LADWP Concurrent Year 1 Evaluation

Fiscal Year 20/21

Submitted to:

Los Angeles Department of Water & Power

Prepared 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 2021/2022 (FY 21/22). This chapter summarizes the impacts from FY 21/22 and $94,448,012 in spending, achieving over 142 GWh in energy savings.

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.

Portfolio Performance Summary

Table ES-1 shows Ex-Ante and Ex-Post MWh savings and the realization rate for each program during FY 21/22. The overall MWh realization rate not including Codes, Standards, and Ordinances was 97%. 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 142%.

Table ES-1: FY 21/22 MWh Portfolio Performance Summary

Sector	Program	Ex-Ante MWh	Ex-Post MWh	Realization Rate
Non-Residential	Commercial Direct Install	8,287	9,480	114%
	Commercial Lighting Incentive Program	1,362	4,192	308%
	City Plants	2,672	2,841	106%
	Custom Performance Program	6,306	2,070	33%
	Food Service Program Comprehensive	123	102	83%
	Food Service Program Point-of-Sale	44,234	43,798	99%
	LADWP Facilities	32,059	29,681	93%
	LAUSD Direct Install	6,896	6,896	100%
	Saving By Design	13,328	15,433	116%
	Upstream HVAC	192	87	45%
Residential	Customer Rebate Program	14	14	100%
	Efficient Product Marketplace	82	116	142%
	Refrigerator Exchange	7,001	5,545	79%
	Refrigerator Turn-in and Recycle Program	8,070	7,999	99%
	Residential Lighting Efficiency Program	2,910	2,078	71%
Cross-Sector	AC Optimization Program	13,176	12,511	95%
	California Advanced Home Program	47	47	100%
	Codes, Standards, and Ordinances	192,011	194,331	101%
Total		338,769	337,224	100%
Total Excluding Codes, Standards, and Ordinances		146,758	142,892	97%

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

Sector	Program	Ex-Ante MW	Ex-Post MW	Realization Rate
Non-Reside	Commercial Direct Install	2.87	2.70	94%
	Commercial Lighting Incentive Program	1.34	2.39	179%

Sector	Program	Ex-Ante MW	Ex-Post MW	Realization Rate
	City Plants	0.51	0.54	106%
	Custom Performance Program	1.21	0.43	35%
	Food Service Program Comprehensive	0.00	0.01	-
	Food Service Program Point-of-Sale	5.88	5.82	99%
	LADWP Facilities	3.54	3.26	92%
	LAUSD Direct Install	7.65	7.65	100%
	Saving By Design	1.76	2.05	117%
	Upstream HVAC	0.02	0.01	45%
Residential	Customer Rebate Program	0.00	0.00	100%
	Efficient Product Marketplace	0.00	0.01	294%
	Refrigerator Exchange	0.50	0.40	79%
	Refrigerator Turn-in and Recycle Program	0.00	1.18	-
	Residential Lighting Efficiency Program	0.00	0.34	-
Cross-Sector	AC Optimization Program	0.00	9.04	-
	California Advanced Home Program	0.01	0.01	100%
	Codes, Standards, and Ordinances	0.00	32.58	-
Total		25.29	68.43	271%
Total Excluding Codes, Standards, and Ordinances		25.29	35.84	142%

Figure ES-1 shows Ex-Ante and Ex-Post energy savings and the realization rate for each program during FY 21/22, while Figure ES-2 shows Ex-Ante and Ex-Post peak demand impacts and the realization rate for each program during FY 21/22. Both figures do not include energy and demand impacts from Codes, Standards, and Ordinances.

Figure ES-1: FY 21/22 Energy Impacts Not Including Codes, Standards, and Ordinances

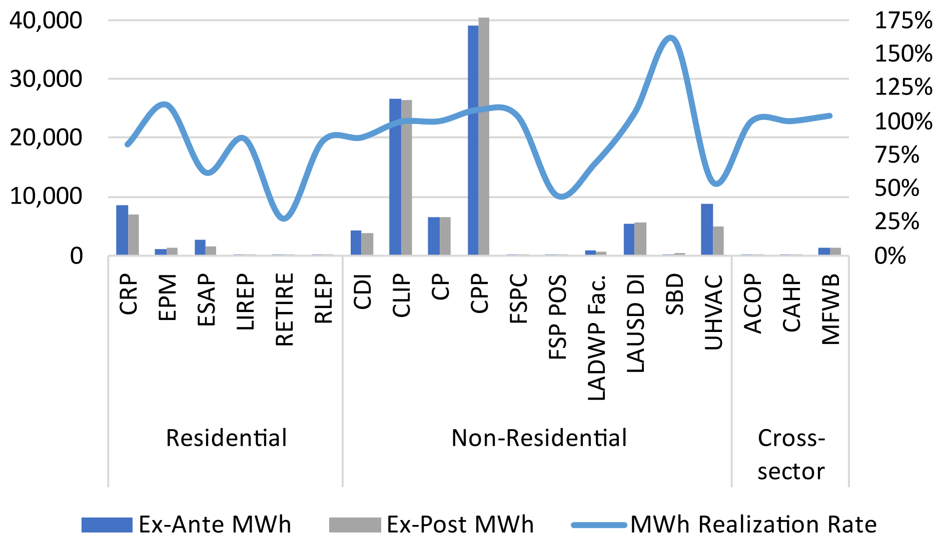
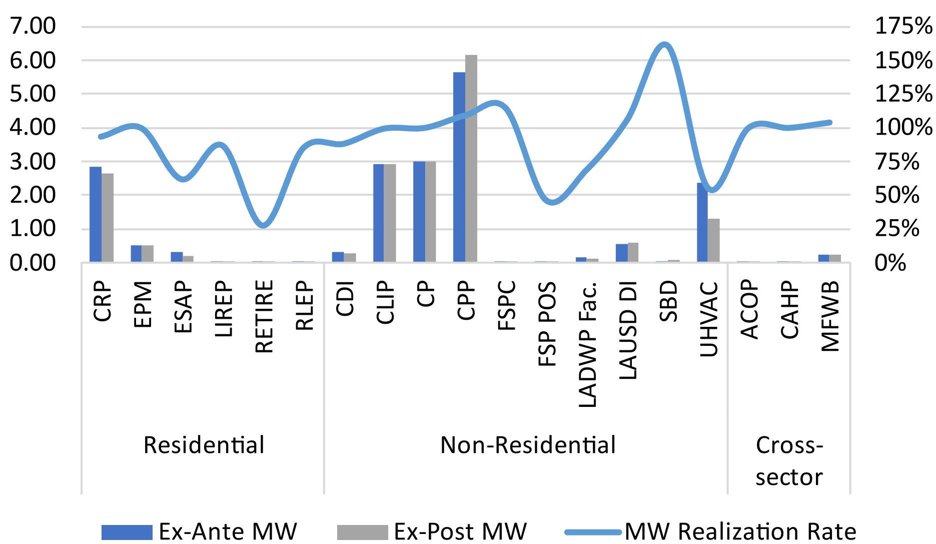


Figure ES-2: FY 21/22 Peak Demand Impacts Not Including Codes, Standards, and Ordinances



1 Introduction

This report is a summary of the evaluation, measurement, and verification (EM&V) effort of the portfolio of programs for the Los Angeles Department of Water and Power (LADWP) during Fiscal Year 21/22 (FY 21/22). The evaluation was administered by ADM Associates, Inc (herein referred to as 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) – which are 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 the 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 three years that highlights cost-effective electric potential savings from energy efficiency and established annual targets for electricity energy efficiency and demand reduction over ten years.

The California Energy Commission (CEC, or the Commission) was given the mandate to oversee the 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 1.1.3.

This plan is submitted in compliance with the CEC EM&V guidelines. In this plan, the Evaluator provides a description of the technical and economical reasoning including the 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 the 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 the 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:

1. For electric energy efficiency programs:
   1(a) description of each program by category (residential, nonresidential, new construction, cross-customer, and other);
   1(b) expenditures by program category, identified as administrative costs, delivery costs, incentive and installation costs, and evaluation, measurement, and verification costs;
   1(c) 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.
2. For demand reduction programs:

2(a) a description of each program;

2(b) expenditures associated with each program;

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

2(d) 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 and is based on the California Energy Commission EM&V Guidelines for Energy Efficiency Programs, "CEC Framework of Criteria" guidelines (Part D).

1.1.3.1 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.

1.1.3.2 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 the 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.

1.1.3.3 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 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.

1.1.3.4 Net Savings

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

1.1.3.5 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 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)

The Food Service Program (FSP) 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 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 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 the 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 features and details, popularity/review ratings, an Eco review, and locations 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 in 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, and 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

The RETIRE program is designed to target LADWP residential customers that have either made a retail purchase of a new refrigerator and/or those that have two 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 third-party contractor, ARCA, to administer the delivery of the program, while LADWP oversees and manages the program and rebate processing to the end-user 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, toward purchasing and installing 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 important 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 (POCP) 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 the US Department of Energy. The program was considered successful and was extended utilizing ratepayer funding. This program is a partnership between LADWP and selected nonprofit 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)

The Emerging Technology Program (ETP) was introduced to LADWP's portfolio to support increased energy and water efficiency, market demand, and technology supply by contributing to the 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 Methodology

1.3.1 Primary Data Collection

1.3.1.1 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 1-1 Summary of 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
MEO	7
PADP	4
PCOP	1

1.3.1.2 Participant Surveys

The Evaluator administered surveys to customers who participated in the following programs during FY20/21:

- Commercial Lighting Incentive Program (CLIP);
- Custom Performance Program (CPP);
- Food Services Program (FSP) – Comprehensive and Point-of-Sale;
- Consumer Rebate Program (CRP); and
- Efficient Products 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 the retrospective period. 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 FY20/21 and FY19/20 records to increase the probability of meeting the sample size target.

Table 1-2 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 Sample1	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.

1.3.1.3 Interviews with Program Partners and Market Actors

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

Table 1-3 Summary of 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 1-4.

Table 1-4 Process Evaluation Types and Research Objectives

Process Evaluation Type	Process Evaluation Objective
Technical	Evaluate energy-saving algorithms and criteria used in the 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 processes 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), and 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 FY20/21 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 Products Marketplace (EPM)
- Codes, Standards, and Ordinance Program (CSO)
- Emerging Technologies Program (ETP)

Additionally, full process evaluations began in FY20/21 for these programs. 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 FY20/21 for the following programs.

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

2 Commercial Direct Install Program (CDI)

This chapter summarizes the impact evaluation of the Commercial Direct Install Program (CDI) that LADWP offered customers during Fiscal Year 21/22 (FY 21/22 or Concurrent Year 2).

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

2.1.1 Key Evaluation Takeaways

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 community-based organizations (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 21/22	4,750	44,233,732	8103.33

The design of the CDI program is intended to maximize the electric, water and natural 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 4,750 CDI projects completed for FY 21/22, the project count was sourced from unique project IDs in the program tracking data. Table 2-2 summarizes 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
Exterior Lighting	8,368,173
Interior Lighting	32,605,350
Lighting With Sensors	3,260,208
Total	44,233,732

2.3 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 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, 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 235 measures consisted of 9 categories, or strata. The sample precision based on Ex-Post annual energy savings (kWh) is ±18.1%
- **Algorithms and references**

  - Generally, for projects involving lighting measures, savings were determined utilizing 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, and 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 in-person 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 for interior fixtures were less than the hours utilized by ex-ante. Conversely, the verified hours of use for exterior fixtures were greater than the hours utilized by the 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.

A detailed impact evaluation can be found in Appendix A, Section A.18.1.

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

2, the program level ex-post energy savings realization rate was 99% 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	Program Data Ex-Ante Peak kW Savings	Program Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
Lighting W/Controls 3	2,054,523	1,502,489	73%	477.63	353.68	74%
Lighting W/Controls 2	1,112,161	845,854	76%	244.08	274.92	113%
Lighting W/Controls 1	93,524	69,986	75%	22.45	24.92	111%
Interior Lighting 3	7,186,368	4,240,064	59%	1520.16	1370.55	90%
Interior Lighting 2	19,973,284	17,976,108	90%	4504.95	4593.36	102%
Interior Lighting 1	5,445,699	5,316,672	98%	1334.07	1270.94	95%
Exterior Lighting 3	4,831,133	7,566,988	157%	0.00	27.90	Indeterminate
Exterior Lighting 2	3,266,133	5,990,810	183%	0.00	6.74	Indeterminate
Exterior Lighting 1	270,907	288,929	107%	0.00	0.00	Indeterminate
Total	44,233,732	43,797,900	99%	8103.33	7923.00	98%

The sampled measures had a realization of 97% as seen below in Table 2-5, this was driven by ex-post hours and interactive effects. The sample realization rate was less than 100% because the Evaluator found that the lighting hours of operations were less than those used in the ex-ante estimation for interior fixtures. The hours the Evaluator used in the ex-post savings were sourced from information collected during site visits or from light loggers the Evaluator installed. Additionally, the average sampled ex-post IEFe was less than the those used by the ex-ante. 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 Measure Savings

Measures	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Sampled Measures	939,608	915,526	97%
Non-sampled Projects	43,294,124	42,882,374	99%
Total	44,233,732	43,797,900	99%

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 21/22	44,233,732	43,797,900	99%	8103.33	8031.98	99%

2.6 Process Evaluation

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

- Reviews of program documents and tracking data
- Interviews with program staff
- A survey of program participants
- Interviews and field research with Energy Service Representatives (ESRs)

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.1.3.

- The program serves a wide range of business types. ESRs noted that the wide range of customer types makes it difficult to characterize a “typical” participant.
- Vendors reported difficulty identifying eligible customers who exceed the 200 kW threshold requirement for participating in the program. The top business types, based on survey respondents, were retail/wholesale, nonprofits, manufacturing facilities, and real estate and property management businesses. Fifty-three percent of survey respondents reported that their business employs 10 or fewer staff, while 8% reported that the business location employs more than 100 staff.
- ESRs reported that 90-95% of canvassed businesses will agree to participate during the initial canvassing visit. Similarly, the mobile diary research indicated that all but 3 of the 20 respondents agreed to participate right away.

- The main barriers to participation noted by ESRs are ESRs difficulty reaching the decision-maker, language barriers, and mistrust of the offer. Mistrust is countered through providing information to the customer about how the program works and is funded.
- Overall, survey respondents were highly satisfied with all aspects of the CDI program, with each component of the program receiving a mean score of at least 4.4 out of 5. Ninety-three percent of participants were somewhat or very satisfied with the program overall.

Table 2-7 summarizes the free ridership results for CDI. The free ridership rate for the program was 14%.

Table 2-7 CDI Summary of Free Ridership Estimate

Free Ridership Estimate	Standard Error	Sample Size	Precision
0.14	0.10	104	+/- .16

2.7 Ex-Post Net Savings

The net-to-gross evaluation found a net-to-gross ratio of 0.86.

2.8 Cost Effectiveness Results

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	$1,475,119	$1,475,119	$9,022,747	$1,475,119	$1,475,119
Total Costs	$6,767,866	$3,874,607	$24,896	$12,872,459	$3,874,607
Benefit/Cost Ratio	0.22	0.38	362.42	0.11	0.38

2.9 Program Key Findings and Recommendations

- Evaluation results indicate minor impacts from differing hours of operation and interactive effects. Implementing the following would improve program realization rates:
    - Consider utilizing as-found hours. The project sites are visited by an ESR and a proposed activity report (PAR) is created, during this process lighting hours of operation can be gathered and used in the ex-ante calculation.

- Utilizing interactive effects from DEER workpapers. The workpapers offer more granular interactive effects values that are dependent upon various project-specific factors, such as building type, fixtures type, climate zone, and whether a space is conditioned. The PAR/SOW documents sometimes contain the heating/cool type, it could be made a standard practice to collect that information. The program tracking data, already contains the building type information, fixture type, and zip code (used for climate zone lookup).
    - Communicate to customers the pathway to participate in additional energy efficiency opportunities through LADWP. Currently, ESRs do not provide customers with information about other opportunities beyond the CDI program. The program should consider offering training overviews of other program offerings to ESRs so they can provide a more informed perspective to customers on what they might pursue next and incentives available. The program could also provide literature to customers on other programs, like the Customer Performance Program, Food Service Program, or Upstream HVAC Program.
- Perform additional marketing and outreach to non-English speaking audiences. ESRs note that sometimes they are challenged in reaching and communicating with business decision makers who do not speak English as a primary language. While the program offers flyers in Spanish and Korean, it should consider additional approaches. For example, the program could consider hiring or contracting with individuals within non-English speaking communities to perform outreach on behalf of the program. Alternatively, a stipend could be offered for community members to accompany ESRs during canvassing, make introductions, and help with translation. ESRs could also attend community events to build trust within communities. The program could also engage community organizations or leaders to understand how else they might be able to increase trust and participation in the program by their community members.
    - Proactively communicate the program process and project status to customers. While ESRs and customers are largely satisfied with the program and its operations, there are opportunities to improve communications with customers on the participation process and where they are in the process at a given time. The program could add a brief section to the CDI flyer that clearly lays out the steps in the participation process, along with estimates of how long each step may take. The program could also explore the possibility of sending customers automated emails as they move from one step in the process to another, and who to reach out to if they have additional questions.

3 Commercial Lighting Incentive Program (CLIP)

This chapter presents an evaluation of the Commercial Lighting Incentive Program (CLIP) that LADWP offered customers during Fiscal Year 21/22 (FY 21/22 or Concurrent Year 2).

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 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 21/22.

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 21/22	139	32,061,323	4,898.09

3.2 Methodology

The Evaluator performed a review of program tracking data for projects completed during FY 21/22. A stratified sample was created based on the project tracking data. The Evaluator performed on-site visits and virtual verification visits for sampled sites to gather information and data utilized to calculate energy savings for the sampled project. A detailed evaluation methodology can be found in Appendix A, Section A.2.1.

3.3 Impact Evaluation

The documentation provided by LADWP was reviewed for sampled projects. The ex-post energy savings and demand reduction values were determined using applicable 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 nine randomly sampled projects from FY21/22, 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. A detailed impact evaluation can be found in Appendix A, Section A.2.2.

3.4 Ex-Post Gross Savings

A sample of nine projects from FY 21/22 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 Evaluation Results by Strata

Stratum	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	Program Data Ex-Ante Peak kW Savings	Program Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
1	7,085	17,368	245%	2.20	2.07	94%
2	15,550	10,366	67%	1.78	1.78	100%
3	68,396	31,580	46%	7.81	8.00	102%
4	488,260	489,904	100%	64.95	68.80	106%
5	755,286	679,154	90%	91.23	122.74	135%
6	7,709,592	8,111,865	105%	1,269.49	-	0%
Total	9,044,169	9,340,237	103%	1,437.46	203.38	14%

Sampled projects resulted in a realization rate of 103% as seen below in Table 3-3. The primary factor driving savings discrepancies in the sampled projects were differing hours of use along with a difference in utilized interactive effects. Hours of use were determined by interview of site contact or by logging of installed lighting equipment, whereas the interactive effects were taken from applicable DEER workpapers, where climate zone, building type, and fixture type influenced the utilized value.

Table 3-3 FY 20/21 CLIP Sampled and Non-Sampled Project Savings

Project	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Sampled Projects	9,044,169	9,340,237	103%
Non-sampled Projects	23,017,154	20,347,430	88%
Total	32,061,323	29,687,667	93%

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 21/22	32,061,323	29,687,667	93%	4,898.09	4,309.78	88%

3.5 Process Evaluation

The Evaluator completed a summary evaluation that was limited in scope for CLIP. Findings are summarized in Appendix A, Section A.1.3. A full process evaluation was completed for FY 20/21.

3.6 Ex-Post Net Savings

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

Table 3-5 CLIP Ex-Post Net Savings Evaluation Results

Fiscal Year	Ex-Post Gross kWh Savings	Freeridership (kWh)	Net kWh Savings	Net-to-gross Ratio
FY 20/21	26,524,720	3,488,643	23,036,077	87%

3.7 Cost Effectiveness Results

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	$8,025,710	$8,025,710	$35,102,899	$8,025,710	$8,025,710
Total Costs	$12,830,599	$9,179,265	$2,053,013	$42,229,150	$9,179,265
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 come from different hours of use and utilized 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.

- Utilize multiple schedules for projects in which facilities may have multiple room types/different operating hours.

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. 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.

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 Custom Performance Program (CPP)

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 and peak demand impacts attributable to CPP.

4.1 Program Description

The non-residential CPP provides incentives for energy savings measures which include lighting, 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. Figure 4-1 summarizes the program's ex-Ante energy savings and peak demand reduction for FY 21/22.

Table 4-1 CPP Ex-Ante Savings Summary

Fiscal Year	Number of Projects	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 21/22	134	13,327,718	NA

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.

4.2 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, A.3.1.

4.3 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 EM&V efforts. Ex-post kWh savings and peak kW reduction were estimated using proven industry techniques. Important input parameters were based on information collected 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.3.1.9.

4.4 Ex-Post Gross Savings

Aggregated verified gross energy impacts from the sample (by project) were extrapolated to the population by measure. The evaluation sample was composed of 12 projects and an evaluation was completed for all sampled projects. Verified results from the evaluation sample resulted in a statistical precision of 18.80% at the 90% confidence interval for annual energy savings. However, the precision will be adjusted to 10% for the combined CY1, CY2 and CY3 sample next year. Program level results are shown in Table 4-2.

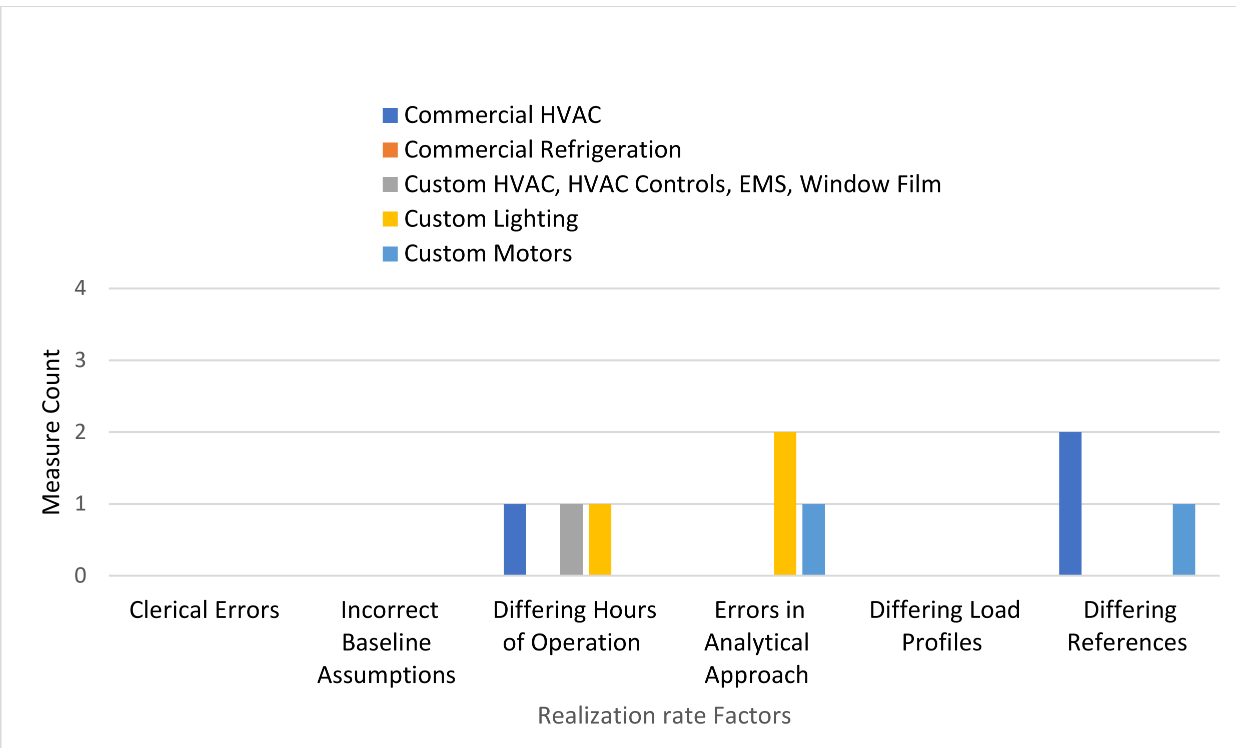
Table 4-2 CPP Evaluation Results by Measure

Measure	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	Program Data Ex-Ante Peak kW Savings	Program Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
Commercial HVAC	5,784,897	7,461,482	129%	1,930	2,540	132%
Custom HVAC, HVAC Controls, EMS, Window Film	3,915,977	4,158,226	106%	264	274	104%
Commercial Refrigeration	192,099	191,839	100%	9	0	0%
Custom Lighting	2,984,464	3,294,385	110%	1,314	1,870	142%

Measure	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	Program Data Ex-Ante Peak kW Savings	Program Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
Custom Motors	450,281	467,484	104%	61	59	96%
Total	**13,327,718**	**15,573,416**	**117%**	**3,578**	**4,743**	**133%**

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 the operating conditions of the installed equipment. This is a large factor in the evaluation finding of different load profiles. There were no clerical errors, incorrect baseline assumptions or differing load profiles. Most differences were found due to differing hours of operation and errors in the analytical approach. The impact of realization rate factors by measure category is shown in Figure 4-1.

Figure 4-1 CPP Ex-Post Impacts by Measure Category



Program level ex-post savings results for the fiscal year are shown in Table 4-3.

Table 4-3 CPP Evaluation Results

Fiscal Year	Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate	Ex-Ante kW Savings	Ex-Post kW Savings	Gross kW Realization Rate
FY 21/22	13,327,718	15,573,416	117%	3,578	4,743	133%

4.4.1 COVID-19 Impacts on Energy Use

Based on the information the Evaluator collected on COVID-19 impacts on the facility or equipment operation, no significant impact was found. Therefore, COVID-19 impacts were not calculated for CPP. The COVID-19 Era Impact on Ex-Post Gross Energy Savings are presented in Table 4-4.

Table 4-4 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]
Commercial HVAC	7,461,482	7,461,482	0	0.00%
Custom HVAC, HVAC Controls, EMS, Window Film	4,158,226	4,158,226	0	0.00%
Commercial Refrigeration	191,839	191,839	0	0.00%
Custom Lighting	3,294,385	3,294,385	0	0.00%
Custom Motors	467,484	467,484	0	0.00%
Total	**15,573,416**	**15,573,416**	**0**	**0.00%**

4.5 Process Evaluation

The Evaluator completed a summary process evaluation of CPP based on an interview with program staff. Additionally, the process evaluation included findings from interviews with program contractors that were not completed as part of the FY 20/21 process evaluation.

The key findings from the interviews with the program contractors are presented below. A detailed process evaluation can be found in Appendix A, A.3.2.

- Contractors integrate rebate offerings into their business sales process by regularly leveraging program rebates to sell jobs.

- Contractors would value any business marketing support LADWP could provide based on their participation in CPP. It would, in turn, help contractors attract more customers to participate.
- Contractors and their customers perceive LADWP's rebate amounts to be pleasantly high compared to other California utilities. However, contractors said the CPP application process can be more work.
- Most contractors we spoke with completed the rebate application for their customers.
- Contractors more often follow the custom track when calculating savings estimates; however, several contractors described experiencing challenges with custom savings calculations.
- Some contractors suggested incorporating electronic customer signatures into the rebate application process.
- When asked for feedback about the program name, contractors explained that if they weren't familiar with the program from their experience with it, they wouldn't understand what the program was about just by the name.
- Contractors continue to experience challenges related to COVID-19 safety restrictions that complicate and slow down project timelines. These include global supply chain impacts on equipment shipping timelines, changing or lowered quality of manufactured products, corporate safety policy, customer needs, and unexpected staffing issues due to illness.

Table 4-5 CPP Ex-Post Net Savings Evaluation Results

Fiscal Year	Ex-Post Gross kWh Savings	Freeridership (kWh)	Ex-Post Net kWh Savings	Net-to-gross Ratio
FY 20/21	42,487,610	20,961,887	21,525,723	51%

4.6 Cost Effectiveness Results

Table 4-6 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

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Costs	$12,832,924	$10,397,655	$5,096,313	$96,834,999	$10,397,655
Benefit/Cost Ratio	2.28	2.82	17.96	0.30	2.82

4.7 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, HVAC controls, lighting and motors related measures while refrigeration projects were the same as ex-ante savings.
- Realization rate factors included errors in analytical approach, differing hours of operation, and differing references. Clerical errors as well as incorrect baseline assumptions 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.
- Consider providing contractors with formalized, LADWP-backed rebate estimate approval letters after the pre-verification process that contractors can share with their customers. Ensure such letters include clear caveats that amounts might

change after post-verification testing, ideally referencing back to program documentation available publicly on the LADWP website.

- Host periodic contractor roundtables to gather feedback from participating contractors about their ideas on how LADWP might help them engage more customers in the program and validate their quality of work. Use this time to workshop with contractors ways to best go about doing that.
- Consider supporting contractors with marketing and customer engagement by showcasing success stories or case studies for a set of projects (and various contractors) that best represent the most prevalent industries across LADWP's service territory.
- Continue to assess program savings acquisition with current CPP rebate rates with careful consideration of contractor needs and satisfaction with the program. For example, establish regular interactions with contractors (like periodic roundtables or regular lunch and learns) to learn more about what specific elements of the program design be changed or made easier for contractors.
- Consider conducting a study to assess the usability of rebate application forms, online and written instructions, and technical support tools that the program provides. The findings from a usability study can help the program identify how to simplify and/or streamline elements of the process such as improving savings calculation tools, limiting technical jargon, and providing step-by-step instructions that are easy to understand.
  - Contractors made several references to what other utility companies were doing that they liked. These are reported throughout this memo. Consider conducting a benchmarking study to learn about and document what other utilities are doing with their custom programs.
- Ensure that all participants are receiving equitable savings rates for the same measures. For example, assess how often or for what express measures contractors do their own custom savings calculations and whether the program is awarding higher rebates to certain participants for flat rate express measures.
- Review how often the program adds new eligible measures or new express measures. Based on this review, determine how the program might:
- Make and inform contractors about these updates more frequently or more consistently.
- Manage contractor expectations for when measures will be added.
- Find ways to streamline and optimize communications about program updates. For example:

- Create regular lunch and learns or webinars with topics such as 1) Updates on new measures added, 2) Opportunities for contractors to suggest new measures to add, and 3) other updates to the program.
- Create and upload to the program website a how-to video that is both contractor- and customer-friendly about the rebate application process.
- Offer a recurring contractor-specific orientation/refresher on the rebate application process.
- To keep the program current and to increase satisfaction among both contractors and customers, adapt the program design to allow electronic customer signatures.
    - As program resources allow, consider assigning one staff contact to coordinate communications (i.e., application status updates, questions from savings calculation engineers, etc.) with each company or per job/rebate application.
- Develop an FAQs document addressing common questions from contractors and post it on the program website.
- Consider adding the word “rebate” to the program name.

5 Food Service Program – Comprehensive (FSPC)

This chapter summarizes the impact evaluation of the Food Service Comprehensive Program (FSPC) that LADWP was offered to customers during Fiscal Year 21/22 (FY 21/22 or Concurrent Year 2).

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.

5.1 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 5-1 presents the FY 21/22 ex-ante energy savings summary.

Table 5-1 FSPC Ex-Ante Savings Summary

Fiscal Year	Number of Projects	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 21/22	31	14,268	1.83

Table 5-2 summarizes the measures installed and ex-ante kWh savings associated with the measures.

Table 5-2 FSPC Program Data Ex-Ante Savings by Measure

Measures	Program Data Ex-Ante kWh Savings	Proportion of Ex-Ante kWh Savings
Ice Machine	2,650	19%
Refrigerator/Freezer	11,618	81%
Total	**14,268**	**100%**

5.2 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 5-3.

Table 5-3 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, verify installation, and determine operating parameters

LADWP provided the Evaluator with 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 3 projects consisted of 2 categories, or strata. The sample precision based on Ex-Post annual energy savings (kWh) is ±16.3%
- **Algorithms and references**
  - Generally, savings were determined utilizing 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 to the sampled sites. The site visits were used to verify equipment installation, and collect data regarding hours of operation, and other parameters that affected savings calculations.

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

5.3 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, unit size/capacity, operating characteristics, etc.) based on information either collected in person, referenced in project documentation or DEER workpapers and, specification sheets
- One main factor affected realized savings. The factor that decreased realized savings were offset by factors that increased savings resulting in an Ex-Post gross savings realization rate of 100%. Description of factors affecting gross realized savings are as follows:
  - 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.
  - In addition, the factors affecting realization rates for two of the three sites were indeterminate. When contacting the individual in charge of ex-ante calculations for this program, they stated "We provided the deemed savings information to Energy Solutions. The measures are not calculated individually. They are an average based on the qualified products in the category…The company we use, Frontier Energy, writes the white papers for the measures. Most of the info is in the eTRM and on the Energy Star website." ADM believes this "averaging" of the measures is responsible for site-level discrepancies and would explain how the measure level realization rates can vary while the overall program realization rate is 100%.

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

5.4 Ex-Post Gross Savings

This section presents ex-post gross savings for FSPC. Table 5-4 compares Ex-Post energy impacts to ex-ante claimed savings from the tracking data. For FY 21/22, the program level ex-post energy savings realization rate was 100% when comparing to tracking data ex-ante savings.

Table 5-4 FSPC Evaluation Results by Strata

Stratum	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	Program Data Ex-Ante Peak kW Savings	Program Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
IM (Ice Machine)	2650	2646	100%	.22	.38	171%
FF1 (Fridge/Freezer)	11,618	11,564	100%	1.31	1.3	99%
Total	14,268	14,210	100%	1.53	1.67	110%

The program level realization rate of 100% was driven by Project 2 and Project 3 as seen below in Table 5-5. Project 2 was the installation of four refrigerators or freezers. Project 5 was the installation of two ice machines and three refrigerators or freezers. The source of the small discrepancies between ex-ante and ex-post values is unknown but most likely to be due to the aforementioned "averaging" method of calculation.

Table 5-5 FY 20/21 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	427	353	83%
Project 2	1,810	1,837	101%
Project 3	2,064	2,095	102%
Non-sampled Projects	9,967	9,925	100%
Total	14,268	14,210	100%

Table 5-6 shows ex-post kWh savings compared to ex-ante. The program realization rate is 100%.

Table 5-6 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 21/22	14,268	14,210	100%	1.83	1.67	91%

5.5 Process Evaluation

The Evaluator completed a summary evaluation that was limited in scope for the FSPC program and the FSP POS programs. The evaluation findings are summarized in Appendix A, Section A.5.3.

5.6 Ex-Post Net Savings

The Evaluator had planned to use data collected through a participant survey to estimate the net savings impacts for the FSPCP program. However, only one participant responded to the survey and as such, it did not yield usable data. Therefore, the net-to-gross ratio was assumed to be 1.00.

5.7 Cost Effectiveness Results

Table 5-7 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	$92,191	$92,191	$309,399	$92,191	$92,191
Total Costs	$263,742	$263,742	$16,967	$556,173	$263,742
Benefit/Cost Ratio	0.35	0.35	18.24	0.17	0.35

5.8 Program Key Findings and Recommendations

The Evaluator offers combined key findings and recommendations for the FSPC program and the FSP POS programs.

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 by 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 POS 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 are tracked for all participants in the FSP. Currently, phone contact information is tracked for 96% of participants and emails are tracked for 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 supports 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.

6 Food Service Program – Point-of-Sale (FSP POS)

This chapter summarizes the impact evaluation of the Food Service Program Point of Sale (FSP POS) that LADWP offered customers during Fiscal Year 21/22 (FY 21/22 or Concurrent Year 12.

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.

6.1 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 customers 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 6-1 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 21/22	66	191,761	24.62

Table 6-2 summarizes the measures installed and ESP Ex-Ante kWh savings by measure.

Table 6-2 FSP POS ESP Data Ex-Ante Savings by Measure

Measures	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
Combination Oven	99,198	12.73
Convection Oven	8,393	1.08
Deck Oven	30,076	3.86
Hot Food Holding Cabinet	13,058	1.68
Ice Machines	3,421	0.44
Refrigerator/Freezer	18,893	2.43

Measures	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
Steamers	18,722	2.40
Total	**191,761**	**24.62**

6.2 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 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, verify installation, and determine operating parameters

LADWP provided the Evaluator with 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 15 projects consisted of 7 categories, or strata. The sample precision based on ex-post annual energy savings (kWh) was ± 26.84%.
- Algorithms and references
  - Generally, savings were determined utilizing 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, and 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.5.1.

