estimate energy and peak demand impacts.

The Ex-Ante energy savings and peak demand impacts were determined by the equations below, respectively:

$$kWh = \#LED\ kits\ x\ 2\frac{lamps}{kit}x\frac{(Watts_{base} - Watts_{LED})}{1000W/kW}x\ HOU\ xISR \qquad \textit{Equation A-42}$$

$$kW = kWh_{savings}\ x\ CDF \qquad \textit{Equation A-43}$$

Descriptions of the savings inputs are tabled below.

Table A-127 RLEP Ex-Ante Energy Savings Algorithm Inputs

Factor	Description
kWh	Annual energy savings
#LED kits	Kit quantity
$Watts_{Base}$	Base case, 36 Watts
$Watts_{LED}$	LED, 12 Watts
HOU	Annual hours of use, 1095 hours
RR	Realization Rate, 0.66

Table A-128 summarizes the review of the Ex-Ante savings sourced from the ESP report and tracking data spreadsheets. There was no participant level data in the tracking spreadsheets, but instead the lighting distribution periods were listed. The tracking data included 100% of the savings in the ESP reports. Peak demand reduction was not listed in the ESP report

Table A-128 RLEP ESP and Program Tracking Savings Comparison

Measure	ESP Data Ex-Ante kWh	Program Tracking Ex-Ante kWh	ESP Ex-Ante Peak kW	Program Tracking Ex-Ante Peak kW
Grantees	21,681	2,602	NA	NA
Other LADWP Units (CPA)		19,079		NA
LED Deliveries Completed W/ Refrigerator Exchanges	5,273	5,273	NA	NA
Total	26,954	26,954	NA	NA

A.16.1.5. M&V Approach

The method to estimate the energy savings for the RLEP program utilized the same algorithm as the Ex-Ante method, but with differences in the source of the inputs. The savings algorithms and savings inputs are detailed below.

$$kWh = Qty_{ver} x\ HOU\ x(Watts_{base} - Watts_{efficient}) x \frac{IE_{kWh}}{1000\frac{Watt}{kW}} x\ ISR \quad \textit{Equation A-44}$$

$$kW = ty_{ver} x(Watts_{base} - Watts_{efficient}) x \frac{IE_{kW}}{1000\frac{Watt}{kW}} x\ ISR\ x\ CDF \quad \textit{Equation A-45}$$

Table A-129 RLEP ENERGY STAR Lighting Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
kWh, kW	Measure savings per program year	DEER Resources Savings Algorithm	Variable
Qty_{ver}	Quantity verified in tracking data to ESP data	RLEP tracking data	100% aligned
HOU	Annual hours of use	RLEP General Population Survey, 2021	Interior: 716 hours Exterior: 2,884 hours
$Watts_{base}$	Baseline watts	2019 California Statewide Residential Appliance Saturation Study	LADWP service area weighted average; 29.9W
$Watts_{efficient}$	LED Lamp wattage	RLEP Program	12 W
IE	Interactive Effects Factor by climate zone	LA Assessor Data & DEER Lighting Interactive Factors	Varies by climate zone
ISR	In Service Rate	RLEP General Population Survey, 2021	75% (14,716 Surveys Deployed)
CDF	Coincident Diversity Factor	LA Assessor Data Climate Zones & DEER Lighting Factors by Climate Zone	Varies by climate zone

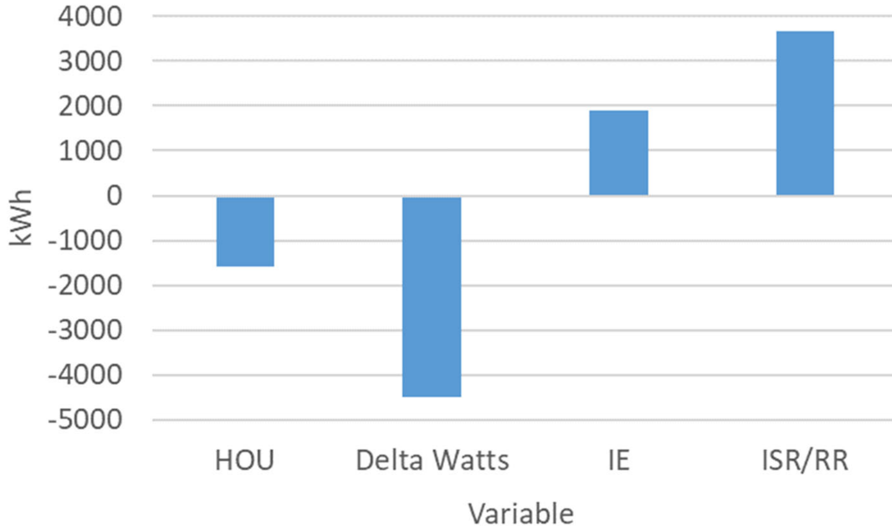
A.16.2. Impact Evaluation

The impact evaluation utilized the General Population Survey response data to calculate the ISR value and the estimate of lighting hours of use. The efficient LED A-Lamp wattage was obtained from equipment specification documents and the baseline wattage developed from the RASS survey results referenced in Table A-126. The peak demand reduction calculation utilized CDF values by climate zone from DEER Resources workpapers.

A.16.2.1. Description of Factors Affecting Gross Realized Savings

Figure A-48 illustrates the difference in factors between the Ex-Ante and Ex-Post energy savings estimate. The CA Title 20 became effective on January 1, 2018 and required General Service A-Lamps sold in the state, to have a minimum efficiency of 80 lumens per watt, or a tradeoff with a higher Color Rendering Index (CRI) value. The 2019 RASS determined 44% of all baseline lamps are LED among the LADWP survey participants, with less delta watts than the Ex-Ante mix of incandescent, CFL, and LED.

Figure A-48 RLEP Realized Savings Factors



A.16.3. Process Evaluation

Notification for the program activity for RLEP occurred later in the evaluation window, and with a relatively small claim of Ex-Ante energy savings. There was not a process evaluation completed for FY 20/21.

A.17. ACOP

This section presents details about the evaluation methodology and impact evaluation for the ACOP.

A.17.1. Evaluation Methodology

This section presents the findings of the tracking data review, and the methodology used to calculate verified Ex-Post energy savings and peak demand reduction for the program.

A.17.1.1. Tracking Data Review

LADWP provided the Evaluator the available program tracking data for measures installed between August 9, 2016, through June 17, 2020. LADWP provided the following datasets:

- Quarterly billable amounts by measure.
- Measure-level tracking data including customer accounts, premise address, measures installed, quantity of measures installed, contractor name, measure cost, and install date; and,
- Monthly measure count summaries with associated measure-level Ex-Ante kWh savings.

The Evaluator reviewed available program data and counted the total number of unique measures completed in FY 20/21. These measure counts were used to extrapolate measure-level regression analysis to program-level savings.

A.17.1.2. Ex-Ante Savings Review

The following table summarizes discrepancies the Evaluator found comparing the reported ESP Ex-Ante kWh savings and Peak kW reduction with the Ex-Ante kWh savings and Peak kW reduction presented in the tracking data delivered by LADWP. There was sufficiently detailed tracking data, which was categorized by building type. The ESP data provided a sufficient level of detail, categorizing savings by building type. The results are tabled below.

Table A-130 ACOP ESP and Program Tracking Savings Comparison

Measure	ESP Data Ex-Ante kWh	Program Data Ex-Ante kWh	ESP Data Ex-Ante Data kW	Program Data Ex-Ante Peak kW
Commercial	159,993	161,325	39.31	149.47
Multifamily	4,989	8,725	1.97	10.09
Single Family	34,759	44,617	15.83	60.77
Undetermined	0	0	0.00	0.00
Total	199,741	214,667	57.12	220.33

A.17.1.3. M&V Approach

Table A-131 summarizes the data sources used in the ACOP impact evaluation.

Table A-131 ACOP Data Sources

Data	Source
Program tracking data	Data requested for all data tracking program participation, rebate applications, and measure details
Recipient billing data	Monthly billing data provided by LADWP for customers that have participated in ESAP in the study periods
Non-participant billing data	Monthly billing data provided by LADWP for customers that have not participated in ESAP in the study periods
Participation in other LADWP programs	Data provided by LADWP for all residential program participation in the study periods

The database review process started with a review of tracking data to ensure that sufficient information was provided to calculate energy and demand impacts.

Field data collection was not completed for ACOP. Savings were evaluated via billing analysis for the program. In addition, no sampling plan was required for this program, as savings was evaluated via billing analysis with a census of participants.

The approach the Evaluator used to determine Ex-Post kWh savings and peak kW reduction for ACOP was based on statistical analysis of billing data. The Evaluator took the following steps during the evaluation approach:

- First, the Evaluator conducted an exploratory data analysis that made use of all provided participant billing data.
- Second, the Evaluator used regression models to make longitudinal and cross-sectional comparisons of energy consumption before and after installation of energy efficiency measures to determine how electricity use changed after a measure was installed at a household or business.
- Third, the Evaluator quantified whole home or building savings by extrapolating regression model outputs with weather and number of participants in each study period.

Ex-Post savings were determined using the regression coefficients. Further details of the billing analysis approach are summarized in Section A.17.1.4.

A.17.1.4. Billing Analysis Approach

The Evaluator performed a billing analysis to evaluate the energy savings for ACOP. Billing analyses provide savings estimates at the premise level. Therefore, customer measures were grouped by name and address, and Evaluator generated estimates at the premise-level. A pooled billing data regression was used to evaluate Commercial premises. A billing data retrofit isolation was used to evaluate Residential premises.

A.17.1.4.1. Billing Data Regression

A pre/post pooled mixed effects billing data regression was selected to evaluate the Commercial measure. Although a billing data retrofit approach was used to evaluate the ACOP Residential measure, a billing data retrofit isolation is inappropriate for the evaluation of commercial buildings as changes that appear weather-dependent in nature can be driven due to operational changes that reoccur on an annual basis. For example, extended store hours in the summer can appear like increased HVAC load for commercial buildings. Additionally, municipal code regarding commercial ventilation may require certain commercial buildings to have HVAC operating year-round, thus rendering a baseload period difficult to isolate. Thus, the most appropriate choice for a comparable baseline to the post-retrofit period is a commercial customer’s own historic usage.

A total of 180 Commercial premises participated in the FY 20/21 ACOP program. This number of premises is not sufficient to obtain statistically significant impacts using regression analysis due to high volatility in the Commercial sector. To supplement the billing data used in the regression analysis, customers who installed similar measures to the FY 20/21 participants from FY 17/18, FY 18/19, and FY 19/20 were included in the pooled regression analysis.

The remainder of this section describes the pooled pre/post mixed effects billing data regression used to evaluate ACOP Commercial.

Billing Data Preparation

LADWP provided participant bi-monthly billing data. Because billing periods varied across participants and did not correspond to the start and end of calendar months, all billing data was calendarized. To accomplish this, the Evaluator first calculated an average daily kWh for each customer bill as represented by Equation A-46.

$$Average\ Daily\ kWh = \frac{Total\ kWh}{Number\ of\ Days} \quad \textit{Equation A-46}$$

The average daily kWh was then multiplied by the number of days in each respective calendar month of the respective bill. For example, for a bill starting on January 15th and ending on March 14th, the average daily kWh would be multiplied by 17 to calculate the bill's January consumption, 28 for February, and 14 to calculate March's consumption. The portions corresponding to each given period in a calendar year would then be summed across for each participant to ascertain that customer's total monthly kWh.

It should be noted that, given billing data is measured at a monthly or lower resolution, there are customer bills which contain both pre and post data. These customer bills and any months that contain calendarized data from these bills were removed from the analysis to prevent savings suppression.

The number of qualified participants remaining in the data set after filtering for the above criteria are provided in Table A-132. As noted at the beginning of this section, the billing analysis was supplemented using customers from previous fiscal years. These are reflected in the Final Sample Size column.

Table A-132 ACOP Commercial Participant Count

Measure	All Participants	Qualified Participants	Final Sample Size
ACOP Commercial	180	157	2,110

For all remaining participants, the zip code for each customer's service address was geolocated to an approximate latitude and longitude and historical weather data was obtained through NOAA for the nearest weather station.

Degree Day Base Optimization

The Evaluator used historical weather data to optimize the heating degree day (HDD) and cooling degree day (CDD) bases for each customer. HDDs were calculated using 50-, 55-, 60-, and 65-degree bases. CDDs were calculated at 65-, 70-, 75-, and 80-degree bases.

The regression equation to determine CDD/HDD fit is specified by Equation A-47:

$$Average\ Daily\ kWh_i = \alpha + \beta_1 \cdot post + \beta_2 \cdot CDD_{i,n} + \beta_3 \cdot HDD_{i,n} + \beta_4 \cdot CDD_{i,n} \cdot post + \beta_5 \cdot HDD_{i,n} \cdot post + \varepsilon \quad \textit{Equation A-47}$$

Where:

- i represents each individual customer for each month,
- n represents each iteration of base pairs,
- $post$ is an indicator variable indicating whether the period is in the post or pre period,
- $CDD_{i,n}$ is the CDD calculated for iteration *n* for customer *i,*
- $HDD_{i,n}$ is the HDD calculated for iteration *n* for customer *i,*
- α is the intercept term,
- β_1 is the main effect of the post period,
- β_2 is the main effect of CDD,
- β_3 is the main effect of HDD,
- β_4 is the additional effect of CDD on the post period,
- β_5 is the additional effect of HDD on the post period, and
- ε is the error term.

For each customer, all 16 combinations were tested to determine which combination provided the best fit. The pair of CDD and HDD bases that provided the highest adjusted R-squared for each customer was selected as that customer's respective CDD and HDD base.

Regression Model

To estimate participant savings for ACOP Commercial, the Evaluator used a treatment-only pre/post regression model with customer fixed effects. The regression equation is specified in Equation A-48. The Evaluator used the LFE 2.8-6 package in R 3.6.3 to perform the mixed effects regression model.

$$\begin{aligned} Average\ Daily\ kWh_i &= \alpha_i + \beta_1 \cdot post + \beta_2 \cdot CDD_i + \beta_3 \cdot HDD_i + \beta_4 \cdot CDD_i \\ &\cdot post + \beta_5 \cdot HDD_i \cdot post + \beta_6 \cdot month_1 + \cdots + \beta_n \\ &\cdot month_{12} + \varepsilon \end{aligned}$$

Equation A-48

Where:

- i represents each individual customer for each month,
- $post$ is an indicator variable indicating whether the observation is in the pre-treatment period or post-treatment period,
- CDD_i is the CDD calculated for iteration *n* for customer *i,*
- HDD_i is the HDD calculated for iteration *n* for customer *i,*
- $month_1$ through $month_{12}$ are indicator variables indicating if the month is January through December,
- α_i is the customer-specific intercept term,

- β_1 is the main effect of the program participation,
- β_2 is the main effect of CDD,
- β_3 is the main effect of HDD,
- β_4 is the CDD-dependent effect of program participation,
- β_5 is the HDD-dependent effect of program participation,
- β_6 through β_n are the main effects of month,
- ε is the error term.

The regression coefficients of interest for estimating savings are β_1, β_4, and β_5. Table A-133 provides information regarding the regression coefficients for the model and the overall model fit.

Table A-133 ACOP Commercial Regression Coefficients

Term	Regression Coefficient	Standard Error	T-value	P-value	Adjusted R-squared
Post	-1.703	0.655	-2.600	0.009	0.939
Post x HDD	-0.249	0.125	-1.996	0.046	0.939
Post x CDD	-0.060	0.109	-0.547	0.584	0.939

The savings for each fiscal year were then calculated using the formula presented in Equation A-49.

$$\begin{aligned} Annual\ Savings &= [Post\ Coefficient \\ &+ (Post\ x\ CDD\ Coefficient\ \cdot \overline{CDD}) \\ &+ \ (Post\ x\ HDD\ Coefficient\ \cdot \overline{HDD})] \cdot -1 \cdot 365.25 \end{aligned}$$

Equation A-49

Where:

- $\overline{CDD}$ is the average daily CDD for a typical weather year, and
- $\overline{HDD}$ is the average daily CDD for a typical weather year.

HDDs and CDDs were weighted relative to the nearest weather stations for the participants in each program year using TMY3. These weighted values are presented in Table A-134.

Table A-134 ACOP Commercial Weighted Average TMY3 HDD and CDD

Measure	Average Daily HDD	Average Daily CDD
ACOP Commercial	2.335	2.090

Savings per household, 90% confidence intervals, and relative precision at the 90% confidence level are presented in Table A-135.

Table A-135 ACOP Commercial Average Savings per Household

Measure	Annual kWh Savings	90% Confidence Interval		Relative Precision (90% CL)
		Lower Bound	Upper Bound	
ACOP Commercial	785	523	1,047	33%

A.17.1.4.2. Billing Data Retrofit Isolation

To evaluate Residential premises, the Evaluator used a billing data retrofit isolation approach. Several considerations were made prior to selecting the retrofit approach over a PSM regression analysis. First, results from the 2019 Residential Appliance Saturation Survey (RASS) suggest a volatile saturation of central HVAC equipment in LADWP service territory (only 10.2% to 37.8% of residential customers have electric space heating depending on building type; only 20.4% to 69.3% of residential customers have central space cooling depending on building type). This renders a PSM inappropriate as there is a high probability that comparison customers selected via PSM may not have comparable equipment installed despite being matched based on energy consumption.

Billing Data Preparation

LADWP provided participant bi-monthly billing data. As with the procedure described with the billing data regression analysis, customer billing data was first calendarized from billing periods to calendar years. After calendarization, customer billing data was filtered for the following criteria:

- The Evaluator reviewed the post-installation data for each measure to determine the optimal post-installation period for each measure. The optimal post-installation period was determined to be August 2021 to January 2022. In all cases, participants were filtered for those participants that had a full 6 months of post-installation data.
- Pre-installation data was reviewed to determine the optimal pre-installation period for each measure. The optimal pre-installation period was determined to be January 2019 through December 2019. In all cases, participants were filtered for those participants that had a full 12 months of pre-installation data.
- Participants must not have taken part in any other energy efficiency programs administered by LADWP during the Retrospective Period and FY 20/21 time period.
- Participants must not have taken part in the ACOP program across multiple program years.
- Participants with apparent photovoltaic generation, as noted by the appearance of negative billing data, were excluded from analysis.

The number of participants remaining in the data set after filtering for the above criteria is provided in the following table:

Table A-136 ACOP Residential Participant Count

Strata	Number of Participants	Final Sample Size
ACOP Commercial	94	26

The zip code for each customer's service address was geolocated to an approximate latitude and longitude and historical weather data was obtained through NOAA for the nearest weather station.

Weather Normalization

After preparing the billing data, the Evaluator proceeded to normalize the billing data. From the candidate HDD and CDD bases, the base pair that provided the best adjusted R-squared was selected as the HDD and CDD base for that individual customer based on the equation provided in Equation A-50.

$$Average\ Daily\ kWh_i = \alpha + \beta_1 \cdot post + \beta_2 \cdot CDD_{i,n} + \beta_3 \cdot HDD_{i,n} + \beta_4 \cdot CDD_{i,n} \cdot post + \beta_5 \cdot HDD_{i,n} \cdot post + \varepsilon \qquad \textit{Equation A-50}$$

Where:

- i represents each individual customer for each month,
- n represents each iteration of base pairs,
- $post$ is an indicator variable indicating whether the period is in the post or pre period,
- $CDD_{i,n}$ is the CDD calculated for iteration *n* for customer *i,*
- $HDD_{i,n}$ is the HDD calculated for iteration *n* for customer *i,*
- α is the intercept term,
- β_1 is the main effect of the post period,
- β_2 is the main effect of CDD,
- β_3 is the main effect of HDD,
- β_4 is the additional effect of CDD on the post period,
- β_5 is the additional effect of HDD on the post period, and
- ε is the error term.

Isolation of Weather-Dependent Load

After normalizing the billing data to TMY3, the Evaluator proceeded to extract the weather-dependent load for each customer for the pre and post periods under the assumption that most weather-dependent loads for residential homes is attributable to HVAC. To accomplish this, the Evaluator first detected a month with minimal HVAC load by selecting, for each customer in each period, the month with the lowest average daily kWh. The Evaluator deemed this value as "baseload," representing the typical household consumption in absence of HVAC. The weather-dependent load for each customer in each month of each period could then be determined by subtracting the baseload from that month's normalized average daily consumption.

For the purposes of this analysis, weather-dependent load between the months of May through October were treated as cooling load while weather-dependent load between November through April were treated as heating load.

Attic Insulation and Cool Roof Savings Calculation

For the Attic Insulation and Cool Roof programs, the difference in pre and post weather-dependent load was treated as the savings for each customer, as represented in Equation A-51.

$$\Delta kWh_{HVAC} = kWh_{HVAC\ Pre} - kWh_{HVAC\ Post} \quad \textit{Equation A-51}$$

Individual savings were then filtered by using the median plus or minus four times the mean-adjusted deviation (MAD) to correct for outliers in a skewed (non-normal) distribution. The individual savings were then aggregated to create an average per household savings, as represented in Table A-137.

Table A-137 ACOP Commercial Participant-Level Savings

Strata	Annual kWh Savings	90% Confidence Interval		Relative Precision (90% CL)
		Lower Bound	Upper Bound	
ACOP Residential	711.51	298.89	1124.13	58%

A.17.1.4.3. Adjustment for COVID-19

It is important to note that the savings calculated as part of the residential billing analysis may be impacted by the ongoing COVID-19 pandemic. Therefore, both the residential energy consumption observed in the billing data and the observed savings for FY 20/21 may inadvertently be impacted by changes due to the COVID-19 pandemic. To account for this impact, the Evaluator created a series of adjustment factors for each measure by leveraging the non-participant billing data received from LADWP.

The creation of these adjustment factors largely followed the logic of the billing data retrofit isolation analysis in the following manner:

- The non-participant data was separated into a typical period (January 2019 through December 2019) and COVID-19-impacted period. Because usable non-participant data was only received through fall of 2021, the COVID-19 period was estimated as October 2020 through September 2021 for program non-participants.
- The non-participant billing data was weather-normalized by optimizing the CDD and HDD bases per participant and normalizing the billing data to TMY3.

- The non-weather dependent load was identified for each customer for the typical year and COVID-19-impacted year (i.e., the month with the lowest normalized average daily consumption).
- Heating-dependent load (November through April) and cooling-dependent load (May through October) was identified for each customer for the typical year and COVID-19-impacted year.
- An adjustment factor was calculated by dividing the COVID-19-impacted load by the typical year load for the non-weather dependent load, the heating-dependent load, and cooling-dependent load, creating a series of adjustment factors.

The adjustment factors were then applied to the COVID-19-impacted post-installation data for the HVAC measures evaluated via billing analysis in the following way:

- The COVID-19-impacted post-installation billing data was normalized for the impacts of COVID-19 by dividing the total post-installation cooling load and heating load by their respective COVID-19 adjustment factors prior to calculating typical year savings.
- The typical year pre-installation billing data was adjusted for COVID-19 equivalency by multiplying the total pre-installation cooling load and heating load by their respective COVID-19 adjustment factors prior to calculating COVID-19-impacted savings.

For Commercial customers, because a within-participants billing data regression was used to perform the analysis, a within-participants billing data regression was performed on the post-installation period preceding and during COVID-19, to assess the change in overall consumption between a typical year and COVID-19. The Evaluator used this change in overall consumption as a best approximation of the impact of COVID-19 on ACOP Gross Ex-Post for Commercial customers.

A.18. CSO Program

This section presents details about the in-depth process evaluation for the CSO Program.

A.18.1. Process Evaluation

An in-depth process evaluation was performed for the CSO Program, as detailed in the following sections.

A.18.1.1. Process Evaluation Approach and Methodology

The following sections describe the process evaluation approach for CSO.

A.18.1.1.1. Materials Review

The evaluation team reviewed program materials, including the Business Plan and past evaluations. We assessed materials to gain a better understanding for how the program is operated and staffed, along with insights from previous performance. We also used the materials review to inform other evaluation activities, including drafting the staff and cross-program interview guides and creating the base logic model.

A.18.1.1.2. Staff interviews

The evaluation team conducted interviews with CSO program staff in December 2020 and June 2021. These interviews explored the following topics:

- Program theory, purpose, and design
- Program activities performed at the local, state, and federal levels
- Communications and collaboration with stakeholders and other program staff
- Program success metrics and tracking
- Challenges and opportunities for the program
- Questions about the evaluation and needs

A.18.1.1.3. Cross-Program Interview

The evaluation team interviewed staff representing the following resource programs: CPP, LADWP ZBD, CAHP, UHVAC, EPM, RLEP, REP, and RETIRE. Interviews explored how staff perceived the CSO program, how they interacted with CSO staff on a regular basis, where they learned about changes to codes and standards, and what type of support and information they would like to have in the future.

A.18.1.1.4. Base Logic Model

A clearly articulated program theory and logic model, including inputs, activities, outputs, and outcomes, is necessary for programs like CSO that rely on education and market-based interventions as a component of program success. This is especially important to map if it intends to claim savings in the future.

The evaluation team created a base program logic model, informed by CSO staff interviews, cross-program staff interviews, and the materials review. The base logic model contrasts with an ideal logic model that integrates potential opportunities presented in the following sections.