6.3 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, unit size/capacity, operating characteristics, etc.) based on information either collected in person, referenced in project documentation, DEER workpapers, or specification sheets.
- Various factors affected realized savings. A description of factors affecting gross realized savings is provided below.
  - Incorrect Equipment Parameters: ex-post calculations utilized purchased unit's specifications such as volume, idle energy rates, cooking efficiencies, and production capacities in lieu of unknown values used in the Ex-Ante estimate.
  - Differing Efficient Specifications: 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.
  - Missing Equipment: A site visit found that the reported purchased equipment was not able to be located.
  - Indeterminate: The reasoning for discrepancies was unable to be determined.

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

6.4 Ex-Post Gross Savings

This section presents ex-post gross savings for FSP POS. Table 6-4 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 45% when comparing to tracking data ex-ante savings.

Table 6-4 FSP POS Evaluation Results by Strata

Stratum	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	Program Data Ex-Ante Peak kW Savings	Program Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
FF1 (Fridge/Freezers 1)	8,027	5,239	65%	.92	.73	79%
FF2 (Fridge/Freezers 2)	6,678	7,245	108%	.76	.77	101%
FF3 (Fridge/Freezers 3)	4,602	4,804	104%	.56	.55	98%
HFC (Hot Food Cabinets)	13,058	8,967	69%	3.83	.89	23%
ICE (Ice Machines)	3,007	1,372	46%	.32	.14	45%
Oven1 (Ovens 1)	8,393	1,563	19%	2.85	1.39	49%
Oven2(Ovens 2)	147,996	57,582	39%	32.42	20.68	64%
Total	**191,761**	**86,773**	**45%**	**41.66**	**25.15**	**60%**

The program level realization rate of 45% was driven by Projects 2, 6, 7, and 8 as seen below in Table 6-5. Projects 2, 6, and 7 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.

Analysis of Project 8 resulted in an energy savings realization rate of 49% and a discrepancy of 15,385 kWh in savings. This project was an electric steamer site where the Evaluator found the size of the efficient equipment to only be 12 pans. The ex-post calculations use the as-found parameters and they are as follows: pre-heat energy of 1 kWh, a convection idle energy rate of .95 kW, convection cooking efficiency of 81%, a convection production capacity of 127 lbs./day, a steam idle energy rate of .87 kW, a steam cooking efficiency of 59%, a steam production capacity of 236 lbs./ day and a water consumption rate of 16.1 gal/hour. The ex-ante site visit found the equipment to be operational nine hours per day and 24 days per year.

The ex-ante calculations use all default DEER workpaper values. In this case, this means with a size of 15-28 pans the parameters are as follows: pre-heat energy of 2 kWh, a convection idle energy rate of 2.5 kW, convection cooking efficiency of 70%, a convection production capacity of 125 lbs./day, a steam idle energy rate of 6 kW, a steam cooking efficiency of 50%, a steam production capacity of 200 lbs./ day and a water consumption rate of 25 gal/hour. The calculations also use values of 12 hours per day and 365 days per year.

Table 6-5 FSP POS Sampled and Non-Sampled Project Savings

Project	Tracking Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
Project 1	3,357	625	19%
Project 2	15,038	4,715	31%
Project 3	4,602	4,804	104%
Project 4	666	377	57%
Project 5	666	231	35%
Project 6	11,501	-	0%
Project 7	11,501	-	0%
Project 8	30,190	14,806	49%
Project 9	558	576	103%
Project 10	11,501	11,501	100%
Project 11	558	574	103%
Project 12	486	551	113%
Project 13	423	276	65%
Project 14	575	600	104%
Project 15	558	-	0%
Non-sampled Projects	99,578	47,135	47%
Total	**191,761**	**86,773**	**45%**

Table 6-6 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 6-6 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 21/22	191,761	86,773	45.3%	24.62	25.14	102%

6.5 Process Evaluation

A summary process evaluation for the FSPC and the FSP POS programs are combined and reported in Appendix A, Section A.5.3.

6.6 Ex-Post Net Savings

The Evaluator used market actor interview responses to assess the net impacts of the program. Based on the responses provided, the Evaluator assigned a free ridership score to each of the interview respondents. The responses were weighted using the assigned weight based on the number of incentive claims submitted. The program net-to-gross ratio was calculated as 1 – the free ridership ratio.

Overall, the program's net-to-gross ratio is 86.2%. The resulting ex-post net savings are presented below in Table 6-7.

Table 6-7 FSP POS Ex-Post Net Savings Evaluation Results

Fiscal Year	Ex-Post Gross kWh Savings	Freeridership (kWh)	Ex-Post Net kWh Savings	Net-to-gross Ratio
FY 20/21	53,952	7,456	46,496	86%

6.7 Cost-Effectiveness Results

Table 6-8 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	$34,824	$34,824	$166,732	$34,824	$34,824
Total Costs	$250,715	$203,117	$6,732	$363,117	$203,117
Benefit/Cost Ratio	0.14	0.17	24.77	0.10	0.17

6.8 Program Key Findings and Recommendations

The Evaluator offers the following combined key findings and recommendations for the Food Service Comprehensive and Point of Sale programs.

Key Findings:

- Ensure incentivized equipment is ENERGY STAR® certified.
- The program should utilize installed unit-specific specifications in lieu 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 POS program, 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 are 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 FSPC and FSP POS are combined and reported in sections A.4 and A.5 .

7 LADWP Facilities and Upgrade Program

This chapter summarizes the impact evaluation of the LADWP Facilities and Upgrade Program that LADWP offered customers from fiscal year 2021 through 2022 (FY 21/22 or Concurrent Year 2).

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

7.1 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 7-1 summarizes the program's ex-ante energy savings and peak demand reduction during fiscal year 2021/22.

Table 7-1 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
FY21/22	2	81,874	3.72

7.2 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 7-2.

Table 7-2 LADWP Facilities Data Sources for Impact Evaluation

Data	Source
Program Tracking Data	Data requested to LADWP for all data tracking program participation

Data	Source
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 21/22 LADWP Facilities program included two projects. For such a small population, all sites were considered for evaluation.
- **Algorithms and references**
    - For projects involving lighting measures, savings were determined utilizing 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. A detailed evaluation methodology can be found in Appendix A, Section A.6.1.

7.3 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
  - Data Entry Errors
  - Differing Baseline Assumptions
  - Differing Hours of Operations
  - Differing analytical approach
  - Differing Algorithm Input Selection

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

7.4 Ex-Post Gross Savings

This section presents ex-post gross savings for the LADWP Facilities Program. Table 7-3 compares ex-post energy impacts to ex-ante claimed savings from the tracking data for sampled sites only and Table 7-4 compares ex-post energy impacts to ex-ante claimed savings from the tracking data for the Fiscal year 21/22. For FY 21/21, the program level ex-post energy savings realization rate was 142% when comparing to tracking data ex-ante savings.

Table 7-3 LADWP Facilities Census Project Savings

Project	Program Data Ex -Ante kWh Savings	Program Data Ex- Post kWh Savings	Gross kWh Realization Rate
Project 1	10,568	6,828	64.6%
Project 2	71,306	109,412	153.4%
Total	**81,874**	**116,240**	**142%**

Table 7-4 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 21/22	81,874	116,240	142%	3.72	0.00	0%

7.5 Process Evaluation

The Evaluator completed a process evaluation of the LADWP Facilities Program in FY 20/21 and did not complete a process evaluation for FY21/22.

7.6 Ex-Post Net Savings

A net-to-gross evaluation was not performed for the LADWP Facilities Program. Therefore, the net-to-gross ratio was assumed to be 1.00.

7.7 Cost Effectiveness Results

Table 7-5 LADWP Facilities Benefit/Cost Test

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	$1,936,078	$1,985,102	$49,023	$3,390,060	$1,985,102
Benefit/Cost Ratio	0.26	0.25	29.66	0.15	0.25

7.8 Program Key Findings and Recommendations

The Evaluator performed on-site inspections at both facilities that included an effort to monitor lighting operating hours. Information collected on-site as well as project documentation and manufacturer specifications led to the verified savings reported by the Evaluator. Several reasons make up the difference between evaluated savings and reported savings estimates; 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. One noticeable difference is the ex-ante calculator appears to calculate annual operating hours by dividing the manufacturer’s expected life of the equipment by a predetermined number of years as opposed to operating hours representative of the facility.

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

- The methods of calculating energy savings estimates differ from lighting projects in other commercial programs. The Evaluator recommends using consistent methods with commercial programs such as the Commercial Lighting Incentive Program (CLIP).

- The Evaluator recommends the collection and management of project documentation in a consistent manner with other commercial programs, such as CLIP.

8 LAUSD Direct Install (DI) Program

This chapter summarizes the impact evaluation of the LAUSD Direct Install (LAUSD DI) Program that LADWP offered customers from fiscal year 2021 through 2022 (FY 21/22 or Concurrent Year 2).

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.

8.1 Program Description

The LAUSD DI Program was launched in October 2012 in response to the opportunities for energy savings 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 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 21/22.

Table 8-1 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 21/22	16	7,001,196	504.10

8.2 Methodology

This section presents the findings of the program 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 LAUSD DI Data Sources for Impact Evaluation

Data	Source
Program Data	Data requested to LADWP for all data tracking program participation

Data	Source
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 with the available program data for rebated measures. The evaluation methodology consisted of the following key components:

- **Program data review**
  - The database review process started with review of program 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 3 projects consisted of 4 strata.
- **Algorithms and references**
  - Generally, for projects involving lighting measures, savings were determined utilizing 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.

8.3 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.7.3.

8.4 Ex-Post Gross Savings

This section presents ex-post gross savings for the LAUSD DI program. Table 8-3 compares ex-post energy impacts to ex-ante claimed savings from the program data for sampled sites only. For FY 21/22, the program level ex-post energy savings realization rate was 79% when comparing to program data ex-ante savings.

Table 8-3 LAUSD DI Evaluation Results by Strata

Stratum	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	Program Data Ex-Ante Peak kW Savings	Program Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
Retrofit Exterior	1,060,820	1,168,868	110%	267.00	-	0%
Retrofit Interior	4,909,247	3,620,863	74%	1,328.12	896.08	67%
Sensor Exterior	274,445	264,848	97%	58.89	-	0%
Sensor Interior	756,685	490,556	65%	206.32	193.69	94%
Total	**7,001,196**	**5,545,134**	**79%**	**1,860.33**	**1,089.77**	**59%**

Table 8-4 compares ex-post energy impacts to ex-ante claimed savings from the program data by sampled project, and for the program overall. The evaluation effort included verification of 154 lighting measures across three schools. For FY 21/22, the program level ex-post energy savings realization rate was 79% when comparing to program data ex-ante savings.

Table 8-4 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	788,655	641,169	81%
Project 2	1,106,265	863,226	78%

Project	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Project 3	578,176	480,005	83%
Non-sampled Projects	4,528,100	3,560,734	79%
Total	**7,001,196**	**5,545,134**	**79%**

Table 8-5 presents comparisons of ex-ante and ex-post energy savings and peak demand reduction for the fiscal year. ex-post results are presented with 26% precision at the 90% confidence interval.

Table 8-5 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	7,001,196	5,545,134	79%	504.10	1,089.77	216%

8.5 Process Evaluation

The Evaluator completed a process evaluation of the LAUSD DI Program in FY 20/21 and did not complete a process evaluation for FY21/22.

8.6 Ex-Post Net Savings

Based on the responses from LAUSD staff, the Evaluator estimated the net-to-gross ratio for the program to be 1.0.

8.7 Cost Effectiveness Results

Table 8-6 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	$11,110,388	$1,925,272	$276,019	$22,892,233	$1,925,272
Benefit/Cost Ratio	0.33	1.93	76.96	0.16	1.93

8.8 Program Key Findings and Recommendations

Upon Evaluation site inspections, project documentation review, and a review of manufacturer specifications, ex-post savings are less than expected. The Evaluator found realization rate factors to include annual operating hours, impact of HVAC interactive effects, lighting controls savings factors, and differences in wattages and quantities.

- ADM offers the following recommendations for the LAUSD DI program:
- A long-term lighting monitoring study representing the county school district could be used to inform annual hours of operation for future evaluations, mitigating evaluation risk in hours of use.
- The methods of calculating energy savings estimates differ from lighting projects in other commercial programs. The Evaluator recommends using consistent methods with commercial programs such as the Commercial Lighting Incentive Program (CLIP).
- The Evaluator recommends the collection and management of project documentation in a consistent manner with other commercial programs, such as CLIP.

9 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 21/22 (FY 21/22). No LADWP Zero by Design (LADWP ZBD) projects were completed in CY2. 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.

9.1 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 9-1 summarizes the program's ex-ante energy savings and peak demand reduction for FY 20/21.

Table 9-1 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 21/22	29	8,069,550	-

9.2 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.8.1.

9.3 Impact Evaluation

This section presents findings from the determination of ex-post gross annual energy savings, lifetimes energy savings, and peak demand reduction through EM&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 impact evaluation can be found in Appendix A, Section A.8.2.

9.4 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 9-2.

Table 9-2 SBD Evaluation Results

Project Type	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	Program Data Ex-Ante Peak kW Savings	Program Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
Modernization	130,226	143,224	110.0%			
New Construction	7,939,323	7,918,154	99.7%			
Total	8,069,549	8,061,378	99.9%			

9.4.1 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. ADM has concluded that the typical year energy savings presented in Table 9-2 represent current and future operating conditions.

9.5 Process Evaluation

Launched in 2021, the LADWP ZBD program is relatively new. 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 22/23.

The summary process evaluation was performed for the LADWP ZBD Program, which can be found in Appendix A, Section A.8.3.

9.6 Ex-Post Net Savings

A net-to-gross evaluation was not performed for the SBD Program. Therefore, the net-to-gross ratio was assumed to be 1.00.

9.7 Cost Effectiveness Results

<Cost effectiveness results placeholder>

Table 9-3 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	$1,647,675	$1,647,675	$106,831	$2,398,359	$1,647,675
Benefit/Cost Ratio	0.23	0.23	8.03	0.16	0.23

9.8 Program Key Findings and Recommendations

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

- 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.
- For some projects, the provided energy model showed a run using the ”Nonresidential Title 24 Performance” calculation method. This method is slightly different from the ”NR SBD Performance”, which should have been used instead. It

is not possible to make this change later on, because, by doing so, the model generates inaccurate results. It is recommended to use the ”Nonresidential SBD Performance” calculation method for the SBD projects.

- For some projects, ADM was not provided with the energy models used to generate ex-ante savings and consequently, it wasn’t possible to verify the model directly. Alternative methods were used instead to calculate the Ex-post savings.
- 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.
- For some large projects, ADM verified the Lighting Power Density (LPD) for many different sections and found the provided plans fixture quantities and types calculated a lower LPD than stated in the EEM. This is likely because the lighting plans provided were incomplete and did not show all the lighting in the facility. For example, in some areas, the plans did not show several lighting fixtures that were discovered during the site visit.

10 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 21/22 (FY 21/22 or Concurrent Year 2, CY2).

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.

10.1 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 10-1 presents the number of projects, ex-ante energy savings and peak demand reduction.

Table 10-1 UHVAC Ex-Ante Savings Summary

Fiscal Year	Number of Measures	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 21/22	708	2,909,502	0

In FY21/22 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 21/22 evaluation included the equipment types summarized in Table 10-2. A large proportion of program reported annual energy savings are from VRF systems.

Table 10-2 UHVAC Equipment Type Summary

Stratum	Count of Measures	Program Data Ex-Ante kWh Savings	Proportion of kWh Savings	Program Data Ex-Ante kW Savings
VRF < 80	78	1,230,350	42%	559.62
AC < 5.4	109	377,159	13%	190.36
ACC < 150	9	297,003	10%	44.41
MSHP	348	270,986	9%	98.60
WSHP < 5.4	59	230,697	8%	107.40

Stratum	Count of Measures	Program Data Ex-Ante kWh Savings	Proportion of kWh Savings	Program Data Ex-Ante kW Savings
AC 5.4-11.3	47	223,497	8%	79.22
AC 11.3-20.0	13	130,008	4%	66.88
AC 20-63.3	5	53,460	2%	24.09
HP < 5.4	28	48,134	2%	27.63
ERV	2	25,935	1%	14.55
HP 5.5 - 11	4	13,357	0.46%	5.03
PTAC	6	8,914	0.31%	4.16
Total	**708**	**2,909,502**	**100%**	**1,221.93**

10.2 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;
- Database for Energy Efficient Resources (DEER) Workpaper review and analysis;
- Industry standard analysis; and
- Billing analysis.

The methodologies described in this section 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.9.1. Rates from DEER workpapers were used in lieu of the industry standard algorithms. This is because DEER workpapers are specifically applicable to California efficiency measures while industry standards are only defensible on a federal level. The industry standards are used as a benchmark to compare rates provided by the DEER workpapers.

10.3 Impact Evaluation

The Evaluator conducted an impact evaluation to determine ex-post annual energy savings, peak demand reduction, and lifetime energy savings for FY 21/22. 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.9.2.

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 general equipment type (AC, HP, ACC, VRF) as well as measure level system capacity as found based on the measure description. For example, the strata AC <5.4 means AC units with a capacity less than 5.4 tons. Evaluation results presented by detailed equipment type are shown in Table 10-3. The extrapolated results are presented with a +/- 39.08% precision at a 90% confidence interval.

Table 10-3 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	Program Data Ex-Ante kW Savings	Program Data Ex-Post kW Savings	Gross kW Realization Rate
VRF < 80	1,230,350	1,121,659	91%	559.62	519.28	93%
AC < 5.4	377,159	277,117	73%	190.36	118.61	62%
ACC < 150	297,003	146,878	49%	44.41	71.34	161%
MSHP	270,986	231,011	85%	98.60	105.93	107%
WSHP < 5.4	230,697	194,492	84%	107.40	114.80	107%
AC 5.4-11.3	223,497	26,523	12%	79.22	20.80	26%
AC 11.3-20.0	130,008	15,110	12%	66.88	16.09	24%
AC 20-63.3	53,460	6,296	12%	24.09	6.08	25%
HP < 5.4	48,134	40,580	84%	27.63	29.53	107%
ERV	25,935	3,220	12%	14.55	3.77	26%
HP 5.5 - 11	13,357	8,709	65%	5.03	4.84	96%
PTAC	8,914	6,550	73%	4.16	2.59	62%
Total	2,909,502	2,078,144	71%	1,221.93	1,013.66	83%

Table 10-4 shows results simplified into three equipment type categories.

Table 10-4 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
VRF	1,230,350	1,121,659	91%	0	519.28	NA
AC	1,115,976	481,694	43%	0	239.28	NA
HP	563,174	474,791	84%	0	255.10	NA
Total	2,909,502	2,078,144	71%	0	1,013.66	NA

10.3.1 Billing Regression

The evaluation samples resulted in 19 unique sites available for a billing regression. The Evaluator performed a data check to determine if a billing analysis was feasible. Upon cursory review, 18 of these sites were deemed unfit for a regression due to a combination of factors. For 13 of the candidate sites consumption data was not available in the online tool.

For the remaining 5 sites that failed the initial examination, the Evaluator found that the savings were significantly lower than 10%, the advised threshold as defined by the ASHRAE or because the meter configuration at the address could not be verified.

Multiple regressions were performed on the remaining site, which installed four air-cooled chillers. The variables used for these multi-variate regressions were HDD, CDD, a binary entry outlining whether the measure was installed or not (“Pre/Post”), HDD multiplied by pre/post, CDD multiplied by pre/post, a binary entry outlining whether it was the weekend, and finally a numerical entry tracking the number of days since the start of COVID. The Evaluator ran the regression multiple times, removing variables such as HDD due to their lack of correlation with consumption. However, when regressing on the bases of CDD, CDDxPre/Post, and Pre/Post versus energy usage, it was found that there was poor correlation between the remaining variables (p=.69 and .76 respectively) and the overall correlation (R2) was 0.156. The Evaluator determined that the billing regression results were not reliable based on the available information to use as variables.

10.3.2 EFLH Comparison

During a previous evaluation, the Evaluator performed energy simulations using eQuest to compare the EFLH available in the DEER workpapers. As an alternative approach for this evaluation, the Evaluator reviewed EFLH derived from previous evaluation samples from the Savings by Design program.

The Evaluator was able to review 41 relevant projects and classified each by their climate zone, building type, code year, and HVAC system if the information was available. These projects' EFLHs were estimated using the ratio of annual consumption with the standard peak demand as documented by LADWP. The EFLH for each classification was then compared with an appropriate DEER workpaper, and a relative percent difference (RPD) was calculated.

The Evaluator ended up with 23 unique classifications of climate zone, building type, and HVAC type (AC, HP, -*-*-*VRF). In most cases there are too few samples to draw significant conclusions. Results are shown in Table 10-5.

Table 10-5 UHVAC Equipment Type Summary

Facility Type	Climate Zone	Mechanical Systems	Number of Projects	SBD Code EFLH	DEER EFLH	Percent Difference
Airport	CZ6	AC	2	4,166	2,952	-41%
Grocery	CZ9	HP	1	4,504	4,914	8%
Hotel	CZ9	VRF	2	5,205	1,948	-167%
Hotel	CZ9	AC	1	4,109	1,668	-146%
Multifamily	CZ9	HP	9	3,924	NA	NA
Multifamily	CZ6	HP	1	5,935	NA	NA
Multifamily	CZ6	VRF	1	6,749	NA	NA
Office Large	CZ9	HP	2	3,558	2,645	-35%
Office Large	CZ9	VRF	2	4,714	NA	NA
Office Large	CZ6	VRF	1	6,476	2,649	-144%
Office Small	CZ9	AC	3	4,075	3,032	-34%
Office Small	CZ6	AC	1	3,800	2,966	-28%
Public	CZ9	HP	1	5,359	2,610	-105%
Public	CZ9	VRF	1	2,584	2,610	1%
Public	CZ6	HP	1	4,170	2,610	-60%
Refrigerated Warehouse	CZ6	HP	1	7,679	4,771	-61%
Refrigerated Warehouse	CZ9	AC	1	8,706	4,753	-83%
Retail Large	CZ9	AC	1	3,509	3,710	5%
School	CZ9	HP	4	2,159	2,294	6%
School	CZ8	HP	2	2,925	2,294	-27%
School	CZ9	AC	1	2,974	2,282	-30%
School	CZ9	VRF	1	2,931	2,294	-28%
Stadium	CZ8	VRF	1	3,871	2,824	-37%

10.4 Process Evaluation

The Evaluator completed a summary evaluation that was limited in scope for CLIP. Findings are summarized in Appendix A, Section A.9.3. A full process evaluation was completed for FY 20/21.

10.5 Cost-Effectiveness Results

Table 10-6 UHVAC Equipment Type Summary

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	$2,798,658	$1,567,359	$518,029	$14,504,939	$1,567,359
Benefit/Cost Ratio	2.21	3.95	25.97	0.43	3.95

10.6 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 to 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:

- Ex-ante estimates for some HVAC units appear to calculate savings from code to efficient condition as well as pre-existing condition to code. As the program design is based on influencing distributors and suppliers, the pre-existing equipment and replacement type is not known. The Evaluator recommends energy savings calculations from code to efficient condition.
- New workpapers have become available that may be relevant to future HVAC equipment claimed in the program. The Evaluator recommends that reported ex-ante savings estimates reflect recent DEER workpapers.

- 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 for all unique equipment.
- As baseline conditions become more efficient, better-than-code systems will continue to increase in complexity. The program already sees a 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.

11 Consumer Rebate Program (CRP)

This chapter presents an evaluation of the Consumer Rebate Program (CRP) that LADWP offered customers during fiscal year 21/22 (FY 21/22 or Concurrent Year 2).

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

11.1 Program Performance Summary

11.1.1 Key Evaluation Takeaways

- California Energy Commission adopted the US Department of energy (DOE) efficiency requirements for dedicated purpose pool pumps manufactured after July 19, 2021. Site visits found all pumps manufactured prior to 7/19/21 and the normal replacement baseline established as a two-speed pool pump motor, along with existing motor for early replacements. All the new variable speed pump motors were labeled with a weighted energy factor (WEF) that exceed the DOE minimum standard. The WEF specification is weighted by the low flow kgallon/kW energy factor x 80% use and the high flow kgallon/kW energy factor x 20%.
- For future program years, reduced savings is expected, as more pump motors manufactured after 7/19/21 can be expected, with savings determined by a normal replacement baseline, a variable speed pool pump with a compliant WEF.

11.2 Program Description

The CRP provides incentives to residential customers to promote the use of energy efficient equipment, including HVAC systems, attic/ceiling insulation, variable speed pool pump and motors, cool roof materials, energy efficient windows and whole house fans. In addition, the pool pump and motor measure offer and additional rebate for installation by a certified pool pump contractor. The program allows up to 12 months from date of purchase to complete the rebate application. 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 11-1.

Table 11-1 CRP Ex-Ante Savings Summary

Measure	Number of Orders	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
Attic Insulation	12,160	2,339,956	2,361.30
Central Air Conditioner	504	192,464	200.83

Measure	Number of Orders	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
Central Heat Pump	64	27,984	26.40
Cool Roof	724	880,309	1,600.56
Dual Pane Skylights	1	11	0.02
Dual Pane Windows	105	9,067	16.49
Pool Pump and Motor	5,787	4,835,666	1,525.24
Whole House Fan	4	1,696	3.12
Total	**19,349**	**8,287,153**	**5,734**

11.3 Methodology

The program evaluation was informed with programing tracking data and the collection of primary data. Primary data included participant surveys, and onsite visits for verification and metering of equipment usage. The data was used as either inputs to engineering algorithm measure savings or to guide a billing data analysis. The engineering analysis sourced the California eTRM based savings' algorithms, or the IPMVP Option A – retrofit isolation. Billing analysis included participant and non-participant bi-monthly usage data. 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 Appendix A, Section A.10.1. The following table summarizes the primary data collection.

Table 11-2 CRP Evaluation Methodology by Measure

Measure	Savings Calculation Method	Site Visits	Completed Participant Surveys
Attic Insulation	Billing Analysis	2	132
Cool Roof	Billing Analysis	-	51
HVAC	Billing Analysis	4	37
Variable Speed Pool Pump/Motor	IPMVP Option A	20	134
Energy Star Windows	Engineering Calculation	-	9
Whole House Fan	Engineering Calculation	-	0

11.4 Impact Evaluation

The energy and demand savings were determined by engineering algorithms or analysis of billing data. The billing data approach determined the savings for Attic Insulation, Cool Roof, and HVAC measures. The billing data retrofit isolation approach was selected over a PSM method as there was high probability comparison customers may not have comparable equipment installed. Bi-monthly billing data provided by LADWP was transformed to average daily usage due to the variable end date for billing periods among customers. The billing data was regressed with local weather data, and supplemented with prior program cycle periods when the participation was not high enough.

Site visit pool pump and motor metering data for the new equipment informed the IPMVP Option A analysis method, along with site data collected for the pre-existing equipment model nameplate data.

The savings for Energy Star Windows were determined by the algorithm published by CMUA based on the square feet of the installed window area.

The whole house fan utilized the DEER Resources' measure, "Whole House Fan, Residential", with inputs for home square footage from online residential data, along with model specification data.

A detailed impact evaluation is found in Appendix A, Section A.10.2.

11.5 Ex-Post Gross Savings

The summary of the participant surveys and residential site visits are listed in Table 11-3. All products were still installed at the time of the survey response. Most equipment replacements were Normal Replacements, except for pool pumps with 57% early replacement.

Table 11-3 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
Skylights	Whole House Fan					
Installed	100%	100%	100%	100%	100%	-
Early Replacement	0%	0%	3%	57%	0%	-
Responses	132	47	51	103	9	-
Precision	+/-0.10	+/-0.19	+/-0.20	+/-0.06	NA	NA

The energy savings and peak demand reduction are summarized in Table 11-4 and Table 11-5.

The program realization rate is 114% with 9,479,814 kWh savings. The program peak demand reduction totaled 2,654 kW, resulting in a 46% realization rate. The savings included the factor for the ISR rate of 100% for all measures supported by the participant survey, pool pump motor site visits, and attic insulation site visits.

Table 11-4 CRP kWh Evaluation Results

Measure	Quantity	ISR	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross Realization Rate
Attic Insulation	15,850,723 SF	100%	2,339,956	5,679,470	243%
Central Air Conditioner	523 units	100%	192,464	118,898	62%
Central Heat Pump	66 units	100%	27,984	24,803	89%
Cool Roof	2,000,703 SF	100%	880,309	359,797	41%
Dual Pane Skylights	24 SF	100%	11	154	1345%
Dual Pane Windows	20,607 SF	100%	9,067	111,576	1231%
Pool Pump and Motor	5,788 pumps	100%	4,835,666	3,183,405	66%
Whole House Fan	4 fans	100%	1,696	1,711	101%
Total		100%	8,287,153	9,479,814	114%

Table 11-5 CRP kW Evaluation Results

Measure	Quantity	ISR	ESP Data Ex-Ante kW Savings	ESP Data Ex-Post kW Savings	Gross Realization Rate
Attic Insulation	15,850,723 SF	100%	2,361.30	1,278.24	54%
Central Air Conditioner	523 units	100%	200.83	88.81	44%
Central Heat Pump	66 units	100%	26.40	8.78	33%
Cool Roof	2,000,703 SF	100%	1,600.56	155.72	10%
Dual Pane Skylights	26 SF	100%	0.02	0.01	29%
Dual Pane Windows	20,607 SF	100%	16.49	0.63	4%
Pool Pump and Motor	5,788 pumps	100%	1,525.24	1,120.69	73%
Whole House Fan	4 fans	100%	3.12	0.79	25%
Total		100%	5,734	2,653.66	46%

11.5.1 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 11-6 lists the first-year savings, and the savings for the remaining useful life, after the COVID-19 Era.

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

Measure	Typical 1st Year Annual Ex-Post kWh Savings (A)	COVID-19 Era 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	3,634,820	5,679,470	2,044,650	56%
Central Air Conditioner	63,842	118,898	55,055	86%
Central Heat Pump	15,436	24,803	9,367	61%
Cool Roof	236,439	359,797	123,359	52%
Dual Pane Skylights	109	154	45	41%
Dual Pane Windows	81,244	111,576	30,332	37%
Pool Pump and Motor	3,183,405	3,183,405	0	0%
Whole House Fan	1,711	1,711	0	0%
Total	**7,217,006**	**9,479,814**	**2,262,808**	**31%**

11.6 Process Evaluation

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

- Interviews with program staff
- Surveys of participating customers

The key findings are presented below.

- 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. The length of time to get the rebate and the communication from LADWP were both important drivers of overall program satisfaction. Program satisfaction had a moderately strong relationship with how favorably respondents viewed LADWP.

- Two-thirds of participants only spoke English at home. Among the remaining participants, Spanish (14.7%), Armenian (4.9%), and Persian (3.5%) were the most common languages spoken at home. We note that most participants (93.8%) either only spoke English at home or preferred LADWP communications to be in English. Spanish was the second most common language.

Detailed findings can be found in Appendix A, Section A.10.3.

11.7 Ex-Post Net Savings

Measure level net ex-post savings results for the fiscal year are shown in Table 11-7.

The program net-to-gross ratio of 78%, resulted in 7,413,967 ex-post net kWh savings. HVAC equipment had high free rider scores of 73%, indicating the many purchases would have been made without the program influence with similar timing of purchase for the majority of participants.

Table 11-7 CRP Ex-Post Net Savings Evaluation Results

Measure	Program Data Ex-Post Gross kWh Savings	Freeridership (kWh)	Ex-Post Net kWh Savings	Net-to-gross Ratio
Attic Insulation	5,679,470	1,022,305	4,657,166	82%
Central Air Conditioner	118,898	86,795	32,102	27%
Central Heat Pump	24,803	18,106	6,697	27%
Cool Roof	359,797	190,693	169,105	47%
Dual Pane Skylights	154	65	89	58%
Dual Pane Windows	111,576	47,141	64,435	58%
Pool Pump and Motor	3,183,405	700,349	2,483,056	78%
Whole House Fan	1,711	394	1,317	77%
Total	**9,479,814**	**2,065,847**	**7,413,967**	**78%**

11.8 Cost Effectiveness Results

Table 11-8 below summarizes the total CRP benefit/costs and ratios.

Table 11-8 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	$18,614,365	$18,614,365	$46,174,985	$18,614,365	$18,614,365
Total Costs	$33,205,918	$40,417,382	$35,596,973	$50,995,395	$40,417,382
Benefit/Cost Ratio	0.56	0.46	1.30	0.37	0.46

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

11.9 Program Key Findings and Recommendations

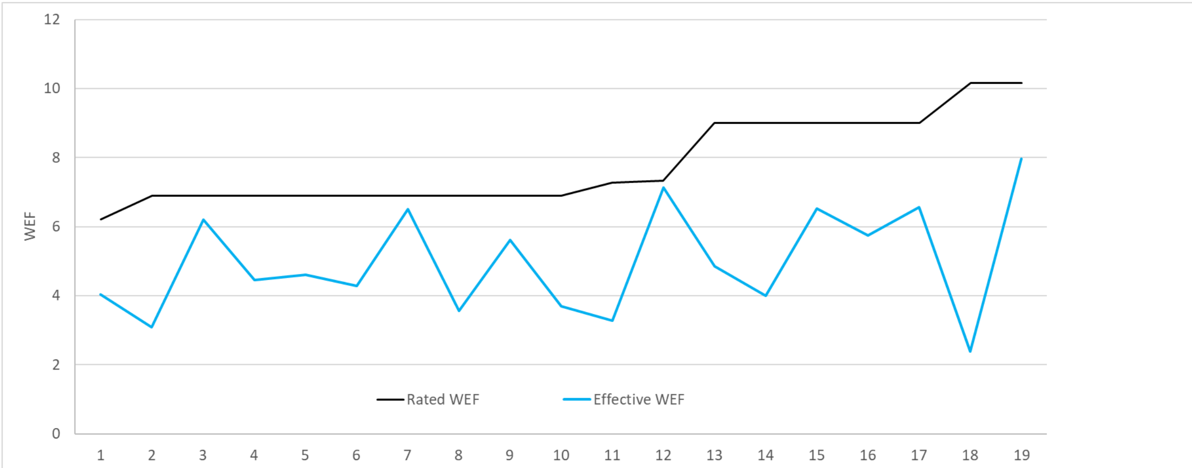
11.9.1 CRP Impact Key Findings and Recommendations

11.9.1.1 Pool Pumps and Motors

Pool pump and motor savings were primarily from the 58% of participants with early replacements based on survey responses of existing pump motor type and operating condition. The baseline for the remaining 42% with normal replacements was a two-speed pump motor. The California Energy Commission has mandated the efficiency level for motor capacity greater than 1 total horsepower since 2018. The difference in energy usage between the two-speed motor operating at 50% speed compared to a VSD motor operating at 30% speed is much less than full speed to VSD motor. The normal replacement baseline for CY3 may not produce any program energy savings, as the new requirement for pump motors manufactured after July 2021, mandates a weighted energy factor (WEF) that can only be achieved by a variable speed motor operating at low speed for 80% of its usage and high speed for 20% of its usage.

The following fixture aggregated the effective WEF from the site visit sample sites and compares the WEF to the minimum efficient WEF. All of the values on the Effective WEF trendline are less than their respective minimum efficient WEF.

Figure 11-1 CRP Pool Pump Motor Effective WEF to standard WEF



To meet the standard efficiency, the pump would need to run at the lowest speed for 80% of its operation and the remaining 20% of the time, could operate to full speed. Table 11-9 below summarizes the average motor speed/flow for each of its operating schedules. Nineteen pumps had at least one schedule with an average speed/flow of 73%, and fifteen of those also had a second schedule, averaging 60% flow and one had a third schedule at 55% speed/flow.

Table 11-9 CRP Pool Pump Site Visit Operating Speed/Schedule

Measure	Motor Speed/Flow	n
Schedule 1	73%	19
Schedule 2	60%	15
Schedule 3	55%	1

Although the certified pool pump measure specifies the pool pump programming to operate during non-peak demand periods, only 53% of the pool pumps were programmed to run only during off peak periods.

Table 11-10 CRP Pool Pump Peak Demand Scheduling

Measure	Motor Speed/Flow	n
Operates only night off peak	53%	39
Daytime peak and nights	5%	5
Only daytime peak period	40%	29

Most (93%) participants received both the VSD Pool Pump Motor incentive along with the Certified Pool Pump Replacement measure. The CPPR program addendum includes the pump scheduling requirement of operating only during the non-peak periods of 8:00PM-9:59AM and requires the installer to list the pump controllers' settings. Although only 53% of the program pool pump replacements operate solely during off peak periods, as determined by participant survey self-report data and from site visits; the non-certified pool pump replacements have a much lower program conformance ratio (13%). The CPPR program is influencing the peak demand savings over those pumps installed with the certified contractor, but also has an opportunity for improvement.

Table 11-11 CRP Pool Pump – CPPR Influence on Schedules

Measure	Survey responses and site visits	All schedules operate off peak	Percent operating only off peak
Non Certified Pool Pump Replacement	8	1	13%
Certified Pool Pump Replacement	64	37	58%
Total	72	34	53%

11.9.1.2 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 three-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 focusing on incentivizing the SRI values that greatly exceed code, and less on the minimum code compliant SRI roofing materials.

11.9.2 CRP: Process Key Findings and Recommendations

Consider providing program marketing and application materials in Spanish and other languages. Although the program materials are currently in English and participant survey was administered in English, the participant survey found that 34% of participants spoke a language other than English. Spanish was the most commonly spoken language (spoken by 14.7%). While the share of participants that prefer to speak a language other than English was small (about 6%), there may be a sizable customer base that would participate if materials were in a language other than English.

Continuing to focus on rebate processing time and communication to participants on rebate status may improve participant satisfaction. Time to get the rebate and communication from LADWP were the two factors that were most strongly predicted overall program satisfaction, and overall program satisfaction and communication from LADWP were strong predictors of how favorably participants viewed LADWP.

12 Efficient Products Marketplace (EPM)

This chapter presents an evaluation of the Efficient Products Marketplace (EPM) that LADWP offered customers during fiscal year 21/22 (FY 21/22 or Concurrent Year 2).

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

12.1 Program Performance Summary

12.1.1 Key Evaluation Takeaways

- The Light Bulb measure tracking data does not consider the lamp quantity per package.
- The participant survey identified higher percentage of incandescent replaced lamps.

12.2 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 for customers to make online purchases or allows customers to submit receipts for approved equipment to receive a rebate for the purchased equipment. The program implementer tracks their energy savings throughout the year, with the year-end savings and number of enrollments listed in Table 12-1.

Table 12-1 EPM Ex-Ante Savings Summary

Measure	Number of Enrollments	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
Air Conditioner	274	8,546	0.00
Light Bulb	3,106	69,430	0.00
Power Strip	31	11,236	0.00
Refrigerator	2,052	105,586	0.00
Television	4	477	0.00
Thermostat	5,167	1,167,043	0.00
Total	**10,634**	**1,362,318**	**0.00**

12.3 Methodology

The evaluation method for the impact savings is to first collect all available program tracking data, then determine the best approach for the determination of the energy and demand savings of each measure. Tracking data is supplemented with primary collected data from participants. The aggregated data is then used as inputs to engineering algorithms, to inform a billing analysis, or to estimate the energy and demand savings.

The summary of data types and their sources are listed in Table 12-2.

Table 12-2 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)
Model specifications; efficiency levels	Energy Star Database

A detailed evaluation methodology for engineering calculations and billing analysis can be found in Appendix A, Section A.11.1.

12.4 Impact Evaluation

Measure energy savings were determined by engineering analysis based on DEER Resources Workpapers or by utility billing analysis. A detailed impact evaluation can be found in Appendix A, Section A.11.2.

12.5 Ex-Post Gross Savings

The evaluation results for the energy and demand savings are summarized in the following table. The results are also listed again in this section by energy savings and then by demand savings with discussion of the realization rates.

Table 12-3 EPM Evaluation Results

Measure	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	Program Data Ex-Ante Peak kW Savings	Program Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
Air Conditioner	8,546	32,065	375%	0.00	0.06	>100%

Measure	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate	Program Data Ex-Ante Peak kW Savings	Program Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
Light Bulb	69,430	2,197,485	3165%	0.00	1738.80	>100%
Power Strip	11,236	9,682	86%	0.00	0.13	>100%
Refrigerator	105,586	121,030	115%	0.00	0.00	>100%
Television	477	114	24%	0.00	0.00	>100%
Thermostat	1,167,043	1,832,036	157%	0.00	741.05	>100%
Total	**1,362,318**	**4,192,411**	**308%**	**0.00**	**2,480.00**	**>100%**

Determination of the ex-post savings in the previous table included factors for the in-service rates to consider if the product was installed and functioning. A participant survey was administered with questions dependent on the measures that were incentivized. The responses from the participant survey are tabulated in Table 12-4 for the in-service rate and also the replacement type.

Table 12-4 EPM In-service Rates and Replacement Type

Operating Condition	Air Conditioner	Lighting	Powerstrip	Refrigerator	Television	Thermostat
ISR	93%	68%	100%	100%	100%	92%
Replacement Type: Early Replacement	13%	77%	33%	12%	N/A	94%
Total Responses	12	132	3	93	0	71

Ex-Post gross energy savings and their realization rates for each measure are listed in Table 12-5. Although there is a high variability in the realization rates among the measure types, the total program ex-post, first-year savings of 4,192,411 kWh has a 308% realization rate.

The primary contributor to the high rate is the measure Light Bulb with a 3,165% realization rate. There are two factors in the savings algorithm that influenced the annual energy savings. First, the quantity of lamps for the ex-post savings was much higher. The tracking data does not consider packaging that includes more than one lamp per package. The ex-post savings determined the quantity of lamps per package and updated the quantity input to the savings algorithm. The 35,992 Light Bulb packages in the tracking data were actually 141,527 lamps purchased by the participant. Secondly, the input to the algorithm for the base lamp wattage was higher, as the participant survey identified a higher percentage of replaced incandescent lamps, compared to CFL or LED lamps. Based on the 132 survey responses, 58% of the baseline consisted of incandescent lamps.

Table 12-5 EPM kWh Evaluation Results

Measure	Quantity	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross Realization Rate
Air Conditioner	283	8,546	32,065	375%
Light Bulb	35,992	69,430	2,197,485	3165%
Power Strip	53	11,236	9,682	86%
Refrigerator	2,059	105,586	121,030	115%
Television	7	477	114	24%
Thermostat	5,844	1,167,043	1,832,036	157%
Total	**-**	**1,362,318**	**4,192,411**	**308%**

Table 12-6 presents the measure types and ex-post peak kW reduction and ex-ante kW along with realization rates. The ex-ante peak demand was not listed in the ESP database, nor the tracking data.

Table 12-6 EPM kW Evaluation Results

Measure	Quantity	ESP Data Ex-Ante kW Savings	ESP Data Ex-Post Gross kW Savings	Gross Realization Rate
Air Conditioner	283	0.00	0.06	>100%
Light Bulb	35,992	0.00	1738.80	>100%
Power Strip	53	0.00	0.13	>100%
Refrigerator	2,059	0.00	0.00	>100%
Television	7	0.00	0.00	>100%
Thermostat	5,844	0.00	741.05	>100%
Total	**-**	**0.00**	**2,480**	**>100%**

12.5.1 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 12-7 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	21,013	32,065	11,052	53%
Light Bulb	2,206,868	2,197,485	-9,383	0%
Power Strip	10,205	9,682	-522	-5%
Refrigerator	121,030	121,030	0	0%
Television	100	114	14	14%
Thermostat	1,205,287	1,832,036	626,749	52%
Total	**3,564,502**	**4,192,411**	**627,909**	**18%**

12.6 Process Evaluation

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

1. Review of program tracking data
2. Interviews with program staff
3. Surveys of participating customers

The key findings are presented below.

- Most respondents (94%) were satisfied with the LADWP Efficient Product Marketplace. The program is working well for instant rebate participants and those who submitted for a rebate after purchasing the product they submitted.
- Nineteen respondents applied for a rebate for measures that had an instant discount available. Better pricing and perceived quicker times to get the measure were the main reasons customers purchased instant rebate measures without getting a rebate.
- Sixty-six percent of respondents were classified as promoters of the program – ease of use and the rebates were the most common reasons why these respondents would recommend the service to others.
- Most respondents preferred communications in English (92%), although a third of respondents spoke a language other than English. Two percent of respondents preferred to communicate in Spanish.

Detailed process evaluation findings can be found in Appendix A, Section A.11.3.

12.7 Ex-Post Net Savings

Measure level ex-post net savings results for the EPM Program are shown in Table 12-8.

The net to gross ratio for the program is 64% with 2,667,019 kWh in first-year net energy savings.

Table 12-8 EPM Ex-Post Net Savings Evaluation Results

Measure	Program Data Ex-Post Gross kWh Savings	Freeridership (kWh)	Ex-Post Net kWh Savings	Net-to-gross Ratio
Air Conditioner	32,065	16,470	15,595	49%
Light Bulb	2,197,485	813,038	1,384,446	63%
Power Strip	9,682	1,550	8,132	84%
Refrigerator	121,030	52,289	68,741	57%
Television	114	80	34	30%
Thermostat	1,832,036	641,965	1,190,071	65%
Total	**4,192,411**	**1,525,392**	**2,667,019**	**64%**

12.8 Cost Effectiveness Results

Table 12-9 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	$2,153,682	$2,153,682	$3,112,176	$2,153,682	$2,153,682
Total Costs	$2,087,601	$2,313,455	$854,065	$4,571,566	$2,313,455
Benefit/Cost Ratio	1.03	0.93	3.64	0.47	0.93

12.9 Program Key Findings and Recommendations

Consider providing program marketing and application materials in Spanish and other languages. Although the program materials are currently in English and participant survey was administered in English, the participant survey found that 35% of participants spoke a language other than English. Spanish was the most commonly spoken language (spoken by 13.9%). While the share of participants that prefer to speak a language other than English was small (about 8%), there may be a sizable customer base that would participate if materials were in a language other than English.

13 Energy Savings Assistance Program (ESAP)

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.

13.1 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 13-1 summarizes the program's ex-ante energy savings and peak demand reduction for the FY 20/21.

Table 13-1 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 13-2 provides a complete list of ESAP measure offerings for FY 20/21.

Table 13-2 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

Measure Category	Measures
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 13-3 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.*

13.2 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 is summarized below.

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

- Billing analysis approach

A detailed evaluation methodology can be found in Appendix A, Section A.12.1.

13.3 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 Appendix A, Section A.12.2.

13.4 Ex-Post Gross Savings

Table 13-4 summarizes the household-level ex-post kWh savings and peak kW reduction for FY 20/21.

Table 13-4 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 13-5 summarizes the program-level ex-ante and ex-post energy savings for FY 20/21.

Table 13-5 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	61.8%

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 13-6 summarizes the program-level ex-ante and ex-post peak demand reduction for FY 20/21.

Table 13-6 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	61.8%

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.

13.4.1 Gross Realization Rate Distribution by Measure

The Evaluators are unable to estimate gross realization rate distribution by measure for ESAP, as the impact analysis method is a whole-building billing analysis.

13.4.2 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, Section A.12.2.1.1. Table 13-7 below 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 13-7 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	40.64%

13.5 Process Evaluation

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

13.6 Ex-Post Net Savings

ESAP is a program intended for income-qualified participants. This type of program assumes a net-to-gross ratio of 1.00; therefore, ex-post gross savings are equal to ex-post net savings. Furthermore, The ESAP impact evaluation was based on a billing analysis. The billing analysis compares the energy use of the customers that received the rebated measures to a matched group of customers that did not receive rebated measures, therefore, the findings of the analysis represent the net savings impact and no additional net-to-gross adjustment is needed.

13.7 Cost Effectiveness Results

Table 13-8 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	$453,253	$453,253	$444,298	$926,202	$453,253
Benefit/Cost Ratio	0.26	0.26	2.06	0.13	0.26

13.8 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.

14 Low-Income Refrigerator Exchange Program (LIREP)

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.

14.1 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 rated 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 nonprofit customer. The old refrigerator must be a minimum size of 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 16 *Residential Lighting Efficiency Program*.

Table 14-1 presents ESP summary savings for the REP Retrospective Evaluation.

Table 14-1 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

14.2 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.

14.3 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.

Table 14-2 summarizes the full year UEC estimate for refrigerators during FY 21/22.

Table 14-2 REP Full Year Average UEC Estimates

Appliance Type	Average Full Year UEC
Refrigerator	1,192

Per-unit gross peak demand reduction for refrigerators for FY 21/22 is presented in Table 14-3.

Table 14-3 REP Per-Unit kW Reduction

Appliance Type	Per-unit kW Reduction
Refrigerator	0.099

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

14.4 Ex-Post Gross Savings

This section presents program-level ex-post gross energy savings and demand reduction for FY 20/21. Table 14-4 and Table 14-5 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 14-4 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	86.9%

Table 14-5 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	86.9%

14.4.1 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.

14.4.2 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.

14.5 Process Evaluation

The Evaluator completed a process evaluation of Low-Income Refrigerator Exchange Program (LIREP) that included the following activities:

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

A net-to-gross ratio of 1.0 was assumed for the LIREP, consistent with common practice for the evaluation of programs targeting low-income customers.

The key findings are presented below. A detailed process evaluation can be found in Appendix A, Section A.14.3.

The program has well established and effective procedures for enrolling customers. Residential customers sign up for the program using the online portal or through calling the ARCA call center. The call center is open six days a week and has the capacity to communicate with customers who speak Spanish or other languages. LADWP transmits data to ARCA for use in qualifying the customer for the program and there is a process for validating customers eligibility if they are not located in the transmitted data. Each residential customer undergoes a site inspection to verify that the unit qualifies, and that a three-pronged grounded outlet is available for the new unit. Ninety-five percent of residential participants were satisfied with the sign-up process and 91% were satisfied with the process of scheduling the replacement.

Institutional participants enroll by emailing LADWP program staff. An application is sent to the institutional participant. To keep the process streamlined, LADWP does not require any documentation of the applicant meeting the organizational qualifications, but instead uses a web search to verify that the organization qualified. Institutional participants were generally satisfied with the sign-up process (88% were somewhat or very satisfied) and the scheduling process (75% were somewhat or very satisfied).

Providing a confirmation of appointment scheduling for online sign-ups may reduce program staff time. Thirty-five percent of customers who signed up online stated that they contacted program staff to confirm when their appointment is scheduled. Sending a confirmation email to these customers may reduce the need for customers to contact program staff.

Program marketing is limited for institutional participants and post card mailings are the primary means of recruiting residential customers. Program staff reported that they do little marketing to institutional participants, and this is consistent with survey responses – most institutional participants had heard of the program through internet research or the LADWP website or by word-of mouth. LADWP staff have found postal campaigns to be an effective means of driving residential customer participation. The program has begun experimenting with promoting the program through their electronic newsletter as a means of driving participation at a lower cost than postal mailings. Most residential customers learned of the program through a mailing or by word of mouth.

ARCA has quality assurance procedures in place to ensure a positive customer experience. ARCA records customer calls and periodically engages in live-listens to maintain quality of service. Similarly, third-party field staff are also trained to provide quality service to customers. These efforts are reflected in survey responses – all customers that signed up by telephone reported that the representative they spoke with was courteous and could answer all of their questions. Additionally, 97% were somewhat or very satisfied with the appliance pickup and 96% though that the pickup crews were professional.

Procedures are in place to verify that appliances are operating and to prevent recycled appliances from being reused. Field crews verify that the old units are producing cold air and operating through on-site inspections. Ninety-three percent of survey respondents recalled that the field crew verified that the unit was operating. At the time of replacement, the old unit is rendered inoperable by destroying the cooling unit and cutting the cord.

Program data captures key appliance attributes. The program data captures the information needed to estimate the energy savings associated with removing the old appliances. The data may be enhanced by adding information on whether the participant is an institutional or residential participant to make it easier to track participation by channel in the future.

The program is reaching a diverse group of customers. Survey response indicate that 49% of participants identify as black or Hispanic/Latino/Spanish and that 34% speak Spanish at home. Fifteen percent identified as white and 9% identified as Asian. A sizable share, 23%, preferred not to provide information on their race or ethnicity.

Overall program satisfaction is high. The LIREP is a popular program among participants – 97% of residential participants and all institutional participants were satisfied with the program overall.

Survey responses suggest the LIREP is providing a needed service to residential customers. A plurality of respondents stated that they would be unable to replace the refrigerator if it stopped working (39%), and others stated they would need to finance a replacement (10%), try to find a used unit (8%), or contact LADWP for assistance (6%).

A majority of residential participants (64%) and all of the institutional participants agreed that they would have preferred more choice on one or more aspects of the new refrigerator they received. For residential participants, there was not any one aspect of the refrigerator that a majority of customers preferred additional choice – about one-half of respondents would have preferred more choice in features, color, size, and configuration, a third would have preferred more choice in brand. In contrast, brand was the aspect of the refrigerators that the most respondents would have preferred more choice for.

In addition to preferring more choice, some participants also indicated that they would be willing to pay more for that choice. About one-third of respondents indicated that they would prefer more choice and would be willing to pay more. Most of the respondents who would be willing to pay more would be willing to pay between $100 - $300 to have more choice. All of the institutional participants said they did not know if and how much more they would be willing to pay more.

14.6 Ex-Post Net Savings

REP is a program intended for income-qualified participants. This type of program assumes a net-to-gross ratio of 1.00; therefore, ex-post gross savings are equal to ex-post net savings.

14.7 Cost Effectiveness Results

Table 14-6 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	$562,546	$474,633	$2,888	$804,851	$474,633
Benefit/Cost Ratio	0.20	0.23	115.34	0.14	0.23

14.8 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.

Continue to offer a free, no cost to the customer replacement option if refrigerator choice is provided with a copay. The survey research indicates that 42% of customers would not prefer more choice in a unit and 34% would prefer more choice and be willing to pay more.

Consider tracking participant type. Currently the program data does not record participant type. Adding this information may be helpful to monitoring participation by the residential and institutional market segments.

Consider providing an email confirmation of appointment to customers who sign up online. ARCA does not currently provide an email confirmation of appointments, but 35% of online sign up said they contacted program staff to confirm an appointment.

Piloting room air conditioner recycling and replacement is worth consideration. Review of 2019 California RASS data indicates that there is some potential for replacing older room AC units in multifamily properties, albeit the potential may be somewhat limited. Adding this measure may fit well with the LADWP Cool LA initiative to offer high rebates for energy efficiency room and portable air conditioners and evaporative coolers. Replacing old room AC's may be best done in conjunction with replacement of old refrigerators to manage costs.

Consider adding leave-behind materials to educate participants on energy efficiency and other programs offered by LADWP. A goal of the program is to educate customers on energy efficiency. Leave-behind materials could include tips on how to save on energy costs and information on applicable programs such as HEIP.

15 Refrigerator Turn-in and Recycle Program (RETIRE)

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.

15.1 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 an 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 16 *Residential Lighting Efficiency Program*.

Table 15-1 presents ESP summary savings for the RETIRE Program Retrospective Evaluation.

Table 15-1 RETIRE Ex-Ante Savings Summary

Measure	Number of Projects	Ex-Ante kWh Savings	Ex-Ante Peak kW Savings
Air Conditioner	75	3,164	3.50
Freezer	124	241,304	46.22
Refrigerator	3,115	6,061,790	1,161.02
Total	3,314	6,306,258	1,210.74

15.2 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.

15.3 Impact Evaluation

This section presents an overview of the impact evaluation of the RETIRE Program 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.

Table 15-2 summarizes the full year UEC estimate for refrigerators during FY 21/22.

Table 15-2 RETIRE Full Year Average UEC Estimates

Appliance Type	Average Full Year UEC
Freezer	1,128
Refrigerator	1,192

Table 15-3 summarizes the part-use UEC estimate for refrigerators during FY 21/22.

Table 15-3 RETIRE Part-use Average UEC Estimates

Appliance Type	Average Full Year UEC
Freezer	654
Refrigerator	627

Per-unit gross peak demand reduction for refrigerators for FY 21/22 is presented in Table 15-4.

Table 15-4 RETIRE Per-Unit kW Reduction

Appliance Type	Per-unit kW Reduction
Freezer	0.08
Refrigerator	0.07

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

15.4 Ex-Post Gross Savings

This section presents program-level ex-post gross energy savings and demand reduction by fiscal year. Table 15-5 and Table 15-6 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 15-5 RETIRE kWh Evaluation Results

Measure	Quantity	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross Realization Rate
Air Conditioner	75	3,164	34,479	>100%
Freezer	124	241,304	81,058	33.6%
Refrigerator	3,115	6,061,790	1,954,324	32.2%
Total	3,314	6,306,258	2,069,861	32.8%

Table 15-6 RETIRE kW Evaluation Results

Measure	Quantity	ESP Data Ex-Ante kW Savings	ESP Data Ex-Post kW Savings	Gross Realization Rate
Air Conditioner	75	3.50		
Freezer	124	46.22		
Refrigerator	3,115	1,161.02		
Total	3,314			

15.4.1 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 six households that participated in the program.

15.4.2 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.

15.5 Process Evaluation

The process evaluation completed by the Evaluator of the Refrigerator Turn-in and Recycle Program (RETIRE) program included the following activities:

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

The Evaluator used participant surveys to estimate the net savings of the program.

The key findings are presented below. A detailed process evaluation can be found in Appendix A, Section A.15.3.

The program has well established and effective procedures for enrolling customers. Customers sign up for the program using the online portal or through calling the ARCA call center. The call center is open six days a week and has the capacity to communicate with customers who speak Spanish or other languages. LADWP transmits data to ARCA for use in qualifying the customer for the program and there is a process for validating customers eligibility if they are not located in the transmitted data. Screening of units is accomplished during the online or telephone enrollment process. Ninety-nine percent of residential participants were satisfied with the sign-up process and 95% were satisfied with the process of scheduling the pickup.

Post card mailings are the primary means by which the program is marketed. LADWP staff have found postal campaigns to be an effective means of driving residential customer participation. ARCA supports marketing through placement of Google Ads. The program has tried promotion through a retailer (Home Depot) but did not find that to be an effective means of increasing enrollments. Based on survey responses, the Google Ads and LADWP website appear to be key means of driving participation. Fifty-six percent of participants reported learning of the program through internet research and the website. In comparison printed, emailed or outreach materials sent by the program were a source of program awareness for 10% of respondents.

ARCA has quality assurance procedures in place to ensure a positive customer experience. ARCA records customer calls and periodically engages in live-listens to maintain quality of service. Similarly, third-party field staff are also trained to provide quality service to customers. These efforts are reflected in survey responses. All customers that signed up by telephone reported that the representative they spoke with was courteous and could answer all of their questions. Additionally, 97% were somewhat or very satisfied with the appliance pickup and 99% thought that the pickup crews were professional.

RETIRE and EPM are cross-promoted and a sizable share of RETIRE participants also participated in EPM during FY21/22. Fifteen percent (15%) of customers in RETIRE also participated in EPM. Moreover, 13% of customers who recycled a refrigerator through RETIRE also received an incentive for a new refrigerator through EPM.

Procedures are in place to verify that appliances are operating and to prevent recycled appliances from being reused. Program procedures are for participants to keep their unit plugged in at the time of pick-up and for field crews to verify that the old units are producing cold air and operating. However, 20% of respondents who interacted with the pick-up crews said the unit was not plugged in at the time of pickup. Additionally, 14% said that pick-up crew did not check that the unit was working.

Program data captures key appliance attributes. The program data capture the information needed to estimate the energy savings associated with removing the old appliances. The program does not capture appliance serial or model numbers.

Overall program satisfaction is high. RETIRE is a popular program among participants – 98% of participants were satisfied with the program overall.

The net-to-gross ratio was 52% for refrigerators. The net-to-gross ratio for freezers was 58% and 82% for air conditioners.

15.6 Ex-Post Net Savings

The RETIRE Program impact analysis is based on the Uniform Methods Project and the CA ARP part-use factors and counterfactual actions, which involve determining actions participants might have taken with the old refrigerator (keep or discard) in the absence of the program. As such, free ridership is calculated in the impact analysis and no additional net-to-gross adjustment is needed.

15.7 Cost Effectiveness Results

Table 15-7 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

15.8 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.

Revise estimated savings values to differentiate between the savings associated with refrigerators and freezers. Freezers typically have lower savings than refrigerators. The ex-post savings values should be used to update the estimated savings from appliances.

Review pickup procedures with field crew managers. Program procedures are for participants to keep their unit plugged in at the time of pick-up and for field crews to verify that the old units are producing cold air and operating. However, 20% of respondents who interacted with the pick-up crews said the unit was not plugged in at the time of pickup. Additionally, 14% said that the pick-up crew did not check that the unit was working.

Monitor savings over longer term but consider customer satisfaction benefits when assessing the viability of RETIRE. The age of appliance manufacture has increased since FY15/16, but not at a rate commensurate with the number of years that have passed. Nonetheless, as newer appliances are recycled the energy savings will decrease. The program should monitor these changes and continue to focus marketing efforts to target older appliances. When making decisions about the program, LADWP should consider the benefits of customer satisfaction. Appliance recycling programs tend to be popular with customers and participants in RETIRE were satisfied with the program overall. Additionally, because customers can participate without any cash-outlay, the program is accessible to a large number of customers.

16 Residential Lighting Efficiency Program (RLEP)

This chapter presents an evaluation of the Residential Lighting Efficiency Program (RLEP) that LADWP offered customers during fiscal year 21/22 (FY 21/22 or Concurrent Year 2).

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

16.1 Program Performance Summary

16.1.1 Key Evaluation Takeaways

The lifetime energy savings has a mid-life baseline shift as the normal replacement baseline lamp is compliant to CA Title 20 after the remaining life of the existing baseline lamp expires. The RUL was determined by an estimate of two baseline lamps stocked and the mix of incandescent lamps, CFL and LED from responses in the LADWP service territory from the 2019 Residential Appliance Saturation Study (2019 RASS). The midlife baseline shift with a baseline wattage determined by the CA Modern Appliance Database for GSL lamp certification. Future RLEP program years offering GSL lighting can expect reduced energy savings as the baseline mix of incandescent/halogen/CFL/LED lamps migrates to 100% LED.

16.2 Program Description

The RLEP program distributed LED lighting kits at zero cost to the participant in conjunction with the RETIRE and LIREP refrigerator programs. Two A19, medium base, LED screw in GSL lamps were left with the resident.

Table 16-1 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 21/22	3,533	122,996	-

16.3 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.

The General Population Survey completed in 2021 was leveraged for the savings algorithm inputs of annual hours of use, and interactive factors based on an interior or exterior installation, along with ISR. The baseline mix of incandescent/CFL/LED lamps were sourced from the 2019 Residential Appliance Saturation Study. The baseline mix was also compared to the recent EPM program participant survey for GSL lamps, with a similar mix, indicating that incandescent bulbs still have significant usage. A detailed evaluation methodology and impact evaluation can be found in Appendix A, Section A.16.2.

16.4 Impact Evaluation

The early replacement period energy savings were determined by the following equation with the $watt_{baseER}$ value developed from survey data for existing lamp technology from California Statewide Residential Appliance Saturation Study 2019 for the LADWP service area. The mix of interior and exterior GSL lamps was developed from the Retrospective Evaluation Period with the General Population Survey. The remaining useful life (RUL) for the early replacement savings is 2.8 years. This RUL was estimated with the life of two lamps in storage and the mix of incandescent, CFL and LED lamps from the 2019 RASS survey. After this period, the baseline shifts to a normal replacement base wattage. Data from the CA Modern Appliance Database filtered for JA8 standard compliance and Edison base, omnidirectional indicated the lowest 25th percentile lamps have a luminous efficacy of 88 lumens/watt. Applying this efficiency to the program lamp, produce an equivalent lamp of 13.2 watts for midlife. Gross energy savings and peak demand for the program were calculated using the following equations, respectively:

kWhEarly Replacement =

$$Kits\ x \frac{Lamps}{Kit} x\ (watt_{baseER}\ -\ watt_{eff})x \frac{1000W}{kW}\ x\ HOU\_w\ x\ ISR$$

Equation 16-1

kWhNormal Replacement =

$$Kits\ x \frac{Lamps}{Kit} x\ (watt_{baseNR}\ -\ watt_{eff})x \frac{1000W}{kW}\ x\ HOU\_w\ x\ ISR$$

Equation 16-2

$$kW = kWh_{savings}\ x\ CDF$$

Equation 16-3

Collected data for inputs to the savings algorithm are listed in Table 16-2.

Table 16-2 RLEP Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
$Kits_{ver}$	Quantity verified in tracking data to ESP data	RLEP tracking data	Variable
Lamps/kit	LED lamps per kit	RLEP tracking data	2

Variable Name	Input	Source	Value Range
HOU_w	Weighted Annual hours of use	RLEP General Population Survey, 2021	Interior: 716 hours Exterior: 2,884 hours HOUw: 1,060 hours
$Watts_{baseER}$	Early replacement: Weighted baseline mix of existing lamps	California Statewide Residential Appliance Saturation Study 2019	LADWP service area weighted baseline mix: 30 W
$Watts_{baseNR}$	Normal replacement: Lumen equivalent wattage	CA MAEDbs, 25th percentile lumens/watt and Mfg spec lumen range	13.2 W
$Watts_{efficient}$	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 & DEER Lighting Interactive Factors	Weighted by population of climate zone
RUL	Remaining Useful life	2 stored lamps x Lamplife/Annual Hours of Use	2.8 years
EUL	Effective Useful Life	DEER Resources	16 years

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

16.5 Ex-Post Gross Savings

Table 16-3 summarizes the FY 21/22 gross kWh realization rate for the RLEP by delivery channel. Table 16-4 show the overall kWh and peak kW realization rate for the program during FY 20/21.

Table 16-3 RLEP kWh Evaluation Results

Delivery Channel	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Deliveries with Refrigerators	122,996	98,030	79.7%
Total	122,996	98,030	79.7%

Table 16-4 RLEP kW Evaluation Results

Delivery Channel	Ex-Ante kW Savings	Ex-Post kW Savings	Gross kW Realization Rate
Deliveries with Refrigerators	NA	9.175	>100%

16.5.1 COVID-19 Impacts on Energy Use

The change in hours of use for the baseload energy usage in a home during the COVID-19 Era was estimated for each climate in the LADWP service territory by a utility billing analysis regression comparing the current fiscal year to the pre-installation period with the factors of heating load, cooling load and non-weather load. The values were weighted by the population in each climate zone, resulting in a hours of use factor of 0.96 for the baseload, which includes the lighting end-use. The factor was applied to the hours of use, resulting in the savings values in Table 16-5.

Table 16-5 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]
Lighting	102,259	98,030	-4,229	-4.1%

16.6 Process Evaluation

Door-to-door distribution of LEDs continued to be suspended during FY 21/22. As such, a summary process evaluation, based on an interview with the program manager and review of program data, was completed to understand the current status of the program.

- Door to door distribution has been on hold since 2020 due to COVID (although may start back up in 2023).
- The program provides bulbs for distribution during events that are typically run by community grantees. Each grantee can provide customers with one or more bulbs during their events.
- REP distribution has been ongoing. Each participant in the REP is provided with a kit that includes two bulbs. The number of kits being provided to customers depends on the number of actual refrigerators exchanged. From July 2021 through May 2022, REP handed out 3,422 kits (for 6,844 lamps and an estimated 119,114 kWh in savings).
- While there are not specific plans for the future of the program at this time, the most likely scenario would be to either continue the program with different bulbs (e.g.,

nightlights or candelabra) or shutter the program until a new technology comes forward.

16.7 Ex-Post Net Savings

The RLEP program offered lighting kits at zero cost to the participants. The net impact savings are equal to the gross impact savings.

16.8 Cost-Effectiveness Results

Table 16-6 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	$2,123	$2,123	$794	$59,628	$2,123
Benefit/Cost Ratio	8.23	8.23	73.40	0.29	8.23

17 Air Conditioning Optimization Program (ACOP)

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.

17.1 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); and
- Installation of smart, Wi-Fi enabled thermostat (for compatible residential systems only and if customer does not already have a smart thermostat; zoned systems qualify for only one free thermostat).

If the customer’s home is not Wi-Fi enabled, or if the customer would prefer not to have a smart thermostat installed, the Western Cooling Control can be installed as an alternative option at no charge to the customer.

Table 17-1 summarizes the ACOP ex-ante energy savings and peak demand reduction for FY 20/21.

Table 17-1 ACOP Ex-Ante Savings Summary

Fiscal Year	Number of Projects	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
21/22	33,053	13,174,595	0.00

17.2 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
  - 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
- Ex-Ante Savings Review
  - The tracking data delivered by LADWP and ESP data were sufficiently detailed and was categorized by building type
- M&V Approach
  - 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
- Billing Analysis Approach.
  - Billing analyses provide savings 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 detailed evaluation methodology and impact evaluation can be found in Appendix A, Section A.17.1.

17.3 Ex-Post Gross Savings

Table 17-2 summarizes the measure-level per-unit ex-post kWh savings and peak kW reduction for FY 21/22.

Table 17-2 ACOP Summary Ex-Post Per-unit Energy Savings

Measure	Per-unit Ex-Post kWh Savings	Per-unit Ex-Post Peak kW Savings
Commercial	855	0.24
Multi-Residential	345	0.20
Single Family	480	0.35
Mobile Home	480	0.35
Total	379	0.23

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 17-3 summarizes the program-level ESP ex-ante and ex-post energy savings for FY 20/21.

Table 17-3 ACOP kWh Evaluation Results

Measure	Quantity	ESP Ex-Ante kWh Savings	Ex-Post Gross kWh Savings	Gross Realization Rate
Commercial	446	415,631	381,251	91.7%
Multi-Residential	25,991	9,548,325	8,955,573	93.8%
Single Family	6,583	3,200,219	3,158,504	98.7%
Mobile Home	33	10,420	15,833	151.9%
Total	33,053	13,174,595	12,511,161	95.0%

Table 17-4 summarizes the program-level ex-ante and ex-post peak demand savings for FY 20/21.

Table 17-4 ACOP kW Evaluation Results

Measure	Quantity	ESP Ex-Ante Peak kW Savings	Ex-Post Gross Peak kW Savings	Gross Realization Rate
Commercial	446	0.00	106.56	NA.
Multi-Residential	25,991	0.00	5,164.04	NA.
Single Family	6,583	0.00	2,271.86	NA.
Undetermined	33	0.00	11.39	NA.
Total	33,053	0.00	7,553.85	NA.

17.3.1 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. Table 17-5 presents the COVID-19 Impacts to ACOP energy savings.

Table 17-5 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	431,669	381,251	-50,418	-12%
Multifamily	5,765,696	8,955,573	3,189,877	55%
Single Family	1,991,981	3,158,504	1,166,523	59%
Mobile Home	9,986	15,833	5,847	59%
Total	8,199,331	12,511,161	4,311,830	53%

17.4 Process Evaluation

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

- Reviews of program documents and program tracking data
- Interviews with program staff
- HVAC technician interviews and ride-alongs
- Surveys of program participants

The key findings are presented below. A detailed process evaluation can be found in Appendix A, Section A.17.1.5.

ACOP results in more tune-ups than would have occurred without it. Few tune-up recipients have ongoing air conditioning maintenance contracts and fewer than half reported ever having had their air conditioning tuned up. A large majority said that they did not have plans to have their air conditioning tuned up and/or did not have the funds to pay for a tune-up before learning about ACOP.

Despite the fact that the program website provides detailed information about program rules and requirements, some participants have incomplete or inadequate understanding of the program rules, requirements, and services. Such incomplete or inadequate understanding may lead to dissatisfaction (see Conclusion 4) or may prevent some tune-up participants from using the early replacement rebate to replace old and inefficient air conditioners, resulting in missed opportunities for savings.