The different elements of a logic model are described below:

Inputs: the resources a program uses to perform activities and produce outputs and outcomes. Inputs could include funding, program staff or volunteers, or other resources

- Activities: the distinct actions taken to engage program actors and achieve the intended outcomes
- Outputs: the quantity of program services provided, typically involving counts of different program activities, like number of trainings, number of participants, etc.
- Outcomes: Measurable and meaningful changes that can have medium-to-long term effects on the market, organization, or participants served

This base logic model can be used by program staff as a tool to reflect on and further shape program activities and set and track goals.

A.18.1.1.5. Industry Scan

The evaluation team performed an industry scan to understand how other utilities or states are approaching codes and standards work within their energy efficiency portfolios. We reviewed each publication to attempt to answer the following questions:

- What activities should program administrators consider implementing?
- What staff roles are important to fill to produce intended outcomes?
- How are programs tracking and measuring progress?
- What other key considerations, opportunities, or obstacles do they face?

Twelve publicly available industry studies, reports, and resources reviewed as a part of the industry scan are included in Table A-138.

Table A-138 CSO - Studies Reviewed for Industry Scan

Reference	URL
Bonneville Power Administration, 2016-2021 Energy Efficiency Action Plan (2017).	https://www.bpa.gov/EE/Policy/EEPlan/Documents/2016-2021_BPA_EE_Action_Plan.pdf
California Public Utilities Commission, California Statewide Codes and Standards Program Impact Evaluation Report Phase Two, Volume One: Appliance Standards (2017).	http://www.calmac.org/publications/CPUC_CS_Volume_1_Report_FINAL_R1_05232017.pdf
Cities for Responsible Investment and Strategic Enforcement (Cities RISE), The Power & Proximity of Code Enforcement: A Tool for Equitable Neighborhoods (Hester Street, 2019).	https://hesterstreet.org/wp-content/uploads/2019/07/CR_-Phase-I-_Equitable-Code-Enforcement-report_FINAL-JUNE-2019.pdf
Energy & Resource Solutions, Commercial Code Enhancement Market Progress Evaluation #1 (Northwest Energy Efficiency Alliance, 2021).	https://neea.org/img/documents/Commercial-Code-Enhancement-Market-Progress-Evaluation-1.pdf
Industrial Economics, Incorporated, Advanced Energy Codes Program: Process Evaluation Phase II (New York State Energy Research and Development Authority, 2017).	https://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2017ContractorReports/AEC-Phase-II-report.pdf
Institute for Energy Efficiency, Integrating Codes and Standards into Electric Utility and Energy Efficiency Portfolios (2011).	https://www.edisonfoundation.net/-/media/Files/IEI/publications/IEE_IntegratingCSintoEEPortfolios_final.ashx
Lee, Allen, Evaluation and Codes and Standards Programs (Cadmus, 2020).	https://cadmusgroup.com/wp-content/uploads/2020/10/MN-Codes_Standards-Allen-Lee-Cadmus.pdf
Midwest Energy Efficiency Alliance, Minnesota Codes and Standards Program: Concept to Realization Roadmap (Minnesota Department of Commerce, Division of Energy Resources, 2021).	https://mn.gov/commerce-stat/pdfs/20210419_mn_codes_standards_roadmap.pdf

Reference	URL
Nadel, Steven, How Energy Efficiency Programs Can Support Building Performance Standards (ACEEE, 2020).	https://www.aceee.org/sites/default/files/pdfs/how_energy_efficiency_programs_can_support_building_performance_standards.pdf
National Action Plan for Energy Efficiency, Energy Efficiency Program Administrators and Building Energy Codes (EPA, 2009).	https://www.epa.gov/sites/default/files/2015-08/documents/codes.pdf
National Energy Efficiency Partnerships, Attributing Building Energy Code Savings to Energy Efficiency Programs (2013).	https://www.imt.org/wp-content/uploads/2018/02/NEEP_IMT_IEE_Codes_Attribution_FINAL_Report_02_16_2013.pdf
U.S. Department of Energy, Building Energy Codes Adoption Toolkit (2012).	https://www.energycodes.gov/sites/default/files/2019-09/ACE_Adoption_Toolkit.pdf

A.18.1.2. Process Evaluation Findings

The following sections are organized by the different logic model components, including activities, outputs, and outcomes. Throughout, the evaluation team presents additional considerations and opportunities for the program to consider that are informed by the industry scan. A base logic model is then presented at the end.

A.18.1.2.1. Codes and Standards Activities

CSO program activities are summarized in this section. Activities are organized by level – state, local, within LADWP, and within the CSO program. Each set of activities includes a list of current CSO program activities and opportunities identified by the evaluation team.

State-Level Activities

At the state-level, program staff support the Codes and Standards Enhancement (CASE) activities and initiatives. The CASE program currently operates as a program for coordinating the CSO activities of the four California IOUs and some of the larger municipal utilities, including LADWP and SMUD. PG&E currently leads this program.

This section discusses current activities and describes potential opportunities to supplement these efforts below. The activities and opportunities discussed are:

Current Activities:

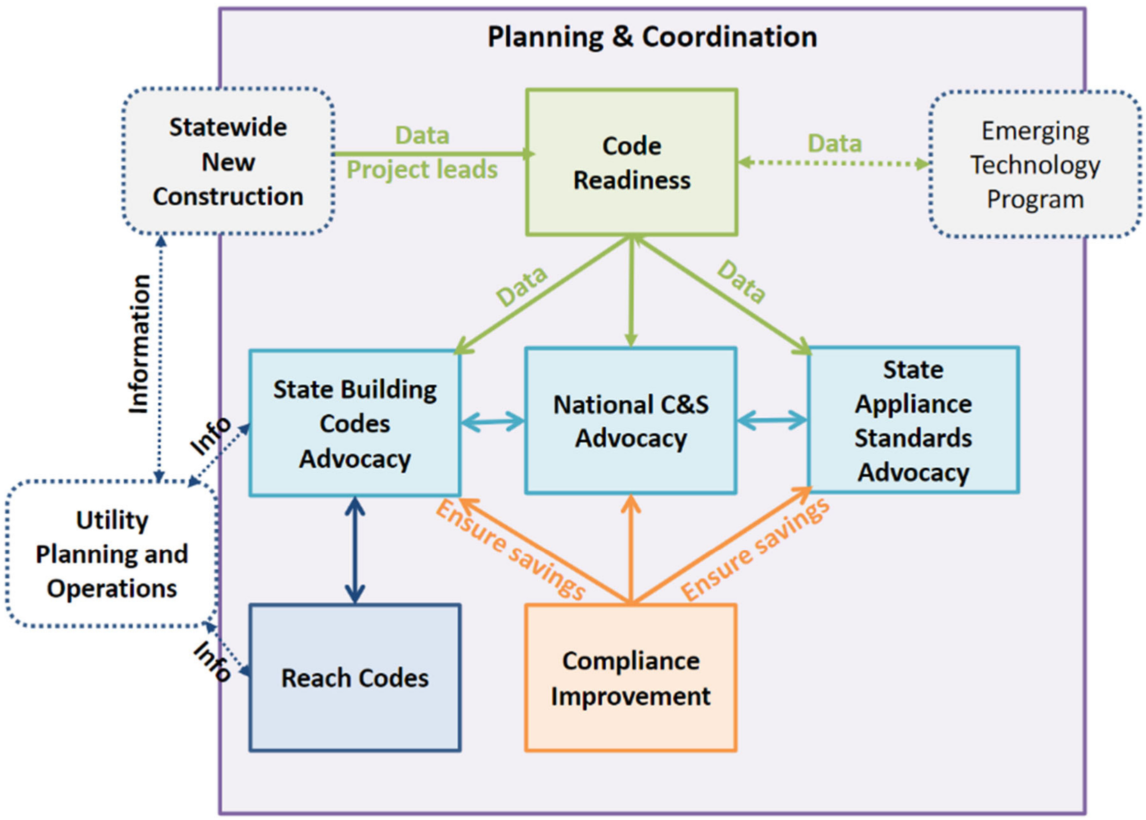
- Attend CASE meetings
- Support CASE initiatives

Opportunities:

- Track CSO program outputs
- Track code compliance data

LADWP's involvement with CASE is the utility's primary mechanism for influencing state- and national-level codes and standards. CASE also conducts research to characterize the impacts of codes and standards activities of California utilities, which informs how energy savings from utilities' codes, standards, and ordinance programs are attributed to and allocated among California utilities. Figure A-49 depicts these activities and the relationships between them.

Figure A-49 CSO - Statewide CASE Program Logic Diagram



LADWP currently participates in regular CASE meetings, supports the crafting and revision of CSO proposals developed by CASE, and contributes funding to CASE-led research. Co-funded CASE research is designed to identify viable candidate technologies for reach codes or mandatory codes and standards proposals, provide technical support in the form of relevant information on the costs and benefits of CSO proposals developed by CASE or other entities such as the USDOE, and measure the impacts of CSO activities conducted by utilities across the state.

The team's research identified opportunities for the CSO program to indirectly increase its capacity to support the consortium of California utilities involved with the CASE initiative by (1) monitoring outputs from the CSO program, and by (2) capturing and combining new construction data that is already being collected through LADWP's new construction programs and through local code enforcement activities.

1. Monitoring Program Outputs: Staff interviews identified an opportunity for the CSO program to track and monitor some of its outputs, which could support not

only local efforts but also statewide efforts. These are described in greater detail in the "Codes and Standards Outputs" section below.

2. New Construction Data Tracking: The CSO program could coordinate with LADWP's new construction programs to track data on building code and ordinance compliance that gets collected as part of the programs' regular functions, like on-site verifications and desk reviews. The CSO program could partner with code enforcement officials to track code and ordinance compliance data gleaned from selected permits. This third opportunity would likely require additional program resources and is described in greater detail in the "Code and Ordinance Enforcement Support" section below.

The information captured through these activities could support CASE's efforts to develop and revise reach codes, assess code readiness, and advocate for the adoption of proposed codes. Most directly, information gleaned from LADWP's new construction programs and from local enforcement officials could provide an indication of the level of compliance with existing codes and could help characterize readiness for, and barriers to, adopting and implementing proposed codes. Additionally, tracking CSO program outputs would provide useful information about the CSO-related activities being conducted by LADWP, which could help with attributing and allocating C&S savings to LADWP's activities and could be useful for other utilities – particularly other municipal utilities – in California and beyond as they look for ways to design or redesign their CSO programs. Collecting and sharing the quantity and quality of LADWP's CSO program outputs could help other utilities identify activities that are likely to be effective or ineffective in their communities.

Local-Level Activities

At the local-level, program staff provide technical support to the mayor's office as new code and ordinance proposals are developed and vetted and support local codes compliance and enforcement activities. This section discusses current activities and describes potential opportunities to supplement these efforts below.

Code and Ordinance Development

Current Activities:

- Technical support to mayor's office
- Efficiency programs to support code compliance

Opportunities:

- Conduct or fund savings potential and cost-effectiveness studies

LADWP currently supports local codes and ordinance development and adoption by providing technical support to Los Angeles's mayor's office. Most recently, this support resulted in the successful adoption of the Existing Buildings Energy and Water Efficiency (EBEWE) ordinance.

The CSO provides technical support in several ways – by:

- Scanning the market and reviewing current construction practices to identify opportunities for ordinance development

- Providing the mayor's office with data and technical expertise about ordinances the likely costs and benefits of codes and ordinances, and
- Providing information about potential barriers to successful implementation of codes and ordinances.

Through its efficiency programs, the LADWP also supports code adoption by using program incentives to offset the cost of code compliance.

An opportunity exists to conduct or co-fund (with SoCalGas or other partners, depending on the measures targeted) savings potential studies and cost-effectiveness studies of considered codes and ordinances. These studies could include estimates of energy savings over time under a variety of assumed conditions. LADWP's new data analytics tool created through NREL, which brings together several data sources and the ability to drill down to distinct parts of the city, could be used to identify and measure potential impacts.

Code and Ordinance Compliance Improvement

Current Activities:

- Training for code officials

Opportunities:

- Training for larger design and construction community
- Provision of code manuals, software, or other supporting resources in partnership with the Department of Building and Safety

LADWP's CSO program currently supports improvements to codes and ordinance compliance by providing training for code officials to help them understand and enforce energy codes. These trainings have historically been co-funded with SoCalGas, although collaboration has been limited in the past fiscal year. Opportunities exist to expand training offerings to include the larger design and construction community – contractors, builders, and engineers, in addition to the existing training offerings to code officials. The CSO program could partner with LADWP's new construction programs to offer these trainings to contractors, builders, and engineers. In addition to training offerings, LADWP could partner with the Department of Building and Safety to provide materials such as code manuals and software as part of their engagement with this community.

Code and Ordinance Enforcement Support

Current Activities:

- Training for code officials

Opportunities:

- Support permit reviews for Department of Building and Safety

The CSO program currently supports code and ordinance enforcement through the training offered to code officials described above. A potential opportunity for LADWP's CSO program is to support enforcement more directly by having an LADWP engineer review permits for the Department of Building and Safety to identify potential code violations. Permits could be selected purposively or randomly but would ideally be selected with an eye toward equitable enforcement.

Implementing this kind of direct support for permit reviews is a longer-term proposition for the program, as it would require additional staff resources. However, effective enforcement of energy efficiency codes is highly critical to realizing the intended savings. Other institutions that have used this approach (e.g., NEEA) have identified several purposes for integrating this service. These purposes include improved enforcement fidelity, improved enforcement capacity, and better visibility into code and ordinance effectiveness.

First, the most direct impact would be to improve the fidelity of enforcement for the selected permits, as an LADWP engineer could identify potential issues with the permits they review.

Second, these reviews could improve the overall capacity of enforcement officials to identify and respond to energy code issues. Each permit that an LADWP engineer helps review would presumably marginally reduce the workload for code officials – allowing code officials to review permits more quickly or to spend additional time reviewing each permit. More significantly, the reviews would also complement the training the CSO program already provides, as each LADWP-reviewed permit provides an opportunity for LADWP engineers to provide a small amount of training to code enforcement officials by identifying and explaining gaps in those officials' application of building code.

Third, important details from each reviewed permit could be captured and stored as data, allowing for some degree of visibility into the typical level of compliance with existing codes, and identifying which parts of the building code are not being followed consistently. Data on code and ordinance compliance are typically included as a moderating factor in code impact evaluations, and this data could prove useful for conducting cost-benefit analyses of the CSO program or estimating savings attributable to the CSO program's efforts. Additionally, identifying common areas of code noncompliance may point to a need for increased or improved training for the building design and construction community, or may indicate parts of the code that are confusing or difficult to comply with.

LADWP-Level Activities

LADWP resource program staff interviewed had varying levels of awareness for CSO program activities and how codes and standards were integrated into program design and savings. While one program team noted that they felt they received the right level of information and support from CSO, the remaining program teams expressed that they would like to receive more frequent communications, updates, and support. These interviews surfaced opportunities for the CSO program to expand its role as a knowledge management resource and to become more directly involved with resource program design and redesign.

Knowledge Management Resource

Current Activities:

- Field LADWP staff inquiries about codes, standards, and ordinances
- Maintain repository of codes, standards, and ordinances

Opportunities:

- Increase maintenance of CSO repository and application of codes, standards, and ordinances to savings workbooks
- Develop and distribute CSO fact sheets to LADWP staff

LADWP's CSO program currently serves as a knowledge management resource for utility staff. This function is characterized by the development and maintenance of information and materials about codes, standards, and ordinances. It serves this function by fielding staff inquiries about relevant regulations.

The team's research identified opportunities to increase the program's effectiveness in providing these knowledge management services by developing and disseminating informational materials that keep staff apprised of relevant changes to CSOs and how those changes may impact program savings or processes. Resource program staff reported that they were not sure if savings workbooks were regularly updated, suggesting that this resource could be maintained more regularly – at least every 3 years to capture code changes as they occur in the development cycle, and ideally more frequently to include forecasts of proposed changes to codes and to capture updated standards as they are considered and adopted.

Program staff report that some changes are already underway to better inform resource program staff on relevant codes, standards, and ordinances. For example, future iterations of the Business Plan will include snapshots of the CSO landscape for each program and potential ramifications. The CSO program could consider other opportunities to further disseminate information, such as developing and distributing "CSO Fact Sheets" to serve as a learning aid and reference for staff, and to help them with responding to customer inquiries or address other program issues as they arise. CSO program administrators can support program staff by developing these fact sheets as easy-to-understand summaries of relevant codes, standards, and ordinances, that also describe how these regulations might impact utility programs.

Program Design and Redesign

Current Activities:

- Occasional trainings for LADWP staff

Opportunities:

- Additional trainings for LADWP staff (e.g., 2x/year)
- Participate directly in program design and redesign processes

The CSO program conducts occasional trainings for program staff to provide information about relevant codes, standards, and ordinances. Staff interviews identified an opportunity for the CSO program to expand this support and participate more directly in program design and redesign conversations. Providing more frequent trainings and deepening the CSO program's engagement in program design conversations would also help to support the CSO program's contribution to LADWP's market transformation activities – preparing the market for proposed code changes by using rebate programs to grow the market share of energy efficient products to increase the viability of proposed code. In addition, more regular engagement with resource program staff can provide CSO program staff with useful information about the market adoption of various measures, and the challenges and successes resource programs have had in driving adoption. Relevant information can be captured and stored by CSO staff and used to inform the development of successful regulations.

Resource program staff suggested that the CSO program could meet with them once or twice a year to discuss upcoming code changes, impacts to programs, and discuss questions or concerns. A few staff members also noted that they did not always understand how codes affect savings values and why a measure may or may not receive an incentive, which leaves them unprepared to address related customer questions. They said they would like training opportunities or workshops to better understand the technical aspects of energy savings and incentive setting so they can feel more prepared.

Program-Level Activities

The evaluation team identified several opportunities within the CSO program's internal processes to define and expand roles and responsibilities and track program outcomes. These are described more fully in the sections below.

Develop and Maintain Program Process Documentation

Current Activities:

- None identified (this activity was identified as an opportunity by CSO program staff)

Opportunities:

- Revise and maintain logic model
- Develop role-based process diagrams

To support the sustainability of program processes and to aid in training any new CSO program staff, CSO program staff identified an opportunity to develop and maintain documentation detailing CSO program processes. This documentation could also be useful as a model for other utilities, as limited resources are available to guide CSO program administrators. This would be particularly useful for program administrators at other municipal utilities, as guidance for administrators in these roles is extremely limited in the existing literature.

Revising and maintaining a program logic model is the first step toward building out this documentation. The program could expand on this model by naming the distinct roles that CSO program staff play, identifying the activities each of those roles executes, and designing and maintaining process diagrams depicting the steps for successfully performing these activities. Even if these roles are all currently executed by the same person this documentation will allow for increased flexibility as the program grows and develops.

The evaluation team identified five roles needed to execute the key CSO program activities, with a sixth role if LADWP decides to implement a permit review initiative. Note that these should be adapted and revised as needed to align with shifts in program designs. Additionally, this is one of many possible role groupings, and alternative sets of roles may be equally useful for program design. The roles the team identified include:

- Current Roles
    - CASE Liaison: Engages with CASE stakeholders, attends CASE meetings, and supports CASE initiatives
    - Government Liaison: Engages with local government stakeholders, provides technical support for code and ordinance adoption and implementation
    - Department of Building and Safety Liaison: Engages with DBS stakeholders, conducts trainings with code enforcement officials and other members of the building design and construction community
    - CSO Knowledge Manager: Maintains CSO knowledge repository, conducts trainings with LADWP staff, develops and distributes informational resources, participates in LADWP program design and redesign activities
    - CSO Program Administrator: Coordinates activities across roles, engages with key LADWP stakeholders
- Possible Additional Role
    - Permit Review Engineer: Assists the DBS with permit reviews and collects compliance data

Monitor CSO Program Outputs and Outcomes

Current Activities:

- None identified (this activity was identified as an opportunity by CSO program staff)

Opportunities:

- Monitor CSO program outputs
- Evaluate CSO program outcomes

CSO Program staff also identified an opportunity to track metrics related to CSO program activities, to help document the program's outputs and, over time, its impacts. Evaluating program outcomes and characterizing the causal mechanisms for producing these outcomes through program activities are long-term goals. However, the team identified several program outputs that CSO program staff could monitor in the short-term to begin building an evidence base. Details on potential outputs to consider tracking are summarized in the "Codes and Standards Outputs" section below.

A.18.1.2.2. Codes and Standards Outputs

The evaluation team identified several potential outputs tied to the CSO program's activities. Outputs are the direct results of activities and are typically value-neutral, meaning that measuring program outputs does not necessarily measure a program's effectiveness. For example, having a high number of participants in a training session would not indicate that the session was effective, as the training session may not have increased participants' knowledge.

Nonetheless, these outputs may provide a useful starting point for identifying metrics that the CSO program staff could monitor immediately or in the near future. These outputs are organized by the program's current activities. There are many other outputs that the CSO program could track in addition to the ones listed, but the outputs presented here are the most feasible to track in the near-term. Some of these outputs could be documented qualitatively rather than tracked with a quantitative metric, and these are indicated in the list. Note that these outputs are simplified considerably in the logic model to capture essential components while retaining an easy-to-read format. The team identified the following outputs:

- Support CASE initiatives
    - $ Funds provided to CASE research
    - $ Funds provided to CASE reach code development
    - # Funded CASE reach codes that are implemented
    - Contributions to crafting reach codes (qualitative)
    - Contributions to crafting other CASE proposals (qualitative)
    - Contributions to other CASE initiatives (qualitative)
- Attend CASE meetings
    - # CASE meetings attended
    - Contributions to CASE meetings (qualitative)
- Provide technical support to mayor's office
    - # Meetings with mayor's office
    - # Codes and ordinances supported
    - # Supported codes and ordinances that are adopted
    - Contributions to meetings with the mayor's office (qualitative)
    - Contributions to crafting codes or ordinances (qualitative)
- Train local code officials
    - # Trainings conducted
    - # Topics covered
    - # Participants in each training
    - Participant knowledge, skills, and abilities ratings before and after training
    - Participant satisfaction rating with training
- Maintain CSO knowledge repository
    - Date of most recent repository update
    - # Annual repository updates
    - # Codes, standards, and ordinances included in repository
    - # Cities and states included in repository

    - # Unique users accessing repository
    - # Repository views by non-CSO program staff
    - Staff satisfaction rating with repository
    - User and viewer roles (qualitative)
- Field LADWP staff inquiries
    - # Inquiries resolved
    - # Unique inquirers
    - Inquirer roles (qualitative)
    - Inquiry content (qualitative)

A.18.1.2.3. Codes and Standards Outcomes

The evaluation team also identified several desired outcomes of the CSO program based on staff interviews and the industry scan. Evaluating these outcomes is a longer-term goal for the CSO program. Collecting and storing program output data will be vitally important for enhancing the evaluability of the CSO program to enable formative or summative evaluations of these outcomes and the program's contributions toward them. The outcomes team identified the following intended outcomes for the program's current activities:

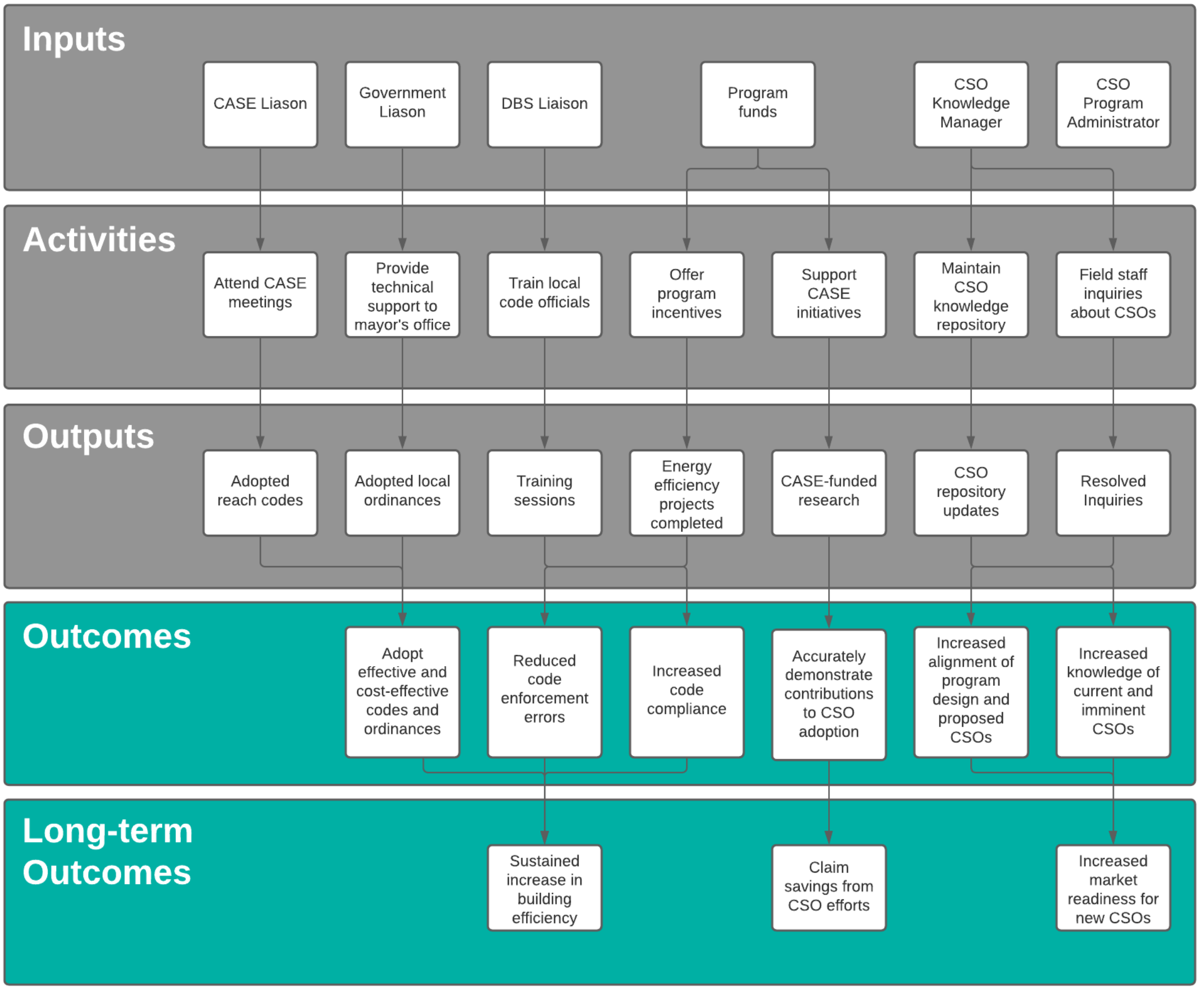
- Accurately demonstrate program contributions to codes, standards, and ordinance adoption
- Adopt effective and cost-effective codes and ordinances
- Reduced errors in local code and ordinance enforcement
- Increased compliance with local codes and ordinances
- Increase LADWP staff knowledge about current and imminent codes, standards, and ordinances
- Increase alignment of LADWP program design with proposed codes, standards, and ordinances

A.18.1.2.4. Base Logic Model

The evaluation team developed the following logic model based on interviews with program staff and a review of materials (Figure A-50). To design the model for immediate use by program staff, the team only included currently implemented program activities.