ACOP technicians generally do a good job of explaining the tune-up process but may not communicate other valuable information effectively. Most may not advise their customers to visit the LADWP website for more information, but doing so significantly increases customer visits. Further, some may not effectively communicate to customers about the early replacement rebate for qualifying air conditioning systems or the availability or advantages of smart thermostats.

Although ACOP participants generally are satisfied with several program aspects and the program overall, it appears that some participants received subpar service. The fact that one in five surveyed respondents were sufficiently moved to provide a written complaint that the technician charged or attempted to charge them for services they believed were free, performed the service badly or in a rushed manner, or was rude or otherwise disrespectful or difficult to deal with is a matter of concern. As noted above, some of these responses may reflect incomplete or inadequate communication of the program rules and requirements, program services, or reasons for replacing an operating air conditioning system, but others seem to reflect improper behavior on the part of the technicians as well as lack of responsiveness from LADWP and/or the implementer.

Further, it appears that some dissatisfied participants do not receive adequate response to complaints made to LADWP and/or the implementer. Fewer than half the technicians that serviced surveyed participants accounted for nearly all the technician-related respondent complaints. Of particular concern, both respondents served by one specific technician reported that their air conditioning failed within two weeks after being serviced by that technician.

It is important to manage participants' expectations about the outcome of a tune-up. Relatively few participants observe a decrease in energy bills after their tune-up, even up to a year later. While many recognize that it may be too early to see a difference in energy bills after a few months, those who do not experience an energy bill decrease are less satisfied than others with the tune-up quality, their air conditioning performance, and their new smart thermostat (if one is installed). Lack of satisfaction with outcomes may prevent repeat participation, potentially undermining program savings in the long run.

17.5 Ex-Post Net Savings

The ACOP impact evaluation was based on a billing analysis. The billing analysis compares the energy use of the customers that received the rebated measures to a matched group of customers that did not receive rebated measures, therefore, the findings of the analysis represent the net savings impact and no additional net-to-gross adjustment is needed.

17.6 Cost Effectiveness Results

Table 17-6 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	$155,180	$208,801	$198,996	$339,523	$208,801
Benefit/Cost Ratio	0.83	0.62	1.66	0.38	0.62

17.7 Program Key Findings and Recommendations

In general, there's 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.

The recommendations based on the process evaluation findings are as follows.

- LADWP should revise the program website to list any potential costs that may be required. At a minimum, the website should make it clearer that participants may be charged for the refrigerant if more than two pounds are needed. Currently, the website states only that the program provides up to two pounds, and this is stated in small print that can easily be missed.
- LADWP and the implementer should work to ensure that all communication with signed-up customers should reiterate the program rules, requirements, and services, specifying what is and is not covered in the program.
- The implementer should revisit its training procedures to address the following: 1) technicians should advise ACOP participants to visit the program website and other LADWP websites for more information about this and other programs; and 2) technicians should always tell eligible participants about the early replacement rebate and explain that inefficient air conditioners waste energy even if they seem to be operating well.
- The implementer should seek information to explain why some contractors have a lower-than-average percentage of smart thermostat installations and consider provide additional training to ensure that such contractors are able to explain the benefits of smart thermostats to their customers.
- LADWP should provide participants with explicit information on whom to contact with any program dissatisfaction: this information should be provided on the program website and on any written communication with signed-up customers.
- The implementer should carry out a higher degree of QC for the technician associated with a higher-than-expected incidence of post-tune-up air conditioning failure. ADM will provide LADWP with the name of that technician.

- LADWP should provide participants with information to help manage expectations about the results of a tune-up, such as the fact that many factors may affect their energy bill from one month to the next.

18 City Plants (CP) Program

This chapter presents an evaluation of the City Plants Program (CP) that LADWP offered customers during Fiscal Year 21/22 (FY 21/22 or Concurrent Year 2).

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

18.1 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 important 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.

18.2 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 18-1.

Table 18-1 City Plants 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
Desk Review	Review of project documentation
On-Site Verification	On-site verification of a small sample of projects

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.
- On-Site Verification
  - On-site verification of a small sample of projects, using drive-by surveys, 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.18.1.

18.3 Impact Evaluation

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

- On-site verifications.
- 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.18.2.

18.4 Ex-Post Gross Savings

Table 18-2 shows ex-post kWh savings compared to ex-ante savings. The program realization rate is 100%.

Table 18-2 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 21/22	6,896,107	6,896,107	100%	n/a	n/a	n/a

18.4.1 COVID-19 Impacts on Energy Use

The Evaluator determined COVID-19 era impacts as shown in Table 18-3. 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 18-3 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 21/22	6,896,107	7,496,069	599,961	8.7%

18.5 Process Evaluation

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

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

The key findings are presented below. A detailed process evaluation can be found in Appendix A, section A.18.3.

- The program application and data tracking system may hamper the effectiveness with which LADWP and City Plants are able to manage the program. The online

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

application has several imperfections, which appears to result in lost opportunities for enrollments, a fact that both LADWP and City Plants contact recognized. Further, the data management system seems inefficient. Data from the three tree request channels (street, delivery, and adoption) are tracked separately, with no unique customer identifier for tracking participation across channels or for tying a given customer to multiple addresses. Further, there does not appear to be a mechanism for tracking whether a given request was for a residence or business.

- The ease of program participation and the personal benefits of shade trees, such as shade and the availability of fruit, are more influential arguments for program participation than are messages touting environmental benefits.
- Cross-program marketing and word of mouth are the most common individual sources of program awareness but, taken together, the City Plants activities are second only to LADWP cross-marketing.
- About one-third of recipients plant their trees too close to or too far away from structures for optimal energy savings.
- Although program satisfaction was generally high, there is some dissatisfaction with aspects of the tree delivery process, including the overall delivery time as well as lack of communication about tree delivery. City Plants staff understand the issue with the delivery schedule, which has been slowed because of staff turnovers.
- The current cap of seven trees per customer is reasonable, as most participants would not plant more trees if the cap were increased beyond seven.

18.6 Ex-Post Net Savings

A net-to-gross evaluation was not performed for the CP Program. Therefore, the net-to-gross ratio was assumed to be 1.00.

18.7 Cost Effectiveness Results

Table 18-4 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	$4,862,291	$4,862,291	$1,535,761	$23,915,720	$4,862,291
Benefit/Cost Ratio	4.84	4.84	13.41	0.98	4.84

18.8 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 18-5, 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.

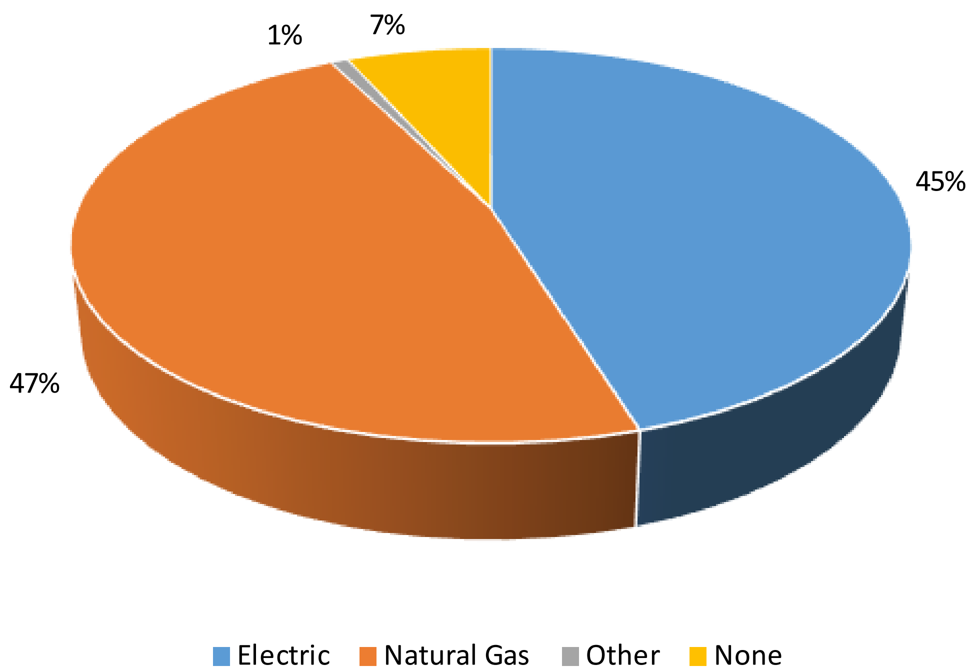
Table 18-5 Energy Saving Estimates by different Methods

Method/ Orientation	South	East	West	North	Average (Shade Only)	Climate Only
EcoLayers	not calculated	not calculated	not calculated	not calculated	41.3	14.9
i-Tree Design	64.4	42.70	96.2	44.2	61.9	not calculated
eQuest Simulation	44.5	59.2	92.5	25.6	55.5	not calculated
Secondary Research	25.0	25.5	41.5	not calculated	30.7	20.5
Average (2,3,4)	44.6	42.5	76.7	34.9	49.3	20.5

The ex-ante energy savings consider the summer savings only, due to the tree shade. Winter savings associated with the space heating, whether positive or negative, have been ignored. The shade 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 18-1, 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 18-1 Percent homes by heating source type



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.

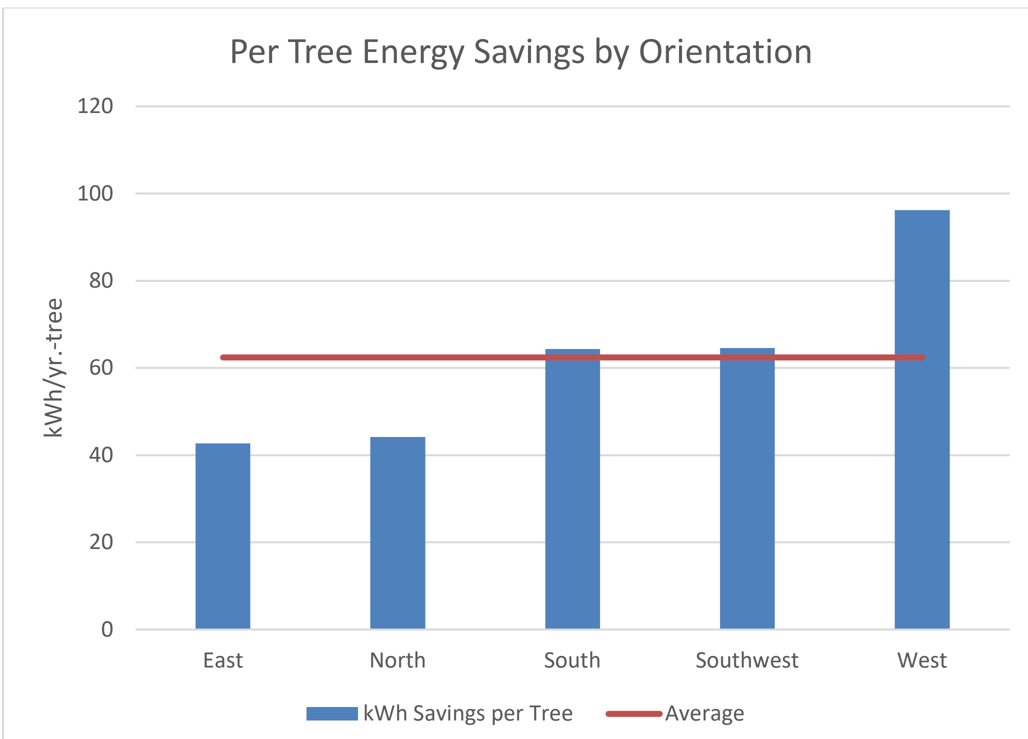
A building's physical characteristics will affect the building's cooling-energy use by lowering or raising it. In summer, trees block unwanted solar radiation entering the building and, if placed properly around the building, can reduce the cooling load; while in winter, tree shade can increase the heating load. Therefore, planting deciduous trees is most 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 18-2, the best orientation for planting a shade tree is west or south. 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.

Figure 18-2 Per Tree Energy Savings by Orientation



McPherson et al.[2] have reported that west trees produced greater annual cooling savings than east trees, which produced greater savings than south trees except in the South 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.

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

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[2]. 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 18-2 , 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 and do not shed their leaves in winter. Homeowners should be made aware of relevant economic benefits from selecting the right species that will optimize these benefits. Until and unless these home occupants can be shown the money they will continue to save with rational and predictable decisions, for the most part, they will ignore the energy conservation benefits from the shade trees.

Previous shade tree program impact evaluations found that energy savings are sensitive to tree growth and mortality rates (McPherson and Simpson[2]). 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 the annual mortality rate was 3.8%. The CP program considers 4.6% mortality for the first year and 3% per year thereafter. However, the reported energy savings are discounted by 10% every year to account for tree mortality.

Based on the on-site verification of a small sample of shade trees planted under the CP program, the Evaluator found that 68% of the planted trees were present and in good shape. The remaining 32% either died or there was no evidence of trees being planted. More information regarding on-site verification can be found under Appendix A, Section A.18.2. The Evaluator recommends conducting a program participant survey every three 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 the decision-making process on which species should be offered in the future.

- LADWP and City Plants should consider overhauling the application and data tracking systems to coordinate requests through different channels and at different times. At a minimum, this should include the use of a single unique customer identifier to be recorded with each request. In addition, the application should specify whether the request is for a residence occupied by the customer, a residence owned by the customer but occupied by someone else (e.g., renters), or a business. Such revisions will facilitate program management as well as evaluation.
- Program marketing and outreach should emphasize personal benefits and ease of participation over environmental benefits. The research indicates that the appeal of personal benefits influences customers more than environmental benefits.
- LADWP should continue cross marketing the program through the Home Energy Improvement Program and the Turf Replacement Program, but LADWP also should continue to support and fund City Plant’s promotion and marketing efforts.
- City Plants should consider approaches to increase recipient awareness of and compliance with the recommended planting zone. This may include revising applications to ask customers to commit to planting trees within the 5-to-20-foot zone. Research has demonstrated that asking for specific commitments can promote adoption of targeted behaviors.
- City Plants should continue to try to improve the tree delivery time but, at a minimum, should work at improving communication about the expected time. As part of this communication, City Plants should provide advance notice to participants about the delivery schedule when it is known.
- City Plants should leave the current cap in place as it provides as many trees as most customers want, discourages ordering more trees than customers will plant, and allows the program to distribute resources and trees to a larger number of customers. Most customers stated they would not plant more trees if the cap was increased.

19 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).

19.1 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 nonprofit 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.

19.2 Process Evaluation

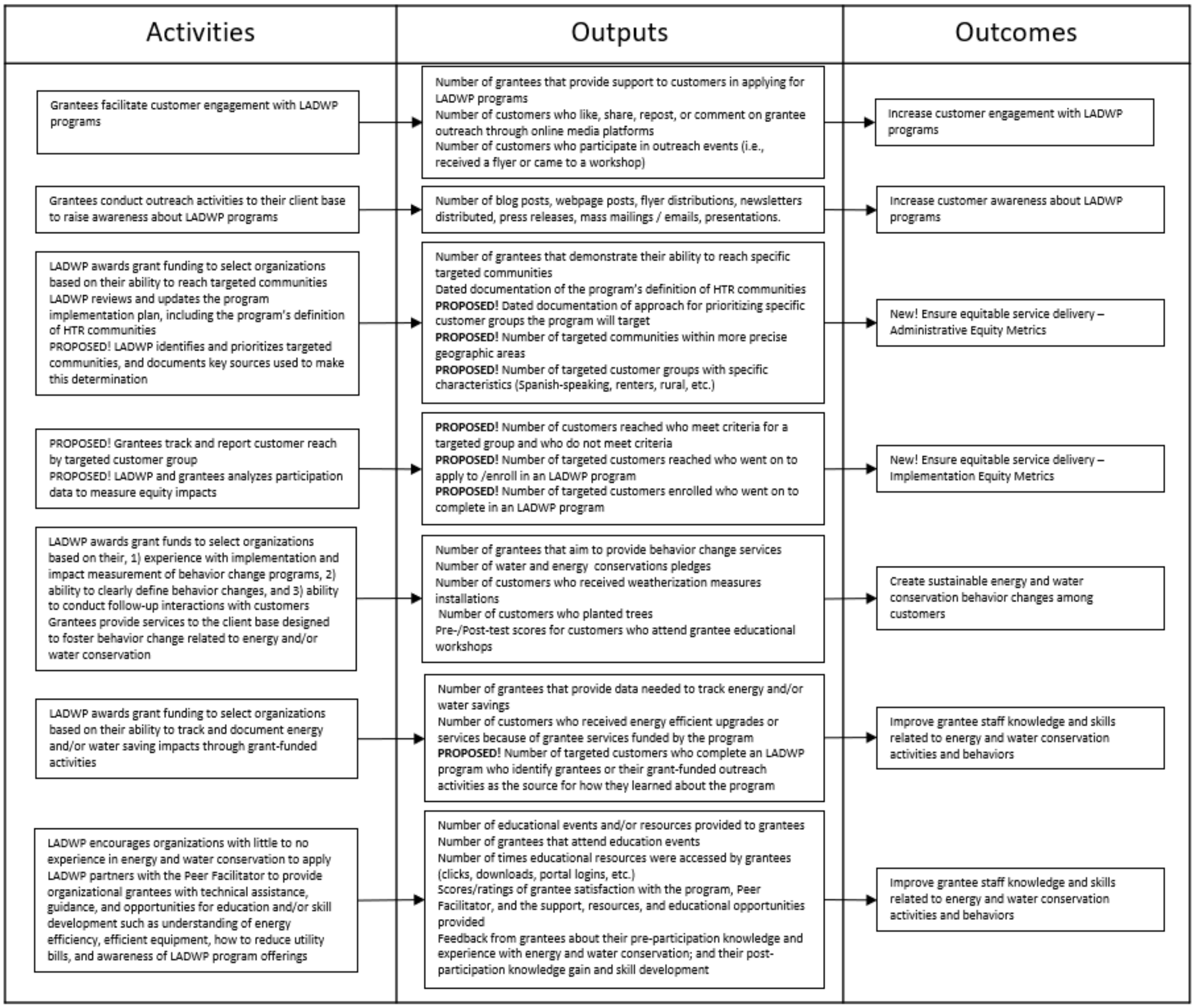
The Evaluator completed a process evaluation of the POCP that included the following activities:

1. Interviews with program staff.
2. Review of program materials and tracking data.
3. Interviews with program grantees.
4. Development of a baseline program theory logic model and program metrics.

19.3 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 19-1 and a more detailed logic model and program metrics are presented in Appendix A, Section A.19.3.5.

Figure 19-1 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
- 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 nonparticipant 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.

20 Codes, Standards, and Ordinances Program (CSO)

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 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 in Table 20-1 below.

Table 20-1 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

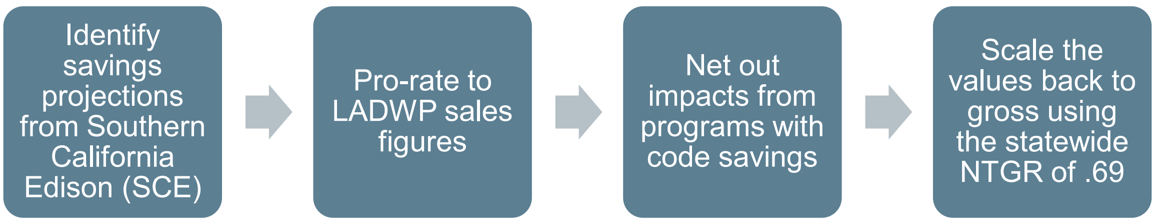
In addition, the CSO program incorporates impacts from the following Los Angeles ordinances:

- Plumbing Ordinances – Residential
    - Toilets: ≤ 1.28 gallons per flush (GPF)
    - Showerheads: ≤ 2.0 GPM
    - Urinals: ≤.5 GPF
    - Prohibited use of single-pass cooling systems
- Plumbing Ordinances – Non-residential
    - Urinals: ≤.5 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

20.2 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 FY14/15 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.

20.2.1 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

20.3 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.

20.3.1 Plumbing Ordinances

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

1. USEPA WaterSense estimates of a 12-15 year cycle of fixtures
2. Energy intensity of water taken from the Urban Water Management Plan (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	137.9%	178.40	245.97	137.9%

20.3.2 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, 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 LADDWP correctly pro-rated SCE codes and standards values to scale for the LADWP service territory; see Table 20-4.

Table 20-4 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	101.0%	26,002.67	26,250.91	101.0%

20.4 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	137.9	178.40	245.97	137.9%
Title 20/24	192,363,020	194,199,475	101.0%	26,002.67	26,250.91	101.0%
Total	193,682,780	196,019,094	101.2%	26,181.06	26,496.88	101.2%

20.4.1 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 impacts for LADWP is not feasible.

20.5 Process Evaluation

The Evaluator completed a summary evaluation that was limited in scope for CSO. Findings are summarized in Appendix A, Section A.20.2.

A full process evaluation was completed for FY 20/21.

20.6 Ex-Post Net Savings

A net-to-gross evaluation was not performed for the SBD Program. Therefore, the net-to-gross ratio was assumed to be 1.00.

20.7 Cost Effectiveness Results

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	$154,734,882	$154,734,882	$470,181,624	$154,734,882	$154,734,882
Total Costs	$13,513,217	$13,513,217	$0	$483,694,842	$13,513,217
Benefit/Cost Ratio	11.45	11.45	0.00	0.32	11.45

20.8 Program Key Findings and Recommendations

The Evaluator offers the following program recommendations:

- Develop and maintain additional program documentation, detailing CSO program processes and program roles; and
- Offer training sessions to Building and Safety code officials to improve compliance with codes and ordinances guidelines.

21 Emerging Technology Program (ETP)

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.

The program recently established a formalized workflow with National Renewable Energy Laboratory (NREL), designed to intake new technologies and ideas and evaluate them against program goals and enhanced technology screening.

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 summary evaluation that was limited in scope for ETP. Findings are summarized in Appendix A, Section A.21.2. A full process evaluation was completed for FY 20/21.

22 Marketing, Education, and Outreach (MEO)

This chapter presents the process evaluation of LADWP's Marketing, Education, and Outreach (MEO) that operated during fiscal year 20/21 (FY 21/22 or Concurrent Year 2).

22.1 Program Description

LADWP marketing efforts aim to increase customer awareness of energy efficiency, in general, 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.

22.2 Process Evaluation

The Evaluator completed a general population survey and additional surveys with program participants for the CY2 process evaluation activities. The general population survey was administered via email invitation in the summer and fall of 2022, resulting in 1,000 usable responses. The Evaluator also fielded several residential program surveys in CY2, including for the Refrigerator Exchange Program (REP), the Refrigerator Turn-in and Recycle Program (RETIRE), the Air Conditioning Optimization Program (ACOP), and the City Trees Program. Where relevant, comparisons and insights are also drawn from the results of these surveys.

22.3 Program Key Findings and Recommendations

With just 64% of the general population aware of LADWP programs—and 90% interested in learning more—there is still room to increase awareness with program opportunities and convert this awareness into participation. Additionally, while 76% of customers prefer to receive information on program offerings via email, LADWP should also carefully consider how its communication strategies serve different types of customers with varying needs and barriers. As LADWP continues to pursue increasing goals of decarbonization and equity, expanding awareness and familiarity with programs—and the strategies used to communicate this information—will be increasingly critical.

- **Recommendation:** LADWP should consider more clearly charting out the customer journey within and across programs opportunities to increase awareness and familiarity. The Evaluator's full process evaluation for MEO identified some initial considerations to improve the customer journey, and opportunities for MEO support. Beyond this, LADWP may wish to also consider how customers interact with different LADWP programs as they move along in their energy efficiency journey overtime. For example, if a customer first participates in the RETIRE program, how can LADWP help them to identify and take part in the next opportunity? Completing a portfolio journey mapping exercise would help to streamline the path for customers and create “handshakes” between programs.

- **Recommendation:** Identify opportunities to educate contractors and vendors about the full suite of LADWP programs. Contractors and vendors play an important role in educating customers about energy efficiency opportunities, especially when an appliance fails or when other renovations or repairs are being made in the home. Contractors are also actively in the field responding to customer needs on a day-to-day basis, making them ideal partners for LADWP programs. Arming them with information about additional program opportunities can support the customer in their energy savings journey, and boost program awareness and participation.
- **Recommendation:** LADWP should consider conducting a study to understand non-participant barriers and opportunities more deeply. Increasing goals of decarbonization and equity are prompting utilities across the nation to look more closely at how to best serve populations that they have not historically reached. If pursued, study research areas could include characterizing nonparticipants, investigating barriers to participation, and identifying engagement opportunities.

A small but notable proportion of customers learn about programs through community organization outreach. Of those customers aware of an LADWP program, about 14% said that they learned about it through community organization materials or email outreach. Nine percent of customers also say that they would prefer to learn about energy savings opportunities from community organizations.

- **Recommendation:** To support POCP metrics and impact assessment, consider tracking the incidence of customers learning about and participating in programs through local community organizations with more frequency and earlier in the participation process. This could be achieved by including a question on program applications asking how a customer heard about the program, and including an option to select local community organizations outreach or materials. Results could be supplied to POCP on a quarterly basis (or more frequently depending on ability) to better understand the effect of grantee activities overall on participation.

Program participation appears to have a positive effect on customer attitudes towards LADWP. This is good news as LADWP pursues goals like decarbonization and equity that require it to expand its reach and implement new approaches and strategies.

- **Recommendation:** LADWP should consider additional ways to increase access to program participation opportunities for its customers. MEO should also consider ways to offer support and coordination across resource programs to ensure efforts are aligned. Drawing from the full process evaluation recommendations delivered in March 2022, MEO could create an annual calendar of marketing promotions to consolidate and coordinate marketing efforts across the company, as well as develop a program theory and logic model to refine inputs, activities, and overall outcomes.

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[3]. 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[4].

[3] LADWP staff have also used other names to refer to the program, including the PA&D program and the Program Development program.

[4] 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

23.2 Process Evaluation

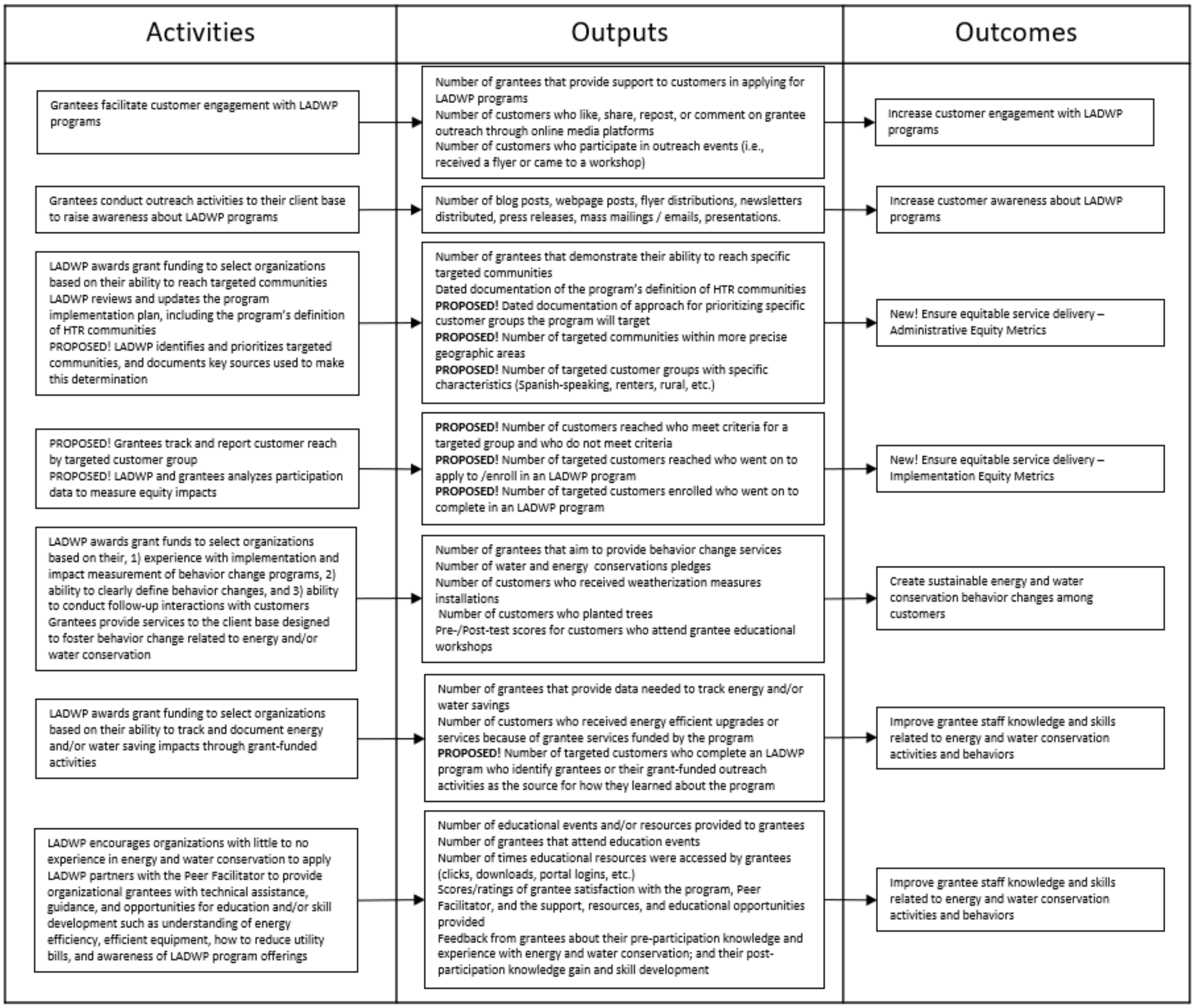
The Evaluator completed a process evaluation of the PADP that included the following activities:

- Interviews with program staff.
- Materials review and development of baseline logic model and process flow chart.
- 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. The baseline logic model is presented in section A22.2.1. A simplified version of the logic model is presented in Figure 23- and a more detailed logic model and program metrics are presented in Section A.23.2.

Figure 23-: Simplified baseline logic model for the PADP program



At the request of LADWP, the Evaluator identified metrics that would allow LADWP to classify PADP as a Market Support program. Section A.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.

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 ever-changing 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 Cost-Benefit Analysis

This chapter provides an overview of cost effectiveness for each LADWP program, verified kWh savings, annual administrative costs, total program costs, as well as a summary of the cost effectiveness analysis. Costs include program costs incurred in the implementation of the FY 20/21 LADWP energy efficiency portfolio from July 1, 2020, through June 30, 2021.

24.1 Cost Effectiveness Summary

The cost-effectiveness of ONG's PY2021 programs was calculated based on reported total spending and verified net energy savings for each of the energy efficiency programs. All spending estimates were provided by ONG. The Evaluator used incentive amounts from program tracking data. 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 came from the Arkansas Technical Reference Manual 8.0 (TRM). Additionally, assumptions regarding incremental/full measure costs were necessary.

Avoided energy, capacity, and transmission/distribution costs used to calculate cost-effectiveness were provided by ONG. Residential and commercial rates used to estimate certain cost-effectiveness tests were also provided by ONG.

Table 24-1 lists each program included in this analysis, along with the final verified net savings estimates, total expenditures, and Total Resource Cost (TRC) test results.

In addition to TRC results, results from the Program Administrator Cost Test (PACT), the Rate-payer Impact Measure (RIM) test, and Participant Cost Test (PCT) are included in the body of this chapter.

24.2 Cost Effectiveness Program Results

The LADWP FY 20/21 portfolio consisted of nineteen programs with verified gross kWh savings of 299,043,772. Total spending in PY2021 equaled $106,486,536. Table 24-1 provides a summary of program benefits and costs and cost effectiveness results for the TRC and PACT cost effectiveness results.

Table 24-1 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

Program	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
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
CSO	11.45	11.45	0.00	0.32	11.45
Portfolio Total	2.35	2.65	15.26	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 21/22.

A.1 Commercial Direct Install (CDI) Program

This section details the impact evaluation for the Commercial Direct Install (CDI) program that LADWP offered customers during FY 21/22. 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 2021 and June 2022 was provided by LADWP. The database was reviewed to ensure that the data provided sufficient information to calculate energy and peak demand impacts.

A.1.1.2 M&V Sample Design

A sample design was developed for measure level analysis utilizing the tracking data provided. The Evaluator selected a stratified sample for measures (known as ratio estimation) to represent the population of program. The FY 21/22 sample measures are enough to estimate the total achieved savings with ±18.1% precision at a 90% confidence interval. The Evaluator's previous sample (FY 20/21), current sample (FY 21/22) and future sample (FY 22/23) will in total be enough to estimate the total achieved savings with ±10% precision at a 90% confidence interval.

Measures were categorized to each stratum by ex-ante kWh savings and measure type. 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 measures sampled in each stratum were only extrapolated to other measures within that stratum. Table A-2 presents the number of measures and tracking ex-ante kWh savings for the sampled measures by stratum.

Table A-2:

Stratum	Strata Boundaries (Ex-Ante kWh)	Measures	Sampled Measures	Standard Deviation of Ex-Ante kWh Savings	Total Ex-Ante Annual kWh
Int_Light_Control_3	>5,000	126	13	16,027	2,054,523
Int_Light_Control_2	500 – 5,000	768	26	1,056	1,112,161
Int_Light_Control_1	<500	312	11	94	93,524
Int_Light_3	>5,000	706	8	9,641	7,186,368
Int_Light _2	500 – 5,000	14558	72	943	19,973,284
Int_Light _1	<500	23556	58	121	5,445,699
Ext_Light _3	>5,000	368	15	29,116	4,831,133
Ext_Light _2	500 – 5,000	1923	18	1,072	3,266,133
Ext_Light _1	<500	1013	14	115	270,907
Total	NA	43330	235	3,677	44,233,732

The resulting sample of 235 measures consisted of nine categories, or strata. The ex-post gross annual energy savings (kWh) precision is ±18.1%.

A.1.1.3 Baseline Assumptions Review

Generally, for projects involving lighting measures, savings can be determined as presented in Equation A-1 and Equation A-2 on the following page.

$$kWh = \frac{Watt_{base} * HOU_{base} * Qty_{base} - Watt_{installed} * HOU_{installed} * Qty_{installed}}{1000} * IEFe \qquad \text{Equation A-1}$$

$$\Delta kW = (Watt_{base} - Watt_{installed}) * CF * IEFd/1000 \qquad \text{Equation A-2}$$

Equation A-1 and Equation A-2 detail the algorithms used to determine energy savings and peak demand reduction for lighting measures.

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 Evaluator's comparison of 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 Population Statistics used for Sample Design

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
FY 21/22	44,233,732	44,233,732	0%	8103.33	8103.33	0%

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 for some sites install lighting loggers to monitor the lighting hours of use.
- 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 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. Lastly, for some sites lighting loggers were utilized and left in place for 3-4 weeks to monitor the lighting of use hours of sites that installed occupancy sensors.

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, logging data, and 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 21/22, the program level ex-post energy savings realization rate was 99% when compared to ex-ante savings.

Table A-4: CDI Concurrent Year 2 Stratum Savings Summary

Stratum	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Int_Light_Control_3	2,054,523	1,502,489	73%
Int_Light_Control_2	1,112,161	845,854	76%
Int_Light_Control_1	93,524	69,986	75%
Int_Light_3	7,186,368	4,240,064	59%
Int_Light _2	19,973,284	17,976,108	90%
Int_Light _1	5,445,699	5,316,672	98%
Ext_Light _3	4,831,133	7,566,988	157%
Ext_Light _2	3,266,133	5,990,810	183%
Ext_Light _1	270,907	288,929	107%
Total	44,233,732	43,797,900	99%

The program level realization rate of 99% was a result of the sampled projects seen below in Table A-5**Error! Reference source not found.** . Although the realization rate for some sampled sites was less than 100%, they were offset by some sites with realization rates greater than 100%.

Table A-5: CDI Concurrent Year 2 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	176,896	341,499	193%
Project 2	40,454	31,740	78%
Project 3	369,741	300,471	81%
Project 4	88,499	66,252	75%
Project 5	1,925	2,053	107%
Project 6	189,695	113,037	60%
Project 7	72,398	60,474	84%
Non-sampled Projects	43,294,124	42,882,374	99%
Total	**44,233,732**	**43,797,900**	**99%**

The Evaluator sample included seven projects. The specific factors affecting the projects' realized energy savings were as follows.

- **Project 1:** The Evaluator's site visit found average annual hours of 8,760. The ex-ante used annual hours of 2,346.
- **Project 2:** The Evaluator's lighting logger data found average annual hours of 3,386. The ex-ante used annual hours of 4,004.
- **Project 3:** The Evaluator's lighting logger data found average annual hours of 3,342. The ex-ante used annual hours of 3,612. Additionally, the ex-post utilized a IEFe of 1.00 while the ex-ante used a value of 1.08.
- **Project 4:** The Evaluator's site visit found average annual hours of 2,768. The ex-ante used annual hours of 3,612.
- **Project 5:** The Evaluator's site visit found average annual hours of 4,377. The ex-ante used annual hours of 4,100.
- Project 6: The Evaluator's site visit found average annual hours of 2,873. The ex-ante used annual hours of 3,612. Additionally, the ex-post utilized an IEFe of 1.03 while the ex-ante used a value of 1.08.
- **Project 7:** The Evaluator's lighting logger data found average annual hours of 3,276. The ex-ante used annual hours of 4,004. Additionally, the ex-post utilized an IEFe of 1.07 while the ex-ante used a value of 1.11.

Description of Factors Affecting Gross Realized Savings

The Evaluator determined 2 main factors that contributed to discrepancies in the realized savings of the sampled projects. Explanations of how each factor affected realized savings are found below, along with frequency of occurrence as illustrated in Figure A-1. Figure A-1 quantifies the impact of these identified factors on the gross realized savings of the project sample.

- **Differing Hours of Operation:** The verified lighting hours of use for interior fixtures were less than the hours utilized by ex-ante. Conversely, the verified hours of use for exterior fixtures were greater 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.

Figure A-1

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Workbook: CDI CY2 Analysis.xlsx
Worksheet: Report Tables
Cell Reference: M44>

Figure A-1 Impact of Factor's Effecting Gross Realized Savings

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Figure A-2

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Location: L:\P\2020\2. Core Scope\3. Concurrent Impact Evaluation\CY2\CDI_CY2 (Commercial Direct Install Program)
Workbook: CDI CY2 Analysis.xlsx
Worksheet: Report Tables
Cell Reference: M44>

A.1.3 Process Evaluation

The Evaluator completed a full evaluation of the CDI Program for FY21/22.

A.1.3.1 Process Evaluation Approach and Methodology

A.1.3.1.1 Document Review

The Evaluator reviewed program documentation available for the program, including application materials and the program website. The team reviewed this information to understand how the program engages with the market, what the intended touch points are for customers and program actors, how program processes work together, and intended program outcomes. This information provided critical information that was integrated into the staff interview guides, participant survey, and Energy Service Representative (ESR) research instrument.

A.1.3.1.2 Program Staff Interviews

The Evaluator completed two phone interviews with program staff: one with LADWP program managers, and another with Willdan program staff. Interviews were designed to provide details 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, marketing and outreach strategies, program processes, future risks to program performance, and evaluation needs. This information was used to inform the creation of the participant survey and ESR data collection instrument.

A.1.3.1.3 Participant Survey

The Evaluator administered an online survey via Qualtrics in July and August of 2022. The sample included 1,353 participants, and the team collected 110 responses. The survey explored various topics to understand the participant experience, including program awareness, participation processes such as the assessment and recommendations, program satisfaction, program influence, and free ridership.

A.1.3.1.4 ESR Research

In September and October of 2022, the Evaluator performed research focused on the role of the ESR and their interactions with customers. The Evaluator coordinated with LADWP staff and Wildan staff to recruit the ESRs. This research was divided into two distinct areas:

Interviews: The Evaluator conducted in-depth interviews with four ESRs. The interviews explored how ESRs target and sell the program to customers, how customers respond to the program and assessment, as well as gain other perspectives on the program operation and processes that the ESR could provide.

Field research: The four interviewed ESRs responded to a series of post-site-visit questionnaires over the period of a day or a few days. The ESRs were invited to reply to a series of questions at the conclusion of up to five site visits conducted. In this way, the Evaluator was able to gather data around specific challenges or opportunities the ESR faced, as well as specific customer responses. ESRs provided the team with a total of 20 audio recordings of their responses. As a follow-up, the Evaluator held brief phone interviews with four customers from the group that was recently engaged by the ESRs. These interviews explored whether they decided to move forward with the program and why, their experience with the program, and if there was anything else the program could do for businesses like theirs.

A.1.3.2 Process Evaluation Findings

Overall, the program is operating as intended from the perspectives of customers, ESRs, and program staff. Program delivery is running smoothly, and customers are satisfied with participation processes and with the services and products they receive. Areas of opportunity include pursuing more proactive communications about the program process with customers, expanding outreach to non-English speaking communities, and strengthening the connections between the CDI program and other C&I programs.

A.1.3.2.1 Program Marketing and Outreach

The CDI Program does not perform marketing or promotion through traditional channels like bill inserts, direct mailers, television, radio, or internet advertising; rather, the program utilizes a direct-to-consumer canvassing approach, whereby ESRs go door to door and inform customers about the program personally. The subsections below provide additional details on this approach as expressed by ESRs, as well as customer responses from the participant survey.

Customer Identification and Customer Types

As noted above, the primary mode of program outreach is through door-to-door canvassing performed by ESRs. ESRs report that they are each assigned to zip codes and provided an eligible customer list by LADWP. One ESR noted that they receive a disposition report for each site, which includes information on the efficiency level of the location, if they have participated in the past, and other business details. Based on the customer list and the area, the ESR will map out a general route for themselves and begin canvassing from business to business. One ESR noted that the number of locations canvassed each day varies depending on the density of the businesses in a particular area. For higher density areas, they may reach 100-150 customers in a day, while in areas that are more spread out – for example, areas with larger warehouses – the number of locations canvassed will be fewer.

The Evaluator asked the ESRs to describe a typical program customer, and if they see any commonalities in the types of businesses or sectors served. All four ESRs noted that the current eligibility criteria (up to 250 kW per month) allow for a wide variety of different customers, making it difficult to pinpoint what a “typical” customer looks like. One ESR stated that he will go from “mom and pop” retail shops, grocery stores, churches, and fire stations to government agencies, corporations, or manufacturing facilities.

This wide range of business types and sizes is also represented among survey respondents and indicative of the program’s broad reach. The most common industry among survey respondents was retail/wholesale (19%, Figure A-3), followed by nonprofits (12%), manufacturing (10%), and real estate and property management (9%). Most survey respondents (53%) have fewer than 10 employees (Table A-4), while 8% of respondents indicated their business had 100 or more employees.

Figure A-3: Survey Respondent Industry/Organization Type (n=105)

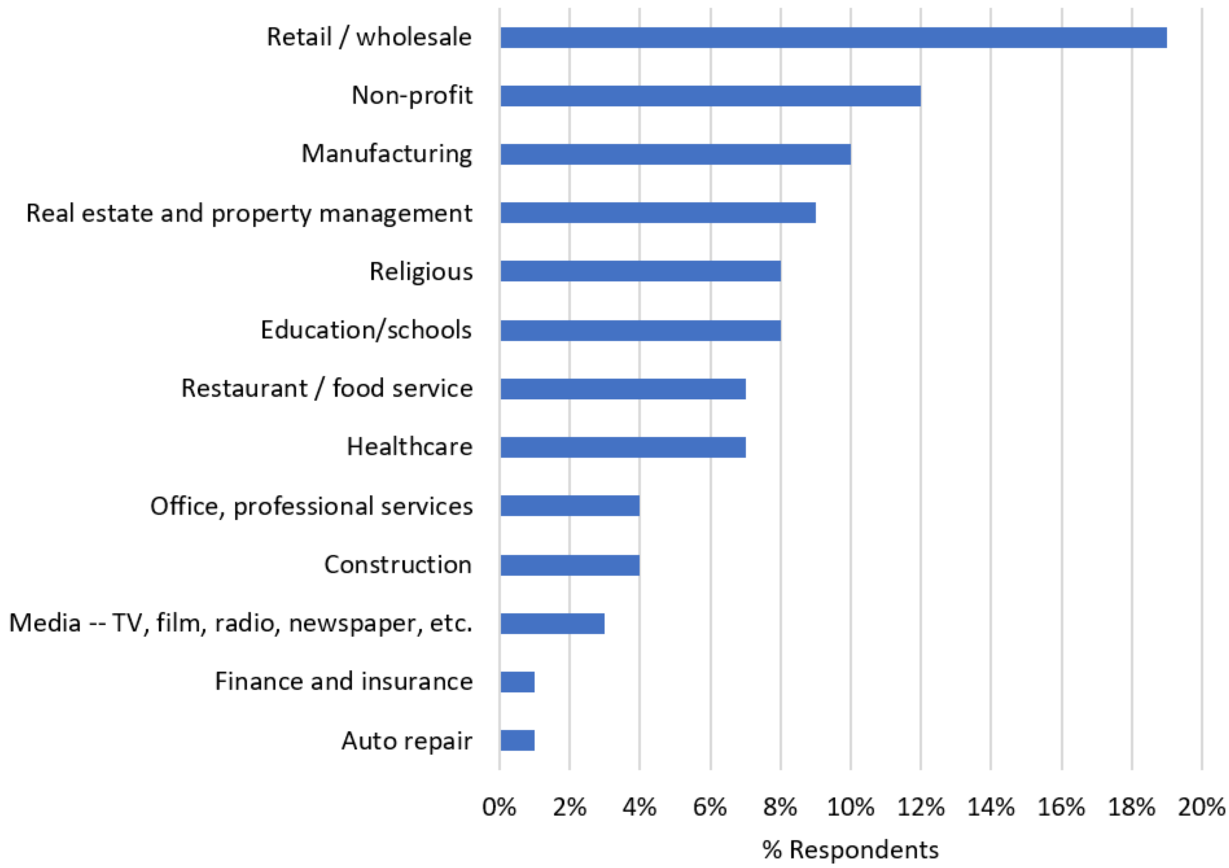
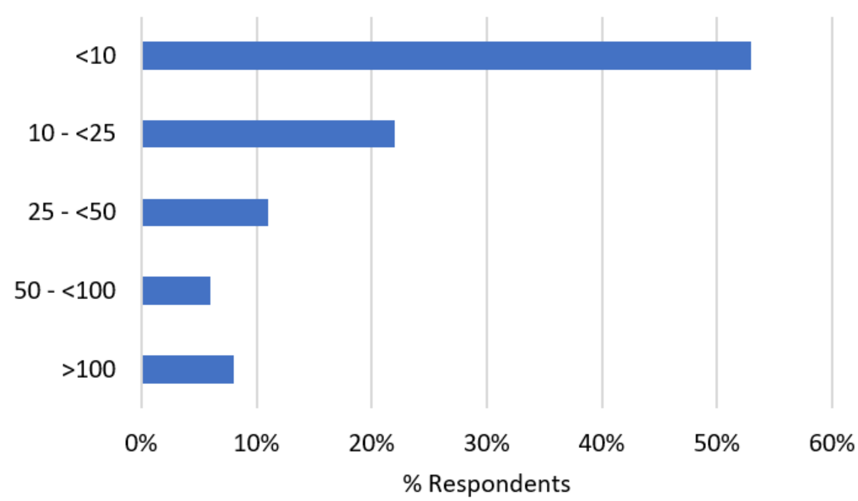


Figure A-4: Number of Employees (n=100)



Customer Targeting and Selling

ESRs mentioned that as they approach a business, they will often observe whether a customer is a good program candidate based on the appearance of their exterior lighting or from what they can see of the interior lights (e.g., if they spot old T8 fluorescents through the windows or inefficient looking exterior lights). They may also observe in the provided customer data that the property has not previously participated, or they have not participated in several years, making them eligible again. Based on this and other information they can gather about the customer, the ESR formulates a “pitch” to the customer. The Evaluator’s ESR research suggests that a pitch typically contains the following components:

1. **Identification and verification of their role** within the CDI program and LADWP (show their badge, provide a flyer, or direct the customer to the website)
2. **Information about the program**, typically highlighting that it provides free lighting to customers that will save them energy
3. **Information specific to the customer that further motivates participation**, for example, they participated in the past and now they’re eligible again, they have lighting that appears to be eligible, a neighbor recently participated, etc.

ESRs noted that this approach generally works well, and two ESRs stated that in their experience about 90-95% of customers will agree to participate during their initial canvassing visit. This is also consistent with the mobile diaries received from the ESRs, where all but three of 20 customers decided to move forward with participation right away. However, ESRs did identify a few barriers that can get in the way of participation. These barriers are highlighted below, along with information on how ESRs manage around them.

- Difficulty in reaching the decision-maker. ESRs noted that as they first approach a business, they will ask to speak with the owner or decision-maker. In some cases, the decision-maker is not at the location when they visit, and they need to follow-up via phone. In other cases, the person they are speaking with is the decision-maker, but they are hesitant to identify as such until they understand that the program is real and will be a benefit to them. Lastly, if a business is a corporation with additional levels of authority to get through, the ESR will likely not receive approval for an assessment during the initial visit and the ESR must call the corporate office to seek approval.
- Language barriers. Two ESRs stated that in some cases, the decision maker does not speak fluent English. In these situations, sometimes another staff or family member at the business speaks some English and they will serve as a translator, or a neighboring business owner who previously participated may assist in translating. LADWP also provides the program flyer in Spanish and Korean, and the ESR will also provide this if it is in the customer’s primary language.

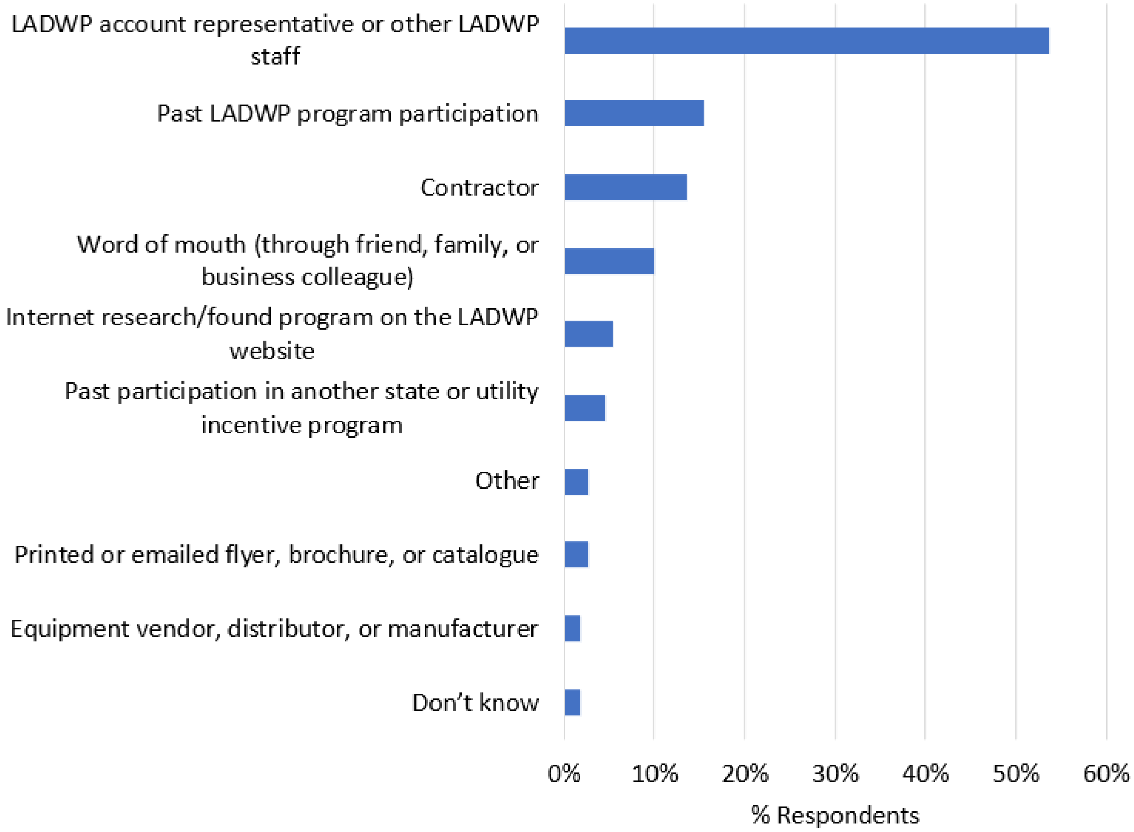
- Mistrust of the offer. ESRs noted that mistrust is not a significant barrier, as typically they are able to provide the customer with the right information to counter it. For example, one ESR mentioned that some customers question how the program is free. The ESR said he will explain that the program is funded through a fee on their utility bill, and in some cases will even show the customer where the fee is located on their bill.

At times, participation may also be hindered by other factors more prevalent to small businesses or start-ups that have less stable revenues. In a follow-up interview, one customer said that they could not participate because after the site visit, they made the decision to shut down their business.

Awareness and Motivations

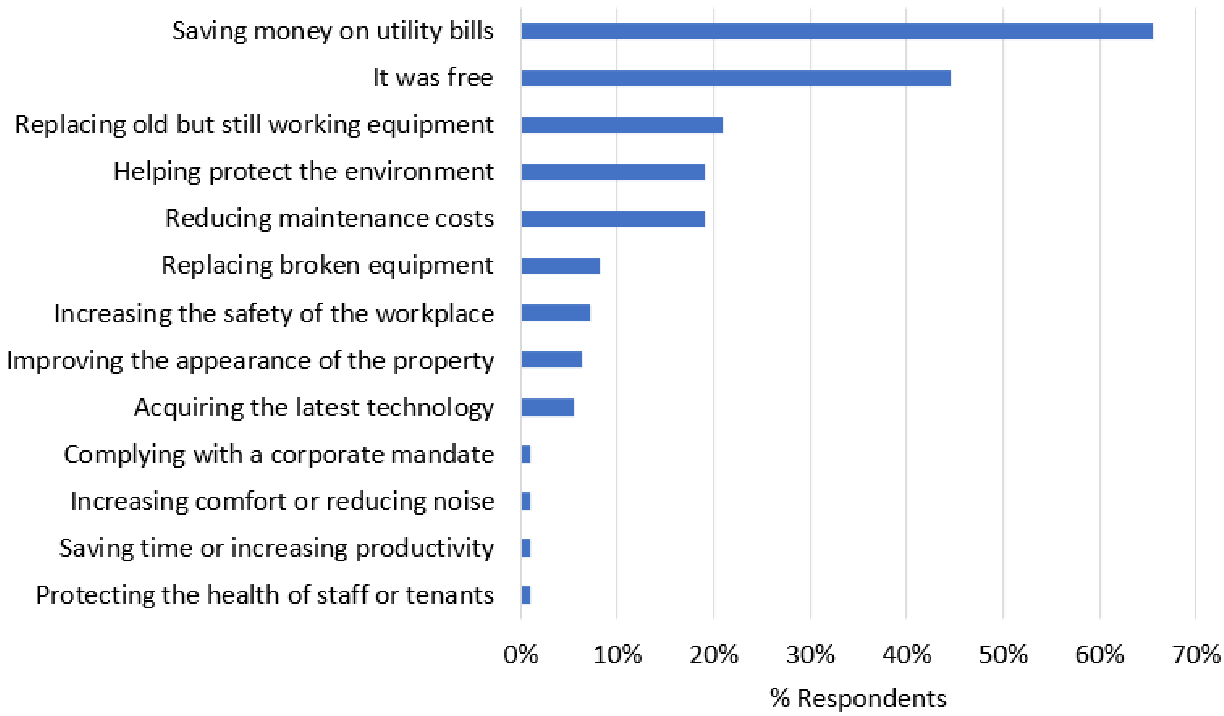
Survey respondents indicated that LADWP account representatives or staff are the most common way they learned about the program (54%, Figure A-5). The ESRs interviewed noted that during canvassing they wear an LADWP program-branded shirt and carry an LADWP contractor badge, so it is possible that survey respondents also associate ESRs as LADWP representatives. Other common avenues for customers to learn about the program include past participation in LADWP programs (15%), contractors (14%), or word of mouth (10%). ESRs corroborated that word of mouth is an important channel for customer awareness, and further indicated that those customers are typically easier to sell the program to and move through the process.

Figure A-5: How Respondents Learned About CDI (n=110)



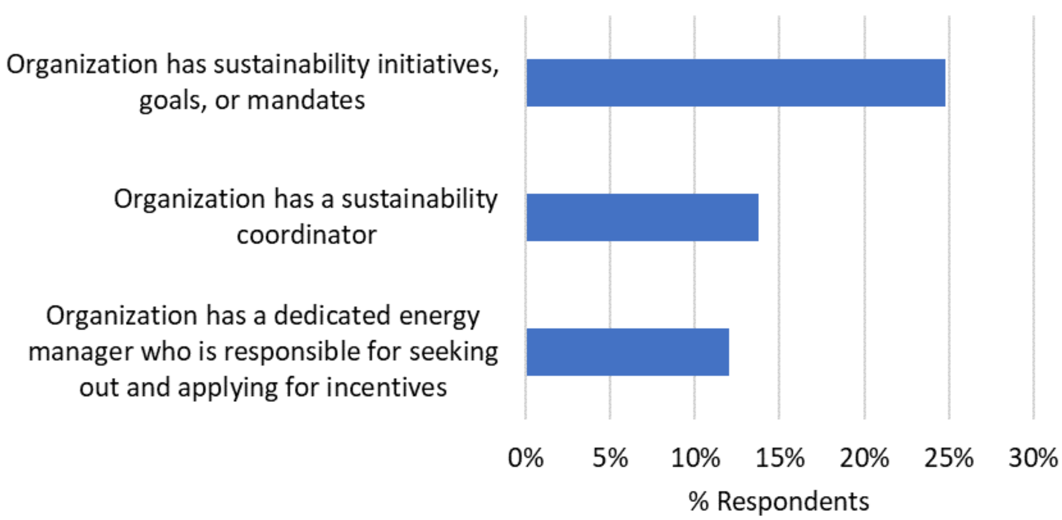
Customers surveyed were primarily motivated to participate in the program for financial reasons, as 'Saving money on utility bills' was most frequently cited (65%, Figure A-6). A large percentage of customers (45%) also reported that the program being free was one of the most important motivating factors to their participation. The ESR research reiterates this, with ESR interviews and mobile diaries noting that most customers are very excited about receiving new lighting for free. Other factors such as replacing old but still working equipment (21%), helping protect the environment (19%), and reducing maintenance costs (19%) were less prevalent motivators of program participation.

Figure A-6: Most Important Factors Motivating Respondents to Participate in CDI (n=110)



Organizational policies related to sustainability or energy are not a prevalent motivator for most businesses participating in the program. Only a quarter of survey respondents (25%) have sustainability initiatives, goals, or mandates (Figure A-7), while 14% have a sustainability coordinator, and 12% have a dedicated energy manager responsible for seeking out and applying for incentives.

Figure A-7: Organizational Motivations to Completing Energy Efficiency Projects (n=109)

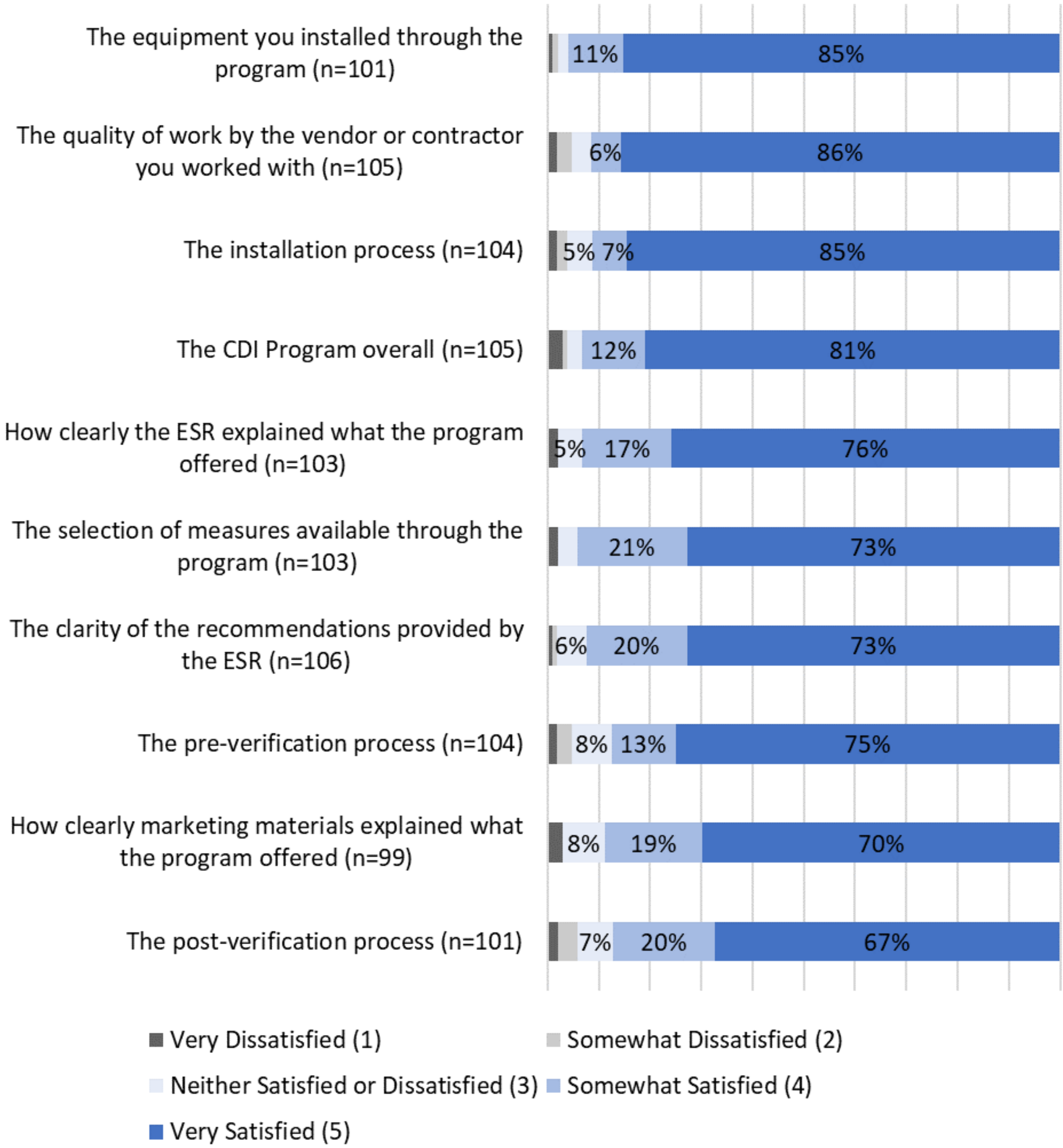


A.1.3.2.2 Satisfaction with Program Processes

Overall, survey respondents were highly satisfied with all aspects of the CDI program, with each component of the program receiving a mean score of at least 4.4 out of 5 (see Figure A-8) for the different components rated). Respondents rated their overall satisfaction with the program as a 4.7 and were most satisfied with the equipment that was installed through the program (4.8). Respondents were also highly satisfied with the services provided by the program subcontractors, the quality of work provided by the vendor (4.7), the installation process (4.7), and how clearly ESRs explained what the program offered (4.7). These rankings are consistent with two follow-up interviews with customers who recently completed participation in the program. One noted that the process was “thorough, clean, and fast; very satisfied with the experience.” Another said that the program, “did a good job, I’m happy. There were just a couple of places they couldn’t get to because it was too dangerous. Appreciate it, helps bring down the bills.”

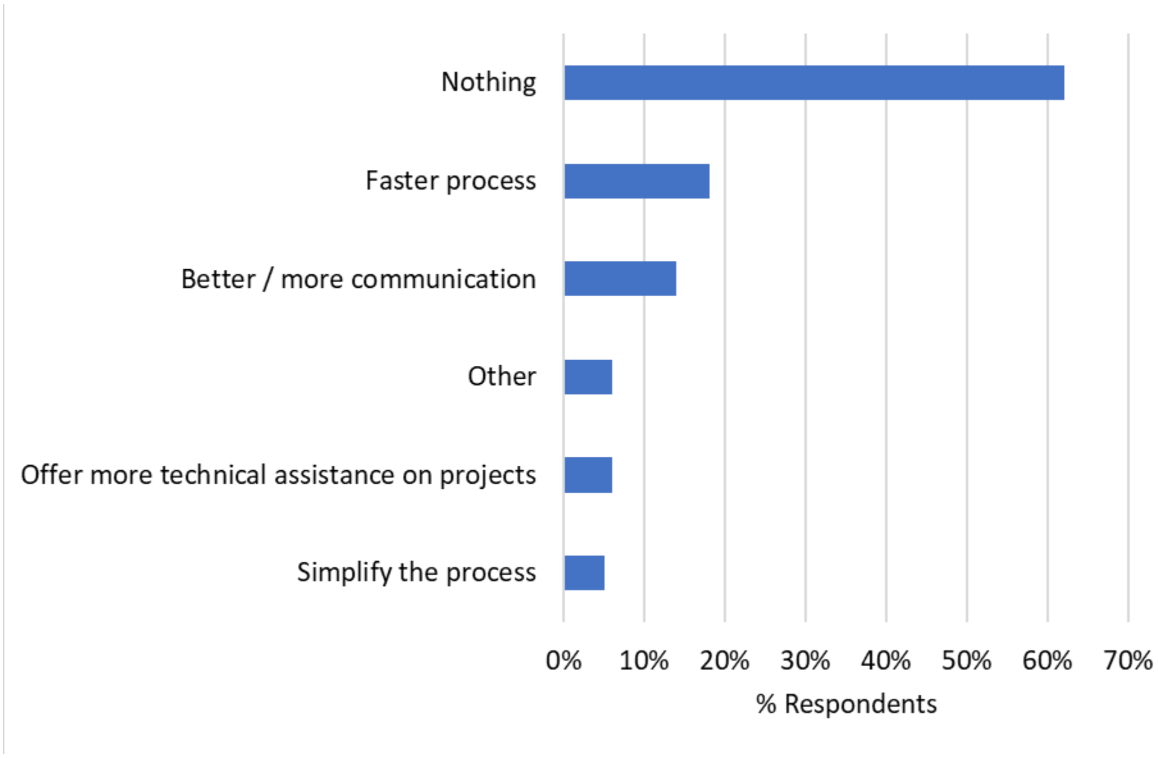
Figure A-9 shows in more detail the distribution of participant satisfaction scores on a scale of 1 to 5 where 1 is “very dissatisfied” and 5 is “very satisfied” for each program element of CDI. Most respondents (93%) were at least somewhat satisfied with the program overall, with 81% indicating they 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 post-verification process” and “how clearly marketing materials explained what the program offered” with 70% and 67% of respondents, respectively, reporting that they were “very satisfied” with these elements.

Figure A-8: Participant Satisfaction with CDI Program Elements



In line with the high levels of satisfaction with the program overall, and with the program's respective components, nearly two-thirds (62%, n=110) of survey respondents indicated that nothing could be done to improve the program (Figure A-9). The two leading suggestions for program improvements were a faster process (18%), and better/more communication (14%). Concerning communication improvements, this aligns with information reported by ESRs that the most common reason participants contact them is to receive updates about where they are in the process, and when they can expect the next phase of the process to commence. In a follow-up interview, one customer also noted that they were scheduled to have an assessment, but the subcontractor did not show up, and they were still waiting to receive more information. Proactive and consistent communication from the program to participants is one area where the program can focus on improving to increase overall participant satisfaction.

Figure A-9: Participant-selected Suggestions for Improving CDI (n=110)



Survey respondents further communicated their desires for program improvements via open-ended responses. While the vast majority of these responses were compliments of the program and staff (n=16), other themes identified included: communication improvements (n=4), assistance with operation/verification of equipment functionality (n=3), increased awareness (n=2), additional measures (n=2), assurance of legitimacy (n=1), multi-lingual communication (n=1), and improvements in the sign-up process for customers who aren't directly contacted (n=1). A few responses are presented below.

Communication Improvements

"Communicate when they were coming to the store the review and take pictures. Day, time, and name of person would have been possible."

"More and better communication between myself and the DWP representative."

"More follow up/follow through and better communication."

"Providing vendor contact info on the web will be helpful."

Assistance with Operation/Verification of Functionality

"In doing research, I discovered that you can adjust some of the lighting. I never got any assistance nor any help with this and had to figure it out on my own."

"Should have tested back up lights before leaving install."

Increased Awareness

"I am the chair of the property committee at the church and am always trying to get more energy and water efficient fixtures at the church, but as a volunteer I don't have a lot of time to track down the programs like this. Having a rep reach out to me was key to getting us onboard."

"Additional Measures"

"Air conditioning units."

"I would have loved…a choice of lighting options."

Multi-Lingual Communication

"LA is home to many multi-ethnic people. In order to publicize and implement these projects more, it requires a lot of explanation and understanding, and English is often not as perfect as mine. In this case, the installation is not easy due to the problem of dialogue. I think it would be better if we could communicate in more different languages."

Improvements in the Sign-Up Process for Customers not Directly Contacted

"I was only able to get hold of someone because one of my tenants was doing work and gave me the contractor's contact info. Even though I've already submitted an email request well before my tenant and no one ever got back to me."

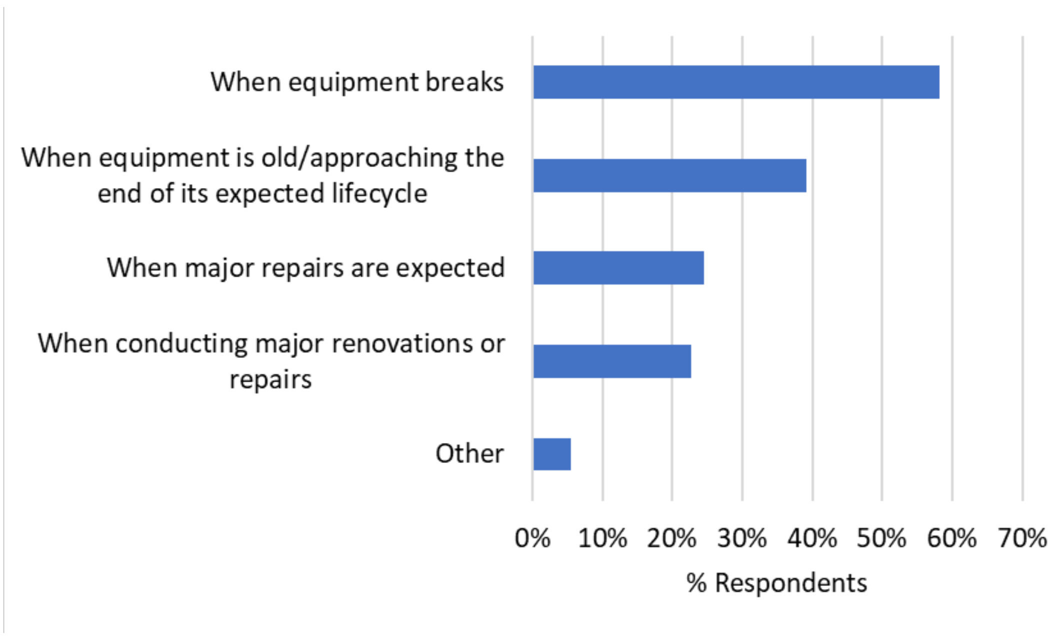
Like the customer suggestions above, ESRs also proposed that additional measures be offered. ESRs recommended that the program also offer exterior pole lights, circular LED lights for apartment hallways, T5 high bay fixtures, and refrigeration lighting. One ESR recommended that the program offer air conditioner tune-ups to garner additional savings.

As previously noted, ESRs also recommended additional outreach and support to non-English speaking communities as this can be a barrier during canvassing and getting customers to participate. One ESR suggested attending local community events to build trust and provide flyers about the program (in their language), as well as an opportunity to sign up.