A next step for the program may be to build out an ideal logic model, integrating potential opportunities presented in the earlier sections.

Figure A-50 CSO Base Program Logic Model



A.18.1.3. Recommendations

- **Lead more frequent trainings for LADWP staff and participate directly in the program design and redesign processes.** Interviews with resource program staff identified an opportunity for the CSO program to lead staff trainings and to participate more directly in program design and redesign conversations. Trainings would ideally occur twice per year. Some program staff said that trainings would help program staff prepare for the impacts of new codes and standards on their program processes and the savings they can claim.
- **Additionally, CSO program staff have unique visibility into proposed codes and standards.** By participating in program design and redesign, CSO program staff could identify ideas for new programs or changes to existing programs that could help prepare the market for proposed code changes.
- **Develop and maintain additional program process documentation.** To support the sustainability of program processes and to aid in training any new CSO program staff, the CSO program administrator identified an opportunity to develop

and maintain documentation detailing CSO program processes. Revising and maintaining a program logic model and documenting program roles and processes will allow the CSO program to grow and develop more effectively, as new staff will have a greater understanding of how to support the program.

- **Track CSO program outputs.** Staff interviews identified an opportunity for the CSO program to track and monitor some of its outputs. Tracking CSO program outputs would provide useful information to the CASE program about the CSO-related activities being conducted by LADWP, which could help with attributing and allocating C&S savings to LADWP's activities and could be useful for other utilities. Tracking these outputs could also help the CSO program to improve over time, as this documentation will increase the evaluability of the program, leading to additional insights about program improvements.
- **Monitor compliance with codes and ordinances.** The CSO program could coordinate with LADWP's new construction programs to track data on building code and ordinance compliance that gets collected as part of the programs' regular functions such as on-site verifications and desk reviews. The CSO program could also partner with code enforcement officials to track code and ordinance compliance data gleaned from selected permits. As the CSO program develops this data repository for compliance with codes and ordinances, program staff will be able to provide the mayor's office and CASE colleagues with more information about the effectiveness of a code or ordinance and can help to identify potential barriers to implementation of proposed regulations.
- **Consider supporting permit review for the Department of Building and Safety.** While this recommendation is likely not feasible in the immediate future, the CSO program could support code and ordinance enforcement more directly by having an LADWP engineer or another third-party review permits for the Department of Building and Safety to identify potential code violations. Permits could be selected purposively or randomly but would ideally be selected with an eye toward equitable enforcement. Reviewing permits for energy code violations could help to improve the fidelity of enforcement for the selected permits, which would reduce the amount of energy savings lost due to noncompliance. These reviews could also improve enforcement capacity of DBS officials by reducing their workload and through the real-world training opportunities that these reviews could provide for enforcement officials.

A.19. ETP

The LADWP Emerging Technologies Program (ETP) accelerates the introduction of innovative energy-efficient and water-efficient technologies, applications, and analytical tools that are not yet widely adopted in California. By reducing both the performance uncertainties associated with new technologies as well as institutional barriers, the ultimate goal of this program is to increase the probability that promising energy- and water- saving technologies will be commercialized.

In its current design, vendors approach the ETP with their most recent developments and demonstrations, and the ETP team establishes pilots to study them as opportunity and bandwidth allows. However, the program is considering updating some processes, most notably through the addition of a model developed with the National Renewable Energy Laboratory (NREL) designed to inform program goals and enhance technology screening. This ongoing effort may ultimately create updates to the overall program design.

A.19.1. Process Evaluation Approach and Methodology

This section summarizes the process evaluation's research objectives and the activities the evaluation team conducted to evaluate the ETP.

Table A-139 Summary of ETP Process Evaluation Research Questions and Objectives

Research Question or Objective	Evaluation Activity
How is success measured in other programs? What program metrics are used?	Review of program documentation Staff interviews
How do LADWP's proposed processes for tracking, selecting, testing, and adopting technologies compare to those of other utilities?	Industry scan
How do other utilities staff their ET programs?	Industry scan
Where do hand-offs happen in other ET program processes, and what specifics are communicated?	Review of program documentation

A.19.1.1. Staff Interviews

The Evaluator completed two group interviews with LADWP program staff in December 2020 and July 2021. During these interviews, we sought to clarify our understanding of the program design and procedures developed from our review of program documentation. Specifically, we discussed:

- The program's theory and anticipated outputs and outcomes
- The program's goals, how they are measured, and achievement to-date
- A walk-through of how emerging technologies are selected and studied
- How program information is communicated to internal and external stakeholders, and the level of engagement with these stakeholders
- Perceived barriers to emerging technology development through the program
- Where the program faces challenges and potential opportunities for improvement or change

The team also used the interviews to clarify and revise, as appropriate, the research questions to be addressed in this study. Table A-139 presents the refined set of questions.

A.19.1.2. Document Review

The Evaluator reviewed Program documents including the most recent Business Plan[50], process flowcharts, and program overview slide decks. These documents helped provide

[50] Los Angeles Department of Water & Power (LADWP). "LADWP Efficiency Solutions Portfolio Business Plan FYs 2017/18 – 2026/27." ES PBP Update 2018-19 FD 3.2, Los Angeles, CA, 2017/18/19.

the team an understanding of activities and partnerships the program is engaged in; how the program is communicated internally and externally; and other currently established program processes.

A.19.1.3. Industry Scan

The Evaluator conducted an industry scan to understand how LADWP's ETP compares to similar programs and to identify opportunities for adding or evolving approaches to better serve the ETP in meeting its goals. To provide a framework for this scan, we categorized programs using the key characteristics presented in Table A-140.

Table A-140 ETP - Key Characteristics of Emerging Technology Related Programs

Program Characteristic	Process Characteristic
Size	Planning
Strategic Objectives	Pipeline Development
Focus Areas	Selection
Project Types	Evaluation
Goals and Performance Metrics	Portfolio Integration

To identify a set of programs that would best enable the Evaluator to answer the specified research questions, the team selected programs with;

- A similar range of considered ideas (customer side emerging technologies spanning all sectors) and levels of market readiness,
- A relatively narrow range of annual budgets (between $2.5 to $11.8 million) inclusive of ETP's draft annual budget of roughly $5.8 million[51],
- A wide range in past implementation history (less than 2 years to 16 years), including for some programs that have undergone recent process evolutions in response to lessons learned to-date.

The Evaluator compiled shareable findings into a separate searchable Excel spreadsheet with links to available references where possible, and summarized findings from the scan as well as subsequent recommendations in this report. The spreadsheet is available in Appendix D. For confidential and privacy considerations of participants, Appendix D was not published with the public version of the report. Appendix D was provided only to LADWP as reference to supplement this EM&V report.

A.19.2. Process Evaluation Findings

In this section we provide program summaries for the set of comparison ET programs then juxtapose select program and process characteristics against those of the ETP. The comparison programs include Focus on Energy's Future Focus Initiative (Focus on Energy), Commonwealth Edison's Emerging Opportunities program (ComEd), and the Bonneville Power Administration's (BPA) Technology Innovation Office. The spreadsheet

[51] IBID.

also includes some details on NEEA's publicly accessible R&D program model which may be of use to the LADWP ETP.

A.19.2.1. Program Summaries

LADWP. The ETP's stated primary objective is the adoption of emerging technology to help customers reduce energy use, water use where applicable, and cost, while also enabling the department to save money through enhancements to existing systems or new technology. Secondary to energy-saving emerging technology, the program also considers emerging energy storage and production mechanisms. The program's annual budget is roughly $5.8 million, expanding to $6.3 million in FY 21/22.

Focus on Energy. The overall objective of the Focus on Energy Future Focus initiative is to review new concepts and technologies that have the potential to expand the range and value of services available to Wisconsinites, as well as to help the program achieve the desired outcomes of energy savings, customer satisfaction, and/or market transformation.[52] This initiative launched in 2020 as an extension of Focus on Energy's Environmental & Economic Research and Development Program. It was designed to be R&D 're-imagined' leveraging 'fresh and crowd-sourced' innovation, and it appears to have an annual budget of roughly $2.4 million.[53]

ComEd. For their Plan 6 period (2022-2025), the ComEd Emerging Opportunities program will focus on innovative projects that explore ways to make energy efficiency more accessible, affordable, and effective for everyone. Projects can include emerging technology, innovative program designs, operational enhancements for implementation teams, and market adoption strategies for underperforming portfolio measures. A primary area of focus within ComEd's program is 'identifying, testing, validating, and integrating solutions that improve how the [broader] ComEd Energy Efficiency (EE) portfolio serves income eligible (IE) customers, prioritizing initiatives focused on assessment or delivery of comprehensive measures.'[54] $2 million of the program's roughly $11.8 million annual budget is designated for projects that target ComEd's IE customers.

The Plan 6 areas of focus, as well as the team's new name, speak to this program's evolution since its inception in 2018. One of the key new elements of the portfolio that year, ComEd's expanded R&D effort included the creation of a dedicated team, named the Emerging Technology team at the time, tasked with engaging the stakeholder community to develop a structured process that identified opportunities for deployment of new technology or program designs that expand ComEd's ability to meet increasingly aggressive savings goals over time.[55]

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[52] Focus on Energy. "Research & Pilots." FocusOnEnergy.com. Published 2020. Accessed August 2020. https://focusonenergy.com/about/research

[53] Focus on Energy. "An eye to the future. A focus on what's next." FocusOnEnergy.com. Published 2020. Accessed August 2020. https://focusonenergy.com/about/future-focus

[54] ComEd Energy Efficiency Program. "Commonwealth Edison Company's Energy Efficiency and Demand Response Plan 2022–2025." Docket No. 21- ComEd Ex. 1.01. March 1, 2021.

[55] ComEd. "Commonwealth Edison Company's 2018 – 2021 Energy Efficiency and Demand Response Plan." Docket No. 17- ComEd 1.0. June 30, 2017.

BPA. Created in 2005, BPA's Technology Innovation Office manages the Agency's strategic approach to research and development. BPA's technology innovation objectives support three of the Agency's strategic priorities: preserve and enhance generation and transmission system assets and value, advance energy efficiency, and expand balancing capabilities and resources.[56] This includes identifying and developing innovations in transmission, smart grid, demand response, and energy efficiency. Historically, BPA has allocated slightly less than one-half of one percent of its gross revenue to fund R&D, which in 2015 reached roughly $16.6 million.[57]

For the 2021-2023 period, however, BPA has dedicated fewer resources, both financially and in personnel, and reimagined their framework for managing research activities.[58] Given the program's focus on technology development and demonstration, most projects funded to date have been in the transmission research area. However, a new research area, Products, Markets and Services, has emerged as a result of discussing future needs with subject matter experts involved in BPA's analysis of potential new markets.[59]

A.19.2.2. Select Program Characteristics

Goals and Program Metrics: The ETP does not currently identify a specific goal for the program, such as GWh savings, program spend, greenhouse gas (GHG) emission reduction or quantity of completed projects. As such, the ETP has yet to establish program metrics. The team is currently in the process of incorporating the use of a model developed with NREL designed to help the ETP identify and integrate more precise goals based on estimated program potential. This model is described further within the "Selection" portion of Section A.19.2.2.

ComEd's key program metric is annual electricity savings achieved in the ComEd EE portfolio that can be attributed to the Emerging Opportunities program. Between 2022 and 2025, this annual savings contribution goal is 14 GWh of cumulative annual persistence savings (CPAS).[60]

Similar to ComEd, Focus on Energy's goal is to help the overall energy portfolio meet its goals. However, Focus on Energy does not set a specific energy savings target in part due to the variation of funding and subsequently, number of projects undertaken. Instead, Focus on Energy tracks the number of technologies moved into their approved program offerings and their corresponding savings as metrics of program performance. In general, it is useful to track pipeline progression and screening effectiveness in order to evaluate the quantity, quality, and alignment of ideas being pulled through as additional metrics of program performance.

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[56] Bonneville Power Administration. "Technology Innovation" Factsheet. DOE/BP-4709. July 2015.

[57] Bonneville Power Administration. "Technology Innovation Office Introduction & Overview." June 17, 2016.

[58] The Evaluator is unable to find the current annual budget for BPA's program.

[59] Bonneville Power Administration. "Technology Innovation: Research Priorities for Fiscal Years 2021-2023." September 23, 2021.

[60] In Illinois, CPAS are defined by the Future Energy Jobs Act as "the total electric energy savings in each year from measures installed in that year or in previous years, but no earlier than January 1, 2012, that are still operational and providing savings in that year because the measures have not yet reached the end of their useful lives." U.S. Congress, Senate. "Future Energy Jobs Act," SB2814 Enrolled. p.183 line 14.

BPA's program has no publicly stated numerical program metrics or goal. Instead, BPA identifies, documents, and works toward meeting research priorities for 2-to-3 year periods. These priorities are the product of a comprehensive process of engagement with internal BPA customers (Power, Transmission, and Information Technology) designed to capture their research requirements and to identify the topics deemed high priority to BPA's core business lines. We describe this process further in the sections that follow.

Staffing: At the time of this writing, the ETP had no dedicated staff. Instead, LADWP staff were pulled into program work as needed. At present, LADWP has assigned dedicated staff to manage ETP.

The ComEd program employs a dedicated head of the effort who oversees three fully dedicated staff, as well as a third party implementer who administers the program and funded projects.[61] Focus on Energy hires a subcontractor to administer the initiative, and teams to evaluate submitted ideas and funded projects at various points along the process.[62] BPA has a dedicated R&D manager and multi-person team.[63]

Pipeline Development: Historically, the ETP pipeline was a reactive and ad hoc process driven by submissions from vendors. In July 2020, the ETP took a proactive approach and sent out an open request for ideas (RFI) through their purchasing channel, which includes all groups signed up to receive bids through the City of Los Angeles. In parallel, LADWP reached out to the LA chapter of the U.S. Green Building Council, LA Better Buildings Challenge, CleanTech Incubator, and a small group of other stakeholders to help spread the word.

ComEd's program includes both a reactive (open submission portal) and proactive (RFI and request for proposal) approach to pipeline development. Somewhat different than the ETP, ComEd's RFI and Requests for Proposal (RFP)s have included a range of open to targeted requests, ranging from an open RFIs calling for interventions for IE customers to requests for specific pilots and research efforts. ComEd has a dedicated website which includes the portal for idea submission, a separate page detailing the development and submission process, which include evaluation criteria, a page showcasing existing projects, and the option to be added to a mailing list.

Focus on Energy uses a similar proactive and reactive approach to ComEd. The Future Focus page includes a form to submit an idea, as well as a link to complete project reports. In addition, Focus issues RFPs on an intermittent basis.

BPA uses a proactive approach through an opportunity announcement to solicit projects that support BPA specified research needs and that have a direct path to application. In a slightly different approach than the other comparison programs, BPA uses roadmaps to create a tailored pipeline of ideas that tie directly to their identified immediate and future technology needs.

> "[BPA] begins the annual technology management cycle by facilitating the creation of detailed technology roadmaps based on with [sic] input from technical staff and

[61] ComEd ET Team. "Emerging Technologies Project Catalogue." Updated January 2020.

[62] Correspondence with Focus on Energy staff in July 2021.

[63] Bonneville Power Administration. "Technology Innovation Office Introduction & Overview." June 17, 2016.

> Agency executives and experts from throughout North America. Roadmaps provide a publicly-articulated research agenda communicating Agency needs to the international research community. They show diagrammatically the incremental and breakthrough R&D programs the BPA can pursue to achieve its strategic objectives and how these programs link to business drivers. In identifying business and operational challenges, technical needs, required capabilities, and associated R&D programs, roadmaps define the types of projects [BPA] will invest in and, by extension, provide a foundation for the R&D portfolio."[64]

To date, the agency has developed technology roadmaps for energy efficiency, hydroelectric operations, physical security and transmission planning, operations and design.[65] In utility R&D efforts, BPA pioneered this road mapping approach. "The agency's chief technology innovation officer, Terry Oliver, led the creation of [this] research discipline unique to the electric utility industry. 'We borrowed ideas from companies whose very existence depends on good outcomes.'"[66]

One additional unique element of BPA's process is that it includes a defined annual timeline comprised of two core phases, production, and introspection.

- "**Production begins each December when [BPA] prepares for the upcoming Funding Opportunity Announcement. The Announcement occurs in March, proposals are received and reviewed between March and June, and the upcoming fiscal year portfolio is awarded in July.**
- **Introspection occurs between July and December. It is a period to evaluate and improve upon internal processes, produce updated roadmaps, and work on other areas that will enhance the Production cycle, such as:**
    - Determine likely BPA future technology gaps.
    - Identify what R&D can be done to fill those gaps.
    - Decide what the upcoming portfolio should look like to meet the identified technology needs.
    - Communicate process improvements to the TCI Council.

Figure A-51 illustrates typical activities that take place during the cycle."[67]

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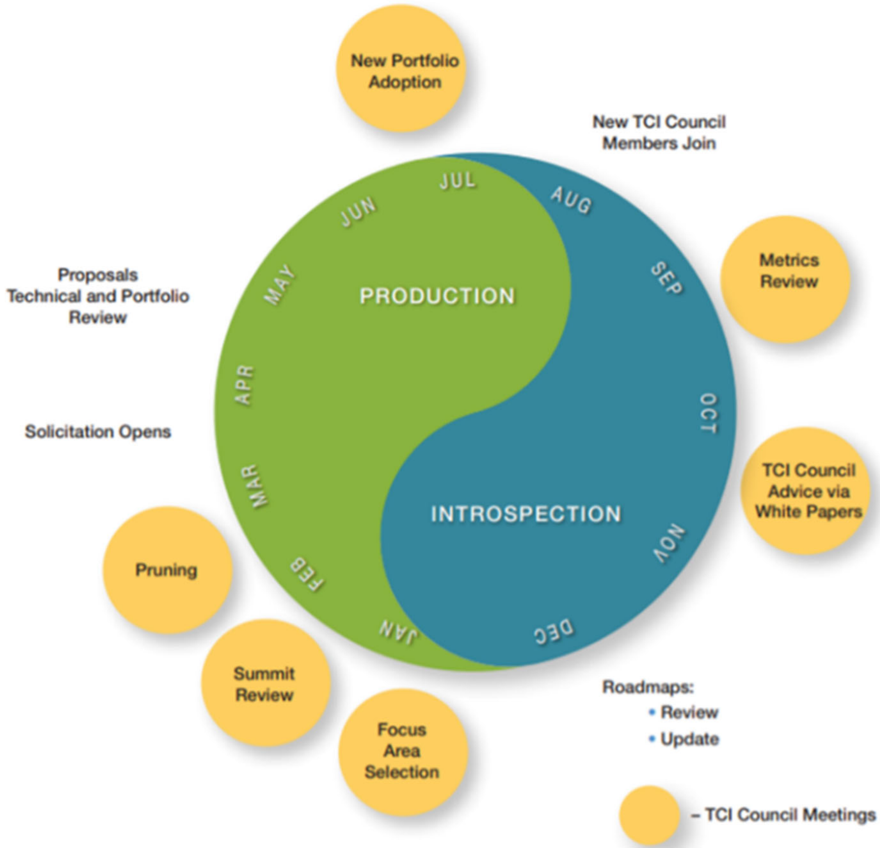
64 Bonneville Power Administration. "Technology Innovation Office Introduction & Overview." June 17, 2016

65 Example roadmap: Bonneville Power Administration. "Power Services Technology Roadmap." March 2017 (version 3)

66 Bonneville Power Administration. "Technology Innovation" Factsheet. DOE/BP-4709. July 2015.

67 Bonneville Power Administration. "Technology Innovation Office Introduction & Overview." June 17, 2016

Figure A-51 ETP - Bonneville Power Administration Technology Innovation's Annual Cycle



Selection: In its current design, ETP staff are pulled in as needed for idea review and selection. The incorporation of the NREL model will likely evolve this process and allow the team to screen and prioritize technologies based on metrics including estimated savings potential, technology readiness level, grid impacts, and cost effectiveness.

Ideas submitted to ComEd are reviewed by a panel of experts in the relevant topics according to 16 criteria, arranged in the following three categories: quality of idea, potential impact on ComEd Portfolio, and likelihood of a successful pilot. ComEd provides the details of this selection criteria on their website. BPA includes the criteria used to evaluate submitted proposals in their opportunity announcements, which includes among several criteria the relevance of the proposed project to the research agenda and project team qualifications.

Focus on Energy does initial concept screenings, and submitted ideas go through a series of stage gates towards concept development. This method of tracking may allow for projects with potential future merit to be kept in a holding tank. The idea can then be reviewed on its anticipated goals, strategy, and/or other metrics of interest such as savings potential.

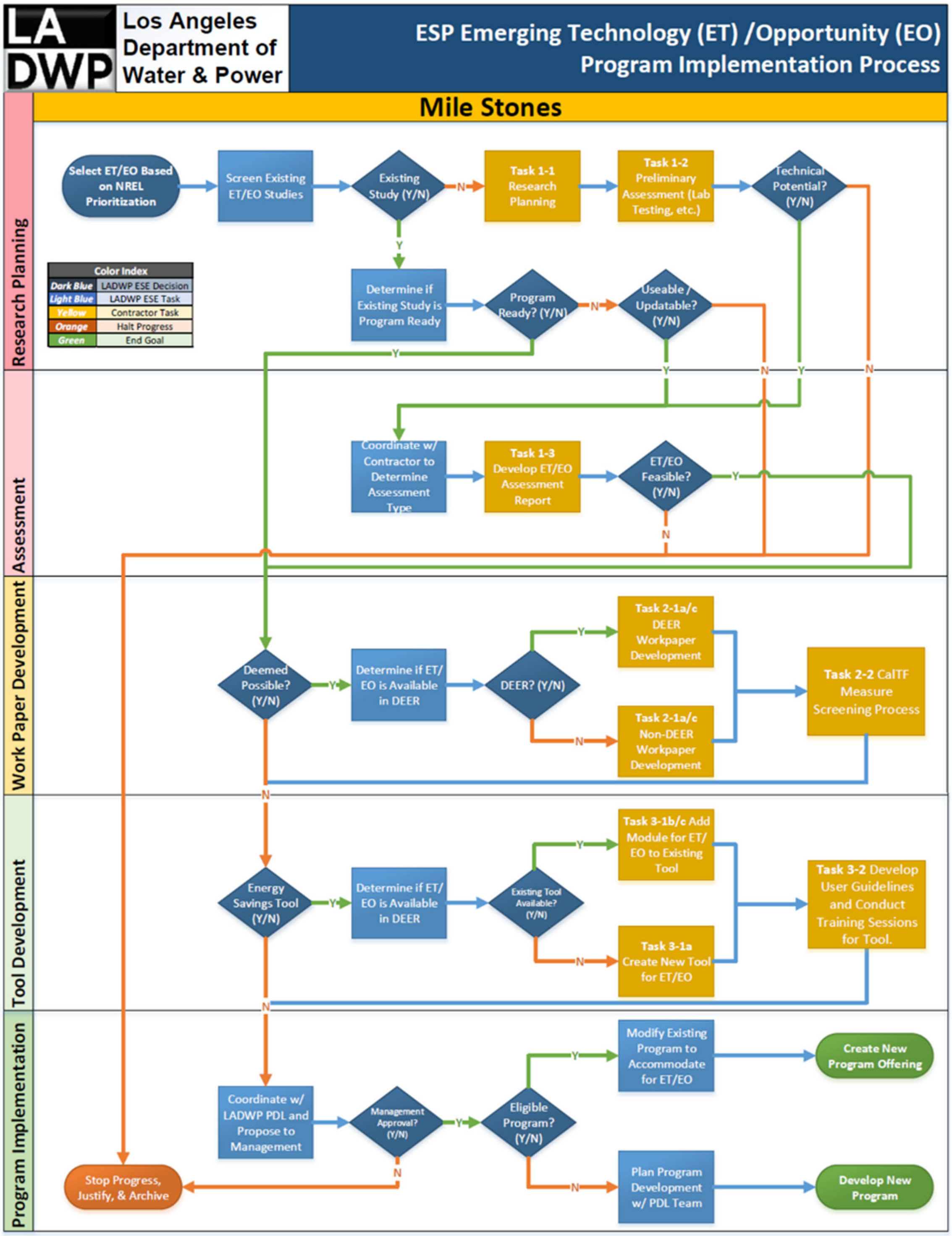
Project Types and Testing: The Evaluator lacks information regarding specific processes used by the ETP, Focus on Energy and ComEd for technology testing or piloting. Based on publicly available reports, each program appears to fund project types that range from field trials of a single installation to multi-installation pilots, to market characterization and market research. We can also see that some of these efforts were evaluated using third party evaluation.