A.1.3.2.3 Customer Decision Making and Barriers Faced

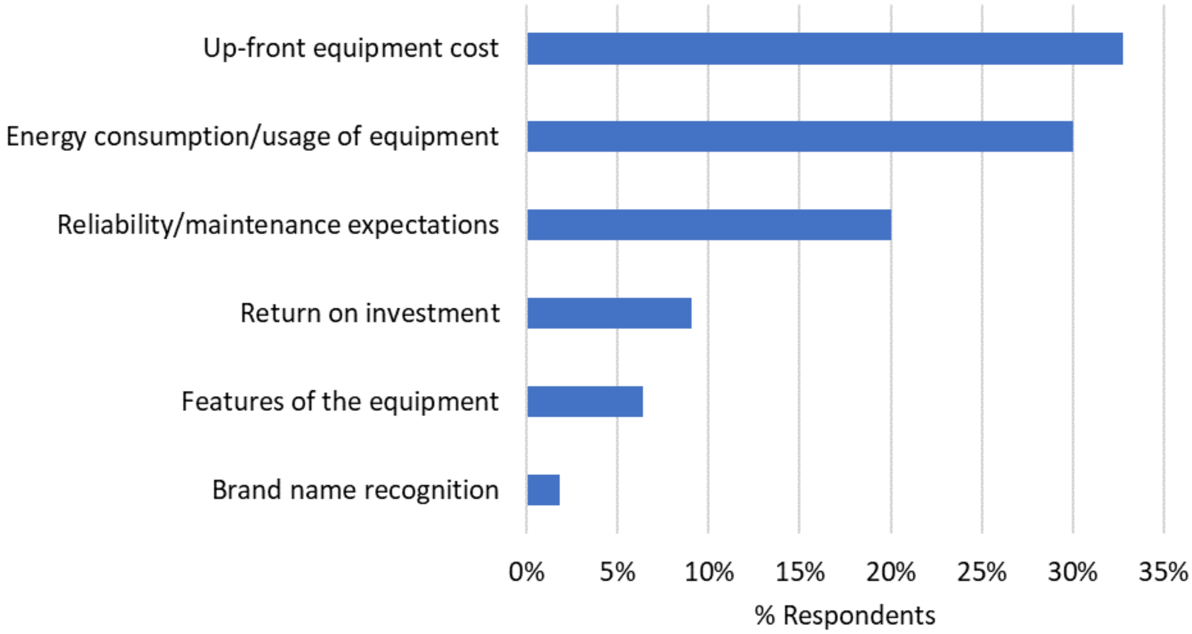
Most survey respondents (58%, n=110) indicate that they typically do not replace equipment until it breaks (Figure A-10). Additionally, survey respondents report that up-front equipment cost is the most important criteria when selecting equipment to install (33%), and that high initial cost and lack of awareness of available incentives are the two largest barriers to investing in energy efficient equipment (40% and 33% respectively, Figure A-11). These results speak to the value that the program delivers to participants, as it is designed to directly address each of these issues by informing customers of available lighting measures and provides them for free before the equipment fails.

Figure A-10: When Do Respondents Typically Replace Equipment? (n=110)



While survey respondents indicated that up-front equipment cost was the most important criteria for selecting equipment to install (33%, Figure A-11), operational features including the energy consumption/usage of the equipment (30%) and the reliability/maintenance expectations of the equipment (20%) were also presented as strong considerations. Return on investment was a relatively low priority among survey respondents (9%). The features of the equipment (6%) and brand name recognition (2%) are also of less importance to most respondents.

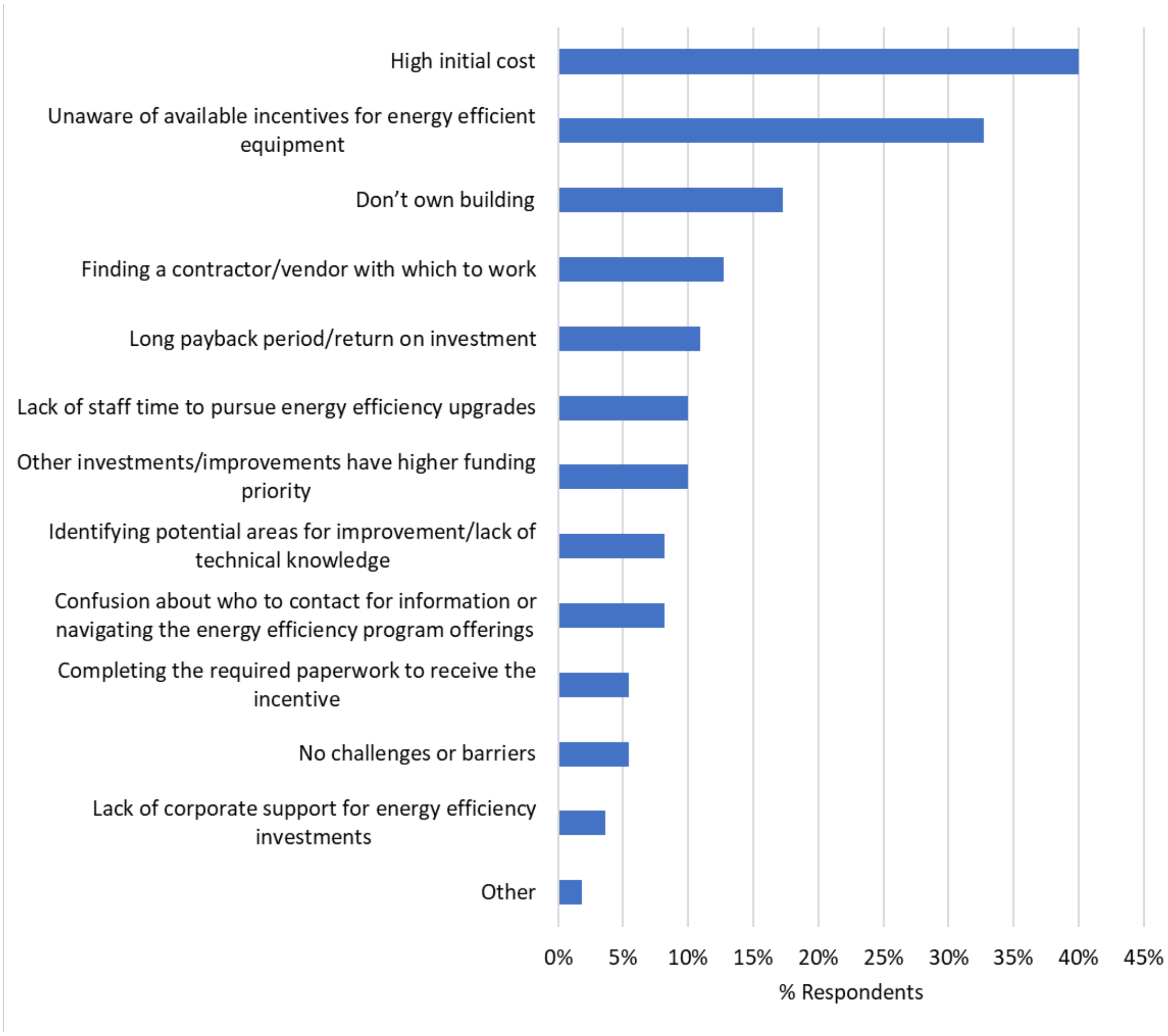
Figure A-11: Most Important Criteria for Selecting Equipment to Install (n=110)



As previously noted, the program addresses the top two barriers to making investments in energy efficiency equipment (high initial cost and not being aware of available incentives, shown in Figure 10) through its program design. The CDI program could take this a step further by also marketing other commercial program offerings (and even residential offerings) to its customers as a next step in saving money on their energy bills. In a follow-up interview, one customer inquired about other programs and ways to save energy. In discussion with ESRs, one noted that he was not familiar with other LADWP program offerings, and they only carry CDI literature with them for customers. Given the volume of direct customer outreach performed by ESRs, marketing other programs may be a way to boost the amount of savings overall per customer.

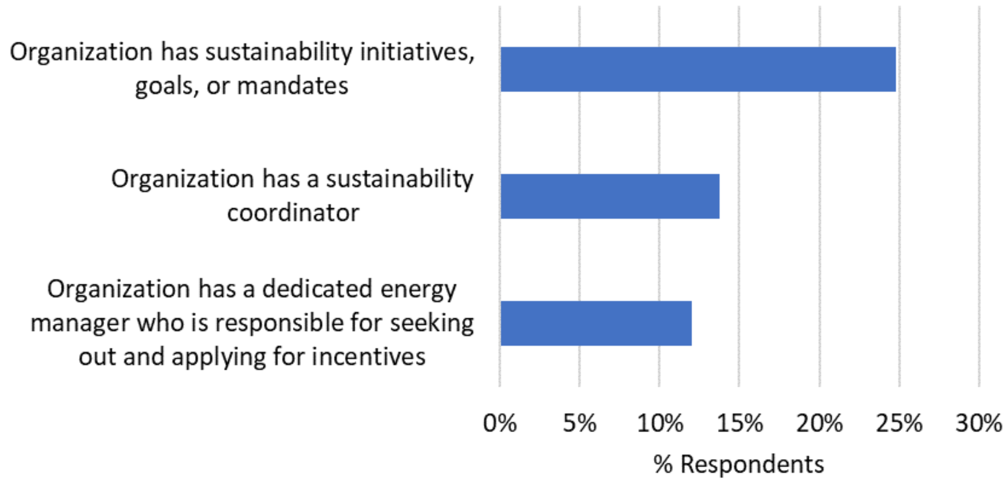
Beyond the top two barriers, the split-incentive issue of not owning the building where the business is located ranks as the third highest barrier (17%, Figure A-12). LADWP might consider how to provide a more tailored path to participation for these types of projects. For example, where LADWP can access building owner contact information, ESRs could conduct phone calls prior to visiting the businesses within the property to gain buy-in of the program and potential approvals.

Figure A-12: Barriers to Respondents' Investment in Energy Efficient Equipment (n=110)



In terms of corporate oversight, participants in the CDI program have far less to contend with than participants in LADWP's Commercial Lighting Incentive Program (CLIP). While 78% of CLIP survey respondents indicated that their organization has a formal approval process for making capital improvements, only 35% of CDI respondents indicated that they face a similar requirement (Figure A-13). This may be because most businesses participating in CDI are smaller than those participating in CLIP – 45% of CLIP survey respondents have 49 or fewer employees, whereas 86% of CDI survey participants are like-sized. Similarly, nearly half of CLIP respondents reported that they must meet specific ROI criteria on improvements (46%) or that they have specific policies related to the energy efficiency of equipment installed (48%), compared to 18% and 13% of CDI respondents, respectively.

Figure A-13: Other Considerations for Energy Efficient Upgrades (n=110)



A.1.4 Recommendations

- **Recommendation 1**. Communicate to customers the pathway to participate in additional energy efficiency opportunities through LADWP. Currently, ESRs do not provide customers with information about other opportunities beyond the CDI program. The program should consider offering training overviews of other program offerings to ESRs so they can provide a more informed perspective to customers on what they might pursue next and incentives available. The program could also provide literature to customers on other programs, like the Customer Performance Program, Food Service Program, or Upstream HVAC Program.
- **Recommendation 2**. Perform additional marketing and outreach to non-English speaking audiences. ESRs note that sometimes they are challenged in reaching and communicating with business decision makers who do not speak English as a primary language. While the program offers flyers in Spanish and Korean, it should consider additional approaches. For example, the program could consider hiring or contracting with individuals within non-English speaking communities to perform outreach on behalf of the program. Alternatively, a stipend could be offered for community members to accompany ESRs during canvassing, make introductions, and help with translation. ESRs could also attend community events to build trust within communities. The program could also engage community organizations or leaders to understand how else they might be able to increase trust and participation in the program by their community members.
- **Recommendation 3**. Proactively communicate the program process and project status to customers. While ESRs and customers are largely satisfied with the program and its operations, there are opportunities to improve communications with customers on the participation process and where they are in the process at a given

time. The program could add a brief section to the CDI flyer that clearly lays out the steps in the participation process, along with estimates of how long each step may take. The program could also explore the possibility of sending customers automated emails as they move from one step in the process to another, and who to reach out to if they have additional questions.

A.2 Commercial Lighting Incentive (CLIP) Program

This section details the impact evaluation for the Commercial Lighting Incentive Program (CLIP) program that LADWP offered customers during FY 21/22. 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 1/22. 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 21/22, the sample resulted in a program level precision of ±14.88% 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/Sample Statistics

	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	13	52	123	124	120	24	456
Total ex-ante kWh savings	74,443	632,423	2,952,391	6,170,149	12,174,752	10,057,164	32,061,323
Average ex-ante kWh Savings	5,726	24,324	72,010	199,037	507,281	2,514,291	230,657
Standard deviation of ex-ante kWh savings	3,261	7,908	23,228	53,349	163,747	2,288,647	551,435
Final design sample	1	1	1	2	2	2	9

A.2.1.3 Baseline Assumptions Review

Generally, for projects involving lighting measures, savings can be determined as follows:

$$kWh_{Savings} = \frac{Watt_{Baseline}*HOU_{Baseline}*Qty_{Baseline} - Watt_{Installed}*HOU_{Installed}*Qty_{Installed}}{1000} * IEFe$$ *Equation A-1*

$$kWh_{Code} = \frac{Watt_{Code}*HOU_{Baseline}*Qty_{Baseline} - Watt_{Installed}*HOU_{Installed}*Qty_{Installed}}{1000} * IEFe$$ *Equation A-2*

$$\Delta kW = (Watt_{Baseline} - Watt_{Installed}) * CF * IEFd/1000$$ *Equation A-3*

$$Dual\ Baseline\ Lifetime\ Savings = kWh_{Savings} * \frac{EUL}{3} + kWh_{Code} * (EUL - \frac{EUL}{3})$$ *Equation A-4*

Equation A-1 and Equation A-3 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-4. Calculation of dual baseline lifetime savings required the use of savings using code standards found using

Equation A-2. 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 by Fiscal Year

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
21/22	32,061,323	32,061,323	0%	4,898.09	4,898.09	0%

The ex-ante kWh and kW reported in the tracking data was the same as the ESP ex-ante savings for FY 21/22, as opposed to FY 20/21, where for Peak kW the comparison differed by 38.2%.

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:

1. **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.
2. **Phone:** 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 Section A.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 9 of the randomly sampled projects from FY 21/22. Project-level and Measure-level results can be found in project site-level reports. 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” & “Differing Algorithm Input Selection”. Explanations of how each factor affected realized savings are found below, along with frequency of occurrence as illustrated in Figure A-2. Figure A-3 quantifies the impact of these identified factors on the gross realized savings of the project sample.

- **Differing Algorithm Input Selection:** 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.
- **Data Entry Error:** Data entry error was listed as a factor affecting gross realized savings for one CLIP project, where the provided ex ante calculator didn't match with the tracking data available for said project.

Figure A-2 Factors Affecting Gross Realized Savings

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Workbook: CLIP CY2 Analysis.xlsx
Worksheet: RR Factors
Cell Reference: L15>

Figure A-3 Factor's Effect on Realized Sample Savings

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Workbook: CLIP CY2 Analysis.xlsx
Worksheet: RR Factors
Cell Reference: E24>

A.2.3 Process Evaluation

A.2.3.1 Process Evaluation Approach and Methodology

For FY21/22, the Evaluator performed a summary process evaluation of CLIP. This included an in-depth interview with LADWP program staff to understand and explore the following:

- Program changes to design, delivery, or incentives
- Program performance, including areas for improvement and success

- Market changes affecting performance
- Barriers and opportunities going forward
- Other topics as relevant

The Evaluators performed a full process evaluation of CLIP in FY20/21.

A.2.3.2 Process Evaluation Findings

LADWP staff note that CLIP's program design and delivery is largely the same as the previous fiscal year (FY20/21). The same measures and incentives are offered to the market, and the same market actors are engaged. Program staff believe that customers and vendors are generally happy with the program and incentive rates, which are higher than surrounding utilities.

While the program is largely the same, program staff note that they have made some updates to how they engage program vendors and participants. These changes are summarized below:

- Program staff have implemented a new process of meeting early and often with customers with active projects, including the vendors they have hired. This additional engagement ensures that projects go smoothly, and all parties understand the next steps. Given the level of complexity of some projects, program staff note that this process has been very helpful, and they have received a positive response from customers and vendors, especially those that they work with regularly.
- Program staff note that they are partnering more closely with key account advisors (serving customers greater than 200 kW). Staff will offer specific workshops for customers served by key account advisors, which the advisor attends as well. This increased engagement and coordination offers a more streamlined experience for the customer and highlights additional opportunities that they may not have been aware of.

Program staff also note that internal operations, including application processing, are going smoothly. Over the last several months, the program has hired six additional team members. To support the onboarding of new staff the program produced a step-by-step guide for processing new applications. Program staff expect to see process improvements over time now that they are fully staffed and trained in program processes.

A.2.3.2.1 Barriers and Opportunities

Program staff highlighted the following barriers:

- No online portal for application submittal, though this may change going forward. Currently, customers and vendors must email all application materials to the program, which can be a slow and laborious process. Program staff note that a contractor has been hired by the department to explore the potential for an online application process.

- Supply chain challenges and labor shortages are still issues. Like the previous year, the program still faces market challenges. Staff note that in some cases a vendor may not have a product in stock, or it's delayed overseas. Additionally, some installation contractors may not be sufficiently staffed to meet full demand, which can also add delays to the project timeline.
- Limited access to program metrics. Program staff note that they would like access to additional program and market data to inform outreach and customer targeting. For example, data regarding who has previously participated and market saturation for various energy efficient lighting products would be useful.

Program staff see additional opportunities in the following areas:

- Gain more energy savings through lighting controls. Program staff note that in most cases, customers only install lighting equipment and do not install lighting with controls. Not all vendors are educated on controls, and controls can also add to the project cost. When bidding, typically vendors want to be the least cost. Program staff see an opportunity to gain additional energy savings through adding more controls to lighting projects. They are working with LADWP engineers to understand the market and are also considering strategies such as increasing controls incentives and offering a lighting controls seminar to vendors and customers.
- Offer a whole-building approach. Program staff note that coordination across programs and offerings could be increased to better meet customer needs. They are exploring what a whole building approach might look like for commercial and industrial customers to, for example, identify opportunities to improve energy efficiency for non-lighting end-uses.

A.2.3.2.2 Previous Evaluation Recommendations

Table A-8 below includes a summary of previous recommendations and the program's response to date.

Table A-8 Previous CLIP & Recommendations and Program Response

Summary of Past Recommendations	Program Response
Support vendors in identifying eligible customers	No changes. The program cannot endorse specific vendors and lacks market data to identify customers for vendors.
Communicate with vendors early and often about program changes	No changes at this time.
Simplify program forms and processes	The program has not changed external forms or processes. However, program staff recently

Summary of Past Recommendations	Program Response
	updated internal processes, added new team members, and are working with the department to explore an online portal. These may provide efficiencies for customers in the future.
Build trust with Recognized Vendors	The program is considering a redesign of the Recognized Vendor Program. Features may include establishing regular communications like a quarterly program newsletter and offering a regular meeting during the year so they can receive feedback and continuously improve the program.

A.2.4 Recommendations

The Evaluators do not have any recommendations for CLIP at this time.

A.3 Custom Performance Program (CPP)

This section details the impact evaluation and process evaluation for the Custom Performance Program (CPP) program that LADWP offered customers during FY 21/22. 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.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 and peak demand reduction for the program.

A.3.1.1 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 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-9.

Table A-9 CPP Measure Categories

Stratum	Total Program Projects	Total Ex-Ante Annual kWh	Minimum Ex-Ante kWh	Maximum Ex-Ante kWh	Percent of Population
Commercial HVAC	70	5,784,897	216,505	579,348	43%
Custom HVAC, HVAC Controls, EMS, Window Film	38	3,915,977	142	593,783	29%
Commercial Refrigeration	5	192,099	2,219	74,984	1%
Custom Lighting	19	2,984,464	124	687,374	22%
Custom Motors	2	450,281	161,780	288,501	3%
Total	**134**	**13,327,718**	**124**	**687,374**	**100%**

A.3.1.2 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). The evaluation sample is grouped by measure, except for HVAC Commercial, where strata is based on both magnitude of annual energy savings and by measure, because it is the largest strata. Under Commercial HVAC Strata only, the realization rate is extrapolated based on both the kWh size and by measure to find RR.

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 21/22, the sample resulted in a program level precision of ±34.2% at the 90% confidence interval using ex-ante estimates. A summary of the sample is shown in Table A-10. The selected sample represents about 33% of the CPP population.

Table A-10 CPP Evaluation Sample

Stratum	Strata Boundaries (Ex-Ante kWh)	Projects	Sampled Projects	Standard Deviation of Ex-Ante kWh Savings	Total Ex-Ante Annual kWh	Sample Ex-Ante Annual kWh
Commercial HVAC	< 200,000	61	53,362	53,699	3,255,076	1,053,909

Stratum	Strata Boundaries (Ex-Ante kWh)	Projects	Sampled Projects	Standard Deviation of Ex-Ante kWh Savings	Total Ex-Ante Annual kWh	Sample Ex-Ante Annual kWh
Commercial HVAC 2	>= 200,000	9	281,091	61,902	2,529,821	691,506
Commercial Refrigeration	all	5	38,420	31,339	192,099	2,219
Custom HVAC, HVAC Controls, EMS, Window Film	all	38	103,052	135,006	3,915,977	425,209
Custom Lighting	all	19	157,077	237,632	2,984,464	2,101,531
Custom Motors	all	2	225,141	89,605	450,281	288,501
Total	NA	134	99,461	135,635	13,327,718	4,562,876

A.3.1.3 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.

If 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.3.1.4 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.3.1.5 On-Site Data Collection Activities

The Evaluator conducted in-person site visits to perform 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, the Evaluator made sure to work collaboratively with the participant to ensure the data collection procedure was feasible and acceptable.

Prior to on-site 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 an on-site data collection event with the site contact; and
- Performing data collection through physical inspections and interviews with the site contact.

A.3.1.6 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 p.m. to 5 p.m. on non-holiday weekdays from June through September.

A.3.1.7 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 with provided ex-post energy savings results that were aggregated to the program level.

A.3.1.8 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. It was concluded that there was no considerable COVID-19 impact during PY 21/22.

A.3.1.9 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.3.1.10 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 included 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.3.1.11 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-11.

Table A-11 CPP Evaluation Data Collection by Site

Stratum	M&V Plans	On-Site Verification	Virtual Verification	Evaluated
Commercial HVAC	2	2	0	2
Commercial HVAC 2	2	2	0	2
Commercial Refrigeration	1	1	0	1
Custom HVAC, HVAC Controls, EMS, Window Film	2	2	0	2
Custom Lighting	2	2	0	2
Custom Motors	3	3	0	3
Total	**12**	**12**	**0**	**12**

A.3.1.12 Sample Results

Measurement and verification for the determination of verified energy impacts was conducted on all twelve sampled projects from the 2021/2022 fiscal year. Evaluation protocols were classified using the IPMVP Options. A summary of the protocols used is shown in Table A-12.

Table A-12 CPP Evaluation Protocols by Measure

IPMVP Option	FY2021 – 2022
Option A: Spreadsheet or Basic Bin Analysis	3
Option A+: Engineering Analysis (Based on Trend or Monitored Data)	7
Option A-: TRM (Or other Deemed) Analysis	2
Total	**12**

A summary of evaluated measures by measure types selected from the population is shown in Table A-13. 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 2021/2022.

Table A-13 CPP Evaluated Measures by Category and Protocol

Measure Type	Option A	Option A+	Option A-	Total
Commercial HVAC	1	0	1	2
Commercial HVAC 2	0	2	0	2
Commercial Refrigeration	0		0	1
Custom HVAC, HVAC Controls, EMS, Window Film	0	2	0	2
Custom Lighting	1	1	0	2
Custom Motors	1	2	1	3
Total	**3**	**7**	**2**	**12**

Project-level and measure level results can be found in the provided site-level reports. Sampled measures represented 30% of the reported annual energy savings. The evaluation sample was grouped by measure. Energy savings for projects within each measure were aggregated to determine a strata-level realization rate for extrapolation to the population. Sample savings impacts by strata are shown in Table A-14.

Table A-14 CPP Evaluation Sample Savings Summary

Measure	Tracking Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate	Tracking Data Ex-Ante Peak kW Savings	Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
Commercial HVAC	3,254,366	3,765,782	116%	1,465	1,862	127%
Commercial HVAC 2	2,529,821	3,694,878	146%	464	678	146%
Commercial Refrigeration	209,726	209,442	100%	10	0	0%
Custom HVAC, HVAC Controls, EMS, Window Film	3,899,061	4,140,263	106%	263	273	104%
Custom Lighting	2,984,464	3,294,385	110%	1,314	1,870	142%
Custom Motors	450,281	467,484	104%	61	59	96%
Total	**13,327,718**	**15,572,234**	**117%**	**3,578**	**4,742**	**133%**

Evaluation sample savings impacts by measure category are shown in Table A-15.

Table A-15 CPP Evaluation Sample Savings by Measure Category

Measure Category	Tracking Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate	Tracking Data Ex-Ante Peak kW Savings	Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
Commercial HVAC	5,784,187	7,460,661	129%	1,930	2,540	132%
Custom HVAC, HVAC Controls, EMS, Window Film	3,899,061	4,140,263	106%	263	273	104%
Commercial Refrigeration	209,726	209,442	100%	10	0	0%

Measure Category	Tracking Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate	Tracking Data Ex-Ante Peak kW Savings	Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
Custom Lighting	2,984,464	3,294,385	110%	1,314	1,870	142%
Custom Motors	450,281	467,484	104%	61	59	96%
Total	13,327,718	15,572,234	117%	3,578	4,742	133%

The largest project in the evaluation sample is also the largest project in the population. This project consists of LED lighting and lighting controls, dating back to September 2021. This project was placed under Custom Lighting measure category.

A.3.2 Process Evaluation

A.3.2.1 Process Evaluation Approach and Methodology

For FY21/22, the Evaluator performed a summary process evaluation of CPP. This included an in-depth interview with LADWP program staff to understand and explore the following:

- Program changes to design, delivery, or incentives
- Program performance, including areas for improvement and success
- Market changes affecting performance
- Barriers and opportunities going forward
- Other topics as relevant

The Evaluator also conducted interviews with contractors who participated in the Customer Performance Program (CPP) to gather feedback on their experience with the program, interactions with customers and program staff, and suggestions for program improvement. Specifically, the Evaluation Team conducted five interviews through semi-structured discussions guided by the research questions shown in Table A-16.

Table A-16 Research Questions

Research Topic	Primary Research Questions
Program Value and Integration	▪ How do contractors integrate the program into their regular business practices?

Research Topic	Primary Research Questions
Customer Engagement Support	▪ What is the value of the program to contractors? Why did contractors decide to participate? ▪ What support, resources, or information would help contactors engage more customers in the program? ▪ What do contractors need to better support their customers who participate
Rebate Application Process	▪ What are contractors' experiences with the rebate application process? ▪ What is the rebate application workflow? ▪ How does it vary between the custom and express program tracks? ▪ What feedback do contractors receive from customers about the application process? ▪ How might LADWP improve or streamline the application process?
Secondary Research Questions	
Program Interactions	▪ What are contractors' experiences with interactions with program representatives? How could LADWP improve these interactions? ▪ How do contractors stay up to date on program offerings and procedures? ▪ What are contractors' perceptions of the program name?

A.3.2.2 Process Evaluation Findings

The following sections include a summary of findings informed by the LADWP program staff interview and interviews with contractors.

A.3.2.2.1 Program Design and Delivery

LADWP staff note that CPP's program design and delivery is largely the same as the previous fiscal year, including the same measures and incentives offered to the market. Staff also report that the participation process from project intake to rebate payment is going smoothly and that customers seem satisfied with the program overall.

Program staff note they have resumed in-person site visits, which were put on hold during the height of the pandemic. The program has also hired three additional team members to assist with operations. While the program's design and delivery are largely the same as the previous fiscal year, staff are actively working towards future initiatives. A few of these efforts are summarized in the next section.

A.3.2.2.2 Barriers and Opportunities

Program staff highlighted the following barriers:

- Lingering effects of the pandemic. Building energy usage baselines are uncertain and shifting due to increased vacancy rates. Program staff report that businesses have struggled to bring employees back to the office. Going forward, the program will need to thoughtfully consider how this affects energy usage baselines. Additionally, like other programs, CPP projects have experienced delays due to lagging shipment timelines.
- Inflation pressure on project costs. Program staff note that project costs are higher, which affects the size of projects and the number of projects that customers are willing to take on.

Program staff see additional opportunities in the following areas:

- Building electrification incentives. The program is currently setting up a structure for building electrification projects, including how to claim and incentivize savings.
- Tools to streamline processes and increase transparency to customers.
  - The program is developing a pilot project with Simuwatt, which offers a workflow platform for application processes. This platform could support streamlining quality assurance and control reviews, as well as offer an online application intake form to customers. This pilot may also benefit several programs down the road.
  - The California Technical Forum is working to bring more standardization to custom projects. A framework is in development to make project decisions simpler and more consistent across different types of projects may ultimately reduce engineering review time as well. By the end of the year, program staff hope to launch this as a pilot effort.
- Other cross-program updates. LADWP staff are also considering other offerings that may cut across several programs, such as a whole-building incentive as well as offering additional incentives in designated disadvantaged communities.

The program is also monitoring several areas, including the effect that building decarbonization efforts may have on codes and ordinances. For example, the City's building benchmarking efforts are currently on hold, and will need additional assessment to factor in electric baselines.

A.3.2.2.3 Contractor Interview Findings

In this section, we provide findings from the five contractor interviews including program benefits and pain points identified by contractors. Each section also reports contractors' comments, comments suggestions for improvement, and study recommendations.

Program Integration and Value

Contractors integrate rebate offerings into their business sales process by regularly leveraging program rebates to sell jobs.

Benefits	Pain Points
Contractors say the program helps them: ▪ Drive sales ▪ Engage customers ▪ Influence customers' decisions to make energy efficient upgrades ▪ Add legitimacy to their businesses	Contractors say the current program design: ▪ Makes it difficult to quickly provide their customers with job quotes that factor in a reasonable rebate estimate ▪ May result in customer dissatisfaction if initial savings or rebate estimates are wrong

Contractors said:

"…if [LADWP] can make it easier to get upfront estimates or have somebody that is vastly knowledgeable with the program…that you can call and get some feedback…would be good to have. [For example,] if you were to come to me and say, 'I need to replace this equipment, what will it cost me?', I [could] call a vendor and guestimate that."

"We under-promise (in savings/rebate amounts) and over deliver."

"DWP never tells us what incentive amounts will be. They never share that with you automatically. It makes it hard to work with customers – they want a number. Information about incentive amount used to be in an offer letter from DWP, but not anymore."

Contractors suggested:

- Support contractors by helping them calculate faster, more accurate initial rebate estimates for their customers (see also savings estimate feedback below).
- Ease pressure contractors face with rebate estimates by providing estimate approval letters clearly backed by LADWP.

Evaluator Recommendations

- Consider providing contractors with formalized, LADWP-backed rebate estimate approval letters after the pre-verification process that contractors can share with their customers. Ensure such letters include clear caveats that amounts might change after post-verification testing, ideally referencing back to program documentation available publicly on the LADWP website.

Customer Engagement Support

Contractors would value any business marketing support LADWP could provide based on their participation in CPP. It would, in turn, help contractors attract more customers to participate.

Benefits	Pain Points
Contractors say the program helps them: ▪ Attract more customers to participate in the program ▪ Raise customers' awareness of the businesses and the program ▪ Increase customers' senses of legitimacy about the businesses	▪ One contractor described not wanting to promote their participation in CPP because doing so would inform their competitors about how they gain an advantage over other companies to win customers' business ▪ Another contractor liked how other utilities provide a short third-party engineering report for each project including savings and rebate amounts and said that if LADWP did a report like this, they would "market the heck out of those reports."

Contractors said:

> *"In this industry, if you have an advantage over somebody, you're probably going to get the job. If they don't know about…I can use it to my advantage."*

Contractors suggested:

- Establish a preferred contractor list
- Create contractor "impact awards" based on project savings performance, then announce or celebrate award winners through LADWP marketing streams.
- List on the LADWP website the contractors who generated the most savings in a period, or who generated high savings among unique markets (parking garages, data centers, theme parks, refrigeration, etc.)
- Provide third-party engineering reports for each project including savings and rebate amounts that contractors could use for marketing purposes
- Evaluator Recommendations

- Host periodic contractor roundtables to gather feedback from participating contractors about their ideas on how LADWP might help them engage more customers in the program and validate their quality of work. Use this time to workshop with contractors on ways to best go about doing that.
- Consider supporting contractors with marketing and customer engagement by showcasing success stories or case studies for a set of projects (and various contractors) that best represent the most prevalent industries across LADWP's service territory.

Contractors and their customers perceive LADWP's rebate amounts to be pleasantly high compared to other California utilities. However, contractors said the CPP application process can be more work.

Benefits	Pain Points
▪ CPP's higher rebates motivate both contractors and customers to participate despite perceptions that the process is too tedious. ▪ Not all contractors agreed the application process was more tedious than other utilities.	▪ High incentives are not always enough for contractors who find the rebate application process tedious.

Contractors said:

"Essentially what we find with LADWP versus other rebates in CA is that the LADWP program is 10x as much work as all the utilities around it…I consider them a government agency because [the rebate application process is] slow, but when they do pay, they pay well."

"[LADWP] has a pretty good [rebate application] process. There is not as much 'red tape/bureaucracy' as other utilities."

"We have to ask – is it really worth going through this process."

Contractors suggested:

- Continue offering rebates at the current rates.
- Streamline the rebate application process. (See the *Rebate Application Process* section on page A-45.)

Evaluator Recommendations

- Continue to assess program savings acquisition with current CPP rebate rates with careful consideration of contractor needs and satisfaction with the program. For example, establish regular interactions with contractors (like periodic roundtables or regular lunch and learns) to learn more about what specific elements of the program design be changed or made easier for contractors.

Most contractors we spoke with completed the rebate application for their customers.

Benefits	Pain Points
▪ Some contractors provide technical support while their customers fill out the application.	▪ Contractors prefer to fill out the application for their customers because they believed customers could make mistakes that slow down the process.

Contractors said:

"We'll coordinate with whoever is in charge of the building. They'll start it, then we'll assist. We help submit the application and procure the rebate."

"Filling out applications for customers is best because I know what DWP wants."

Contractors suggested:

- N/A

Study Recommendations

- Consider conducting a study to assess the usability of rebate application forms, online and written instructions, and technical support tools that the program provides. The findings from a usability study can help the program identify how to simplify and/or streamline elements of the process such as improving savings calculation tools, limiting technical jargon, and providing step-by-step instructions that are easy to understand.

Rebate Application Process

Overall, contractors have consistent experiences with how the rebate application process works.

Contractors identified similar steps of the rebate process. These include:

- Step 1. Estimate savings
- Step 2. Send savings estimate to LADWP and iterate on the calculations, especially for new measures.
- Step 3. Pre-installation verification, 1-3 weeks

- Step 4. LADWP emails a notice to proceed once pre-installation verification is complete
- Step 5. Contractor begins installation soon after receiving the notice
- Step 6. Contractor sends LADWP the invoice
- Step 7. Post-installation verification
- Step 8. Contractor gets and customer signature on forms and submits them to LADWP

Benefits	Pain Points
▪ Contractors noticed that LADWP delivers rebate checks faster now than in the past.	▪ Contractors' perceptions of a slow rebate process are usually tied to specific stages they experienced as slower or overly complex, namely estimating savings and obtaining written customer signatures. (See Savings Estimates and Customer Signatures sections.)
▪ LADWP moves through the pre-installation verification process quicker than other utilities (LADWP requires 1-3 weeks where other utilities require 7-8 months).	

Contractors said:

"It takes about 6 weeks from project start to receive the check. That's much better than the 8 months it took when first participated."

"Other utilities require 7-8 months before we can issue a PO for equipment. LADWP is the best."

Contractors suggested:

See section, *Savings Estimates with Custom versus Express Track Feedback*

below and section *Customer Signatures*

on page A-48.

Evaluator Recommendations

- Contractors made several references to what other utility companies were doing that they liked. These are reported throughout this memo. Consider conducting a benchmarking study to learn about and document what other utilities are doing with their custom programs.

Savings Estimates with Custom versus Express Track Feedback

Contractors more often follow the custom track when calculating savings estimates; however, several contractors described experiencing challenges with custom savings calculations.

<table>
<tr><th>Benefits</th><th>Pain Points</th></tr>
<tr><td rowspan="3">▪ Express. While most contractors described using the custom track, many of them had no opinions about the express track. Their reasons included that they, 1) were unaware of the express track, 2) were aware but were not familiar with how it works, or 3) believed measures their company typically offered or newer measures (emerging tech) their customers wanted were not on the express list.</td><td>▪ Custom. Contractors perceive the custom savings calculation spreadsheets/tools that LADWP provides as less helpful and more complex than tools from other utilities. For example, multiple contractors referenced using software from other utilities for their LADWP calculations.</td></tr>
<tr><td>▪ Others had developed their own spreadsheets for estimating savings, although one contractor described using spreadsheets at all as “very time consuming.”</td></tr>
<tr><td>▪ Both. One contractor preferred the custom track over the express track because they believe their custom calculations resulted in higher savings and rebates than the express flat rates.</td></tr>
</table>

Contractors said:

“I use PG&E’s software…it’s not actually PGE&E software, they subcontracted it. SCD&E has a software as well… [The software] gives a breakdown of savings…DWP doesn’t provide software.”

"There is no profit in express (for us). Our savings are low hanging fruit - better than LED lighting – have a one-year payback typically. Sometimes [program staff] try to get me to do a flat rate per measure, but my way with measured savings is much higher.”

Contractors suggested:

- Custom. Provide software for savings calculations to make the application process easier and faster. Software may also help contractors develop more accurate rebate estimates to include in their early cost quotes to customers – prior to submitting the rebate application.
- Express. Add more measures to the express list and update the list of eligible program measures more frequently.
- Host lunch and learns or webinars to share program updates, specifically about measures added to the program measure or express lists.
- Offer recurring orientation to or how-to video about the application process.

Evaluator Recommendations

- Ensure that all participants receive equitable savings rates for the same measures. For example, assess how often or for what express measures contractors do their own custom savings calculations and whether the program is awarding higher rebates to certain participants for flat rate express measures.
- Review how often the program adds new eligible measures or new express measures. Based on this review, determine how the program might:
  - Make and inform contractors about these updates more frequently or more consistently.
  - Manage contractor expectations for when measures will be added.
- Find ways to streamline and optimize communications about program updates. For example,
  - Create regular lunch and learns or webinars with topics such as, 1) Update on new measures added, 2) Opportunity for contractors to suggest new measures to add, 3) and other updates to the program.
  - Create and upload to the program website a how-to video that is both contractor- and customer-friendly about the rebate application process.
  - Offer a recurring contractor-specific orientation/refresher on the rebate application process.

Customer Signatures

Some contractors suggested incorporating electronic customer signatures into the rebate application process.

Benefits	Pain Points
▪ N/A	▪ Obtaining written and not electronic customer signatures adds time and work to the rebate application process for both contractors and customers. The requirement feels outdated, especially when compared to other utilities who allow electronic signatures and the prevalence of electronic signatures more generally.

Contractors said:

> *"[The] LADWP form process is onerous with the signatures. They won't accept digital signatures so we're signing and scanning and emailing lots of documents."*

Contractors suggested:

- Allow electronic customer signatures to make the process easier and faster.

Study Recommendations

- To keep the program current and to increase satisfaction among both contractors and customers, adapt the program design to allow electronic customer signatures.

Program Interactions

Contractors are happy with most of their interactions with program staff.

Benefits	Pain Points
▪ Staff are responsive, keep contractors informed and aware of any issues, and seem genuinely motivated to help contractors and customers.	▪ Some contractors described how trying to get ahold of program staff that were knowledgeable about the program was sometimes difficult. They believed challenges they experienced were likely due to staff having very high workloads and staff turnover.
▪ Contractors are aware of and utilize program support through the website, by phone, and by email.	
▪ When contractors want to check updates to the program measures list and whether new measures were added to the express list, they look on the website, or call or email one of their program contacts.	
▪ Contractors use both phone and email to stay up to date about their projects' rebate application statuses.	

Contractors said:

"Every once in a while, [LADWP] switches the PMs on a job. There's a communication gap there. You don't know you need to email someone else. Little quirks like that [slow the process down]."

Contractors suggested:

- Have one key contact for each company to provide end-to-end participation support.

Evaluator Recommendations

- As program resources allow, consider assigning one staff contact to coordinate communications (i.e., application status updates, questions from savings calculation engineers, etc.) with each company or per job/rebate application.
- Develop an FAQs document addressing common questions from contractors and post it once the program website.

Other Findings

Program Name

When asked for feedback about the program name, contractors explained that if they weren't familiar with the program from their experience with it, they wouldn't understand what the program was about just by the name.

Benefits	Pain Points
▪ Contractors who are familiar with the program are also comfortable with the name.	▪ Contractors and customers who are not familiar with the program likely would not understand the offering by the name alone.

Contractors said:

- N/A

Contractors suggested:

- Add the word "rebate" to the program name to make the offering clearer. For example, "Custom Rebates Program" or "Custom Equipment Rebates".

Evaluator Recommendations

- Consider adding the word "rebate" to the program name.

COVID-19 Impacts

Contractors continue to experience challenges related to COVID-19 safety restrictions that complicate and slow down project timelines. These include global supply chain impacts on equipment shipping timelines, changing or lowered quality of manufactured products, corporate safety policy, customer needs, and unexpected staffing issues due to illness.

Benefits	Pain Points
▪ N/A	▪ Almost all contractors commented on how delays in the global supply chain causes significantly longer timelines on equipment shipments than pre-COVID.
	▪ One contractor described delays of 63-78 weeks for one product and 6-10 weeks for another product. They said the delay times were "only getting longer."
	▪ One contractor described how their clients' months- or years-long lead times on their projects leads them to choose not to apply for rebates because delaying their equipment orders could cost them 5 times more than the value of the incentives.

Benefits	Pain Points
	▪ Another contractor said their go-to manufacturers were unable to deliver products with the same quality at the same cost as they did pre-COVID.
	▪ Some customers only want to work with vaccinated technicians, which makes processes slightly more complicated for contractors and can slow down the project timeline.

Contractors said:

"It's a big no-no to get equipment prior to getting authorization from the utility because [LADWP] wants to show influence and impact. [Our clients] may go out and order a bunch of new units and may not know where they'll go at the time, but want to get the order in. Going through the utility process could jeopardize their projects [since shipping time could] delay project by months and that is worth 5 times more than the incentives."

"We have some people that only want vaccinated technicians. There are select individuals that we can send to certain clients."

Contractors suggested:

- N/A

Evaluator Recommendations

- Impacts from COVID-19 continue to affect contractor businesses. While these impacts are becoming normalized over time, these disruptions indicate that contractors would likely appreciate any opportunity to make their processes faster and easier. Continue to work with contractors, program engineers, and LADWP staff to find ways to make the rebate application process easier and faster to support contractors' participation and help engage more customers.

A.3.3 Recommendations

The table below includes a summary of previous recommendations and the program's response to date.

Table A-17 Program Responses to Past Recommendations

Summary of Past Recommendations	Program Response
▪ Track and measure rebate processing times to confirm that processing time stays low	▪ Program staff report that processing times are about the same as the previous year. The

	addition of three more team members will help in bringing these times down.
▪ Review application process and identify opportunities to streamline	▪ The program is identifying opportunities for online intake of applications through Simuwatt's build-ee platform.

The recommendations based on the contractor interview findings are summarized below.

- Consider providing contractors with formalized, LADWP-backed rebate estimate approval letters after the pre-verification process that contractors can share with their customers. Ensure such letters include clear caveats that amounts might change after post-verification testing, ideally referencing back to program documentation available publicly on the LADWP website.
- Host periodic contractor roundtables to gather feedback from participating contractors about their ideas on how LADWP might help them engage more customers in the program and validate their quality of work. Use this time to workshop with contractors on ways to best go about doing that.
- Consider supporting contractors with marketing and customer engagement by showcasing success stories or case studies for a set of projects (and various contractors) that best represent the most prevalent industries across LADWP's service territory.
- Continue to assess program savings acquisition with current CPP rebate rates with careful consideration of contractor needs and satisfaction with the program. For example, establish regular interactions with contractors (like periodic roundtables or regular lunch and learns) to learn more about what specific elements of the program design be changed or made easier for contractors.
- Consider conducting a study to assess the usability of rebate application forms, online and written instructions, and technical support tools that the program provides. The findings from a usability study can help the program identify how to simplify and/or streamline elements of the process such as improving savings calculation tools, limiting technical jargon, and providing step-by-step instructions that are easy to understand.
- Contractors made several references to what other utility companies were doing that they liked. These are reported throughout this memo. Consider conducting a benchmarking study to learn about and document what other utilities are doing with their custom programs.
- Ensure that all participants receive equitable savings rates for the same measures. For example, assess how often or for what express measures contractors do their

own custom savings calculations and whether the program is awarding higher rebates to certain participants for flat rate express measures.

- Review how often the program adds new eligible measures or new express measures. Based on this review, determine how the program might:
  - Make and inform contractors about these updates more frequently or more consistently.
  - Manage contractor expectations for when measures will be added.
- Find ways to streamline and optimize communications about program updates. For example:
  - Create regular lunch and learns or webinars with topics such as, 1) Update on new measures added, 2) Opportunity for contractors to suggest new measures to add, 3) and other updates to the program.
  - Create and upload to the program website a how-to video that is both contractor- and customer-friendly about the rebate application process.
  - Offer a recurring contractor-specific orientation/refresher on the rebate application process.
- To keep the program current and to increase satisfaction among both contractors and customers, adapt the program design to allow electronic customer signatures.
- As program resources allow, consider assigning one staff contact to coordinate communications (i.e., application status updates, questions from savings calculation engineers, etc.) with each company or per job/rebate application.
- Develop an FAQs document addressing common questions from contractors and post it one the program website.
- Consider adding the word “rebate” to the program name.

A.4 Food Service Program – Comprehensive (FSPC)

This section details the impact evaluation and process evaluation for the Food Service Program – Comprehensive (FSPC) that LADWP offered customers during FY 21/22. 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.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. As part of the impact evaluation, the Evaluator performed the following data collection activities outlined in Table A-18.

Table A-18 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.4.1.1 Tracking Data Review

Program tracking data for measures incentivized between July 2021 and June 2022 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.4.1.2 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 21/22 sample projects were enough to estimate the total ex-post savings with ±16.3% precision at a 90% confidence interval. The Evaluator's current sample (FY 20/21) combined with (FY 21/22) as well as the future sample (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 measure. Table A-19 presents the number of projects and tracking ex-ante kWh savings for the sampled projects by stratum.

Table A-19 Population Statistics used for Sample Design

	FF1 (Fridges/Freezers)	IM (Ice Machines)	Totals
Population Size	29	3	32
Total Ex-Ante kWh Savings	11,618	2,650	14,268
Average Ex-Ante kWh Savings	401	883	
Standard deviation of Ex-Ante kWh Savings	87	377	
Coefficient of Variation	0.22	.43	
Final Design Sample	9	2	1

The resulting sample of three projects consisted of two categories, or strata. The sample precision based on ex-post gross annual energy savings (kWh) was ±16.3%.

A.4.1.3 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 21/22 start dates in order to ensure the appropriate DEER workpaper was used.

A.4.1.4 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. On-site visits were conducted to collect data for energy savings calculations, to verify measure installation, and to determine measure operating parameters. For the three sampled sites, the Evaluator completed three on-site visits.

A.4.1.5 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.

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 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.4.2 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.4.2.1 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, unit size/capacity, operating characteristics, etc.) based on information either collected in person, referenced in project documentation, or DEER workpapers and specification sheets.

A.4.2.2 Extrapolation of Results

Table A-20 compares ex-post energy impacts to ex-ante claimed savings from the tracking data. For FY 21/22, the program level ex-post energy savings realization rate was 100% when compared to tracking data ex-ante savings.

Table A-20 FSPC Concurrent Year 1 Stratum Savings Summary

Stratum	Tracking Data Ex-Ante kWh Saving	Ex-Post kWh Savings	Gross kWh Realization Rate
FF1 (Fridges/Freezers)	11,618	11,564	100%
IM (Ice Machines)	2,650	2,646	100%
Total	14,268	14,210	100%

The program level realization rate of 100% was a result of the sampled projects seen below in Table A-21.

Table A-21 FSPC FY 20/21 Sampled and Non-Sampled Savings Summary

Project	Tracking Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
Project 1	427	353	88%
Project 2	1,180	1,837	101%
Project 3	2,064	2,095	101
Non-sampled Projects	9,967	9,925	100%
Total	14,268	14,210	100%

The Evaluator sample included 31 projects. The specific factors affecting the projects' realization rates were as follows.

- **Project 1:** Ex-Post utilized purchased unit's specifications such as volume rates in lieu of default DEER work paper values used in the ex-ante estimate. The ex-ante estimate used a volume of 10 cu ft. The ex-post calculation used values from the product specification sheet of 6.52 cu ft.

- **Project 2 & 3:** Specific factors affecting project realization rates for both these projects were found to be indeterminate. However, when contacting the individual in charge of ex-ante calculations for this program, they stated "We provided the deemed savings information to Energy Solutions. The measures are not calculated individually. They are an average based on the qualified products in the category. The company we use, Frontier Energy, writes the white papers for the measures. Most of the info is in the eTRM and on the Energy Star website." ADM believes this "averaging" of the measures is responsible for site level discrepancies and would explain how measure level realization rates can vary while overall program realization rate is 100%.

Table A-22 compares ex-post energy savings to ex-ante claimed savings from the tracking data at the measure level. For FY 21/22, the program level ex-post energy savings realization rate was 100% when compared to ex-ante savings.

Table A-22 FSPC Concurrent Year 1 Measure Summary

Measure	Tracking Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
Ice Machine	2,650	2,646	100%
Refrigerator/Freezer	11,618	11,564	100%
Total	14,268	14,210	100%

A.4.3 Process Evaluation

The process evaluation for the FSPC and FSP-POS are combined and reported in Section A.5.3.

A.5 Food Service Program – Point of Sale (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 21/22. 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.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-23.

Table A-23 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.5.1.1 Tracking Data Review

Program tracking data for measures incentivized between July 2021 and June 2022 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.5.1.2 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 21/22 sample projects are enough to estimate the total achieved savings with ±26.8% precision at a 90% confidence interval. The Evaluator's current sample (FY 21/22) combined with the prior sample (FY 20/21, FY 22/23) will in total be enough to estimate the total achieved savings with ±15.66% precision at a 90% confidence interval.

Projects were categorized to each stratum by ex-ante kWh savings and measure. 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-24 presents the number of projects and tracking ex-ante kWh savings for the sampled projects by stratum.

Table A-24 Population Statistics used for Sample Design

	Strata Boundaries (kWh)	Population Size	Total Ex-Ante kWh Savings	Average Ex-Ante kWh Savings	Standard deviation of Ex-Ante kWh Savings	Coefficient of Variation	Final Design Sample
FF1	<400	28	8,027	287	78	0.27	1
FF2	1000>FF2>400	12	6,678	557	176	0.31	2

	Strata Boundaries (kWh)	Population Size	Total Ex-Ante kWh Savings	Average Ex-Ante kWh Savings	Standard deviation of Ex-Ante kWh Savings	Coefficient of Variation	Final Design Sample
FF3	>1000	1	4,602	4,602	0		1
HFC1		7	13,058	1,865	2,247	1.2	3
ICE		5	3,007	601	144	0.23	2
OVEN1	<3500	4	8393	2,098	839	0.4	1
OVEN2	>3500	9	147,996	16,444	6,508	0.4	5
Totals		66	95,805				15

The resulting sample of 15 projects consisted of seven categories, or strata. The ex-post gross annual energy savings (kWh) precision was ±26.8%.

A.5.1.3 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 21/22 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 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 15 sampled sites, the Evaluator completed nine onsite verification visits and six desk reviews.

A.5.1.5 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 interviews were performed with site contacts to discuss project details and to collect information to support the impact analysis.

A.5.2 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.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 FSP POS savings was accomplished using the Evaluator's custom-designed food service evaluation tool with system parameters (unit efficiencies, unit 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-25 compares ex-post energy impacts to ex-ante claimed savings from the tracking data. For FY 21/22, the program level ex-post energy savings realization rate was 45% when comparing to tracking data ex-ante savings.

Table A-25 FSP POS Concurrent Year 1 Stratum Savings Summary

Stratum	Tracking Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
FF1 (Fridge/Freezers 1)	8,027	5,239	65%
FF2 (Fridge/Freezers 2)	6,678	7,245	108%
FF3 (Fridge/Freezers 3)	4,602	4,804	104%
HFC (Hot Food Cabinets)	13,058	8,967	69%
ICE (Ice Machines)	3,007	1,372	46%
Oven1 (Ovens 1)	8,393	1,563	19%

Stratum	Tracking Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
Oven2(Ovens 2)	147,996	57,587	39%
Total	**191,761**	**86,777**	**45%**

The program level realization rate of 45% was a result of the sampled projects as shown below in Table A-26.

Table A-26 FSP POS Concurrent Year 1 Sampled and Non-Sampled Savings Summary

Project	Tracking Data Ex-Ante kWh Savings	E- Post kWh Savings	Gross kWh Realization Rate
Project 1	3,357	625	19%
Project 2	15,038	4,715	31%
Project 3	4,602	4,804	104%
Project 4	666	377	57%
Project 5	666	231	35%
Project 6	11,501	-	0%
Project 7	11,501	-	0%
Project 8	30,190	14,806	49%
Project 9	558	576	103%
Project 10	11,501	11,501	100%
Project 11	558	574	103%
Project 12	486	551	113%
Project 13	423	276	65%
Project 14	575	600	104%
Project 15	558	-	0%
Non-sampled Projects	99,578	47,135.64	47%
Total	**191,758**	**86,772**	**45%**

The Evaluator sample included 15 projects. The specific factors affecting the projects realization rates were as follows:

Project 1: The Evaluator was unable to determine a factor affecting realization rate.

Project 2: Equipment missing during the Evaluator's site visit. The Evaluator was unable to find one of the deck ovens mentioned. This may possibly be a clerical error as the deck oven was a "Two Deck Electric Oven" explaining the reasoning behind the quantity. Hours of use also differed. The ex-ante calculations use 12 hours per day and 365 days per year. The Evaluator found during a site visit this was around 5.5 hours of use 365 days per year

Project 3: The ex-post calculation utilized purchased refrigerator volume in lieu of default DEER work paper values used in the ex-ante estimate. The ex-ante used a volume of 44 cu ft. The ex-post used volume value from the product specification sheet of 46.88 cu ft.

Project 4: The ex-post calculation utilized the harvest rate and operational days found from a site visit in lieu of default DEER work paper values used in the ex-ante estimate. The ex-ante used the ice machine type of “Ice Making Head” with a def normalized harvest rate of 600 lbs./day and 336 days/year. The ex-post used a harvest rate value specified during a site visit of around 400 lbs./day and 260 days per year.

Project 5: The ex-post calculation utilized the harvest rate and operational days found from a site visit in lieu of default DEER work paper values used in the ex-ante estimate. The ex-ante used the ice machine type of “Ice Making Head” with a def normalized harvest rate of 600 lb./day and 336 days/year. The ex-post used a harvest rate value specified during a site visit of around 160 lb./day and 363 days per year.

Project 6: The equipment was 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 determined to be on-site and it could not be determined that the item was installed in LADWP territory

Project 7: The equipment was 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 determined to be on-site and it could not be determined that the item was installed in LADWP territory.

Project 8: The ex-post calculations found the size of the efficient equipment to only be 12 pans. The ex-ante calculations use the as-found parameters and they are as follows: pre-heat energy of 1 kWh, a convection idle energy rate of .95 kW, convection cooking efficiency of 81%, a convection production capacity of 127 lbs./day, a steam idle energy rate of .87 kW, a steam cooking efficiency of 59%, a steam production capacity of 236 lbs./day and a water consumption rate of 16.1 gal/hour. The ex-ante site visit found the equipment to be operational 9 hours per day and 24 days per year. The ex-ante calculations use all default DEER work-paper values. In this case, this means with a size of 15-28 pans the parameters are as follows: pre-heat energy of 2 kWh, a convection idle energy rate of 2.5 kW, convection cooking efficiency of 70%, a convection production capacity of 125 lbs./day, a steam idle energy rate of 6 kW, a steam cooking efficiency of 50%, a steam production capacity of 200 lbs./day and a water consumption rate of

25 gal/hour. The calculations also use values of 12 hours per day and 365 days per year.

Project 9: The ex-post calculation utilized purchased hot food holding cabinet specifications in lieu of default DEER work paper values used in the ex-ante estimate. The ex-ante used a volume of 10 cu ft, baseline idle energy rate of 35 W/ft^3, efficient idle energy rate of 18 W/ft^3, 9 hours per day 365 days per year. The ex-post used volume value from the product specification sheet of 6.8 cu ft and efficient idle energy rate of 25.33 W/ft^3. The ex-post also used the as found hours of use of 24 hours per day, 365 days per year sourced from a site visit.

Project 10: A desk review was conducted on this site. Since hours of use and product specifications could not be verified, the Evaluator used default values from the DEER workpapers resulting in 100% realization rate.

Project 11: The ex-post calculation utilized purchased hot food holding cabinet specifications in lieu of default DEER work paper values used in the ex-ante estimate. The ex-ante used a volume of 10 cu ft, baseline idle energy rate of 35 W/ft^3, efficient idle energy rate of 18 W/ft^3, 9 hours per day 365 days per year. The ex-post used volume value from the product specification sheet of 6.8 cu ft and efficient idle energy rate of 25.33 W/ft^3. Although this was a desk review, the ex-post also used the as found hours of use of 24 hours per day, 365 days per year sourced from a site visit from another location of the same chain.

Project 12: The ex-post calculation utilized purchased refrigerator volume in lieu of default DEER work paper values used in the ex-ante estimate. The ex-ante used a volume of 24 cu ft for each refrigerator. The ex-post used volume value from the product specification sheet of 18.44 cu ft.

Project 13: The ex-post calculation utilized purchased refrigerator volume in lieu of default DEER work paper values used in the ex-ante estimate. The ex-ante used a volume of 24 cu ft. The ex-post used volume value from the product specification sheet of 20.34 cu ft.

Project 14: The ex-post calculation utilized purchased refrigerator volume in lieu of default DEER work paper values used in the ex-ante estimate. The ex-ante used a volume of 44 cu ft. The ex-post used volume value from the product specification sheet of 46.88 cu ft.

Project 15: The Equipment was 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.

Table A-27 compares ex-post energy impacts to ex-ante claimed savings from the tracking data at the measure level. For FY 21/22, the program level ex-post energy savings realization rate was 45% when compared to ex-ante savings.

Table A-27 FSP POS FY 20/21 Measure Summary Savings

Measure	Tracking Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
Combination Oven	99,198	39,732	40%
Convection Oven	8,393	1,563	19%
Deck Oven	30,076	10,566	35%
Hot Food Holding Cabinet	13,058	8,967	69%
Ice Machines	3,421	1,821	53%
Refrigerator/Freezer	18,893	16,839	89%
Steamers	18,722	7,284	39%
Total	191,761	86,773	45%

A.5.3 Process Evaluation

This section presents the process evaluation for the FSPC and FSP-POS programs.

A.5.3.1 Process Evaluation Approach and Methodology

For FY21/22, the Evaluator performed a summary process evaluation of the FSP. This included an in-depth interview with LADWP program staff to understand and explore the following:

- Program changes to design, delivery, or incentives
- Program performance, including areas for improvement and success
- Market changes affecting performance
- Barriers and opportunities going forward
- Other topics as relevant

The Evaluators performed a full process evaluation of FSP in FY20/21.

A.5.3.2 Process Evaluation Findings

In April 2022, LADWP ended the POS program as it was not cost-effective to run. Program staff note that the POS offering had high administrative fees, while participation was limited. Barriers to adequate participation levels were a result of customers not purchasing as much new equipment during the pandemic, and dealer dissatisfaction with the level of paperwork compared to other utilities.

Program staff note that the Comprehensive program design and delivery is still largely the same as the previous fiscal year, though they no longer partner with SoCalGas on offering gas measures. Measures and incentives offered are also the same. At the beginning of 2022, the program offered a 50% bonus incentive, which was well received by the market.

While the POS program has ended, previously participating dealers will promote the Comprehensive program to their customers by adding a note to the invoice if a measure is eligible for an incentive. Program staff also state that now that the pandemic is subsiding, customer interest in the program is going up. They are currently working with LADWP's customer service division to increase marketing and outreach efforts. Program staff are also in the process of reaching out to national and regional franchises to educate corporate offices about the program and electrification measures.

A.5.3.2.1 Barriers and Opportunities

Program staff highlighted the following barriers:

- Market shortages and inflation. Program staff note that several customers have experienced equipment delays due to the chip – or semiconductor – shortage. Inflation has also affected food service businesses' bottom lines, as food costs are high. This means that customers may not have the additional budget to upgrade to new, energy efficient equipment.
- Eligibility confirmation challenges. Sometimes ascertaining whether a customer has an account to confirm eligibility is difficult. Program staff note that buildings may also be master metered (e.g., customers in malls or on a college campus), so their name is not on the bill. This takes staff additional time to work through.

Program staff see additional opportunities in the following areas:

- The changing industry landscape. Shared kitchens are growing in popularity, and the city is now allowing residential properties to cook commercially. Other utility programs allow eligibility so long as the residence is located within their zip code. The program is exploring how to adapt to these new provisions.
- Electrification of food service equipment. Program staff note that the industry is currently skeptical about electrification. The price point is also significant – transitioning from gas to electric equipment can be double or even triple the cost. In response, the program is considering new marketing and educational strategies to change the current narrative of skepticism. This could include case studies and demonstrations on how to cook with electric equipment and opportunities to test it.

A.5.3.2.2 Previous Evaluation Recommendations

Table A-28 below includes a summary of previous recommendations and the program's response to date.

Table A-28 Previous FSP Recommendations and Program Response

Summary of Past Recommendations (Comprehensive only)	Program Response
Consider targeted marketing to boost participation to achieve program goals	The program is currently working with the division's customer service group to develop additional marketing efforts. They are in the process of reviewing recommendations and obtaining approvals.
Create materials to educate customers about why LADWP promotes energy efficiency	This recommendation is under review.
Create follow-up materials on the importance of maintenance for continued efficient operation of equipment	This recommendation is under review.

A.5.4 Recommendations

The Evaluators do not have any recommendations for FSP at this time.

A.6 LADWP Facilities Program

This section details the impact evaluation and process evaluation for the LADWP Facilities Program that LADWP offered customers during FY 21/22. 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.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.

A.6.1.1 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, 2021 and June 30, 2022. 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.6.1.2 M&V Sample Design

A total of two projects participated in the LADWP Facilities Program during FY 20/21. With this small population, there was no need for further sampling and therefore, both sites were evaluated.

A.6.1.3 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:

$$kWh_{Savings} = \frac{Watt_{Baseline} * HOU_{Baseline} * Qty_{Baseline} - Watt_{Installed} * HOU_{Installed} * Qty_{Installed}}{1000} * IEFe$$ *Equation A-5*

$$kWh_{Code} = \frac{Watt_{Code} * HOU_{Baseline} * Qty_{Baseline} - Watt_{Installed} * HOU_{Installed} * Qty_{Installed}}{1000} * IEFe$$ *Equation A-6*

$$\Delta kW = (Watt_{Baseline} - Watt_{Installed}) * CF * IEFd/1000$$ *Equation A-7*

$$Dual\ Baseline\ Lifetime\ Savings = kWh_{Savings} * \frac{EUL}{3} + kWh_{Code} * (EUL - \frac{EUL}{3})$$ *Equation A-8*

Equation A-5 and Equation A-7 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-8. Calculation of dual baseline lifetime savings required the use of savings using code standards found using Equation A-7. 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 DEER 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 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.6.1.4 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-29 FY21/22 LADWP Facilities Ex-Ante Savings Source Comparison

Measure	ESP Ex-Ante kWh	Program Tracking Ex-Ante kWh	ESP Ex-Ante kW	Program Tracking Ex-Ante kW
Project 1	10,568	10,568	1.36	2.98
Project 2	71,306	71,306	2.36	4.18
Total	81,874	81,874	3.72	7.15

A.6.1.5 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.6.1.6 Data Collection Activities

In-person site visits were used to gather information utilized for calculating project savings. Both 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 randomly sampled projects is shown in Table A-30.

Table A-30 LADWP Facilities program Evaluation Data Collection Progression

Fiscal Year	M&V Plans	Contact Attempted	Virtual Verification	On-Site Verification	Evaluated
FY 21/22	2	2	0	2	2

The Evaluator conducted on-site power meter monitoring on one of the two LADWP Facilities projects. The second project involved outdoor lighting, where logger installation is not viable, and monitoring was not performed.

A.6.2 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.6.2.1 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.6.2.2 Data Analysis

A full evaluation analysis was conducted on both projects from FY 20/21. Project-level and measure-level results can be found in the provided site-level reports.

Table A-31 Summary of LADWP Facilities Program Savings by Project

Project	Tracking Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate	Tracking Data Ex-Ante kW Savings	Ex-Post kW Savings	Gross kW Realization Rate
Project 1	10,568	6,828	65%	2.98	3.14	105%
Project 2	71,306	109,412	153%	4.18	0.00	0%
Total	81,874	116,240	142%	7.15	3.14	44%

A.6.2.3 Extrapolation of Results

Both projects were evaluated, and a measure sample was drawn on lighting fixtures. Therefore, project-level extrapolation of results was not necessary.

A.6.3 Process Evaluation

A.6.3.1 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.6.3.1.1 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 handle some of the Program's larger lighting projects.

A.6.3.1.2 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 three-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.6.3.1.3 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 handle 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.6.3.1.4 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.6.3.1.5 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 become the norm, there will be fewer savings from lamp replacements, and more savings will need to come from implementing building controls to integrate lighting with other 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.6.3.1.6 Recommendations

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

- The methods of calculating energy savings estimates differ from lighting projects in other commercial programs. The Evaluator recommends using consistent methods with commercial programs such as the Commercial Lighting Incentive Program (CLIP).
- The Evaluator recommends the collection and management of project documentation in a consistent manner with other commercial programs, such as CLIP.

A.7 LAUSD Direct Install (DI) Program

This section details the impact evaluation and process evaluation for the LAUSD Direct Install Program that LADWP offered customers during FY 21/22. 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 program data review, 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 data for measures installed as a part of LAUSD DI Program between July 01, 2021, and June 30, 2022. Final program data was provided which showed the energy savings for each unique fixture type and location. Detailed program data was provided earlier in the year and matched up to the final data. Detailed program data included fixture quantities, wattages, controls reductions, location, and descriptions. The only missing information is the value used to represent interactive effects and the annual operating hours. Installation dates in the program data were used to confirm eligibility within the program year.

A.7.1.2 M&V Sample Design

Based on the program data provided by LADWP, a sample design was developed for site-level analysis. Sampling occurred prior to the completion of the program year in order to perform timely on-site verification. The Evaluator has a goal of achieving 10% precision at the 90% confidence interval across FY20/21, FY21/22, and FY22/23. Sampling for FY20/21 was based on stratification by project size (annual energy savings). Sampling for FY21/22 has been modified to represent sample strata by measure type. After initial sampling, ADM received measure classifications reported by LADWP and updated the Evaluation sample strata to represent these measures as exterior retrofit, exterior sensor, interior retrofit, and interior sensor. If a lighting fixture maintains an integrated sensor *t* is classified as a retrofit. With the change in strata, the 154 line-items sampled at three schools represent a sample design of 27% precision at the 90% confidence interval.

Realization rates (the ratio of ex-post kWh savings to ex-ante kWh savings) for projects sampled in each stratum are only extrapolated to other projects within that stratum. Table A-32 provides program population and sample statistics.

Table A-32 LAUSD DI Program Population and Sample Statistics

Strata Boundaries	Population Size	Total Ex-Ante kWh Savings	Average Ex-Ante kWh Savings	Standard Deviation of Ex-Ante kWh Savings	Coefficient of Variation	Final Design Sample
Retrofit Exterior	928	1,060,820	1,143	2,196	1.92	35
Retrofit Interior	4,855	4,909,247	1,011	1,488	1.47	50
Exterior Sensor	565	274,445	486	2,030	4.18	43
Interior Sensor	4,209	756,685	180	486	2.41	26
Total	10,557	7,001,196	2,820	6,200	9.98	154

A.7.1.3 Baseline Assumptions Review

The projects completed under the LAUSD DI Program during FY 21/22 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-9

$$kWh_{Code} = \frac{Watt_{Code} * HOU_{Baseline} * Qty_{Baseline} - Watt_{Installed} * HOU_{Installed} * Qty_{Installed}}{1000} * IEFe$$ Equation A-10

$$\Delta kW = (Watt_{Baseline} - Watt_{Installed}) * CF * IEFd/1000$$ Equation A-11

$$Dual\ Baseline\ Lifetime\ Savings = kWh_{Savings} * \frac{EUL}{3} + kWh_{Code} * (EUL - \frac{EUL}{3})$$ Equation A-12

Equation A-9 and Equation A-11 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-12. Calculation of dual baseline lifetime savings required the use of savings using code standards found using Equation A-10. 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 DEER 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 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.7.2 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 program data delivered by LADWP.

Table A-33 FY21/22 Ex-Ante Savings Summary

Measure	ESP Ex-Ante kWh	Program Ex-Ante kWh	ESP Ex-Ante kW	Program Tracking Ex-Ante kW
Lighting	7,001,196	7,001,196	504.10	1,860.33

A.7.2.1 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 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.7.2.2 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-34.

Table A-34 LAUSD DI program Evaluation Data Collection Progression

Stratum	MV Plans	Contact Attempted	Virtual Verification	On-Site Verification	Evaluated
Exterior Retrofit	3	1	0	3	3
Interior Retrofit	3	1	0	3	3
Exterior Sensor	3	1	0	3	3
Interior Sensor	3	1	0	3	3
Total	3	3	0	3	3

A.7.3 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.7.3.1 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.7.3.2 Data Analysis

An evaluation analysis was conducted on 3 of the 16 randomly sampled projects from FY 21/22. Project-level and Measure-level results can be found in the provided site-level reports. 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-35.

Table A-35 Summary of LAUSD DI program Savings by Strata

Stratum	Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate	Ex-Ante Peak kW Savings	Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
Exterior Retrofit	1,060,820	1,168,868	110%	267.00	-	0%
Interior Retrofit	4,909,247	3,620,863	74%	1,328.12	896.08	67%
Exterior Sensor	274,445	264,848	97%	58.89	-	0%
Interior Sensor	756,684	490,556	65%	206.32	193.69	94%
Total	7,001,196	5,545,134	79%	1,860.33	1,089.77	59%

The overall realization rates varied for all strata categories. The Evaluator found an average annual operating hours for interior fixtures to be 2,551. The ex-ante estimates used an annual operating hours varying from 521 to 8760, averaging around 3,603 for interior fixtures in the evaluation sample. The Evaluator found exterior hours to average 4,377 annual hours. ex-ante hours for exterior fixtures varied from 2,972 to 4,067. The difference in operating hours affected energy savings for both interior fixtures, exterior fixtures, and controls. The ex-ante calculations do not appear to include the benefit of interactive effects with air conditioning for interior fixtures in conditioned space whereas the Evaluator included this energy savings benefit. Minor discrepancies were found in fixture quantities, efficient and efficient condition wattages.

A.7.3.3 Realization Rate Factors

The evaluation sample indicated a difference between reported and verified energy savings due to a difference in annual operating hours, a difference in interactive effects, controls savings reductions, and differences in quantities and wattages. The impact of these realization rate factors by magnitude of energy savings and percentage of ex-ante savings is shown in Table A-36 and Table A-37.

Table A-36 Realization Rate Factors Magnitude by Strata

Stratum	Annual Operating Hours	Interactive Effects	Quantities and Wattages	Control Savings Factors
Exterior Retrofit	80,856	-	27,192	-
Interior Retrofit	(1,433,403)	362,086	(217,072)	-
Exterior Sensor	20,918	-	-	(30,515)
Interior Sensor	(220,936)	49,056	-	(94,245)
Total	(1,552,565)	411,142	(189,880)	(124,760)

Table A-37 Realization Rate Factors as a Percentage by Strata

Stratum	Annual Operating Hours	Interactive Effects	Quantities and Wattages	Control Savings Factors
Exterior Retrofit	8%	0%	3%	0%
Interior Retrofit	-29%	7%	-4%	0%
Exterior Sensor	8%	0%	0%	-11%
Interior Sensor	-29%	6%	0%	-12%
Total	-22%	6%	-3%	-2%

A.7.3.4 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 in Table A-35.