We do want to note BPA's testing process that builds in metrics and decision points. Specifically, BPA's program leverages a group of executives and experts known as the Technology Confirmation and Innovation Council to guide the development of each project. This involves creating projects with predefined stage gates that trigger decisions for continuation, revision, or termination. This process helps ensure each project is on course to accomplishing its objectives.[68]

Portfolio Integration: The ETP implementation process includes six phases: technology prioritization, research planning, assessment, work paper development, tool development, and program implementation, all of which necessitate a high degree communication and hand-off coordination between program staff and contractors as represented in Figure A-52 below.

[68] Bonneville Power Administration. "Technology Innovation" Factsheet. DOE/BP-4709. July 2015.

Figure A-52 ETP - LADWP Program Implementation Process



A technology that is ready to be evaluated for its potential for portfolio integration is passed off to the Program Development Liaison. At this point, the decision is made as to whether the technology is appropriate for a new market segment (necessitating a new program being made), or whether it can be integrated into an existing program.

Depending on the specific technology, the Liaison may coordinate with another LADWP division.

While we were unable to find publicly available details surrounding portfolio integration, information we reviewed for all three comparison programs indicate early process components, notably the screening process, are designed with portfolio integration in mind. Most commonly, these programs cite the need to integrate program staff and key stakeholders early on to identify concerns or questions about a concept's viability at scale and to create buy-in.

A.19.3. Recommendations

Establish specific program goals, and create and track specific, measurable program metrics which map directly to them.

- Progress toward the ETP's objectives may be most easily monitored and achieved if they are linked to quantifiable goals for which a set of program metrics can be established**.**
    - Examples of potential program metrics relevant to the ETP's current objectives include quantity of ideas collected, quantity of projects funded, number of ideas transferred into the LADWP portfolio, and savings impact of ideas transferred into the portfolio. If LADWP expects ETP funding to be variable, the ETP might consider normalizing metrics on a budget or per project basis.
- Identify and create mechanisms to track these metrics on a regular basis.
    - The ETP could consider using project management software to track idea submissions, the results of the NREL model, as well as the progress of funded projects. The ETP might also consider establishing a cadence and format of summarizing and reporting this data on a recurring basis.

Increase pipeline and programmatic fit of submitted ideas by creating targeted solicitations.

- Engage LADWP program teams to identify research needs and program gaps.
    - The ETP could consider incorporating this information into a road mapping framework to identify current state, future state, and what types of projects will meet LADWP's mid and long-term needs.
- Create and share targeted RFPs designed to help meet identified needs.
- To increase diversity of idea submissions, expand the ETP distribution list to include other potential collaborators, including universities and national labs.

Improve submitted idea quality by making research priorities and selection criteria clear and publicly available.

- Make the metrics used in the NREL screening tool clearly and publicly available.
    - This could include posting them on a website on including them in future RFIs and RFPs.
- Communicate the program's objectives and research priorities.

    - This approach may be especially important if the ETP prefers to keep a more reactive approach. Consider stating the program's current research priorities on documents or webpages that mention the ETP's standing open request for ideas.

Create regimented time periods for key program processes, specifically idea solicitation and selection.

- Consider establishing defined solicitation and selection intervals.
    - Using an ETP calendar to specify routine activities may allow for ETP staffing to remain flexible because the timing and expectation of team coordination is established. This could ensure that staffing needs are more predictably timed so that such appointments could be anticipated in the larger LADWP planning effort.
- Identify and empower an ETP champion or point-of-contact to plan, lead and maintain adherence to this calendar.
    - Consider having this person also lead the effort to identify, establish and socialize this calendar with relevant program staff and internal stakeholders.

A.20. MEO

LADWP marketing efforts aim to increase customer awareness of energy efficiency, and to increase participation in LADWP's efficiency programs. The MEO program encompasses program-specific marketing to heighten and maintain customer awareness of the need for and importance of efficient energy use. Each energy efficiency program conducts outreach to customers; LADWP also conducts outreach to historically underserved communities through grants through the Program Outreach and Community Partnerships (POCP), and funds education about energy in the LAUSD schools through an MOU with the school district. LADWP's MEO Program is designed to offer and promote energy efficiency within all market sectors.

A.20.1. Full Process Evaluation Approach and Methodology

This section contains the full process evaluation for this program.

A.20.1.1. Program Staff Interviews

The Evaluator completed seven staff interviews with the MEO team as well as an interview with a member of the LADWP marketing and communications team. We also interviewed staff around the education and outreach efforts including the LAUSD contracts to understand the educational outreach that is conducted under the auspices of the MEO program. In coordination with the evaluation of the other non-resource programs, including Codes, Standards, and Ordinances program (CSO), the Program Analysis and Development program (PADP), and the POCP program, the Evaluator completed additional interviews with program staff who oversee residential and commercial energy efficiency programs.

A.20.1.2. Community Based Organization and Stakeholder Interviews

The Evaluator coordinated with the POCP evaluation in developing the interview guide for discussions with grantees of the POCP. The Evaluator conducted a total of 5 interviews with grantee organizations. The Evaluator recruited a census of Round 8 grantees (17 total) and, to the extent possible based on grantee response to the study invitation, prioritized recruitment for organizations that provided a mix of services and/or targeted different markets (see the POCP Process Evaluation for more details on the process of recruiting and conducting these interviews).

A.20.1.3. Marketing Materials Review

The Evaluator reviewed 72 documents provided by the MEO program team and other Efficiency solutions teams to understand marketing practices across the portfolio. The documents reflected both customer-facing (or external) documents, such as advertisements for a rebate, flyers about program offerings, and application materials. The documents the Evaluator reviewed also included internal documents such as an organization chart, typical MEO activities by programs, image guidelines, and rubrics for assessing community organization applications to be POCP grantees

A.20.1.4. Visualization of Marketing Mechanisms and Stakeholder Collaboration

The Evaluator has completed a high-level process visualization of the program marketing process. In addition, the Evaluator has created a high-level visualization of the journey for program participants, identifying pain points across programs and opportunities where MEO could intervene.

A.20.1.5. Residential, General Household, and Commercial Survey Analysis

The Evaluator included survey questions about marketing channels and effectiveness in participant surveys for both commercial and residential program participants. We include relevant findings in this report.

The Evaluator has included MEO-related questions in the general population survey to be fielded in Summer 2022. We will produce a brief supplemental memo with findings based on that survey once it has been fielded.

A.20.2. Administrative and Customer Process in MEO

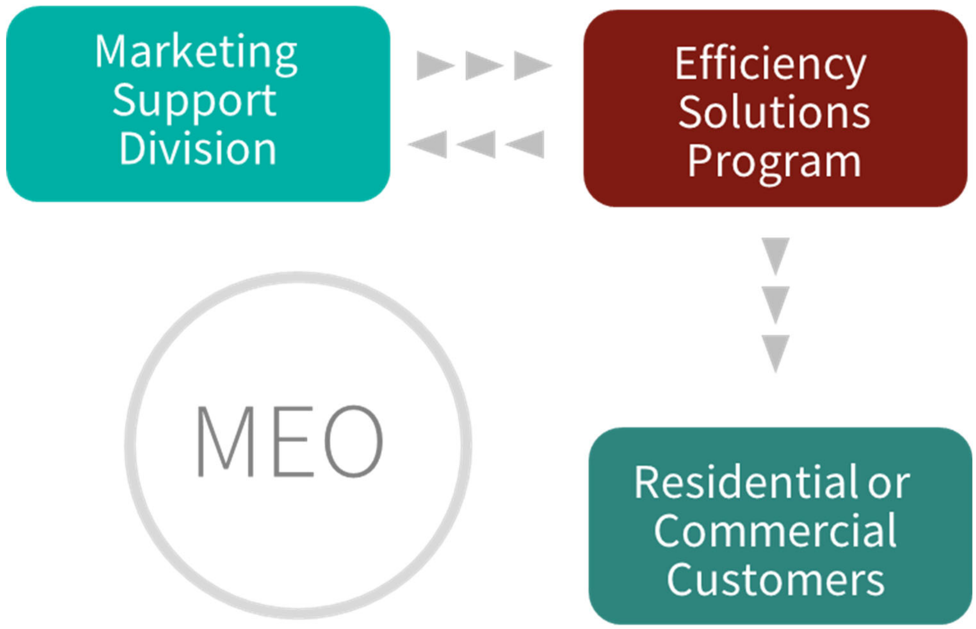
Below we include the findings that the Evaluator provided in the summary process evaluation report, provided in November 2021. Subsequent sections of the report include our updated findings that incorporate additional research activities and information.

A.20.2.1. MEO Roles and Coordination

The Evaluator understands that each program in the efficiency solutions portfolio coordinates with the LADWP marketing support division to develop and distribute marketing materials including email blasts, social media posts, website updates, and other marketing materials. Outreach about energy efficiency programs also takes place through POCP, which offers grants to community organizations to conduct outreach about the LADWP programs. The Evaluator finds that, marketing efforts are largely distributed and not consolidated within the Efficiency Solutions portfolio. There does not appear to be a consolidated effort across the portfolio to streamline or consolidate marketing to customers or to leverage participants in one program when marketing other programs.

The Evaluator has created a high-level visualization of how programs coordinate with the Marketing Support Division to develop outreach and marketing materials that are distributed to customers. Figure A-53 illustrates how the Marketing Support Division interacts with each program individually. Commercial and residential customers receive separate outreach and communications from each program. At this time, MEO is not providing coordination or crossover support between programs. In our recommendations section, we include a revised pathway to highlight how MEO might support residential and commercial programs.

Figure A-53 MEO - Current Marketing Coordination



In addition to marketing efforts, program outreach takes place on a program-by-program basis and is coordinated by each program team. Community outreach takes place through the Program Outreach and Community Partnerships (POCP) program. The POCP grantee organizations conduct outreach on behalf of LADWP in their communities to spread the word about the relevant efficiency solutions programs.

The Evaluator also understands that the education efforts of the MEO program are incorporated into the MOU with the LAUSD to include energy efficiency programming for students in the form of pilot projects at selected schools to assess impact of programming on energy consumption.

In summary, the Evaluator's observations suggest that the MEO program operates as a program largely in name only. Activities are not streamlined or managed across the portfolio, but rather on an individual program level. However, based on our understanding of the program participation rates as well as LADWP's internal structure, we do not necessarily consider this a problem or barrier to participation in LADWP programs. That is, it appears that the current structure is working to enable participation in the Efficiency Solutions portfolio.

A.20.3. Cross- Program Participant Satisfaction and Awareness

The Evaluator included questions related to marketing and outreach in four surveys of program participants, fielded in late 2021 and early 2022. The four programs included 2 residential programs, Efficient Product Marketplace (EPM), and Consumer Rebate Program (CRP), and two commercial programs, Commercial Lighting Incentive Program (CLIP) and Custom Performance Program (CPP). The findings presented below include consolidated findings from both residential and commercial surveys. As MEO considers its role in coordinating across programs, these cross-survey findings may help to inform its efforts.

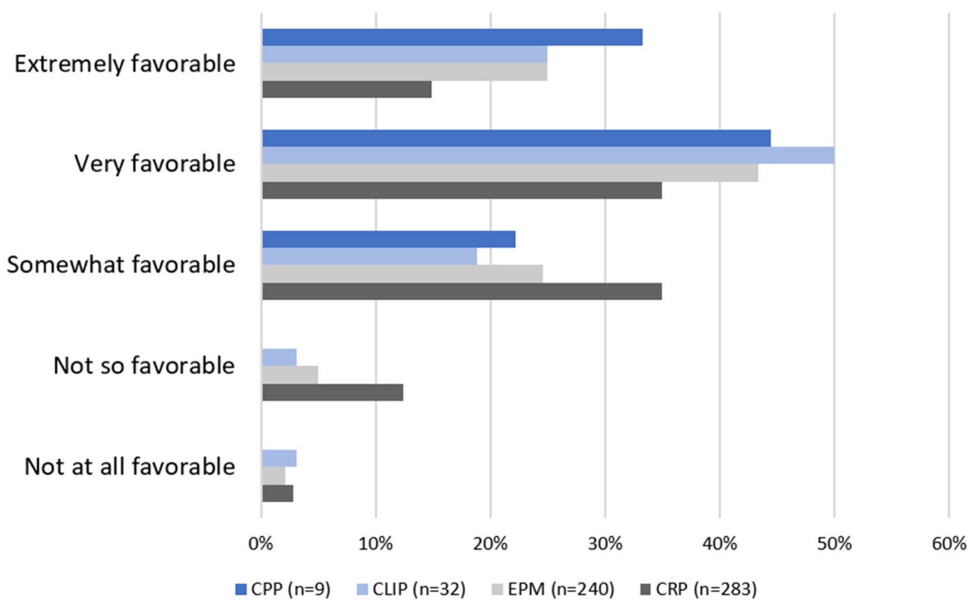
A.20.3.1. Overall Satisfaction: Participants are generally satisfied with the programs.

Across both residential and commercial surveys, most respondents are satisfied with their experience in the program. For the residential respondents who are dissatisfied, the most common reason is because it took too long for them to receive the rebate.

A.20.3.2. Opinion of LADWP is broadly favorable, and if program participation has an effect, it improves overall opinion.

For both residential and commercial customers, over half of respondents describe their opinion of LADWP as at least favorable, shown in Figure A-54 below. Commercial respondents have a slightly higher opinion of LADWP, on average.

Figure A-54 MEO - Satisfaction with LADWP for Commercial and Residential Respondents



When asked what first comes to mind when they think of LADWP, CRP respondents were the most negative, with 50% of responses being negative, followed by 28% neutral and 24% positive. EPM respondents were more evenly mixed, with 38% of responses being positive, 35% negative, and 31% neutral. For both commercial surveys, most responses were neutral. Both commercial surveys had a smaller, nearly even subset of positive or negative responses.

Many (41%) of CRP respondents think of “expensive” when thinking of LADWP. This was also the most common theme in EPM responses (21%), followed by the reliability of

LADWP (10%). In both residential surveys, there was a small subset (4-6%) of responses that expressed distrust in terms of corruption at LADWP.

Participating in the program either improved survey respondents' attitude toward LADWP or it had no effect for most respondents. For CRP respondents, 52% said it had no impact to their opinion of LADWP, while attitudes improved for 47%. For EPM respondents, most (71%) said that participation had a positive impact on their attitude towards LADWP and 28% said it had no impact. For CLIP respondents, 63% of respondents noted that their participation had a positive effect on their attitude of LADWP and 28% said it had no impact. For CPP, 4 of 9 mentioned that their participation had no impact on their attitude and 3 of 9 said they had an improved attitude towards LADWP as a result of the program. Across all surveys, few respondents reported a negative impact to their attitude as a result of participating in the program with as little as two or as great as four respondents reporting a worsened attitude.

A.20.3.3. Program awareness varies by program type. Contractors and online marketing are how most participants found out about the program.

The mechanism or pathway of program awareness differed between residential and commercial participants and depending on program model. Many residential respondents learned about the program through online internet research or the LADWP website, although this pathway is much more common for EPM respondents (41%) than CRP respondents (16%). For CRP respondents, the contractor is the most common and influential source of information (26%). Outreach material is also a common and influential source of awareness for EPM respondents (11%).

As with CRP participants, most common source of awareness for CLIP respondents is their contractor (25%), followed by past program participation (22%). **This suggests that the contractor is an important avenue for increasing awareness in both residential and commercial customers.** For CPP respondents, past program participation (22%), internet research (22%), and an LADWP account representative (22%) are some of the avenues for sources of awareness.

A.20.3.4. Residential respondents are motivated by the rebate and doing good for the environment. Costs around utility bills, maintenance, and the rebate are the most motivating factors for commercial respondents.

For CRP respondents, the most common reasons they installed the equipment through the program are that it was good for the environment, would save money after the upgrade, the rebate, and to replace broken equipment. Unsurprisingly, the instant rebate is the most common and influential reason for EPM respondents choosing to purchase their item online. Other common reasons include that the marketplace is easy to find and buy energy efficient products on (24%) and that the marketplace allows comparison of prices across multiple stores (19%).

Commercial respondents are similarly motivated by cost. Saving money on utility bills, reducing maintenance costs, and getting the rebate are important factors to both CLIP and CPP respondents choosing to participate in the program and make the improvements.

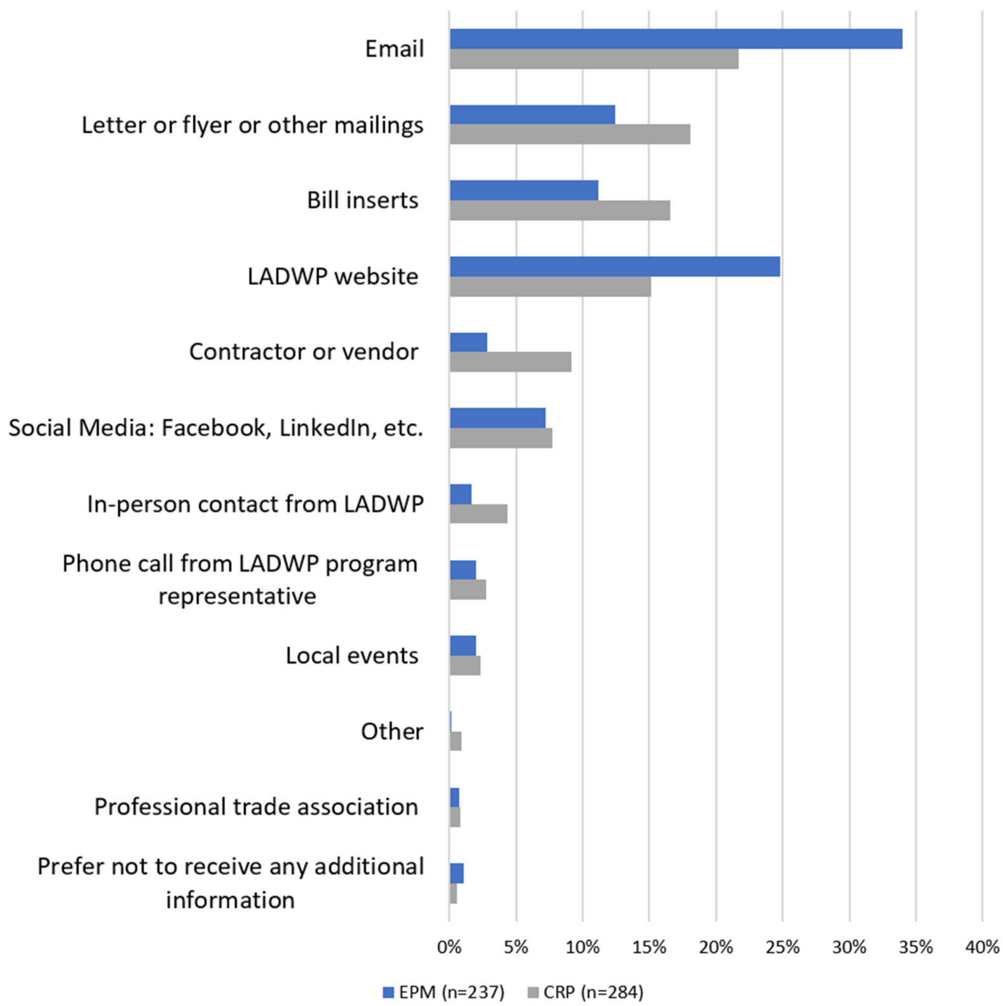
A.20.3.5. Awareness of other programs is limited

Over half (58%) of CRP respondents are not aware of other programs that LADWP offers, while the same percentage (58%) of EPM respondents are aware of such programs. Similar to EPM customers, half (50%) of CLIP respondents are aware of other LADWP programs. Slightly less than half (4 of 9) CPP respondents are aware of other LADWP programs.

The Refrigerator Exchange program and the Refrigerator Turn-In & Recycle Program (RETIRE) are the two most common programs that residential respondents are aware of. Meanwhile, the Commercial EV Charging Station and the Demand Response Program are the two most common programs that commercial respondents are aware of.

For both residential surveys, respondents say that email is the best way for LADWP to keep them informed about ways to save, as shown in Figure A-55 below.

Figure A-55 MEO - Best ways to be Informed for Residential Respondents



A.20.4. POCP Outreach and Engagement

The Evaluator included questions in the interviews with POCP grantee organizations. The full report of those findings can be found in the chapter on the POCP program. In this chapter, we highlight findings relevant to the MEO program, given the extent to which the POCP program activities constitute the outreach portion of the MEO program.

A.20.4.1. Grantee organizations use both direct and indirect means of outreach to their communities

Direct outreach methods include reaching out to customers using strategies such as tabling at community events, newsletters, social media posts, email or text message blasts, radio advertisements, phone calls, and interactive activities. They also detailed more indirect outreach efforts including leveraging intermediaries to bring the message to potential participants such as teachers at school or professional organizations.

Organizations noted that they pivoted from their typical outreach methods during Covid-19, to rely on online platforms and socially distanced in-person activities.

A.20.4.2. Organizations emphasized the need for engaging and accessible materials

The organizations we spoke with highlighted the value of repeated contact and regular follow up. They also noted that materials should be accessible, visually engaging, and text should be at no more than a 3rd or 4th grade reading level. These organizations also noted the importance of having program materials (and processes) available in the multiple languages of the community, such as Spanish or Vietnamese.

Access to technology was a concern that came up in several interviews; one organization noted that any web interface should be optimized for low bandwidth mobile devices. Another partnered with libraries to give people access to programs. Several organizations noted that internet access can be a barrier depending on income, age, technical capability, and geography, noting that rural communities may not have broadband internet.

A.20.4.3. Grantee organizations are satisfied with their relationships with LADWP.

Organizations are very satisfied with their relationship with LADWP, several organizations mentioned their appreciation for the fact that the program structure allows organizations to have control over what they do. They noted that they enjoy the frequent convenings and constant support from LADWP.

"We appreciate the opportunity to work with LADWP, very much appreciate the flexibility they have with us. Really treat us as community partners. In some grants, we experience that our funders don't always treat us as equals – just be compliant. We don't get that sense from LADWP. We feel we're a part of it, our work is acknowledged and appreciated. We really love working with LADWP and having the opportunity to do this work, bring it to our community that mostly likely wouldn't ever easily have access to these conversations."

Some organizations highlighted the program's flexibility, for instance – reassessing criteria for grant purposes when the Covid-19 pandemic began – since organizations had to find new ways to reach the community. At the same time, they appreciated the clarity of expectations that were set at the beginning of the grant period that do not change.

Another source of appreciation for LADWP related to the financial requirements of the grant. Grantee organizations appreciated that they do not have to document every small, detailed use of grant money, which reduces administrative work for organization.

"When they send us a check, they say, this is the funding, you showed us what you did, then it's ours. We don't have to count every single penny. That's how other grants are. That flexibility is helpful. We put money where we need to – incentives, staffing."

Similarly, organizations appreciated the trust the program shows in the organizations. For proposals, organizations can focus on their area of expertise with modifications from LADWP.

A.20.4.4. Interactions with the marketing support department can be challenging

We heard from grantee organizations that the marketing approval process can be laborious. They reported that it could be a challenge to wait to get marketing materials approved by LADWP, especially in Spanish. We also heard a request for more support from LADWP in the creation of materials, for instance, a library of images or stock text about the programs that organizations could distribute in their newsletters regularly.

A.20.4.5. Grantee organizations reported positive experiences with the peer facilitator

Grantee organizations provided positive feedback on the peer facilitator who, they said, provides helpful meetings for ideas and best practices and also helps with reporting such as reviewing draft reports and providing feedback and being available to answer questions.

A.20.4.6. Opportunities to better support organizations

The organizations the Evaluator interviewed identified several ways that LADWP could better support their outreach efforts. These included:

- Provide organizations more support to enroll schools or interact with community institutions– for example provide kits students can take home to educate families, and educational materials or props for teachers to install in classrooms.
- Provide more resources to organizations about different LADWP offerings, for example through email or paper hand-outs that organizations could distribute.
- Partner with organizations to create ways to track the effectiveness of the outreach.
- Allow organizations to see how many people enrolled in LADWP programs so they can see their impact on participation.
- Create a library of images and text that organizations could easily pull into their materials, such as newsletters.

A.20.5. Metrics Development and Considerations

As part of the 2021 evaluation, LADWP requested that the Evaluator identify metrics to allow LADWP to classify MEO as a Market Support program. Due to its status as a publicly owned utility (POU), LADWP is not required to adopt the guidelines put forward by the CPUC, which segment energy efficiency portfolios into the areas of resource acquisition, market support, or equity. However, LADWP typically follows this guidance as industry best practice.

On October 6, 2021, the CAEECC-Hosted Market Support Metrics Working Group (MSMWG) put forward guidance on the most important objectives and associated key metrics for utilities to track for the new market support portfolio segment. The Evaluator reviewed this guidance and identified those objectives and metrics that most related to MEO.

Of the five sub-objectives identified by the MSMWG, Demand, Partnerships, and Access to Capital are most closely related to the current activities of the MEO program. These objectives are defined as follows:

- **Demand:** Build, enable, and maintain demand for energy efficient products, and services in all sectors and industries to ensure interest in, knowledge of benefits of, or awareness of how to obtain energy efficiency products and/or services. [Activity e.g., educating customers, building demand]
- **Partnerships:** Build, enable, and maintain partnerships with consumers, governments, advocates, contractors, suppliers, manufacturers, community-based organizations and/or other entities to obtain delivery and/or funding efficiencies for energy efficiency products, and/or services and added value for partners. [Activity e.g., building partnerships]
- **Access to Capital:** Build, enable, and maintain greater, broader, and/or more equitable access to capital and program coordination to increase affordability of and investment in energy efficient projects, products, or services. [Activity e.g., access to capital]

The metrics for these three sub-objectives are identified in Table A-141 below:

Table A-141 MEO - MSMWG Recommended Metrics for Demand, Partnerships, and Access to Capital Sub-Objectives

Metric Type	Demand	Partnerships	Access to Capital
Applicable Existing Metrics that will continue to be collected	There are not currently applicable existing metrics in this category.	There are not currently applicable existing metrics in this category	Participant data • Credit score • Census tract income • CalEnviroScreen Scores of areas served • Zip code Comparisons between market-rate capital vs. capital accessed via EE programs • Interest rate • Monthly payment
New Metrics with data that can be collected now (program outputs for relevant programs)	• # and % increase/decrease of inquiries and/or requests for information on EE products and services through relevant MS program. • # and % increase/decrease of customers receiving information, education, or outreach on EE projects, products, and services through relevant MS programs.	• Number of EE customers/market actors reached through partner networks and partner communications channels	• Total projects completed • Total measures installed • Dollar value of consolidated projects • Ratio of ratepayer funds allocated to private capital leveraged • Differential of cost defrayed from customers (e.g., difference between comparable market rate products and program products).
New Metrics with data that needs to be collected later	AKAB (Awareness, Knowledge, Attitudes, and Behavior) Survey to IOU Customers • Percent of customer sample aware of EE product/service (awareness)	Assessed value of the partnership by partners Percent of partners that have taken action supporting energy efficiency	• % of market participants aware of capital access opportunities for investments in energy efficient projects,

Metric Type	Demand	Partnerships	Access to Capital
	• Percent of customer sample that is knowledgeable of EE product/service's benefits (knowledge) • Percent of customer sample that is interested in obtaining an EE product/service (attitude) • Percent of customer sample that has taken action to obtain EE product/service (behavior A) • Percent of customers that have obtained EE products/services (behavior B)		products, and/or services (awareness) • % of market participants knowledgeable about capital access opportunities for investments in energy efficient projects, products, and/or services (knowledge) • % of market participants interested in leveraging capital access opportunities for investments in energy efficient projects, products, and/or services (attitude) • % of market participants that were unable to take action due to access to capital or affordability of energy efficient projects, products, or services (behavior)
Indicators (for relevant programs)	Not provided	• Number of partners by type and purpose • Dollar value of non-ratepayer in-kind funds/contributions utilized via partnerships	Not provided

For two of the three categories of metrics identified in the MSMWG recommendations, there are no metrics typically collected, and the metrics relevant to the third category (access to capital) are largely generic program participation information.

The MSMWG report provides guidance around new metrics to incorporate into program activities to be able to measure progress in the relevant areas.

A.20.5.1. Considerations for MEO

The MSMWG report provides guidance around what metrics market support programs should be tracking to demonstrate progress in several categories. The current MEO program activities are not cohesive enough for the Evaluator to recommend specific metrics be tracked. Rather, we recommend the program identify how the activities that fall within the purview of MEO lead to specific outcomes that will help meet the goals of the program. Once those activities have been identified, LADWP can more easily identify the most relevant metrics to track. Alternatively, the program could use the metrics to identify intended outcomes and from there identify the activities that would best support those outcomes. Developing a program theory and logic model to reflect current program activities, identify specific goals, and set measurements to target meeting those goals would be a valuable step in establishing these metrics.

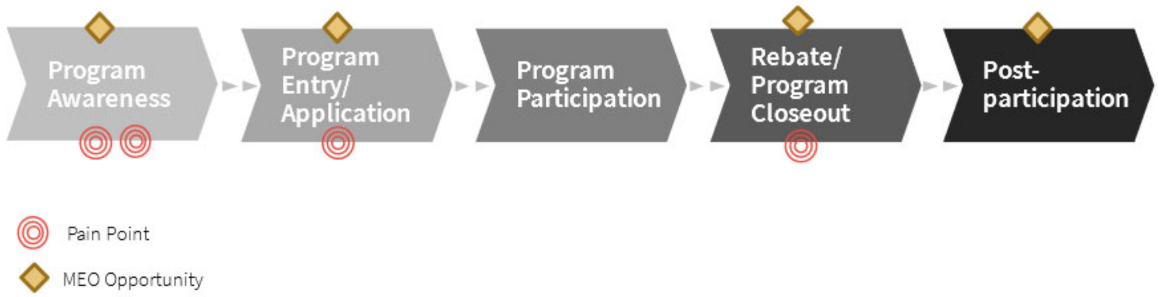
For example, we note that survey respondents in the two residential surveys have, on average, higher incomes than is the norm in Los Angeles (LA) county. According to the Census Bureau, the median household income in LA County is $71,358. However, over 60% of residential respondents reported making $75,000 or more. Integrating specific metrics around access to capital as outlined above might help the MEO program and other program teams across the portfolio identify where there are opportunities to better serve specific communities.

A.20.6. Opportunities to Improve the Customer Pathway

The Evaluator understands that the MEO program operates alongside other resource and non-resource programs in the portfolio. In this section, we identify opportunities for the MEO program to improve or add value to the customer pathway through the residential and/or commercial program pathways.

Figure A-56 below illustrates opportunities for improvement in the customer experience pathway. We highlight current pain points that emerged in the surveys with residential and commercial program participants and areas where MEO could potentially intervene to streamline or improve the customer experience.

Figure A-56 Overarching Customer Journey and Opportunities for MEO Support



The sub-sections below outline the pain points and potential opportunities to intervene or support as indicated in the above figure.

A.20.6.1. Opportunities to improve the Customer pathway:

A.20.6.1.1. Program awareness

- Pain Point 1a. Uneven program awareness: In general, residential customers are aware of the RETIRE program and commercial customers are aware of the Commercial EV Charging Station and Demand Response programs; however, there is less awareness of other programs.
- Pain Point 1b. Perception that LADWP is expensive: One of the most common perceptions of LADWP from residential and commercial respondents is that LADWP is expensive.
- MEO Opportunity 1. This may be a place to highlight opportunities to receive rebates and other program offerings to demonstrate the value that LADWP brings and the commitment they have to supporting their customers.

A.20.6.1.2. Program entry and application

- Pain Point 2. Confusion around the status of the application.
- MEO Opportunity 2. Marketing can help to set expectations around what customers should expect during the application process. For example, materials could state that for most residential programs, it takes X time to process the application. Or materials might reference that last year X percentage of applications had to be re-submitted and offer tips on how to submit a successful application.

A.20.6.1.3. Program participation

- No specified pain points or opportunitiess Customer feedback on program participation was generally positive and where there were concerns the Evaluator does not see them as opportunities for MEO so much as for the program teams to address.

A.20.6.1.4. Rebate/Program Closeout

- Pain Point 3. Taking too long to receive rebate.

- Opportunity 3. Marketing around expectations for when to receive the rebate. For example, providing marketing materials that have contact information (phone number, email, website for chat), for customers to be able to easily contact customer service representatives that can help them should they experience delays.

A.20.6.1.5. Post-participation

- MEO Opportunity 4. Based on participation in a program, MEO could email or send materials like brochures or flyers of other programs that the past participant may also be interested in or eligible for.

A.20.7. Recommendations:

Based on the process evaluation findings, the Evaluator makes the following recommendations for the MEO program to consider.

A.20.7.1. Provide Cross-Program Support and Coordination

- **Create an annual calendar of marketing promotions.** A calendar of all program promotions happening across the year provides insight into what marketing customers are receiving and may identify opportunities to consolidate marketing. This calendar can be built from coordinating with the Marketing Services Division's campaign calendar and adding across-program awareness from the paragraph below.
- **Raise awareness across programs.** MEO can best support cross program participation by identifying and leveraging opportunities to increase awareness of multiple LADWP programs. For example, after a customer participates in a program, this is an opportunity for marketing further programs they may be eligible for participate in. In addition, the marketing calendar may indicate opportunities where marketing for multiple programs may be most effective.

A.20.7.2. Provide Additional POCP Support

- **Provide a library of marketing images for POCP grantee organizations to easily use.** Some POCP organizations mentioned challenges with being able to quickly produce marketing materials approved by LADWP. By providing LADWP-approved images and guidance on how to use them, this will reduce the time needed for grantee organizations to develop materials and decrease the material approval time.

A.20.7.3. Offer Direct Customer Support and/or Customer Expectations Support to Programs

- **Target marketing around customer experience pain points to set expectations, provide tips, and offer resources.** Focusing on addressing common pain points across programs in marketing can allow for greater satisfaction from customers. Setting expectations for wait times in applications and rebates and providing tips on common mistakes to avoid can prepare the customer and give them a sense control in their experience.

A.20.7.4. Take Foundational Steps to Provide the Basis for Market Support Metrics

- **Develop a program theory and logic model for the MEO program, and then identify specific metrics to track to establish progress toward market support program metrics.** The program should develop a program theory and logic model and once that has been established, identify specific metrics to track to show progress toward goals. A program theory and logic model can also offer the program additional benefits, like refining program inputs and activities, which may help to inform the most appropriate structure for MEO going forward.

A.21. PADP

The Program Analysis and Development Program (PADP) is a non-resource function designed to reduce the overall burden on LADWP energy efficiency program teams by monitoring the performance of LADWP's energy efficiency portfolio, supporting ongoing improvements to existing programs, and the development of new programs.[69] PADP looks at how effective programs are in terms of capturing savings, keeping customers satisfied, responding to market demand, meeting portfolio cost-effectiveness goals, and helping LADWP align with long-term regulatory and strategic objectives. The PADP team also monitors results from potential studies and evaluation reports to help decide what measures should be added or removed, what business process improvements should be made, and whether the creation of a new program is warranted at the portfolio level.

In addition to these activities, PADP is responsible for collection and monitoring of program metrics and regulatory reporting, coordinating collaborations with academic, government agencies, and technical groups to advance energy efficiency analysis, and supporting other LADWP groups, including Power Systems and Communications, with analysis and reporting.

This evaluation focuses on activities for new energy efficiency program development and ongoing improvements to existing programs to understand PADP program processes, stakeholder experiences, key objectives, primary work outputs, and metrics, including an exploration of opportunities for LADWP to use existing or new program metrics to demonstrate alignment with CPUC criteria for Market Support programs.[70]

A.21.1. Process Evaluation Approach and Methodology

This section reports the approach, research questions, and study methods of this evaluation.

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[69] LADWP staff have also used other names to refer to the program, including the PA&D program and the Program Development program.

[70] LADWP stays up to date on industry trends in many ways. While as a municipal energy service provider, LADWP is not regulated by the California Public Utilities Commission (CPUC), the company monitors CPUC decisions to understand the local market. In May 2021, the CPUC adopted an approach for segmenting energy efficiency portfolio programs into the areas of resource acquisition, market support, or equity. The CPUC defines these segments in the related filing (see source). In response, LADWP added to this study an exploration of metrics that could demonstrate PADP's alignment with Market Support. Source: [https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M385/K864/385864616.PDF], accessed on 6/24/21.

A.21.1.1. Approach

The Evaluator conducted a materials review, interviews with program staff and internal program stakeholders (LADWP's non-PADP staff that coordinate with PADP), and assessed program theory, process, and metrics through development of a baseline program theory logic model and process flow chart.

A.21.1.2. Research Questions

The PADP process evaluation is designed to answer the research questions included in the table below.

Table A-142 PADP Evaluation Research Questions

Research Question or Objective	Data Sources
What are the program's key objectives, primary work outputs, and focus areas? What metrics should the program measure to assess progress towards those objectives?	Program staff interviews Review of program materials Baseline logic model
What metrics could PADP consider tracking if the program will be categorized as a Market Support program?	Program staff interviews Baseline logic model
What is the process for program analysis and new program development? What are bottle necks and opportunities for the future?	Program staff interviews Stakeholder interviews Process flow chart
How satisfied are stakeholders (non-PADP program staff) with the services and support they receive? Would they suggest any changes?	Stakeholder interviews
What additional services or resources would be helpful to achieve current or future objectives?	Stakeholder interviews

A.21.1.3. Methods

The Evaluator conducted the following activities to answer the research questions.

A.21.1.3.1. Program Staff Interviews

The Evaluator completed an interview with the PADP program staff team in December 2020. This interview provided insight into the program design, including how program efforts integrate into the overall energy efficiency program portfolio. It explored key program objectives, current activities and processes, future activities and processes, performance indicators, and metrics for success. Finally, the Evaluator used the interview to discuss with LADWP their evaluation needs and clarified the research questions to be addressed in the study.

A.21.1.3.2. Materials Review, Baseline Logic Model, and Process Flow Chart

The Evaluator reviewed program materials, including the LADWP Business Plan, internal documentation on the program development process, and internal trainings. The

Evaluator used these materials to construct a baseline logic model and a process flow chart.

Baseline Program Theory Logic Model

The Evaluator developed a baseline program theory logic model (PTLM) for PADP that consists of four elements:

- **Inputs** - the resources a program uses to perform activities and product outputs and outcomes. Inputs could include funding, program staff or volunteers, or other resources
- **Activities** - the distinct actions taken to engage program actors and achieve the intended outcomes
- **Outputs** - the quantity of program services provided, typically involving counts of different program activities, like number of trainings, number of participants, etc. Outputs are the direct results of activities and are typically value-neutral, meaning that measuring program outputs does not necessarily measure a program's effectiveness.
- **Outcomes** - Measurable and meaningful changes that can have medium-to-long term effects on the market, organization, or participants served

This Evaluator used this approach to, 1) identify any gaps between current program activities and planned outcomes or metrics, 2) assess the fit of existing metrics for demonstrating the program's alignment with the CPUC Market Support segment, and 3) identify other Market Support metrics that LADWP could use to demonstrate alignment.

Program staff can use this PTLM as a tool to review and shape program goals, activities, and metrics and tracking data needed to demonstrate progress toward goals.

New Program Development Process Flow Chart

To assess and document new program development activity processes, the Evaluator developed a process flow chart that illustrates, at a high-level, the flows of communication and interactions between program teams.[71] The Evaluator then used the process flow chart to identify any bottlenecks or other issues and made recommendations to address these.

A.21.1.3.3. Stakeholder Interviews

The Evaluator conducted three 60-minute interviews from September 24, 2021, to October 7, 2021, with residential and commercial LADWP resource program staff including program managers, supervisors, and leads. In all, the Evaluator interviewed nine resource program staff covering four commercial programs and five residential programs. The Evaluator used the interviews to collect information on how often program staff work with PADP, what type of support or services they receive, whether they find

[71] The Evaluator based the PTLM on the state of the program at the time of the study. The program experienced several evolutions in structure and design during the study period and additional changes are planned for the near future.

PADP support and services useful, their satisfaction with PADP outputs, and any suggested improvements.

A.21.2. Results and Findings

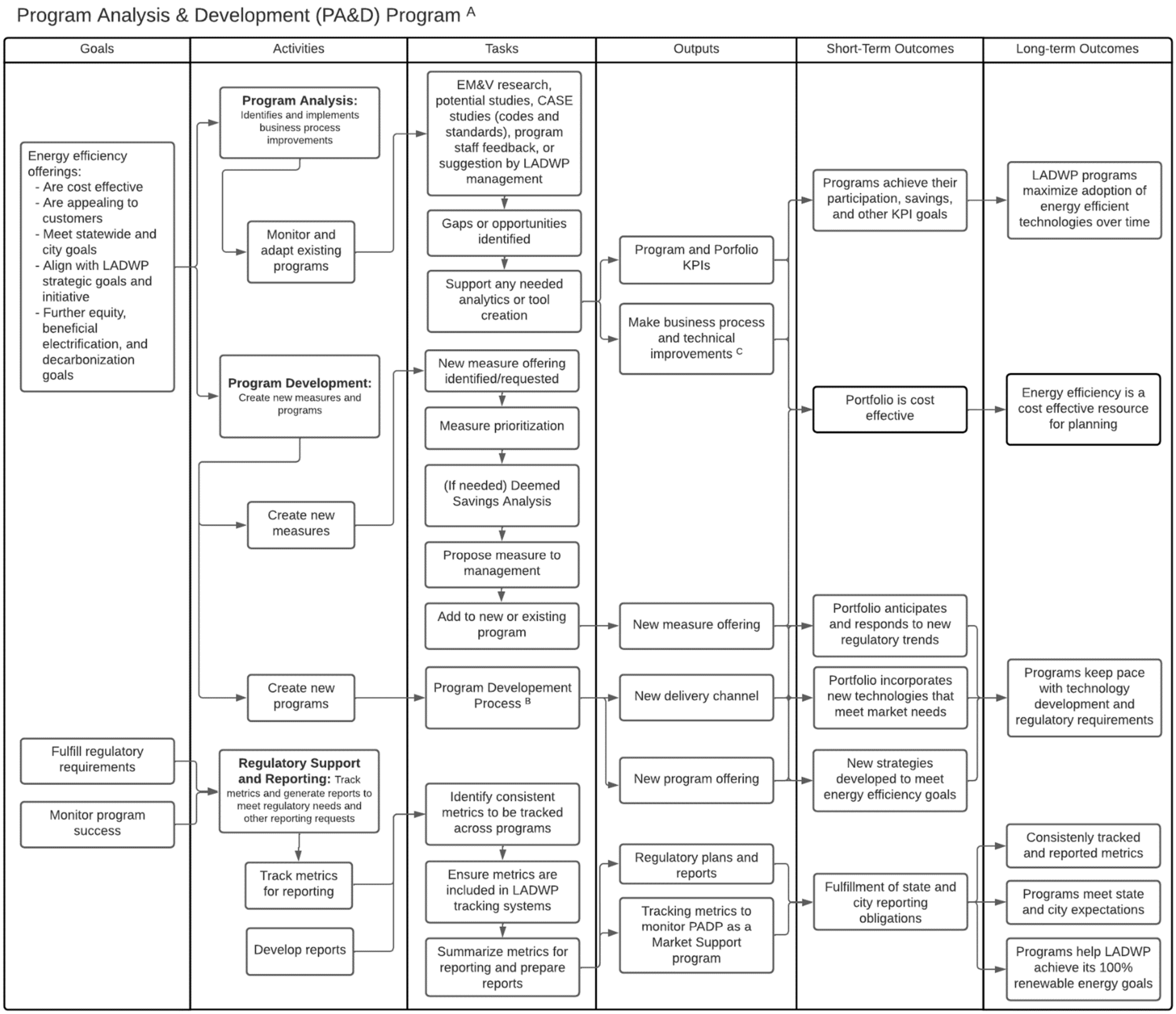
This section presents findings and insights from the evaluation research.

A.21.2.1. Baseline Logic Model

Below we provide an overview of the goals, activities, tasks, outputs, short-term outcomes, and long-term outcomes of the PADP program and present the baseline logic model. We also provide a discussion of metric recommendations, including those to support PADP's characterization as a Market Support program.

Figure A-57 below shows the baseline logic model. The sections that follow describe the goals, activities, tasks, outputs, short-term outcome, and long-term outcomes for the program.

Figure A-57 PADP - Baseline Logic Model



[A] The program analysis and development team also manages attendance and contributions to academia, industry working groups, conferences, government agencies, and other industry dialogues and provides support for other internal and external research, compliance, outreach and training efforts, including supporting the Power Systems and Communications groups. These activities are not included in the logic model above, as they are secondary responsibilities of the PA&D program.

[B] Greater deail on the program development process can be found in the Program Development Process Flow Chart.

[C] Technical improvements include savings quantification, cost effectiveness updates, reprioritization of measure marketing and incentive rate updates for maximizing resource acquisition, and new metrics to reflect secondary goals such as equity or air quality improvements

A.21.2.1.1. Goals

As noted in the Program Description section, PADP is responsible for a variety of non-resource functions that support LADWP's resource program offerings. The primary goal of the PADP program is to support the efficacy of LADWP's Energy Efficiency Resource Programs portfolio. Specifically, PADP aims to ensures that:

- Resource program offerings are cost effective, appealing to customers, meet statewide and city goals, align with LADWP strategic goals and initiatives, and further equity, electrification, and decarbonization goals
- LADWP fulfills its regulatory requirements
- LADWP can monitor the success of its resource program portfolio.

A.21.2.1.2. Activities, Tasks, and Outputs

To meet these goals, PADP completes three primary activities:

Program development supports the introduction of new measures to resource programs, or if needed, the development of new resource programs. The need for new programs or measures may be identified through the program analysis activities described below.

- **Tasks:** help to prioritize measures to be added to LADWP's portfolio through deemed savings analysis, proposing the measure to management, and adding the measure to a new or existing program
- **Outputs:** new programs, new delivery channels, and new measures.

Program analysis supports ongoing monitoring and improvements to LADWP's existing resource programs.

- **Tasks:** compile findings from key sources (i.e., EM&V research, CASE studies (codes and standards), resource program staff feedback, and suggestions by LADWP management), monitor key performance indicators (KPIs) for resource programs, assess existing programs for gaps and/or opportunities for program improvements, develop implementation tools to help resource program staff streamline processes.
- **Outputs:** provide KPI updates for resource programs, new/revised business process, and technical improvements (i.e., savings quantification, cost effectiveness updates, reprioritization of measure marketing, incentive rate updates for maximizing resource acquisition, and new metrics to reflect secondary goals such as equity or air quality improvements.

Regulatory support and reporting supports tracking, monitoring, and reporting of metrics for regulatory compliance.

- **Tasks:** identify metrics to be consistently tracked across programs, ensure data points to measure metrics are in the LADWP tracking systems, and summarize metrics for reporting, and writing reports.
- **Outputs:** regulatory plans, regulatory reports, core program metrics, and metrics to monitor PADP as a Market Support program.

In addition to these activities, PADP manages attendance and contributions to academia, industry working groups, conferences, government agencies, and other industry dialogues. They also support other internal and external research, compliance, outreach and training efforts. After consultation with PADP staff, the Evaluator prioritized 2021 new program development, program analysis, and regulatory support and reporting activities for this study.

A.21.2.1.3. Short- and Long-term Outcomes

The outcomes of the PADP program are defined in the program business plan.

Short term outcomes include:

- Programs achieve their participation, savings, and other KPI goals
- Portfolio is cost effective
- Portfolio anticipates and responds to new regulatory trends
- Portfolio incorporates new technologies that meet market needs
- New strategies are developed to meet energy efficiency goals
- LADWP fulfills its state and city reporting obligations

Long term outcomes of PADP include:

- LADWP resource programs maximize adoption of energy efficient technologies over time
- Energy efficiency is a cost-effective resource for planning
- Programs keep pace with technology development and regulatory requirements
- Metrics are consistently tracked and reported across programs over time
- LADWP resource programs meet state and city expectations
- Programs help LADWP achieve its 100% renewable energy goals

A.21.2.1.4. Metrics to Measure Outcomes

While outcomes of PADP are clearly articulated, the program has not defined metrics to measure PADP's progress towards these outcomes. There are a few terms that are important to consider when developing metrics:

- **Definition of success:** What is each outcome trying to accomplish for LADWP overall?
- **Goal or target:** What measurable goals or targets can be set to determine success?
- **Progress indicators:** What interim actions, steps, or year-over-year changes indicate progress towards outcomes?
- **Key results:** How will LADWP know outcomes have been achieved in the end?

For some of the outcomes listed above, some of these definitions may be clear. For example, LADWP already has program and portfolio-level savings and cost-effectiveness targets, so assessing whether these targets have been met is a relatively straightforward exercise. However, for other outcomes, particularly long-term outcomes, it may be beneficial to further articulate answers to some of the questions posed above. For example, the outcome “Programs help LADWP achieve its 100% renewable energy goals” could be further clarified by:

- **Setting a goal or target:** Defining the percent energy reduction or quantity of demand shifted to an off-peak period that would support LADWP in meeting the 100% renewable energy goals.
- **Setting progress indicators:** Identifying interim targets stating when LADWP hopes to meet those savings or demand reduction goals.

Finally, in developing metrics, LADWP should consider tracking both KPIs and procedural indicators to measure success.

- **KPIs:** LADWP already monitors KPIs for the resource programs and the energy efficiency portfolio overall as part of PADP’s tasks. Program and portfolio KPIs over time can be used to measure PADP success for outcomes such as “Programs achieve their participation, savings, and other KPI goals” and “Portfolio is cost effective.”
- **Procedural metrics:** Procedural metrics measure the completion of actions, steps, or policies. Typically, this is measured with a Yes/No that the action was completed. An example of a procedural metric could include “Establish a biannual process for collecting program staff input on potential program improvements.”

The Evaluator identified several potential metrics to measure PADP outcomes. These metrics are tied to program outputs. Outputs are the direct results of activities and are typically value-neutral, meaning that measuring program outputs does not necessarily measure a program’s effectiveness. For example, having a high number of participants in a training session would not indicate that the session was effective, as the training session may not have increased participants’ knowledge.

Nonetheless, these metrics provide a useful starting point for tracking progress towards both short- and long-term goals. These metrics are organized by the program’s current outputs. Some of these metrics could be documented qualitatively rather than tracked with a quantitative metric, and these are indicated in the list. The Evaluator identified the following metrics:

Program Analysis

- Program-level KPIs (many of these are already tracked)
    - Savings
    - Participation
    - Satisfaction
    - Contributions towards secondary goals, such as beneficial electrification or air quality
    - Cost-effectiveness
- Portfolio-level KPIs (many of these are already tracked)
    - Savings

    - Participation
    - Satisfaction
    - Contributions towards secondary goals, such as beneficial electrification or air quality
    - Cost-effectiveness
- Business Process Improvements and Technical Improvements
    - Completion of an annual or biannual survey of program managers to collect ideas for business process improvements (procedural metric)
    - An inventory of all improvements identified, which ones where selected to be implemented, which ones were postponed or rejected and reasons for selection, postponement, or rejection (procedural metric)

Program Development

- New measure offering, delivery channel, or program offering
    - Completion of EM&V studies, potential studies, and CASE studies (procedural metric)
    - Periodic (e.g., monthly or quarterly) check in with Emerging Technology (ET) and Codes, Standards, and Ordinances Program (CSO) (procedural metric)
    - An inventory of all measures, delivery channels, or new program opportunities identified, which ones where selected to be implemented, which ones were postponed or rejected and reasons for selection, postponement, or rejection (procedural metric)

Regulatory Support and Reporting

- Regulatory plans and reports
    - Completion of required regulatory plans and reports (procedural metric)
    - Periodic (e.g., annual or biannual) review of metrics tracked across programs and whether these are collected/reported consistently (procedural metric)
    - Periodic (e.g. annual or biannual) review of secondary metrics tracked and whether these are sufficient to track progress towards strategic goals (procedural metric)
- Tracking metrics to monitor PADP as a Market Support program
    - Metrics identified to monitor PADP as a Market Support program (more information on this in the following section)

A.21.2.1.5. Metrics to Track PADP as a Market Support Program

As part of the 2021 evaluation, LADWP requested that the Evaluator identify metrics that would allow LADWP to classify PADP as a Market Support program. Due to its status as a publicly owned utility (POU), LADWP is not required to adopt the guidelines put forward by the CPUC, which segment energy efficiency portfolios into the areas of resource acquisition, market support, or equity. However, LADWP typically follows this guidance as industry best practice.

On October 6, 2021, the CAEECC-Hosted Market Support Metrics Working Group (MSMWG) put forward guidance on the most important objectives and associated key metrics for utilities to track for the new market support portfolio segment. The MSMWG specified that the metrics should measure the performance of the overall segment, as opposed to individual programs. They also noted that program administrators (PAs) may propose additional or refined sub-objectives and associated metrics if they have a program that they believe fits into the Market Support segment but does not meet one of the existing sub-objectives. PAs are also encouraged, but not required, to have programs that support all five sub-objectives within the Market Support segment.

The Evaluator reviewed this guidance and identified those objectives and metrics most related to PADP. While this provides a snapshot of sub-objectives and metrics that PADP could support, LADWP should also consider whether the sub-objectives of the Market Support segment are met at the portfolio level. This information can be used to assess whether additional programs or adjustments to existing programs are needed to fully meet the Market Support sub-objectives.

Of the five sub-objectives identified by the MSMWG, Innovation and Accessibility and Access to Capital are most closely related to the current activities of the PADP program. These objectives are defined as follows:

- **Innovation and Accessibility:** Build, enable, and maintain innovation and accessibility in technology, approaches, and services development to increase value of, decrease costs of, increase energy efficiency of, and/or increase scale of and/or access to emerging or existing energy efficient products, and/or services. [Activity e.g., moving beneficial technologies towards greater cost-effectiveness]
- **Access to Capital:** Build, enable, and maintain greater, broader, and/or more equitable access to capital and program coordination to increase affordability of and investment in energy efficient projects, products, or services. [Activity e.g., access to capital]

The metrics for these two sub-objectives are identified in Table A-143 below:

Table A-143 PADP - MSMWG Recommended Metrics for Innovation and Accessibility and Access to Capital Sub-Objectives

Metric Type	Innovation and Accessibility	Access to Capital
Applicable Existing Metrics that will continue to be collected	ETP Common Metrics (selection) • ETP-T1: Prior year: % of new measures added to the portfolio that were previously ETP technologies • ETP-T2: Prior Year: # of new measures added to the portfolio that were previously ETP technologies • ETP-T3: Prior year: % of new codes or standards that were previously ETP technologies • ETP-T4: Prior Year: # of new codes and standards that were previously ETP technologies • ETP-T5: Savings of measures currently in the portfolio that were supported by ETP, added since 2009. Ex-ante with gross and net for all measures, with ex-post where available	Participant data • Credit score • Census tract income • CalEnviroScreen Scores of areas served[72] • Zip code Comparisons between market-rate capital vs. capital accessed via EE programs • Interest rate • Monthly payment
New Metrics with data that can be collected now (program outputs for relevant programs)	• # of new, validated technologies recommended to CalTF • # of market support projects (outside of ETP) that validate the technical performance, market and market barrier knowledge, and/or effective program interventions of an emerging/under-utilized or existing energy efficient technology • Cost effectiveness of a technology prior to market support programs relative to cost effectiveness of a technology after intervention by the market support programs (% change in cost effectiveness)	• Total projects completed • Total measures installed • Dollar value of consolidated projects • Ratio of ratepayer funds allocated to private capital leveraged • Differential of cost defrayed from customers (e.g., difference between comparable market rate products and program products).

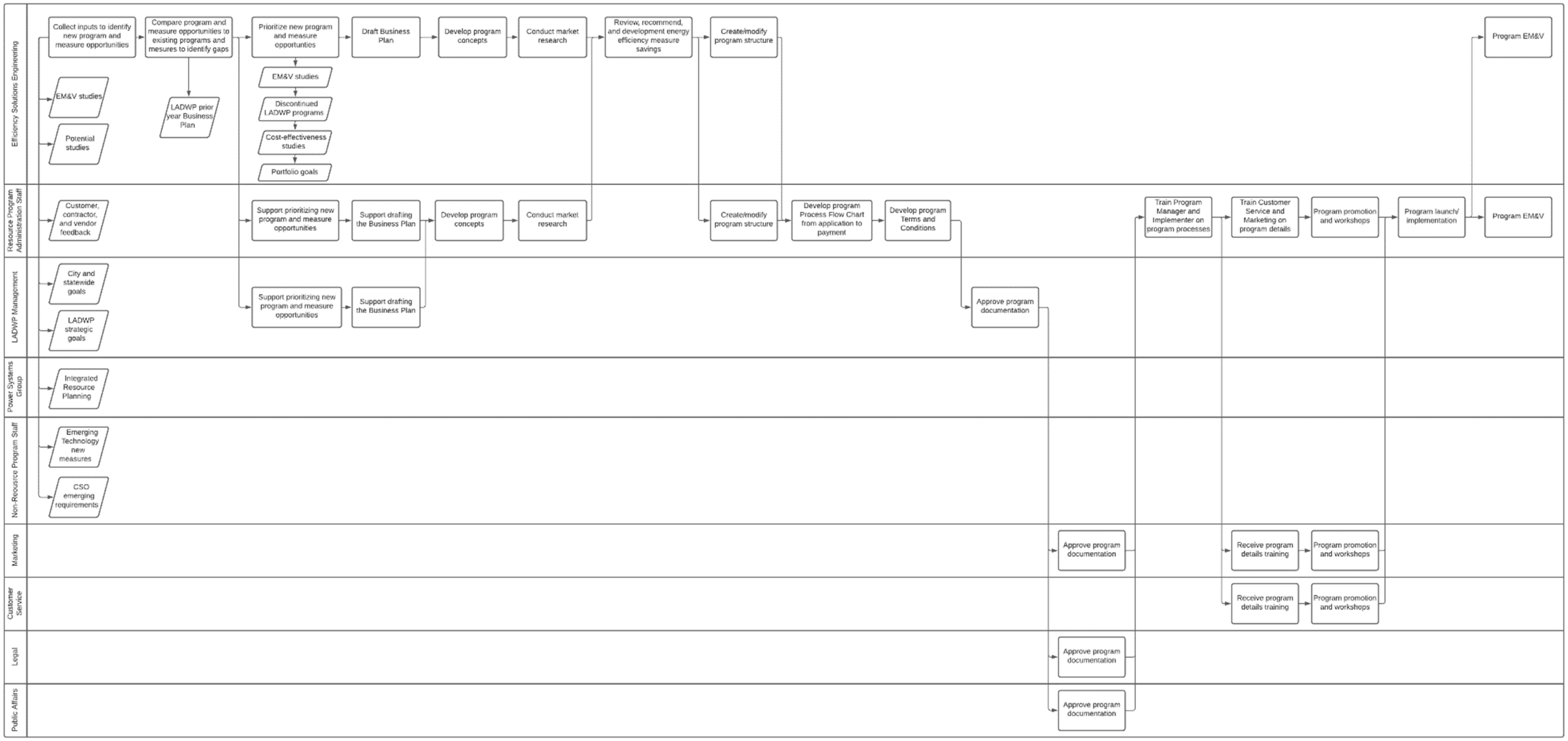
[72] Please reference Appendix A22.3.5.1 for further context on using CalEnviroScreen as a tool to identify disadvantaged communities.

Metric Type	Innovation and Accessibility	Access to Capital
New Metrics with data that needs to be collected later	• Percent market penetration of emerging/under-utilized or existing EE products or services • Percent market participant aware of emerging/under-utilized or existing EE products or services • Aggregated confidence level in performance verification by product, project, and service (for relevant programs)	• % of market participants aware of capital access opportunities for investments in energy efficient projects, products, and/or services (awareness) • % of market participants knowledgeable about capital access opportunities for investments in energy efficient projects, products, and/or services (knowledge) • % of market participants interested in leveraging capital access opportunities for investments in energy efficient projects, products, and/or services (attitude) • % of market participants that were unable to take action due to access to capital or affordability of energy efficient projects, products, or services (behavior)
Indicators (for relevant programs)	• Number of providers for performance verification services	Not provided

A.21.2.2. Process Flow Chart: New Program Development

In this section, we focus specifically on the process for new-program development. Figure A-58 shows the new program development process, including the internal groups within LADWP who are involved and their responsibilities.

Figure A-58 PADP - New Program Development Process Flow Chart



The process flow chart represents the intended process for new program development. LADWP staff have noted that this formalized process is new and still being rolled out, a topic that will be explored more in section A.21.2.3.

As shown, in the intended process, Efficiency Solutions Engineering (ESE) group is highly involved in collecting inputs to identify and prioritize new programs and measures. ESE is also responsible for drafting the business plan, and supporting resource program staff in developing program concepts, conducting market research, and defining the program structure. ESE is also solely responsible for reviewing, recommending, and developing savings for the energy efficient measures. Throughout the initial program identification and definition stages LADWP management provides input and support.

Once the program structure has been defined, resource program staff become the key players in ensuring the program has the necessary plans, documentation, tools, and applications to launch. Resource program staff are responsible for developing the program process flow chart and terms and conditions, which are approved by LADWP management, followed by the Legal, Marketing, and Public Affairs groups. Resource program staff then provide the necessary training to program managers, marketing, and customer service, before the program is launched. ESE is brought in after program implementation to oversee program EM&V and ongoing improvements.

A.21.2.3. Stakeholder Feedback on PADP Processes

In this section, we bring together insights from the PADP and resource program staff interviews to identify how the new program development process has changed over time, identify gaps, and provide recommendations for improvement. As noted above, the process flow chart represents the intended process for new program development. PADP is in the initial stages of rolling out and formalizing these processes. The sections below summarize how the new program development process previously worked, steps PADP has taken to roll out new processes, and resource program staff knowledge and feedback on new processes. Finally, we identify gaps between intended and actual processes.

A.21.2.3.1. Previous New Program Development Processes

Historically, program analysis and new program development activities have been decentralized and conducted by multiple LADWP internal teams like the ESE, the Program Design Liaison (PDL), and the resource program managers, supervisors, and leads. In late 2020, PADP commenced efforts centralize and streamline program analysis and development processes.

Prior to commencing these efforts, individual program managers were responsible for their own program improvements and development. This approach resulted in a lot of reactive analysis and decision making, which strained the capacity of both program managers and internal support teams to prioritize and achieve all the work they wanted to accomplish.

A.21.2.3.2. Current State of New Program Development Processes

Beginning in late 2020, the PADP program team launched an initiative to create a more centralized process to support program managers and ensure that programs are reviewed and updated on a more systemic and regular basis. In establishing these processes, PADP aimed to position their team, resource program managers, and LADWP management staff to make more informed decisions at the portfolio level about how to prioritize and implement changes. PADP also anticipated that formalizing processes will create a more predictable pace of work and reduce burden both on program manager and internal support teams.

In 2021, PADP staff began to roll out processes and raise awareness among LADWP staff about the support the program can provide. The program has recently conducted several activities to accomplish this:

- In July 2021, PADP implemented a semi-annual review of resource programs, in which program managers and supervisors answer a series of questions, update the business plan, and review program against goals. This process helps PADP understand and review potential program modifications and improvements and connect program managers and supervisors with support resources.
- In August 2021, the program held a program staff training about their updated processes for new program development
- In November 2021, the PADP program team shared an updated version of the LADWP business plan with the Evaluator, which reflected the latest key activities, objectives and outcomes, strategy, implementation, barriers, and long-term goals.

A.21.2.3.3. LADWP Resource Program Staff Feedback

The Evaluator conducted interviews with resource program staff to understand how often program staff work with the PADP, what type of support or services they receive, whether they find PADP support and services useful, their satisfaction with PADP outputs, and any suggested improvements. Since not all staff were directly involved in the creation of new programs, the Evaluator also asked about the process for identifying and incorporating program improvements, as well as new measures.

Staff provided the following insights into current PADP processes:

- **Program staff are, and will likely continue to be, heavily involved in the process of modifying and adapting programs.** When asked about the typical steps within the process of modifying and adapting programs, program staff described roles and activities they take on more so than activities of PADP. These include:
    - Frequently identifying program improvements through feedback from customers, contractors, market actors, or implementation contractors
    - Exploring potential program improvements at the request of their management or through suggestion from an internal team, such as Efficiency Solutions or the Program Design Liaison group
    - Conducting preliminary research to vet an idea for improvement before bringing it to management for approval.

  PADP recognizes program staff involvement and indicated that once program support processes are finalized, program staff will still likely play a central role in identifying program improvements given their day-to-day interactions with market actors, customers, and other stakeholders utilizing these programs.

PADP expects to provide additional support to program staff such as ensuring program managers understand when to engage PADP, proactively helping them identify areas of improvement, and support for implementing those improvements.

- **All program staff seemed supportive of efforts to formalize processes for program analysis and development, although levels of familiarity and engagement with PADP varied broadly.** The program staff we interviewed ranged from direct involvement and high familiarity with PADP to not being aware of PADP or efforts. Specifically, three LADWP staff interviewed were directly involved with PADP, three were familiar with PADP and efforts to formalize program processes but not directly involved, and three were unaware of PADP efforts. All nine program staff interviewed were familiar with individual members of the PADP team and had worked with them previously.

  Program staff identified several ways they had worked with PADP including:

  - Research on who to target, and how, for new measures or programs
  - Setting program or measure requirements
  - Customer segmentation for new measures or programs
  - Benchmarking other utility programs for new programs or new program improvement
  - Assessing the impact of adjusting savings or incentive levels on the overall portfolio
  - Assessing the viability of business process improvements

- **Program staff described useful support services PADP could provide.** These include:

  - Clarifying roles and communication to ensure that program teams and PADP were not duplicating work
  - Standardizing processes for identifying and incorporating improvements to the program, including adding new measures, updating savings calculations, and updating incentive amounts*
  - Improving data collection methodologies and data accuracy*
  - Consolidating the internal team identifying program improvements with the internal team responsible for tracking program metrics to ensure the metrics needed to effectively update programs are tracked*
  - Regularly reviewing program savings and incentives amounts to ensure calculation methodologies and assumptions are appropriately documented and up to date*

    * Starred efforts were identified as in-progress by interviewees

A.21.2.3.4. Gaps and Opportunities

Based on the Evaluator's review of LADWP's intended program processes, LADWP has clearly delineated at a high level, the roles and responsibilities of those parties involved in the new program development process. For those steps where multiple parties are involved (e.g. “Conduct Market Research”), it may be beneficial to define which party is primarily responsible for finalizing the outputs of that step. This can be accomplished using tools, such as a RACI chart.

Interviews conducted with LADWP staff highlighted additional opportunities to bridge the gap between intended processes and those implemented in 2021. Interviews highlighted that staff knowledge of PADP and updated program analysis and development processes varied widely, with some staff unaware of PADP and planned updates and other staff being directly involved with these efforts. To encourage organization-wide adoption of new processes, building awareness of planned updates to the program analysis and development processes is a critical first step. This will help resource program managers understand what elements they may have been responsible for previously, that they can now take to PADP for support. Program managers flagged clear roles and communication as an area they would like PADP to provide support as new processes are rolled out. PADP may also help program managers understand new processes by ensuring the differences between the program analysis and program development processes are clear, as well as the support PADP provides for each. They can also help program managers understand how new processes will ensure that things like savings calculations, incentive amounts, and program metrics will be reassessed and update periodically, another area program managers identified as an unfilled need.

Since PADP shifts some responsibilities that were previously under the purview of program managers to the ESE team, PADP may also consider ways to collect feedback from program managers as new processes are implemented to understand where ESE support is most valuable as opposed to where program managers prefer to retain control or provide input. Interviews indicated that program managers have historically been heavily involved with program modification and adaptation, so they will be a critical party to engage as PADP reshapes these processes. Way to collect input may include giving managers a point of contact for questions or suggestions or creating regular check in points where managers can ask questions and identify gaps.

A.21.3. Recommendations

- **Regularly revisit program objectives, activities, tasks, short-term, and long-term outcomes to ensure that current activities and tasks are aligned with program objectives and goals.** Since the PADP program encompasses a wide variety of goals and outcomes, we recommend that LADWP regularly revisit the logic model for PADP to ensure that current activities are aligned with desired program outcomes. This will help PADP remain responsive to LADWP strategic and regulatory objectives in an everchanging environment. This will also ensure that PADP staff have the resources and support to conduct activities that will help them achieve program goals.
- **Establish metrics that track PADP progress towards short and long-term outcomes.** These metrics can be quantitative, qualitative, or procedural in nature. Metrics should be defined based on program activities, outputs, and how these lead to outcomes.

- **Consider which Market Support sub-objectives PADP may help fulfill and consider tracking related metrics.** Depending on the sub-objectives selected PADP may consider updating the program logic model to reflect these.
- **Bridge divide between intended and actual Program Analysis and Program Development process by:**
  - Raising awareness among LADWP staff about new program development processes and the program improvement process
  - Clearly defining, delineating, and communicating roles and responsibilities, especially for tasks which involve multiple parties
  - Giving resource program managers a point of contact for questions about new processes
  - Giving resource program managers a way to provide feedback/suggestions related to new processes, such as regular check in points or internal surveys
  - Ensuring program managers understand the value of new processes, such as ensuring savings calculations and incentives are updated regularly or that programs are tracking relevant and consistent metrics.

A.22. POCP

The LADWP Program Outreach & Community Partnerships Program (POCP), commonly referred to as the Community Partnership Grants program, began in 2011 in response to the City of Los Angeles Green LA Plan, utilizing formula-based Energy Efficiency and Conservation Block Grant (ARRA) funding from US Department of Energy. This non-resource program was considered successful and was extended utilizing ratepayer funding. It is now in its nineth round of Council District reaching grants, the 2022 Phase I and Phase II grant cycle.

POCP is an advocacy program that strives to improve customer awareness among LADWP's "hard-to-reach" (HTR) customers of electric and natural gas efficiency[73] and water conservation programs through the activities of community organizations. This program offers grants to local non-profit organizations with grassroots networks and trusted advisor status for targeted populations. Grantees go through a competitive selection process to work in one of the fifteen Los Angeles City Council Districts or on an at-large basis to improve community and customer awareness of LADWP's core energy efficiency and water conservation programs, and free steps customers can take to reduce energy and water use.

A.22.1. Process Evaluation Approach and Methodology

The Evaluator conducted a Limited Process Evaluation in FY 20/21 and completed the full process evaluation in FY 21/22. In July 2021, LADWP and the Evaluator revised the primary focus and associated activities of this evaluation to assess potential equity

[73] LADWP partners with the Southern California Gas Company to deliver natural gas efficiency programs.

metrics to support LADWP's intention to categorize the program into the Equity segment of their Energy Efficiency Program Portfolio.[74] In addition to reporting high-level insights on grantee experiences, this evaluation explores the potential of POCP to measure equity-based impacts.

A.22.1.1. Research Questions

The following table summarizes the research questions and topics to be addressed through the process evaluation, as well as data sources to address them.

Table A-144 Summary of POCP Process Evaluation Research Questions and Objectives

Research Question or Objective	Data Sources
How do the program interventions, per the program theory and design, drive customer participation in a resource program, and is that happening in practice?	Review of program logic model Program staff interviews Grantee interviews
What metrics are in place to measure program effectiveness? What systems are in place to inform program progress against those metrics? What additional resources and/or information are needed?	Review of program materials Program staff interviews
How effective is the POCP grant application and management process? What is the grantee experience? Are they receiving the support they need? What grant expectations/metrics are set and what are the outcomes?	Review of grant application materials, grant marketing and outreach materials Review of a sample of grantee agreements, workplans, marketing plans, etc. Grantee interviews
Are there additional data sources that should be tracked to more effectively manage or evaluate this program moving forward?	Review of program tracking data Program staff interviews
How do non-profit organizations use the grants? Are there examples of the most effective use of grant funds to engage customers? Least effective? What drives that effectiveness?	Program staff interviews Grantee interviews
What LADWP resources or services would participating non-profits find valuable in working to engage customers?	Grantee interviews
What customer segments is the program most effectively engaging? In other words, are their segments that may not participate at as high of a level if the program were not available? What customer segments are more challenging to target and engage through these grant funds?	Program staff interviews Grantee interviews

[74] The focus on equity metrics resulted from the May 2021 California Public Utilities Commission (CPUC) decision to adopt a new approach to segmenting energy efficiency portfolios into the areas of resource acquisition, market support, or equity. The CPUC will review proposed program segmentations as part of the energy efficiency portfolio planning activities in 2022.

Source: [https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M385/K864/385864616.PDF], accessed on 6/24/21.

A.22.2. Methodology

The information within this chapter is based on three activities: staff interviews, program data tracking and materials review, and grantee interviews.

Staff interviews: The Evaluator completed one in-depth interview with the program manager in December 2020, a follow-up discussion about current grantees in June 2021, and exchanged ad hoc email communications as needed. These interviews and conversations explored program design, grantee participation and data tracking processes, and initial discussions on measurable equity metrics.

Program data tracking and materials review: The Evaluator requested, received, and reviewed program documents including samples of grantee applications, Memorandums of Understanding outlining grantee obligations, data trackers, community outreach materials, and reports. The Evaluator also reviewed recent program reports, notes on the history of the program, the LADWP FY 2017/18 – 2026/27 Efficiency Solutions Portfolio Business Plan, and preliminary access to LADWP's grantee website containing educational materials, technical support information, and other resources for grantees.[75] The Evaluator used this information and information from staff interviews to, 1) conduct an audit to identify information needs to measure equity metrics for this program, and 2) develop a baseline program theory logic model.

Grantee interviews: The Evaluator conducted five (5) phone interviews with Round 8 community organization grantees using Zoom, an online conferencing tool. The Evaluator recruited from a census of Round 8 grantees (17 total). The team worked with LADWP to distribute interview invitations where LADWP sent an introductory email drafted by the Evaluator that briefly described the study and provided advanced notification alerting the grantees to expect a study invitation. Interviews lasted about 60 minutes. Each grantee that completed an interview received an Amazon gift card valued at $50.

Grantee interview discussions explored their program experiences, areas within program processes that could be improved, engagement strategies for HTR communities, and data tracking practices and limitations, specifically as these practices relate to equity metrics. Organizations we spoke with conducted educational and outreach activities to raise awareness about LADWP programs and topics relating to energy and water, including energy efficiency, energy conservation, and water conservation. Some organizations directly assisted clients with other LADWP energy efficiency program applications. These organizations served low-income communities, and other residents, depending on organization's purpose (children at school, teachers at school, landscapers, and the general population). A large portion of their clients are Latinx, therefore, most offered services in Spanish.

A.22.3. Results and Findings

The following sections detail results and findings from the process evaluation activities for POCP.

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[75] The Evaluator will review and assess grantee educational materials, including those on the program website as part of the full evaluation.

A.22.3.1. Administrative and Customer Process Evaluation Findings

This section summarizes key findings from CY1 Process Evaluation activities.

A.22.3.2. Goals and Objectives

The program has steadily evolved over the years, starting with a primary goal of raising awareness about LADWP's energy efficiency programs to more currently, exploring opportunities to drive behavior change, measure energy and water savings, and provide education for customers and grantees.

According to the program manager, the current overarching goal of the program is "to build an informed customer base when it comes to how to save energy and how to save water." There tends to be more focus on energy than water savings because of available program funding resources.[76]

Key program objectives are:

- Raise awareness about LADWP's other energy efficiency programs among HTR residential and small business customers
- Increase customer participation in LADWP's other energy efficiency programs
- Drive behavior change through customer education that increases knowledge about the importance of energy and water conservation and tips for taking no- or low-cost actions to save energy, water, and money on their utility bills (i.e., turn off lights, take short showers)
- Drive behavior change by influencing customers to take non-programmatic actions that result in energy and/or water savings, reduction in customer bills, reduction in customer financial burden, and increased knowledge (i.e., behavior changes by providing tips and education)
- Increase the knowledge and expertise of local non-profit staff about energy and water conservation (i.e., understanding energy efficiency, efficient equipment, ways to reduce utility bills)

A.22.3.3. Implementation

A.22.3.3.1. Grant Awards

LADWP implements the program in a series of two phases, Phase I and Phase II. Program grant cycles or rounds average about 15 months for most grantees and can range from 12-18 months. The program allocates one grant to a Peer Facilitator and all other grants go to non-profit organizations. Typically, there are about 30 grantees per cycle. About 150 grantees have been awarded funding since the program started.

- Phase I. Peer Facilitator and non-profit organization grants, Round 2022
    - One $70,000 grant will be allocated to a Peer Facilitator
    - Fifteen $60,000 grants with additional incremental funds up to $40,000 available will be allocated to organizations in each of the Council Districts

[76] Source: Discussion with the program manager, December 2020

- One $60,000 grant with additional incremental funds up to $40,000 available will be allocated to an organization serving Owens Valley

- Phase II. Special Category Grants
  - Round 2022 Phase II categories align with the prior grant cycle and are Water Conservation, Water Quality, Community Solar, and Under-represented Program Areas
  - Round 2022 grant amounts and quantities were not announced at the time of this study. Round 8/2021 Phase II grants were $50-$60,000 each for 17 grantees.

Non-profit organizations are not currently required to have extensive experience with energy efficiency and are encouraged to apply to either or both phases.

Eligibility criteria as listed in the 2022 Non-Profit Community Partnership Grants Announcement,[77] are that organizations:

- Maintained 501(c)3 status continuously for the past three (3) years and currently located in the City of Los Angeles; this location criterion can be shown through IRS registration at the office address and/or a publicly accessible regular workspace in the City of Los Angeles.
- Have an established track record of providing services to the community – especially relating to education, energy, water, or economic-related issues.
- Demonstrate a commitment toward encouraging energy efficiency and water conservation through its current and/or future programs and structure.
- Have the capacity to track counts of constituents reached, engaged, and referred; labor costs and other expenditures; energy/water savings achieved; and maintain records acceptable for a city financial audit.
- Propose activities that are at least 50% and up to 100% focused on energy efficiency versus water conservation. Retrofits for organizations' own facilities will not be funded; however, retrofits and/or physical demonstrations at other locations that serve as outreach/education tools for the program may comprise up to 1/3 of the proposed budget.
- Research activities may be allowed only if they inform the education and outreach portion of the project and may comprise up to 1/3 of project activities.

While not listed as a criterion for eligibility, the program overall is designed to improve customer awareness among LADWP's HTR customers and considers an organization's ability to support this effort during the application process. Refer to section on Equity Metrics and Measuring reach to HTRs for more detail.

[77] Source: LADWP. Non-Profit Community Partnership Grants Announcement. January 20, 2022. https://www.ladwp.com/cs/idcplg?IdcService=GET_FILE&dDocName=OPLADWPCCB772840&RevisionSelectionMethod=LatestReleased. Retrieved March 25, 2022.

Peer Facilitator Grant

The Peer Facilitator grantee provides technical assistance to organization-based grantees for a period of 18-months. Technical support includes an orientation with all grantees, several workshops and meetings throughout the grant cycle that give grantees opportunities to network and support one another, help with reporting requirements, a dedicated website with resources, announcements, and meeting recordings, and ad hoc support as needed.

Program Updates

The program made the following updates starting in 2022:[78]

- Changed the grant cycle nomenclature to more clearly describes the current grant year by including that year (e.g., 2022) in the title.
- Added to the Phase I application a larger emphasis on financial assistance and promotion of LADWP's financial offerings (energy bill discounts, senior citizen rates, newer programs designed in response to the pandemic) as an area in which organizations specialize.

A.22.3.3.2. Program Awareness and Grantee Engagement

LADWP raises awareness among non-profit organizations about the Community Partner Grants program through social media outreach, posts on the City of Los Angeles website, outreach through other partners such as SoCalGas or Metro Water District, direct mailing select organizations, and at times by searching online or through GuideStar to identify organizations that may qualify. During the 2022 Round Pre-Application Webinar, the program manager identified the following benefits to grantees:

- Organization staff gain a better understanding of efficiency concepts, efficient equipment, and how to reduce utility bills
- Program staff become skilled ambassadors for efficient solutions in the community and the organizations maintain this area of expertise after the grant cycle ends
- Provide energy and water conservation opportunities as a compliment regular programs and services activities
- The services organizations provide with these funds, in conjunction with other LADWP efficiency solutions programs, have broader benefits for LADWP and Los Angeles residents in general. These include:
- Contributing to environmental impacts that help create a more resilient future for Los Angeles and all communities therein by:
    - Reducing GHG emissions
    - Reducing climate change impacts
    - Reducing urban heat island sites

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[78] Source: Community Partnership Outreach Grants for Non-Profit Organizations – 2022 Round Pre-Application Webinar. https://vimeo.com/676419542. Retrieved March 25, 2022.

    - Improving outdoor/indoor air quality
    - Lessening the impacts of drought
- Helping to reduce electricity and water usage and decrease the need for generation and associated costs and environmental impacts
- Supporting the LA100 initiative to achieve 100% energy efficiency in 2025 by optimizing the efficiency of how customers use electricity on a day-to-day basis

A.22.3.3.3. Grant Application Process

All grantees develop and propose unique activities during the grant application process. LADWP streamlines the application process by keeping the application form short at three pages in length, and as simple as possible with no complex requirements. Applicants can submit the form by email.

According to the 2022 Phase I grant announcement, LADWP reviews applications and prioritizes applicants on a 100-point scale:

- Cost-effectiveness and viability of proposal (25 points)
- Addressing local area needs (20 points)
- Energy and/or water savings and/or other related benefits of the proposal (20 points)
- Responsiveness to application requirements (10 points)
- Past performance with behavior impacting programs (10 points)
- Proposed tracking and quantification methods (10 points)
- Innovation (5 points)

In past grant cycles, LADWP has also rated the potential of proposed activities for replication and use by LADWP or other institutions. This and other review points may be embedded in the application scoring process.

Council District staff play a supporting role for the program. As noted above, the program awards at least one grant to non-profit organizations in each of the Los Angeles Council Districts. Each grant cycle, LADWP shares a list of top applicants with each Council District office to gather their insights and take them under advisement. LADWP does not allow Council Districts to make decisions about which applicants are selected. Rather, Council Districts support the program by providing insights on current district needs and their thoughts on how well select grantee proposals seem to address those needs. After LADWP awards the grants, LADWP informs the Council Districts of selected organizations in their areas. Some Council Districts go on to work with and support the grantees by providing information like lists of constituents to target for outreach.

A.22.3.3.4. Reporting

Throughout the grant cycles, grantees submit data tracking impact forms and final reports to LADWP. Information LADWP requests on their 2021 grantee report template included:

- Type of activity/event

- Description of audience (renters, students, business owners, etc.)
- Number of persons/businesses outreached
- Number of persons/businesses engaged in grantee programming
- Number and description of items distributed (flyers, measures)
- Number of behavioral changes or behavioral change commitments per event or activity (shorter shower pledges, or for bill savings comparisons - reduced energy/water use, planted tree, enrolled in an LADWP program)

LADWP uses this information to develop program reports. LADWP shares insights from program reports and grantee final reports on an ad-hoc basis to other program managers.

A.22.3.4. Grantee Feedback

In this section, the Evaluator summarizes key findings from the grantee interviews.

A.22.3.4.1. Experience with Program Processes

All grantee organizations we interviewed had exceptionally good experiences with the overall grant process including the application process. Grantees described how they had good working relationships with LADWP and found working with LADWP extremely easy. One grantee particularly appreciated how the program connects different sectors serving the community.

"[LADWP] bridges the gap between the utilities, policy leaders and the community."

Other shared reasons for good experiences were:

- **Flexibility.** LADWP adapted quickly when COVID-19 safety restrictions hit and threatened to interfere with possibility of fulfilling grantees' annual goals. Grantees had to make significant changes to the way they did their outreach due to the inability to be in the field and have face to face interactions. All grantees said LADWP showed flexibility in reassessing the criteria that needed to be met for grant purposes and in providing useful guidance on how to do so.
- **Financial reporting requirements.** LADWP has reasonable financial reporting requirements, according to grantees. For example, LADWP does not require grantees to show how they allocated the grant money to the last penny. This was notably helpful for grantees since it alleviates administrative work that they otherwise would have hardship completing given limited staff capacity.

"When they send us a check, they say, this is the funding, you showed us what you did, then it's ours. We don't have to count every single penny. That's how other grants are. That flexibility is very helpful. We put money where we need to – incentives, staffing." - Grantee interview

- **Clear rules.** LADWP sets clear grant requirements and rules at the beginning of the grant cycle, and these remained the same for grantees throughout the year.

"We know what's going to happen. They are very clear, don't change it on you. Other grants, every other week it's something new, we have to go back and restructure." Grantee interview.

- **Trust.** LADWP designed the program to leverage local support for the communities served. Grantees noticed this and it bolstered their trust with LADWP. Grantees also felt that LADWP trusts their expertise given that LADWP regularly accepts grant proposals without many modifications. In this respect, grantees felt empowered to do what they know best without feeling imposed upon by certain criteria or set of requirements.

"I will give them kudos - when they put the grant out for the region, they made an eligibility requirement that you had to be in one of the two counties. I appreciated that they knew there was local knowledge. They didn't bring in [another service provider] from the outside [of the community] without local knowledge." Grantee interview.

"Very flexible in terms of what we say we're going to do. I say we'll do x, y, z; they don't change that. They say ok, 'do exactly that.' We appreciate that because we are in control of what we can do. We know our strengths as an organization. They allow us to build on that and not change it. They really trust us with our community experience." Grantee interview.

- **Helpfulness of the Peer Facilitator:** Grantees had very helpful interactions with the Peer Facilitator. They valued the events and technical assistance offered by the Peer Facilitator, and the ability to share best practices and ideas with other grantees in meetings and through the portal. Grantees said the Peer Facilitator was particularly helpful during reporting in how they reviewed and provided feedback on grantees' final reports.

A.22.3.4.2. Satisfaction

Overall, grantees indicated that they were very satisfied with the program and LADWP. They felt their missions aligned well with that of the program and indicated that they would like to continue their partnerships with LADWP.

"I love LADWP. We have relationships with the people that work there. [LADWP] saw my work was relevant. The human aspect behind the company has given me so much hope. That's the bridge I'm trying to build, to connect the bridge between LADWP and the community…" Grantee interview.

"I love LADWP. LADWP sets the standards for other utilities to follow." Grantee interview.

"LADWP is gold standard – perhaps at a national level." Grantee interview.

A.22.3.4.3. Suggestions for improvement

One grantee who provided energy savings services to customers said they were trying to figure out how to capture energy savings and would like LADWP's support. Other grantees who described pain points in the program process described instances where they experienced delays in serving their clients. They offered the following suggestions for improvement:

- **Marketing approval process:** Grantees pointed to the LADWP marketing materials approval process as the greatest challenge in conducting their outreach activities. To address this, grantees suggested:

  - Easy-to-access library of pre-approved images grantees could use for their marketing and outreach materials
  - LADWP liaison that can facilitate a faster approval process for grantee materials in general
  - Faster approval process for translations, particularly Spanish translations
- **Customer application status:** Some grantees help customers apply for other LADWP programs. Their customers then ask for application status updates, and at times, these grantees are unable to get an update from LADWP as quickly as their customers prefer. To better serve their customers, grantees suggest an LADWP liaison that can give real-time updates when needed.
- **Simplified website that is easier to navigate:** Grantees described how their customers have trouble finding things or figuring out what services are available to them through the LADWP website. One grantee, who is familiar with the website, said they themselves have trouble at times.

A.22.3.4.4. Customer Outreach Strategies and Barriers

We asked grantees about their outreach strategies and barriers to reaching customers in their service areas.

Grantee outreach strategies

Grantees typically used the same outreach methods to raise awareness about LADWP's programs as they do to raise awareness about all of their services and offerings. They used direct and indirect outreach strategies, noted below. Particularly after responding to COVID-19 restrictions, grantees started to explore new avenues for outreach using online channels such as Instagram, YouTube, and Facebook.

- Direct strategies included:
  - Hosting or tabling at community events, fairs, and other in-person encounters
  - Mailed or emailed newsletters and other informational materials
- Indirect strategies included:
  - Grantee website postings and updates
  - Social media posts (for example, Instagram, YouTube, Facebook, etc.)
  - Television and/or radio ads

Some grantees relied on intermediary messengers to spread information by word of mouth. For example, grantees worked with teachers at schools or professional organizations who then reached out to students, parents, and other community residents directly. In this case, grantees focused on relationship building with key market actors within the community. This is primarily done through in-person meetings and other face-to-face interactions and direct phone calls.

Grantee strategies for overcoming outreach barriers

Grantees mentioned they encounter several barriers when reaching to their target populations, namely customers' limited access to technology, cultural relevance and trust, and limited English-speaking communication skills.

- **Access to technology and the digital divide.** Grantees described how certain rural areas do not yet have the infrastructure in place to support broad access to affordable internet services. Even with internet access, grantees served customers with limited experience with technology (for example, some senior or immigrant groups) and had challenges such as accessing email, websites, social media, etc. Grantees were unable to rely on digital/online outreach methods in these cases.

  To overcome this challenge, grantees provided paper versions of applications and accepted digital pictures of signed forms. Grantees used text-to-phone outreach and ensured their websites and online platforms were optimized for low bandwidth mobile devices. Some grantees used what they called, "interactive outreach." They did giveaways, showed how to access their website live, helped customers download information from their phones, or showed them how to login to social media sites. They also provided paper copies materials and accepted a digital pictures of application forms filled out in paper.

- **Cultural relevance and trust.** Grantees described how customers may disregard outreach efforts and decide not to engage in programs or services for cultural relevance and/or trust-related reasons. For example, the act of receiving "help" or social services may not be culturally relevant to some, particularly if they are foreign born or reside in English-isolated areas. Some customers may not trust that a utility company has their best interests in mind or may refrain from engaging in services out of fear to reveal their identities.

"The community we work with doesn't realize they can reach out about the services LADWP offers." Grantee interview.

"[Collecting demographic data] would be helpful for marketing, [but]…it gets tricky when you get into demos. It gets personal." Grantee interviewee

  To overcome this challenge, grantees worked hard to build and maintain relationships with the communities they serve and avoided actions that may feel intrusive to customers. Grantees used census data to identify demographic information and did not ask customers for sensitive information like income, race/ethnicity, or tax identification numbers. In most cases, grantees did not track identifiable information like customer names and offered opportunities for customers to participate in offerings anonymously (for example, submitting energy savings pledges anonymously).

- **Limited English communication abilities.** Grantees served, and for some programs and services, targeted native speakers of various languages, usually Spanish, who may have limited English communication skills. Grantees described how limited English communication abilities can also be a barrier for native English speakers.

To overcome this challenge, grantees had bilingual staff and offered services in Spanish and adapted program materials with simplified language, fewer words, and incorporated images that help explain concepts.

A.22.3.5. Program Metrics

The Evaluator used the data and materials review task, as well as discussions with program staff and grantee interviews, to 1) complete an audit of information the program currently collects or needs to collect in the future to measure progress toward equity goals, and 2) develop a baseline program theory and logic model (PTLM). This section describes findings from these evaluation activities.

A.22.3.5.1. Equity Metrics

Key takeaways from the equity metrics audit include findings related to the program's definition of hard to reach (HTR) customers, the process for ensuring the program serves those customers, and suggestions for overcoming barriers to collecting customer information that could inform progress toward equity goals.

Identifying Hard-to-Reach Customers

The program design supports equitable service delivery by centering HTR customers as the targeted audience to whom program resources are delivered. According to the business plan, the program defines HTR populations broadly to include any residential or small business customers that have been historically underserved. Examples of historically underserved customers include lower income households, limited English proficient or English-isolated customers, renters, and others. While the Evaluator found no other formally documented definition of "historically underserved," program staff described targeting customers that live in areas designated as Disadvantaged Communities (DACs) by the California Public Utility Commission (CPUC).[79] Program staff said the program may additionally leverage institutional knowledge and past program participation data to determine who are these underserved populations.

Other LADWP programs like the Program Analysis and Development program and other companies and organizations in California have utilized the CPUC DAC definition, which is based on the CalEnviroScreen scoring system, to identify HTR customers. However, there are limitations to using CalEnviroScreen for this purpose. Specifically, the many indicators that inform the overall CalEnviroScreen score are not all always applicable to a specific program. For example, a program targeting low-income households most closely ties to the Poverty indicator and other socioeconomic factors. A clean drinking water quality program would most closely tie to the Drinking Water Contaminants indicator and other water-specific factors. In either of these examples, indicators like traffic pollution or cleanup sites may have some relevance but should not have equal influence over how

[79] The CPUC targets certain communities, including "Disadvantaged Communities," for their Environmental and Social Justice (ESJ) initiatives, and defines target communities in the ESJ Action Plan: Version 2.0 (October 2021). These include California residents who live in Disadvantaged Communities, all tribal lands, and in lower-income households or census tracks. The CPUC further defines Disadvantaged Communities as, "census tracts that score in the top 25% of CalEnviroScreen 3.0, along with those that score within the highest 5% of CalEnviroScreen 3.0's Pollution Burden but do not receive an overall CalEnviroScreen score." This definition may now or soon be adapted to use CalEnviroScreen 4.0 scores. Source: [https://www.cpuc.ca.gov/dacag], accessed on 10/28/2021.

targeted geographic areas are identified. Scores from the most relevant indicators to a specific program should take priority over the overall CalEnviroScreen score. This approach will more effectively help the program identify, reach, and engage customers with needs that the program could best address.

Figure A-59 shows a snapshot of variation between overall and select indicator scores for different census tracts in Inglewood, CA. The Evaluator notes that census block group or zip code areas may provide better insight about the geographic locations of targeted customer groups than the census tract or city/town.

Figure A-59 POCP - Comparison of CalEnviroScreen 4.0 Overall Scores and Scores by Indicator, March 2022

	A	B	D	E	H	I	J	R	Z	AB	AM	AW	AY	BF
1	Census Tract	Total Population	ZIP	Approximate Location	CES 4.0 Score	CES 4.0 Percentile	CES 4.0 Percentile Range	Drinking Water Pctl	Traffic Pctl	Cleanup Sites Pctl	Pollution Burden Pctl	Linguistic Isolation Pctl	Poverty Pctl	Pop. Char. Pctl
1665	**6037601401**	**5949**	**90301**	**Inglewood**	**64.97**	**97.83**	95-100% (highest scores)	**53.45**	**86.04**	**86.36**	**95.59**	**38.61**	**82.54**	**91.91**
1666	**6037600502**	**2097**	**90303**	**Inglewood**	**59.14**	**95.17**	95-100% (highest scores)	**62.72**	**98.64**	**53.53**	**96.84**	**NA**	**50.01**	**80.24**
1667	6037601302	7333	90302	Inglewood	57.37	94.10	**90-95%**	53.45	84.79	38.80	90.68	56.31	73.89	87.51
1668	6037601402	4793	90301	Inglewood	54.28	91.87	**90-95%**	77.53	96.69	65.04	94.87	76.90	63.64	76.34
1669	6037602004	3709	90303	Inglewood	53.35	91.20	**90-95%**	55.18	33.84	17.08	67.34	84.90	68.27	97.45
1670	6037600902	6491	90302	Inglewood	52.56	90.58	**90-95%**	53.45	45.34	17.08	70.75	64.14	87.88	95.07
1671	6037602003	4760	90303	Inglewood	49.45	87.34	**85-90%**	39.54	78.54	19.91	71.15	89.04	71.91	89.70
1672	6037600912	5659	90302	Inglewood	48.93	86.64	**85-90%**	53.45	47.29	17.08	62.49	76.33	79.31	94.54
1673	6037601900	4847	90303	Inglewood	48.81	86.54	**85-90%**	39.54	28.71	0.00	61.28	79.17	86.86	94.99
1674	6037600602	2542	90303	Inglewood	48.44	86.06	**85-90%**	53.45	35.21	4.12	56.76	49.57	92.51	96.57
1675	6037601100	6869	90301	Inglewood	48.20	85.74	**85-90%**	53.45	58.09	0.00	57.37	68.16	93.25	96.04
1676	6037601002	5167	90301	Inglewood	47.66	85.07	**85-90%**	53.45	51.79	0.00	61.07	54.23	68.27	93.28
1677	6037601211	2880	90301	Inglewood	47.02	84.52	**80-85%**	53.45	33.83	17.08	72.11	66.60	83.42	84.20
1678	6037601212	6774	90301	Inglewood	44.85	81.83	**80-85%**	53.45	20.66	7.71	45.90	73.73	90.48	97.40
1679	6037601801	2834	90304	Inglewood	43.23	79.84	**75-80%**	39.54	64.49	0.00	61.21	94.03	82.73	84.25
1680	6037601001	2381	90301	Inglewood	42.31	78.45	**75-80%**	53.45	46.60	17.49	67.39	36.97	49.31	77.94
1681	6037601303	5084	90302	Inglewood	41.06	76.75	**75-80%**	53.45	42.89	4.12	55.06	33.94	62.25	84.08
1682	6037601202	4000	90301	Inglewood	39.70	74.52	**70-75%**	53.45	43.64	0.00	52.61	85.25	54.03	83.06
1683	6037600802	2485	90305	Inglewood	37.81	71.77	**70-75%**	75.38	70.28	0.00	65.38	3.74	28.63	68.75
1684	6037600501	2712	90303	Inglewood	36.91	70.44	**70-75%**	55.10	42.65	17.08	65.75	13.30	43.14	66.24

Source: CalEnviroScreen 4.0 Excel and Data Dictionary download, retrieved from https://calenviroscreen-oehha.hub.arcgis.com/ March 16, 2022

Measuring reach to HTRs

LADWP designed the POCP program with equitable service delivery in mind. During interviews, program staff described how the program selects grantees that serve DACs as identified through U.S. Census demographic data (primarily household income, etc.) and geographic areas with high overall CalEnviroScreen scores. In this way, LADWP concludes that the POCP program reaches HTR customers and, therefore, delivers equitable services.

This is a reasonable proxy measure for equitable service delivery, but the approach has limitations. When using higher-level secondary data like U.S. Census data or scores from CalEnviroScreen 4.0 to target service areas, the individuals identified within the areas may not all identify with selected characteristics. Additionally, individuals outside of these areas may identify with selected characteristics but may miss out on services since they do not reside in targeted geographic areas. To assess how well the program serves underserved populations, grantees would need to collect primary demographic data from customers.

Primary demographic data for customers that grantees reach is the best source for assessing how well the program serves HTR populations. Characteristics that inform equity metrics include:

- Race/ethnicity
- Household size
- Household income
- Homeowner/renter status
- Preferred language[80]
- Ability to speak English
- Number of years living in the United States
- Tribal affiliation status

Due to grantees' varied outreach approaches[81] that sometimes call for limited personal interactions (i.e., bulk mailers), grantees are not currently required to track demographic characteristics of the individual customers they reach through the program. According to program staff, some, but not all, grantees have expressed concerns to LADWP about asking for this sensitive information, worried that it would cause negative net effects on engagement.[82]

The Evaluator asked grantees about their data tracking practices and how they measure progress toward their program goals. Most described their tracking and reporting of outputs from grant activities. For example, they tracked counts of:

- Materials distributed
- Customer applications or pledges submitted
- Outreach events hosted
- Event attendees
- Clicks on a website
- Visitors to a webpage
- Comments left on social media post

Although grantees tracked these counts, by and large they did not track who, among the people they reached. When asked, "what would you say is most difficult or challenging in implementing the grant?," one grantee said:

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[80] Grantees have provided outreach in multiple languages including English, Spanish, Armenian, Korean, Russian, Farsi, Chinese, and others.

[81] Grantees propose their own unique approaches for outreach as part of the application process. This allows grantees to customize their methods to the audience they serve. Recent approaches include art projects, mass texting, public service announcements/videos, bulk mailers, tabling events, workshops, focus groups, and surveys.

[82] Source: Staff comment, received by email on 6/24/2021.

“[The most difficult thing in implementing the grant [is] probably identifying the impact. We don’t have data access to some of the other programs we have [either].”

Where customer-specific data was collected, grantees said that customers may provide their work addresses instead of their personal addresses or may have informal jobs and cannot demonstrate income. Without access to accurate and customer-specific participant data, grantees were unable to fully understand and demonstrate how well they equitably served specific HTR populations. Additionally, grantees who did not provide support to customers applying for other LADWP programs were unable to monitor if or how many of those they reached went on to learn more about, apply for, or participate in other LADWP programs. In interviews, program staff indicated that they and the grantees were working toward tracking and reporting better data that could inform progress toward equity goals, but that they had not gotten there yet.

A.22.3.5.2. Baseline program theory logic model

A program theory logic model (PTLM) visually articulates the program’s end-goals, associated activities and measurable metrics that intend to meet those goals. It documents the overarching theory (a brief north star of the purpose of the program), objectives or goals (referred to as outcomes), activities, and results of activities (referred to as outputs). The program theory may also separately document performance metrics, which can align with the outputs or outcomes.

First, it is important to articulate and agree on the program theory. As a starting point, below is a preliminary summary of the program theory based on the Evaluator’s review of program documents and discussions with program staff.

Program theory. *Hard-to-reach (HTR) customers are less responsive to standard utility outreach. By leveraging the networks and “trusted source” status of community organizations, LADWP will increase awareness of energy efficiency, water conservation, and financial assistance programs and/or tips/savings behaviors among targeted HTR residential and small business customers.*

The evaluator also identified program objectives, translated to various outcomes. Table 1 details these outcomes potential outputs (or, results of activities) that the program currently does or could track and associated example metric(s). Some of the activities and outputs, particularly related to the equity measurement, may not be feasible given data availability and access, and are provided for the program’s consideration for future planning.

The Evaluator presents the PTLM in table format for clarity and easy reference (Table A-145).

Table A-145 POCP - Example Program Metrics and Outcomes

Outcomes	Activities	Outputs	Metric(s)
Increase customer engagement with LADWP programs	▪ Grantees facilitate customer engagement with LADWP programs	▪ Number of grantees that provide support to customers in applying for LADWP programs ▪ Number of customers who like, share, repost, or comment on grantee outreach through online media platforms ▪ Number of customers who participate in outreach events (i.e., received a flyer or came to a workshop)	▪ Percentage of grantees that provide LADWP program application support ▪ Rate at which grantees met their set targets for customer engagement outlined in their Memorandums of Understanding
Increase customer awareness about LADWP programs	▪ Grantees conduct outreach activities to their client base to raise awareness about LADWP programs	▪ Number of social media posts ▪ Number of blog posts ▪ Number of webpage posts ▪ Number of flyer distributions ▪ Number of newsletters distributed ▪ Number of press releases ▪ Number of mass mailings / emails ▪ Number of presentations	▪ Rate at which grantees met their set targets for customer outreach outlined in their Memorandums of Understanding
Barriers to measurement	These activities, outputs, and metrics are well embedded into the current program design. However, the Evaluator recognizes that the best metrics for increasing customer engagement and awareness are rates of actual engagement and rates of actual change in awareness. These two metrics can be difficult to assess given grantees' limited ability to gather quality information about individual customers. The outcomes of increased customer engagement with and awareness of LADWP programs may be better framed as metrics that help measure progress toward a broader outcome – Increased reach to HTR customer groups.		
Potential measurement solutions	Consider developing proxy measures for customer engagement with and awareness of LADWP programs. Refer to recommendations in recommendations section. Consider the proposed activities, outputs, and metrics proposed under the new outcome, *Ensure equitable service delivery – implementation equity metrics*.		
New! **Ensure equitable service delivery – Administrative Equity Metrics**	▪ LADWP awards grant funding to select organizations based on their ability to reach targeted communities ▪ LADWP reviews and updates the program implementation plan, including the program's definition of HTR communities	▪ Number of grantees that demonstrate their ability to reach specific targeted communities ▪ Dated documentation of the program's definition of HTR communities ▪ ***PROPOSED!*** Dated documentation of the approach for identifying and prioritizing specific customer groups the program will target including a list of key sources	▪ Rate of grantees that serve targeted communities ▪ ***PROPOSED!*** Frequency of updated documentation for the program's definition of HTR communities and the approach for identifying and prioritizing HTR communities to

Outcomes	Activities	Outputs	Metric(s)
	■ ***PROPOSED!*** LADWP identifies and prioritizes targeted communities, and documents key sources used to make this determination	used to make the determination (regulations, US census data, CalEnviroScreen, past program participation data, program evaluation reports, etc.) ■ ***PROPOSED!*** Number of targeted communities within more precise geographic areas (census block group, zip code rather than district, city/town, census tract) ■ ***PROPOSED!*** Number of targeted customer groups with specific characteristics (Spanish-speaking, renters, rural, etc.)	target (Note: This metric helps to measure the program's capacity to deliver services equitably by demonstrating the programs ongoing commitment to learn about HTR customer markets, evolve strategies for identifying them, and selecting organizations that effectively engage them.)
Barriers to measurement	Limited LADWP staff time and resources to: ■ Gather and assess current data sources to identify and prioritize customer groups to target ■ Document or update existing documents with the definition and selected groups. Normal shifts in the customer market that may require a shift in which customer groups the program should target.		
Potential measurement solutions	Consider intervals for reassessing selected targeted customer groups such as each grant cycle or every 3 years.		
***New!* Ensure equitable service delivery – Implementation Equity Metrics**	■ ***PROPOSED!*** Grantees track and report customer reach by targeted customer group ■ ***PROPOSED!*** LADWP and grantees analyzes participation data to measure equity impacts	■ ***PROPOSED!*** Number of customers **reached who meet criteria** for a targeted group ■ ***PROPOSED!*** Number of customers **reached who do not meet criteria** ■ ***PROPOSED!*** Number of **targeted** customers reached who went on to **apply** to an LADWP program ■ ***PROPOSED!*** Number of **targeted** customers applied who went on to **enroll** in an LADWP program ■ ***PROPOSED!*** Number of **targeted** customers enrolled who went on to **complete** in an LADWP program	■ ***PROPOSED!*** Rate of targeted customers reached ■ ***PROPOSED!*** Rate of targeted customer application to LADWP programs ■ ***PROPOSED!*** Rate of targeted customer program enrollment ■ ***PROPOSED!*** Rate of targeted customers program completion
Barriers to measurement	Grantees have limited ability to gather quality information about individual customers' characteristics, participation, and actions following their initial interactions with grantees.		
Potential measurement solutions	Consider raising the value and priority of organizations' ability to track individual customer characteristic or participation data, including contact information for follow-up data collection, during application review. Until better individual customer data becomes more accessible, continue to leverage secondary data sources like grantees' geographic service areas, US Census data, and select CalEnviroScreen indicator scores as proxy measures for how well the program served targeted customers.		

Outcomes	Activities	Outputs	Metric(s)
	Where grantees do collect individual customer data, consider providing technical support in their development of long-term data collection strategies. For example, how to design and administer surveys two years after participation to assess behavior change over time. Consider systematically capturing how customers learned about other LADWP programs when they enroll in them and specifically probe on grantee or POCP-related activities.		
Create sustainable energy and water conservation behavior changes among customers	■ LADWP awards grant funds to select organizations based on their, 1) experience with implementation and impact measurement of behavior change programs, 2) ability to clearly define behavior changes, and 3) ability to conduct follow-up interactions with customers ■ Grantees provide services to the client base designed to foster behavior change related to energy and/or water conservation	■ Number of grantees that aim to provide behavior change services ■ Number of water conservations pledges (i.e., shorter showers) ■ Number of energy conservation pledges (i.e., turning off lights or adjusting home temperature settings) ■ Number of customers who received weatherization measures installations (i.e., weatherstripping, faucet aerators) ■ Number of customers who planted trees ■ Pre-/Post-test scores for customers who attend grantee educational workshops	■ Percentage of grantees that provide behavior change services ■ Rate of knowledge attainment among workshop attendees
Barriers to measurement	Grantees have limited ability to gather quality information about individual customers' characteristics, participation, and actions following their initial interactions with grantees.		
Potential measurement solutions	Consider finding ways to support grantees in measuring longer-term behavior change by developing a participant panel through opt-in follow-up questionnaires with customers they serve. Opt-in questionnaires allow customers to consent to a questionnaire and provide their contact information. A customer incentive may help increase customers' interest in doing so.		
Increase Energy and Water Savings Impacts	■ LADWP awards grant funding to select organizations based on their ability to track and document energy and/or water saving impacts through grant-funded activities	■ Number of grantees that provide data needed to track energy and/or water savings ■ Number of customers who received energy efficient upgrades or services because of grantee services funded by the program ■ ***PROPOSED!*** Number of targeted customers who complete an LADWP program who identify grantees or their grant-funded outreach activities as the source for how they learned about the program	■ Percent of grantees that provide data needed to track energy and/or water saving impacts ■ Amount of energy and water savings from direct install measures ■ ***PROPOSED!*** Amount of energy and water savings from customer participation in other LADWP programs (not to be double counted, but documented)

Outcomes	Activities	Outputs	Metric(s)
Barriers to measurement	LADWP recognizes that organizations may not have a strong ability to track and document energy and/or water savings and that organizations have different levels of capacity to get it done. As an incremental step toward track savings and measuring those impacts, LADWP asks grantees to brainstorm approaches for how they might do that. Most grantees are unsure of how to track and measure savings impacts. Some grantees have requested LADWP's help in figuring out a good process for it. Grantees have limited ability to gather quality information about individual customers' characteristics, participation, and actions following their initial interactions with grantees.		
Potential measurement solutions	If LADWP's intent for this program is to be more of a resource program, LADWP will need to formalize the decision, develop a process for how it should be done, and direct grantees on the process so it is done consistently and easily. As a first step, consider working internally or with evaluators to determine whether savings or behavior changes exist because of grantee activities. This is likely true for grantees that use grant funds for direct installation of energy savings measures. Where savings may be more difficult to calculate (i.e., knowledge gain or behavior change based on education), consider developing deemed savings potential for applicable grantee activities. As a second step, the program might consider providing more hands-on technical assistance and education to grantees specifically on how to track and measure savings goals. Grantees have identified this as an area of need that could also inform progress toward increasing grantees' knowledge and skill related to energy and water conservation. As a longer-term action, the program might consider gleaning detailed insights from grantees about barriers they face in tracking customers actions following initial interactions with grantees as part of this proposed hands-on technical assistance and education. This information could help LADWP identify nuances with these barriers for different grantees and develop effective processes for addressing them.		
Improve grantee staff knowledge and skills related to energy and water conservation activities and behaviors	■ LADWP encourages organizations with little to no experience in energy and water conservation to apply ■ LADWP partners with the Peer Facilitator to provide organizational grantees with technical assistance, guidance, and opportunities for education and/or skill development such as understanding of energy efficiency, efficient equipment, how to reduce utility bills, and awareness of LADWP program offerings	■ Number of educational events and/or resources provided to grantees ■ Number of grantees that attend education events ■ Number of times educational resources were accessed by grantees (clicks, downloads, portal logins, etc.) ■ Scores/ratings of grantee satisfaction with the program, Peer Facilitator, and the support, resources, and educational opportunities provided ■ Feedback from grantees about their pre-participation knowledge and experience with energy and water conservation Feedback from grantees about their post-participation knowledge gain and skill development	■ Rates of grantee satisfaction ■ Rate of grantee knowledge/skill attainment

Outcomes	Activities	Outputs	Metric(s)
Barriers to measurement	The program gathers some information about grantees' knowledge or skills through the program application. Additional and/or more detailed information should be tracked to have a clear understanding of where grantees are when they start a grant cycle. This baseline information is important to estimate new knowledge or skill attainment. Especially given that: ▪ The variety in grantee organizations and their proposed outreach activities, it is likely that some grantees have more knowledge and/or skills related to energy and water conservation than others. ▪ Many grantees have participated in the program for several years (not always consecutively or with the same proposed activities) and are already very familiar with what the program can offer in terms of education for their staff.		
Potential measurement solutions	Consider developing a means to understand grantees' baseline knowledge and skill levels, as applicable to program goals, and a means for determining how the program expands that knowledge/skill in different ways. This enables the program to acknowledge how each grantee organization and individuals within the organizations are starting with varying levels of experience. This approach also creates an opportunity for the program to demonstrate if and how it provides education that meets grantees where they are. Consider gathering feedback, perhaps through an end-of-grant-cycle survey, from grantees about the quality of the program's educational opportunities, knowledge, or skills they gained by participating, and educational needs they may have. This feedback can inform not only grantee knowledge gain metrics, but also more relevant educational offering content.		

A.22.4. Recommendations

The Evaluator identified and prioritized recommendations for the program. This section lists recommendations for three key program areas.

A.22.4.1. Process Improvements

The following recommendations are based on grantees' suggestions for program improvement.

Consider incorporating more in-depth, customized guidance to grantees looking for effective and sustainable strategies for data collection and impacts measurement, particularly for behavior change over time and electricity or water savings. Several grantees indicated an interest in or need for this level of support. In-depth guidance might include gathering or creating step-by-step frameworks, one-on-one consultations, program evaluability assessments for grantees, and more.

Optimize grantees' time during interactions with LADWP. Grantees suggested opportunities to streamline the marketing approval process, the process for getting status updates on applications to other programs that grantees submit for customers, and time they or their customers spend navigating the LADWP website.

- Grantees pointed to the LADWP marketing materials approval process as the greatest challenge in conducting their outreach activities. To address this, grantees suggested:
    - Easy-to-access library of pre-approved images grantees could use for their marketing and outreach materials
    - LADWP liaison that can facilitate a faster approval process for grantee materials in general
    - Faster approval process for translations, particularly Spanish translations
- To better serve their customers, grantees suggested LADWP designate one liaison who could provide real-time status updates on customers' program applications.
- Grantees described how their customers have trouble finding things or figuring out what services are available to them through the LADWP website. To address this, consider simplifying the path from the home page on the LADWP website to the various efficiency solution programs. For example, add a button directing visitors to a landing page for all efficiency programs to the home page or make the "Save Money" tab more prominent on the Residential and Commercial landing pages linked to the home page.

A.22.4.2. Awareness and Engagement with LADWP programs

In the baseline program theory logic model shown in Table A-145, the Evaluator identified metrics that can demonstrate the program's progress toward reaching outcomes. The Evaluator also identified barriers to measurement and potential solutions. The barrier of grantees' limited ability to gather quality information about individual customers' characteristics, participation, and actions following their initial interactions with grantees has implications for measuring several outcomes including levels of customer awareness and understanding of LADWP programs and levels of engagement in LADWP because of grantee efforts. The Evaluator recommends that LADWP consider the following potential solutions for overcoming this barrier.

Consider creating a new proxy measure for the program's impact on customer engagement in other LADWP programs. For example, create a new cross-program participant (i.e., for all customers who participated in LADWP programs other than POCP within a designated timeframe) questionnaire or add a question to an existing questionnaire to estimate the proportion of customers who participated in other LADWP programs that recall POCP outreach efforts. This would be the rate of POCP recall. Then, take the raw number of customers who received POCP outreach (or the number to whom grantees report sending outreach materials) and determine the rate of POCP outreach by calculating the portion of the general, eligible customer base that raw number represents. This would be the rate of POCP outreach. Finally, compare the rate of POCP outreach to the rate of POCP recall. The result is an estimated rate of POCP program influence or impact on customers' decisions to participate in other programs.

Alternatively, consider systematically capturing how customers learned about other LADWP programs when they enroll in them and specifically probe on grantee or POCP-related activities. Given the various activities that the sometimes more than 20 different grantees offer each cycle (Phases I and II), the Evaluator suggests that the systematic approach use cascading questions. For example, first ask how customers learned about the program providing higher-level response options like, 'community workshop,' 'community event,' or, 'flyer from a community organization.'[83] Next, ask the subset of customers who select response options that correlate to grantee activities about more specific activities. For example, ask customers who select 'community workshop' about what the workshop was about using grantee workshop topics like, 'sustainable gardening,' or 'how to save energy in my home.' The Evaluator notes that secondary questions that more specifically probe on activities will need to be regularly updated with each grant cycle and should include options referring to grantee activities from up to three years past.

Consider building on this approach to create proxy measures for the program's impact on customer awareness of other LADWP programs. For example, create a new cross-program participant questionnaire or add questions to an existing questionnaire to estimate their current levels of awareness of other LADWP programs. Then, apply the rate of POCP recall described above and compare levels of awareness between customers that recall POCP outreach efforts and customers that do not. Alternatively, create or add awareness questions to a broader general population survey and compare rates of awareness between respondents that recall POCP outreach efforts, respondents that do not, respondents who are LADWP program participants, and non-participant respondents.

Consider optimizing market engagement (MEO) and program marketing and outreach strategies based on insights from grantees. Grantees have trusted relationships with the communities, including HTR customers, they serve. Their experience enables them to understand and incorporate culturally relevant messaging

[83] These response options are examples and not intended to be used verbatim.

and outreach strategies to effectively engage HTR customers. This is a key value that the POCP program lends to LADWP's efficiency solutions portfolio. LADWP could build on this value by leveraging grantee insights to form optimized marketing and outreach strategies across portfolio programs.

A.22.4.3. Equity Metrics

Select the most relevant CalEnviroScreen indicators when leveraging CalEnviroScreen indicator scores to determine geographic areas where DACs are located. Scores from the most relevant indicators to a specific program should take priority over the overall CalEnviroScreen score. This approach will more effectively help the program identify, reach, and engage customers with needs that the program could best address.

Consider focusing outreach to HTR customers by targeting and prioritizing specific geographic areas (census block group or zip code) or customer characteristics (limited English speakers, single-parent households, etc.). Then reassess selected targeted customer groups at regular intervals such as each grant cycle or every 3 years. Over time, certain customer groups may become more or less important to target depending on the needs of the customer market, regulation, or strategic LADWP initiatives.

Consider incorporating the newly proposed administrative metric to demonstrate how well the program delivers services equitably (Table A-145).

- Frequency of updated documentation for the program's definition of HTR communities and the approach for identifying and prioritizing HTR communities to target

Upon availability of individual customer data from grantees, consider implementation-based equity metrics to demonstrate how well the program delivers services equitably (Table A-145).

- Rate of targeted customers reached;
- Rate of targeted customer application to LADWP programs;
- Rate of targeted customer program enrollment; and
- Rate of targeted customers program completion.

Appendix B Cost Effectiveness Measure Level Results

This appendix presents cost effectiveness results at the measure level for each of the LADWP Energy Efficiency Programs during FY 20/21.

B.1. Non-Residential Programs

Table B-1 CDI Measure Level Cost Effectiveness Results

Measure	PAC Ratio	TRC Ratio	PCT Ratio	RIM Ratio	MTRC Ratio
Lighting	0.22	0.38	362.42	0.11	0.38

Table B-2 CLIP Measure Level Cost Effectiveness Results

Measure	PAC Ratio	TRC Ratio	PCT Ratio	RIM Ratio	MTRC Ratio
Lighting	0.63	0.87	17.10	0.19	0.87

Table B-3 CP Measure Level Cost Effectiveness Results

Measure	PAC Ratio	TRC Ratio	PCT Ratio	RIM Ratio	MTRC Ratio
Shade Trees	4.84	4.84	13.41	0.98	4.84

Table B-4 CPP Measure Level Cost Effectiveness Results

Measure	PAC Ratio	TRC Ratio	PCT Ratio	RIM Ratio	MTRC Ratio
Building Envelope	5.36	5.52	0.00	0.44	5.52
Controls	2.79	2.62	15.42	0.30	2.62
HVAC	2.47	3.33	23.24	0.34	3.33
Lighting	2.08	3.95	46.93	0.28	3.95
Other	2.20	2.00	10.45	0.28	2.00
Process	1.28	0.94	4.73	0.23	0.94
VFD	1.79	1.65	7.37	0.30	1.65

Table B-5 FSP Comprehensive Measure Level Cost Effectiveness Results

Measure	PAC Ratio	TRC Ratio	PCT Ratio	RIM Ratio	MTRC Ratio
Auto Closer - Cooler Doors	0.36	0.36	1.00	0.16	0.36
Combination Oven	0.35	0.35	1.00	0.16	0.35
Convection Oven	0.33	0.33	9.90	0.16	0.33
Hot Food Holding Cabinet	0.28	0.28	1.00	0.15	0.28
Ice Machine	0.30	0.30	5.73	0.15	0.30

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
Kitchen Hood DVC	0.36	0.36	25.05	0.17	0.36
Refrigerator/Freezer	0.33	0.33	1.00	0.16	0.33

Table B-6 FSP POS Measure Level Cost Effectiveness Results

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
Ice Machine	0.16	0.18	0.00	0.10	0.18
Convection Oven	0.09	0.18	0.00	0.07	0.18
Hot Food Holding Cabinet	0.11	0.18	0.00	0.08	0.18
Steamers	0.14	0.15	4.95	0.10	0.15
Refrigerator/Freezer	0.16	0.18	0.00	0.10	0.18

Table B-7 LADWP Facilities Measure Level Cost Effectiveness Results

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
Lighting	0.26	0.25	0.00	0.15	0.25

Table B-8 LAUSD Direct Install Measure Level Cost Effectiveness Results

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
Lighting	0.33	1.93	34.28	0.16	1.93

Table B-9 SBD Measure Level Cost Effectiveness Results

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
New Construction	0.23	0.23	1.00	0.16	0.23
Modernization	0.23	0.23	1.00	0.16	0.23

Table B-10 Upstream HVAC Measure Level Cost Effectiveness Results

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
AC	1.29	4.24	9.18	0.36	4.24
HP	2.48	2.28	0.87	0.42	2.28
VRF	2.55	4.33	3.63	0.44	4.33

B.2. Residential Programs

Table B-11 CRP Measure Level Cost Effectiveness Results

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
Attic Insulation	0.55	0.55	1.51	0.38	0.55
Central Air Conditioner	1.15	0.86	1.60	0.59	0.86
Central Heat Pump	2.04	1.55	3.04	0.69	1.55
Cool Roof	1.56	0.11	0.13	0.68	0.11
Dual Pane Skylights & Windows	2.28	0.18	0.19	0.79	0.18
Pool Pump and Motor	0.46	0.50	2.82	0.19	0.50
Whole House Fan	1.48	0.58	1.96	0.32	0.58

Table B-12 EPM Measure Level Cost Effectiveness Results

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
Air Conditioner	1.10	1.32	13.55	0.56	1.32
Light Bulb	1.43	1.46	382.29	0.25	1.46
Power Strip	1.03	1.02	11.84	0.24	1.02
Refrigerator	0.48	0.82	7.64	0.21	0.82
Television	0.54	0.45	2.81	0.20	0.45
Thermostat	1.08	0.90	2.61	0.55	0.90

Table B-13 ESAP Measure Level Cost Effectiveness Results

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
Whole House	0.26	0.26	2.06	0.13	0.26

Table B-14 REP Measure Level Cost Effectiveness Results

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
Refrigerator	0.20	0.23	115.34	0.14	0.23

Table B-15 RETIRE Measure Level Cost Effectiveness Results

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
Refrigerator	0.01	0.01	5.31	0.01	0.01

Table B-16 RLEP Measure Level Cost Effectiveness Results

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
LED Kit	8.23	8.23	73.40	0.29	8.23

B.3. Cross-Sector Programs

Table B-17 ACOP Measure Level Cost Effectiveness Results

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
Commercial	0.80	0.78	2.34	0.34	0.78
Multifamily	0.83	0.79	1.82	0.44	0.79
Single Family	0.94	0.39	0.77	0.50	0.39

Table B-18 CAHP Measure Level Cost Effectiveness Results

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
Appliances	0.89	0.89	5.36	0.24	0.89
Heating & Cooling	0.77	0.77	1.92	0.46	0.77
New Construction	0.45	0.45	2.43	0.20	0.45

Table B-19 CSO Measure Level Cost Effectiveness Results

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
Plumbing Ordinances	11.45	11.45	0.00	0.31	11.45
Title 20/24	11.45	11.45	0.00	0.32	11.45

Table B-20 MFWB Measure Level Cost Effectiveness Results

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
Low Income	1.15	1.46	13.09	0.27	1.46
Non-Low Income	1.34	1.52	12.23	0.31	1.52