A.7.4 Process Evaluation

A.7.4.1 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.7.4.1.1 Net-to-Gross Approach

The Evaluator interviewed LAUSD representatives to understand and assess the role of the program in the installation of the program lighting equipment to determine the net impact of the program.

A.7.4.2 Process Evaluation Findings

A.7.4.2.1 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.7.4.2.2 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.7.4.2.3 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 issues (i.e., cost); 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.7.4.2.4 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.7.4.2.5 Project Review and Tracking

Upon completion of measure installation at a school, Willdan creates a “completion form,” an itemized lists 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.7.4.2.6 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.7.4.2.7 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.7.4.2.8 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 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 while others are they, and they must then be paid higher rates; and 2) the contractors have to sanitize the classrooms before they go in and after they leave, which adds time.

A.7.4.2.9 Net-to-Gross Findings

The Evaluators spoke with LAUSD staff to assess the influence of the program on their decision to install the lighting equipment. LAUSD staff noted that the improvements would not happen without the program, noting that LAUSD does not currently have the funding for the lighting upgrades and would continue with the installed lighting without program support. Staff also noted that Prop. 39 funding was not applicable to the lighting projects made through the LADWP Program.

Based on the responses from LAUSD staff, the Evaluator estimated the net-to-gross ratio for the program to be 1.0.

A.7.4.2.10 Recommendations

ADM offers the following recommendations for the LAUSD DI program:

- A long-term lighting monitoring study representing the county school district could be used to inform annual hours of operation for future evaluations, mitigating evaluation risk in hours of use.
- The methods of calculating energy savings estimates differ from lighting projects in other commercial programs. The Evaluator recommends using consistent methods with commercial programs such as the Commercial Lighting Incentive Program (CLIP).

- The Evaluator recommends the collection and management of project documentation in a consistent manner with other commercial programs, such as CLIP.

A.8 SBD/LADWP ZBD Program

This section details the impact evaluation for the Saving by Design (SBD) Program that LADWP offered customers during FY 21/22. 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.8.1 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.8.1.1 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.8.1.2 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 21/22, the sample resulted in a program level precision of ±11.4% 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-38 presents population statistics and strata boundaries used for the sample design.

Table A-38 SBD Population Statistics and Strata Boundaries used for Sample Design

Strata	Strata Boundaries	Population Size	CV	Total kWh	Sample Size	Contribution to Variance	Precision
1	<50,000 kWh	9	0.6423	173,310.00	4	1,720,857,229	39.3%
2	50,000 - 150,000 kWh	10	0.2882	1,071,409.00	2	38,140,118,280	29.9%
3	150,000 - 250,000 kWh	5	0.0563	865,016.00	1	1,900,442,044	8.3%
4	250,000 - 750,000 kWh	6	0.5600	2,498,032.60	3	326,187,235,219	37.5%
5	>750,000	4	0.2035	5,133,643.40	3	90,963,356,562	9.6%
Total	**NA**	**34**	**1.4368**	**9,741,411**	**13**	**458,912,009,333**	**11.4%**

A.8.1.3 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 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.8.1.4 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 describe 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.8.1.5 Data Collection Activities

The Evaluator used on-site data collection practices for this evaluation. The first step was to ensure the MV Plans provided defensible methodologies to mitigate data collection by physically inspecting the equipment and through interviews with the site contact. This also included an exploration of available or provided billing data, review of data collected through implementation, and review of the energy simulation models.

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, along with the site verification notes, ADM relied on available data and analysis techniques to both benchmark and calibrate provided simulations.

A.8.1.6 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.8.1.7 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.8.2 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.8.2.1 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.8.2.2 Data Collection

ADM sought data collection from site contacts for nine of the thirteen sampled projects. The remaining four 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-39.

Table A-39 SBD Evaluation Data Collection by Project

Stratum	MV Plans	Desk Reviews	Evaluated
1	1	3	4
2	1	1	2
3	1	0	1

Stratum	MV Plans	Desk Reviews	Evaluated
4	3	0	3
5	3	0	3
Total	**9**	**4**	**13**

A.8.2.3 Project Level Results

The evaluation analysis was conducted on 13 completed SBD program projects in fiscal year 2021-2022. A total of 12 projects were considered to be new construction and one project 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. A summary of results based on IPMVP Option are shown in Table A-40.

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-40 SBD Project-level Results

IPMVP Option	Tracking Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
Option D	5,875,799	5,813,064	98.9%
Total	5,875,799	5,813,064	98.9%

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-41.

Table A-41 SBD Savings Variance by End Use

End Use	Savings Variance (kWh)
Whole Building	-62,735

A.8.3 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 22/23.

A.9 Upstream HVAC Program

This section details the impact evaluation and process evaluation for the Upstream HVAC (UHVAC) Program that LADWP offered customers during FY 21/22. 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.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

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.9.1.2 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 used to target 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/Chiller, HP, VRF) and unit capacity size. A summary of sample statistics is shown in Table A-42. Strata identification is based on equipment category (AC/Chiller, HP, VRF) and unit capacity size. AC systems less than 5.4 tons are represented in strata AC1. AC systems above 5.4 tons are represented in AC2. VRF systems below 10 tons are represented in VRF1 and above 10 tons are represented in VRF2.

Table A-42 UHVAC FY21/22 Evaluation Sample

Strata	Strata Boundaries	Program Line Items	Ex-Ante kWh	Sample Size (line items)	Sample Ex-Ante kWh
AC1	<5.4	82	386,341.57	6	47,163.14
AC2	>=5.4	49	432,630.82	4	64,072.03
Chiller1	18.8 - 149.8	5	297,003.36	3	258,431.22
HP1	.75 - 13.17	91	563,174.19	5	73,320.85
VRF1	<10	16	446,271.21	5	147,308.16
VRF2	>=10	21	784,078.93	6	285,525.33
Total	**NA**	**264**	**2,909,502**	**29**	**875,821**

The evaluation sample design resulted in an ex-post precision of 39.08% at the 90% confidence interval. The original sample design was modified such that strata represent unit capacity as opposed to line-item estimated savings. Ex-ante equipment tonnages 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. The Evaluator will ensure that precision across CY1, CY2, and CY3 meet precision requirements with ex-post results.

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 sample ex-post kWh by the aggregated sample 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.9.1.3 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.9.1.4 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.9.1.5 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.

$$Annual\ kWh = CAP * EFLH * \left(\left(\frac{1}{Effbase}\right) - \left(\frac{1}{Effinstall}\right)\right)$$

Equation A-13

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.9.1.6 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.9.2 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.9.2.1 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 some discrepancies in the program tracking data regarding descriptions of equipment types when compared to reviewing the make and model to information acquired from AHRI. The Evaluator made corrections where necessary. The Evaluator also researched facility types and made corrections as necessary. The impact on results due to this review was minimal as descriptions only impacted strata classification and facility types are often insignificant as DEER workpapers have limited variation in facility type.

When verifying capacities and efficiencies in AHRI, options of equipment are 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. The Evaluator noted that some of the selections appeared to be from discontinued units. In addition, the Evaluator was not able to validate if systems were ducted or non-ducted.

A.9.2.2 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
- SWHC050-02 – Ductless Heat Pumps
- SCE13HC036 - VRF
- SCE13HC048.4 – Water Source Heat Pumps
- SCE17HC012/SCE13HC035 – Unitary AC/HP
- SCE13-HC030.1/SWHC020-01 – 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 227 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-43.

Table A-43 Sample Ex-Post Results (Workpaper) by Strata

Stratum	Count of Measures	Tracking Data Ex-Ante kWh	Ex-Post kWh	Gross kWh Realization Rate
AC1	6	47,163.14	34,653.00	61%
AC2	6	64,072.03	7,546.00	14%
Chiller1	7	258,431.22	127,803.00	49%
HP1	189	73,320.85	61,814.00	67%
VRF1	9	147,308.16	127,349.00	84%
VRF2	10	285,525.33	267,964.00	91%

Stratum	Count of Measures	Tracking Data Ex-Ante kWh	Ex-Post kWh	Gross kWh Realization Rate
Grand Total	**227**	**875,821**	**627,129**	**64%**

Sample results aggregated by equipment type (AC, HP, VRF) are shown in Table A-44.

Table A-44 Sample Ex-Post Results by Equipment Type

Equipment Type	Count of Measures	Tracking Data Ex-Ante kWh	Ex-Post kWh	Gross kWh Realization Rate
HP	129	62,291.24	48,911.00	52%
AC/Chiller	78	347,418.47	155,824.00	46%
VRF	20	466,111.02	422,394.00	87%
Grand Total	**227**	**875,820.73**	**627,129.00**	**64%**

Discrepancies were found in energy savings across the three classifications of equipment type (AC/Chiller, HP, VRF) within the sample. Differences can be attributed to the selection of appropriate work papers, selection of savings rates by measure within a workpaper as well as replacement type. As the program is upstream with limited information from the site, the Evaluator assumes that units are all replaced on burnout. 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 facility type. Differences in facility type were mostly observed for VRF projects.

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 Table A-46. 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).

A.9.2.3 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 input. 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-45.

Table A-45 Sample Ex-Post Results (Industry Standard) by Strata

Stratum	Count of Measures	Tracking Data Ex-Ante kWh	Ex-Post kWh	Gross kWh Realization Rate
AC1	6	47,163.14	30,917.00	66%
AC2	6	64,072.03	112,369.00	175%
Chiller1	7	258,431.22	344,870.00	133%
HP1	189	73,320.85	143,135.00	195%
VRF1	9	147,308.16	58,148.00	39%
VRF2	10	285,525.33	114,747.00	40%
Grand Total	**227**	**875,821**	**804,186**	**92%**

Industry standard analysis sample results aggregated by equipment type (AC, HP, VRF) are shown in Table A-46.

Table A-46 Sample Ex-Post Results (Industry Standard) by Equipment Type

Equipment Type	Count of Measures	Tracking Data Ex-Ante kWh	Ex-Post kWh	Gross kWh Realization Rate
HP	129	62,291.24	86,782.00	139%
AC/Chiller	78	347,418.47	531,644.00	153%
VRF	20	466,111.02	185,760.00	40%
Total	**227**	**875,821**	**804,186**	**92%**

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 2019 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 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.9.2.4 Billing Data Analysis

The Evaluation samples resulted in 19 unique sites available for a billing regression. The Evaluator performed a data check to determine if a billing analysis was feasible. Upon cursory review, 18 of these sites were deemed unfit for regression due to a combination of factors. For 13 of the candidate sites consumption data was not available in the online tool.

For the remaining 5 sites that failed the initial examination, The Evaluator found that the savings were significantly lower than 10%, the advised threshold as defined by the ASHRAE or because the meter configuration at the address could not be verified.

Multiple regressions were performed on the remaining site, which installed four air-cooled chillers. The variables used for these multi-variate regressions were HDD, CDD, a binary entry outlining whether the measure was installed or not (“Pre/Post”), HDD multiplied by pre/post, CDD multiplied by pre/post, a binary entry outlining whether it was the weekend, and finally a numerical entry tracking the number of days since the start of COVID. The Evaluator ran the regression multiple times, removing variables such as HDD due to their lack of correlation with consumption. However, when regressing on the bases of CDD, CDDxPre/Post, and Pre/Post versus energy usage, it was found that there was poor correlation between the remaining variables ($p=.69$ and .76 respectively) and the overall correlation (R2) was 0.156. The Evaluator determined that the billing regression results were not reliable based on the available information to use as variables.

A.9.3 Process Evaluation

The following sections detail the process evaluation of the UHVAC Program.

A.9.3.1 Process Evaluation Approach and Methodology

For FY21/22, the Evaluator performed a summary process evaluation of the UHVAC program. This included an in-depth interview with LADWP program staff to understand and explore the following:

- Program changes to design, delivery, or incentives
- Program performance, including areas for improvement and success
- Market changes affecting performance
- Barriers and opportunities going forward
- Other topics as relevant

The Evaluators performed a full process evaluation of the UHVAC program in FY20/21.

A.9.3.2 Process Evaluation Findings

The following sections include a summary of findings informed by the LADWP program staff interview.

A.9.3.2.1 Program Design and Delivery

LADWP staff note that the UHVAC program's design and delivery is largely the same as the previous fiscal year, including the same measures and incentives levels. The program administrator, Energy Solutions, has explored additional measure options related to indoor air quality but these were determined to be out of the program's scope.

While the program is largely the same, staff report that they are taking a different approach in engaging manufacturers and distributors. Previously, Energy Solutions staff would primarily engage executive level staff to promote the program. In early summer 2022, they also started meeting with sales staff to provide them with training and education about the program. Program staff note that they have received a positive response with this approach, and they are establishing stronger relationships with manufacturers and distributors.

Program staff report that program operations are also running smoothly. Over the last year, staffing at LADWP and Energy Solutions has stabilized, and they have experienced better coverage of program operations. Staff note that this has resulted in faster invoice reviews and other processes.

A.9.3.2.2 Barriers and Opportunities

Program staff highlighted the following barriers:

- Lingering effect of the pandemic. Customers still experience long delays for equipment, and sometimes a project timeframe can take nine to 12 months from the sale to delivery. Energy Solutions does not expect supply chain issues to settle down for at least 18 months.
- Inflation pressure on project costs. Staff have observed higher equipment costs - increases of 20 to 30 percent – even for equipment that just meets the code. While the program's incentives are high, staff note that they do not always make up for incremental cost to customer.
- Permitting delays. Program staff report that some customers have experienced delays in permitting new construction projects, which can affect the payment of incentives. In most cases, customers are waiting for the building and safety inspection or for the meter installation to occur.

Program staff see additional opportunities in the following areas:

- Federal code changes. Program staff said that upcoming federal code changes to commercial HVAC equipment will affect minimum efficiency standards. As a result, the program may need to end tier one equipment incentives (incentives for the least efficient qualifying equipment). Program staff note that with this change in codes, they also can evaluate overall incentive levels and optimize the cost effectiveness of the program.

A.9.3.2.3 Previous Evaluation Recommendations

Table A-47 includes a summary of previous recommendations and the program's response to date.

Table A-47 Previous UHVAC Program Recommendations and Program Response

Summary of Past Recommendations	Program Response
Create additional opportunities for market actor engagement	Energy Solutions staff are now providing education and training to the sales staff of manufacturers and distributors
Review participation process to ensure equality in experience for both active and less active market actors	Program staff have not implemented any changes at this time

A.9.3.2.4 Recommendations

The Evaluators do not have any recommendations for the UHVAC program at this time.

A.10 Consumer Rebates Program (CRP)

This section details the impact evaluation and process evaluation for the Consumer Rebate Program (CRP) that LADWP offered customers during FY 21/22. 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.10.1 Evaluation Methodology

Table A-48 shows the types of data collection that the Evaluator used for the impact evaluation.

Table A-48 FY21/22 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

Data	Source
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.10.1.1 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-49 FY21/22 CRP Program Tracking Data Sources

Workbook File Name
CRP_Jul 2021 with Equity Metrics.xlsx
CRP w-Equity - Aug 2021.xlsx
CRP w-Equity - Sep 2021.xlsx
CRP w-Equity - Oct 2021.xlsx
CRP_11.2021 w-Equity.xlsx
CRP_12.2021 w-Equity.xlsx
CRP w-Equity - Jan 2022.xlsx
CRP w-Equity - FEB 2022.xlsx
CRP Data March 2022.xlsx
CRP w-Equity - Apr 2022.xlsx
CRP w-Equity - May 2022.xlsx
CRP w-Equity June 2022.xlsx

A.10.1.2 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, and central heat pumps. Engineering desk reviews were completed for whole house fans and dual pane windows. Site visit data collection informed the engineering analysis of pool pump motors.

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-50 FY21/22 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/Skylights	Desk review	Census
Pool Pump Replacement	Site visits	20 homes sampled
Whole House Fan	Desk review	Census

**Other program participants excluded*

A.10.1.3 Baseline Assumptions/Savings Method Review

The following sections detail the baseline assumptions review for each measure offered in CRP, along with a comparison of the savings methods between the ex-ante and ex-post.

A.10.1.3.1 Attic Insulation

The ex-ante savings method binned the baseline by insulated and uninsulated spaces, along with building type and climate zone to the corresponding deemed savings values per square feet of insulation. The ex-post baseline was indifferent to individual baseline conditions by disaggregating samples only by building type in the billing analysis.

A.10.1.3.2 Central Air Conditioner, Central Heat Pump

The ex-ante savings method baseline was indifferent to building type, climate zone, HVAC capacity and efficiency as all installations received the same deemed savings per unit. The ex-post baseline was also indifferent to mentioned inputs but did disaggregate savings by baselines for early replacement and normal replacement.

A.10.1.3.3 Cool Roofs

The ex-ante savings method baseline was indifferent to existing roofing type or slope, as all cool roof measures received the same deemed savings per square foot of roof installed. The ex-post was also indifferent to these inputs when completing the billing analysis.

A.10.1.3.4 Dual Pane Windows/Skylights

The ex-ante savings method was indifferent to the baseline, with all measures receiving the same deemed savings per square foot of window. The ex-post savings method considered the baseline as single pane window, typical window properties, and savings by climate zone.

A.10.1.3.5 Pool Pumps

The ex-ante savings method was indifferent to the baseline, with all measures receiving the same deemed savings per pool pump.

The ex-post considered the baseline pool pump type from the site visits and participant survey. The normal replacement 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 collected the manufacturing data from the sampled homes for site visits and apportioned the 100% found pre-July 2021 manufacturing date to the FY21/22 population. It is expected that FY22/23 will have a majority of post manufactured July 2021 pumps.

A.10.1.3.6 Whole House Fan

Both the ex-ante and ex-post baseline were a home without a whole house fan. The ex-post considered the home size, fan size and motor type for the efficient case, whereas the ex-ante method binned the same deemed savings to all types.

A.10.1.4 Ex-Ante Savings Review

The ex-ante data review had two 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.

The comparison of energy, demand, and quantity values between the ex-ante data from ESP and tracking data is summarized in Table A-51. The energy savings and incentive costs were equal for all measures. The ESP database did not list the measured quantities.

Table A-51 FY21/22 CRP: ESP to Program Tracking – Savings Comparison

Measure	Energy (kWh)		Incentive ($)		Quantity (participants)	
	ESP Ex-Ante	Program Tracking Ex-Ante	ESP Ex-Ante	Program Tracking Ex-Ante	ESP Ex-Ante	Program Tracking Ex-Ante
Attic Insulation	2,339,956	2,339,956	15,789,362	15,789,362	N/A	12,160
Central Air Conditioner	192,464	192,464	228,180	228,180	N/A	504
Central Heat Pump	27,984	27,984	21,950	21,950	N/A	64
Cool Roof	880,309	880,309	414,298	414,298	N/A	724
Dual Pane Skylights	11	11	52	52	N/A	1
Dual Pane Windows	9,067	9,067	41,214	41,214	N/A	105
Pool Pump and Motor	4,835,666	4,835,666	2,894,000	2,894,000	N/A	5,787
Whole House Fan	1,696	1,696	800	800	N/A	4
Total	**8,287,153**	**8,287,153**	**19,389,856**	**19,389,856**	**N/A**	**19,349**

A.10.1.5 M&V Approach: Engineering Analysis

A.10.1.5.1 Dual Pane Skylights and Windows

For the ex-post savings, the Evaluator utilized a deemed per square foot savings value, by climate zone by the product of the installed square feet of windows and the ISR, see Equation A-14 and Table A-52.

$$kWh = \frac{kWh_{CZ}}{sf}\ x\ SF\ x\ ISR \qquad \textit{Equation A-14}$$

Table A-52 FY 20/21 CRP Dual Pane Skylights and Windows Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
kWhcz/sf	Measure savings per square feet of window, skylight	CMUA TRM222 Energy Efficient Windows	2.4-4.2 kWh/SF 0.003-0.006 kW/SF
SF	Square feet	Tracking data	17 – 557 SF
ISR	In Service Rate	Participant Survey, 2022	100%

A.10.1.5.2 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, home size and the climate zone. Public LA Open Data records were sourced for the home square feet. Manufacturer model specifications were sourced for type of fan motor and the maximum CFM per fan, see Equation A-15 and Table A-53.

$$kWh = \frac{kWhsavings}{SF} x\ SF_{home} x\ x\ ISR \qquad \textit{Equation A-15}$$

Table A-53 FY21/22 CRP Whole House Fan Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
kWhsavings/SF	kWh savings/SF, home size and climate zone	CA eTRM Whole House Fan, Residential SWHC030-02	0.8-4.2 CFM/SF
Motor Type	Informs TRM measure	Mfg specification sheet	ECM or PSC
CFM	Fan rated air flow	Mfg specification sheet	1452-4195 cfm
SF_{home}	SF of home	LA Assessor Data Open Portal	1672– 2362 SF
ISR	In Service Rate	Participant Survey, 2022	100%

A.10.1.6 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, and cool roof measures.

A.10.1.6.1 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. 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.

Despite the advantages for using this 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 FY21/22 data alone, data from FY20/21 was used to supplement the analysis.

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 the following equation:

$$Average\ Daily\ kWh = \frac{Total\ kWh}{Number\ of\ Days} \qquad \textit{Equation A-16}$$

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 calendarization, customer billing data was filtered for the following criteria:

- The Evaluators reviewed the post-installation data for each measure to determine the optimal post-installation period for each measure. For Attic Insulation and Central Air Conditioner, the optimal post-installation period was determined to be April 2021 through March 2022. For Central Heat Pump and Cool Roof, the optimal post-installation period was determined to May 2021 through April 2022. In all cases, participants were filtered for those participants that had a full 12 months of post-installation data.
- For all measures, a pre-installation period of January 2019 through December 2019 was used to control for the impact of the ongoing COVID-19 pandemic. 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 FY21/22.
- 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 and Central Air Conditioner did not have enough participants in FY21/22 to perform an independent billing analysis. Therefore, data from FY21/22 was appended to the FY20/21 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 Table A-54 below.

Table A-54 FY21/22 CRP: Attic Insulation, CAC, CHP, and Cool Roof Participant Count

Strata	Number of Participants	Final Sample Size
Attic Insulation – MF	1,194	602
Attic Insulation – SF	10,430	5,445
Central Air Conditioner	330	122
Central Heat Pump	50	78
Cool Roof	451	123

The zip code for each customer's service address was geolocated to an approximate latitude and longitude and historical weather data was obtained through the National Oceanic and Atmospheric Administration (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-17. 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-17

Where:

i	=	represents each individual customer for each month
n	=	represents each iteration of base pairs
$post$	=	indicator variable indicating whether the period is in the post or pre period
$CDD_{i,n}$	=	the CDD calculated for iteration n for customer i
$HDD_{i,n}$	=	the HDD calculated for iteration n for customer i

α	=	the intercept term
β_1	=	the main effect of the post period
β_2	=	the main effect of CDD
β_3	=	the main effect of HDD
β_4	=	the additional effect of CDD on the post period
β_5	=	the additional effect of HDD on the post peri
ε	=	the error term

Isolation of Weather-Dependent Load

After normalizing the billing data to NOAA weather data, 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 was 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-18 and Equation A-19. 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-18*

$$EFLH_{heat} = \frac{kWh_{heat,e} \cdot HSPF_e \cdot 1000}{CAPY_{heat}}$$ *Equation A-19*

The EFLHs obtained using the post period data were then applied to the equation presented in Equation A-20 and Equation A-21 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-20*

$$kWh_{heat} = \frac{EFLH_{heat} \cdot CAPY_{heat}}{1000 \cdot HSPF_b}$$ *Equation A-21*

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-55 with the 90% confidence interval of the savings estimate.

Table A-55 FY21/22 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	574	515	633	10%
Central Air Conditioner	ROB	194	169	218	13%
Central Heat Pump	ER	1,037	859	1214	17%

Measure	Scenario	Annual kWh Savings	90% Confidence Interval		Relative Precision (90% CL)
			Lower Bound	Upper Bound	
Central Heat Pump	ROB	354	282	426	20%

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-22.

$$\Delta kWh_{HVAC} = kWh_{HVAC\ Pre} - kWh_{HVAC\ Post} \qquad \textit{Equation A-22}$$

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-56.

Table A-56 FY21/22 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	312	252	373	19%
Attic Insulation – SF	484	459	510	5%
Cool Roof	496	225	768	55%

A.10.1.6.2 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. Therefore, both the residential energy consumption observed in the billing data and the observed savings for FY21/22 may inadvertently be impacted by changes due to the COVID-19 pandemic. To account for this impact, the Evaluators 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 nonparticipant 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 April 2021 through March 2022 or May 2021 through April 2022 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 May 2021 through April 2022. 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.10.1.7 Online Survey Data Collection

The Evaluator administered an online survey of FY 21/22 program participants to collect data for these purposes:

- Verify that the rebated equipment was in-place and operating (as applicable);

- Assess customer experiences with the program.

A total of 4,370 program participants received up to two emails from LADWP inviting them to complete the survey – 363 completed the survey, yielding a response rate of 8%.

Table A-57 CRP: Summary of Survey Sample Measure Coverage

Measure	# of Participants	% of Population	# of Responses	% of Response
Attic Insulation	12,160	63%	132	36%
Pool Pump and Motor	5,787	30%	134	37%
Cool Roof	724	4%	51	14%
Central Air Conditioner	504	3%	32	9%
Dual Pane Windows	105	1%	9	2%
Central Heat Pump	64	<1%	5	1%
Whole House Fan	4	<1%	0	0%
Total	**19,349**	**100%**	**363**	**100%**

A.10.2 Impact Evaluation

This section presents the findings of the impact evaluation of the CRP during the FY21/22 period. ex-post gross energy savings and peak demand reduction are presented at the measure level.

A.10.2.1 Description of Factors Affecting Gross Realized Savings

The following sections describe factors affecting realized savings for each of the CRP offerings.

A.10.2.1.1 Attic Insulation

Attic Insulation has an energy savings realization rate of 243% for first-year savings, and 155% for post COVID-19 Era years, estimated by billing analysis. The savings exceeded the ex-ante expected energy savings.

The ex-ante savings method applied a deemed savings factor to the installed square feet of insulation by climate zone and baseline insulation. Installed products included loose fill insulation, blow insulation, R-30 batts, and R-38 batts. There are only two incentive levels per climate zone determined by an existing insulated or un-insulated attic. The deemed savings per square foot may not represent all the existing/installed R-value scenarios.

The California eTRM Ceiling Insulation measure provides deemed savings tables with dependencies for R-value, climate zone, HVAC type and building type. The program tracking data uses the climate zone, two of the six insulation bins, the weighted HVAC type and the building type.

Table A-58 CRP: Attic Insulation Inputs Used vs ETRM Available Inputs

Input to Measure Selection	Program Tracking Data	eTRM Ceiling Insulation Measure
Climate Zone	CZ1 to CZ16	CZ1 to CZ16
Base to Installed Insulation	R30 Insulated R30 Uninsulated	Add R11 Add R19 Add R30 Add R38 Add R44 Add R60
HVAC Type	Weighted	Gas furnace Heat pump No cooling, electric heat No cooling, gas furnace Weighted
Building Type	SF MF	SF MF

A.10.2.1.2 Central Air Conditioner

The ex-post savings for central air conditioners were calculated through a billing analysis and produced a realization rate of 62%. The Evaluator also researched the AHRI reference numbers when they were provided in the tracking data (60% with data). 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 3% higher. The ex-ante measure bins were either SEER 15 or SEER 16. Some (14% participants installed CAC with AHRI efficiencies of SEER 17 and up to SEER 23. These efficiencies largely exceed the CRP program measure bins of SEER 15 and SEER 16.

A.10.2.1.3 Central Heat Pump

The ex-post savings for central heat pumps were calculated through a billing analysis and produced a realization rate of 89% for first-year savings. The evaluation team also researched the AHRI reference numbers, when provided in the tracking data. Figure A-4 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 21% higher than the program measure bin lower value. The ex-ante measure binned all heat pumps to SEER 15. Most (85%) participants installed units with SEER 16 and up to SEER 23, greatly exceeding the CRP program measure bin of SEER 15.

Figure A-4 FY21/22 CRP Central HP Variable Differences

[insert image]

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A.10.2.1.4 Cool Roof

The Cool Roof measure had a low realization rate for energy savings and peak demand savings, 41% and 10% respectively, as determined by the billing analysis, indicating the ex-ante deemed savings of 0.44 kWh and 0.008 kW per square foot of roof area may be overestimating the energy reduction impact. The ex-ante deemed savings per square foot is constant across both the roof slope (low or steep) and the SRI rating (16,35,75 or 85 SRI). For comparison of the 0.44 kWh per SF deemed savings, the following energy savings table from the CMUA TRM measure 223 Radiant Barriers excerpted for the applicable climate zones, lists energy savings from 0.115 to 0.206 kWh per SF, which is 35% to 47% of the 0.44 value, respectively.

Table A-59 FY21/22 CRP: Alternate Source for Cool Roof Savings per SF – CMUA TRM223 Radiant Barriers

Climate Zone	kWh/SF	kW/SF
CZ08	0.154	0.004
CZ09	0.206	0.003
CZ16	0.115	0.003

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. Most of the cool roof participant survey responses (98%), 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 28% 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.

Table A-60 summarizes the survey responses for the portion of the roof replaced and reason for replacement of the roof.

Table A-60 FY21/22 CRP: Cool Roof Participant Survey – Base Case

Base Case	Responses	% Responses
Older roof replaced, not cool roof	39	85%
Storm damaged roof replacement	4	9%
Older roof with cool roof rating	1	2%
New construction or addition	1	2%
Something else	1	2%
Total	**46**	**100%**

Asphalt shingles are the predominate base case at 81% as indicated in the participant survey responses, see Table A-61.

Table A-61 FY21/22 CRP: Cool Roof Participant Survey – Base Case Material

Base Case	Responses	% Responses
Asphalt shingles	25	81%
Other material	5	16%
Wood shingle	1	3%
Total	**31**	**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. Twenty-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-62.

Table A-62 FY21/22 CRP: Cool Roof Participant Survey – Base Case Insulation

Base Case	Responses	% Responses
Added attic insulation same time	13	28%
Did not add attic insulation	34	72%
Total	**47**	**100%**

The majority (86%) of the cool roof measures in the category of Steep Slope 16 SRI are in the just above code group, with a smaller percentage of measures are in the category that indicated significantly exceeding code(1% steep slope, 8% low slope).

Table A-63 FY21/22 CRP: Cool Roof Tracking Data – Code and Exceeding Code Installed Square Feet

Roof Slope	Cool Roof Measure	Installed (square feet)	% Area
Steep	LADWP CRSS16SRI	1,729,923	86%
	LADWP CRSS35SRI	15,710	1%
Low	LADWP CRLS75SRI	167,320	8%
	LADWP CRLS85SRI	87,750	4%
Total		**2,000,703**	**100%**

The average SRI of the “above code” is significantly above the code threshold of Steep Slope 16 SRI, with an average value of 19.8. The Low Slope installed roofs also exceeded the minimum SRI of 75 with an installed average of 81.0.

A.10.2.1.5 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 indicated most (88%) met the program requirements for replacing existing single pane windows.

Table A-64 FY21/22 CRP: Dual Pane Windows – Baseline Type

Existing window type	Survey responses	% Responses
Single pane	7	88%
New home or addition	1	12%
Total	**8**	**100%**

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 is deemed at 0.44 kWh/square feet of window installed. The CMUA TRM deemed savings value for CZ09 is 4.2 kWh/square feet, with the difference of the two deemed values having a magnitude of 10.

A.10.2.1.6 VSD Pool Pump and Motor

Title 20 appliance efficiency standards have required two-speed pool pump and motor replacements to operate at two or more speeds since 2010 for dedicated pool pumps. During the site visit, prior equipment was identified for scheduling the On and Off cycle of the pool pump motor, but the Evaluator did not locate any pre-existing speed control equipment. Of the pump and motors that were still onsite, zero of eight were found to be two speed motors.

During the site visit, the schedules of the new variable speed motors were collected from the user interface on the motor speed controller for most pumps, except for two that were controlled by pool system controllers. For those with system controllers, the schedules were inferred from the metering period between the first and second site visit.

The table captures the observation that seven of the nineteen participants have schedules that significantly were contrary to the program requirements to operate only from 8PM to 9:59AM.

An effective WEF was determined based on the scheduled motor speed and proportion of time operating at that speed, along with the metered energy usage.

Table A-65 FY21/22 CRP: Site Visit Metered Pool Pump Schedules and Motor Speed

Schedule 1		Schedule 2		Schedule 3		Effective WEF
On - Off	% Full Speed	On - Off	% Full Speed	On - Off	% Full Speed	
9PM-2AM	91%	2AM-11AM	100%			2.39
9AM-5PM	88%					3.09
11AM-330PM	88%					3.29
8PM-9AM	78%					3.56
10PM-12AM	75%	12AM-6AM	57%			3.69
8PM-4AM	68%	8AM-10AM	87%			4.00
9AM-2PM	74%	2PM-4PM	58%			4.05
8PM-12AM	88%	12AM-8AM	42%			4.28
4AM-8AM	76%	6PM-12PM	43%			4.46
12AM-9AM	75%	6PM-12AM	57%			4.60
10PM-12AM	92%	12AM-6AM	72%			4.86
24/7	62%					5.31
8PM-10PM	73%	10PM-545AM	43%			5.61
12AM-730AM	66%					5.75
9AM-4PM	49%					6.20

Schedule 1		Schedule 2		Schedule 3		Effective WEF
On - Off	% Full Speed	On - Off	% Full Speed	On - Off	% Full Speed	
8PM-12AM	40%	7AM-940AM	67%			6.51
7AM-11AM	73%	11AM-2PM	49%	2PM-5PM	55%	6.52
6AM-8AM	72%	12AM-8AM	43%			7.12
8AM-4PM	63%					7.96
Average	73%		60%		55%	4.91

Table A-65 summarizes the pool pump motor schedules from participant site visits.

Table A-66 below summarizes pool pump motor schedules collected from participant surveys with the speed binned to ranges operating ranges. Although the WEF could not be calculated from the survey data, the table includes the level of peak demand savings achieved. Similar to the metered site visit data, there were many participants operating contrary to the program requirements of 8PM to 9:59AM.

Table A-66 FY21/22 CRP: Surveyed Pool Pump Schedules and Motor Speed Range

Number of Survey Responses	Operating Speed Range			Peak Demand Savings
	0-1500 RPM	1501-2500 RPM	2501-2600 RPM	
14	Operates only at night	-	-	Maximum peak savings
3	Operates only at night	Operates only at night	-	
8	-	Operates only at night	-	
4	Operates only at night	Operates only at night	Operates only at night	
1	Operates only at night	-	Operates only at night	
6	-	Operates only at night	Operates only at night	
3	-	-	Operates only at night	
2	Operates only at night	0-6 hours during the day	-	
1	-	Operates only at night	0-6 hours during the day	
1	-	0-6 hours during the day	Operates only at night	Some peak savings
1	0-6 hours during the day	-	Operates only at night	
11	0-6 hours during the day	-	-	Least peak savings
3	7-12 hours during the day	-	-	
9	-	0-6 hours during the day	-	
4	-	7-12 hours during the day	-	

Number of Survey Responses	Operating Speed Range			Peak Demand Savings
	0-1500 RPM	1501-2500 RPM	2501-2600 RPM	
1	-	7-12 hours during the day	7-12 hours during the day	
1	-		0-6 hours during the day	

Table A-67 below aggregates the previous two tables that summarized pool pump schedules obtained from site visits and those from survey, then groups by the installation type, either a Certified Pool Pump Installer or non-certified. Although the population of Non-CPPR pumps is small (8) compared to the CPPR pumps (64), there was a much higher percentage of installations conforming to the program requirements to operate only during the non-peak demand period.

Table A-67 FY21/22 CRP: Survey & Site Visit Pump Scheduling Summary – Peak Demand

Installation Type	Data Source	Total pumps	Operates only during off peak	% Conformant to Program Guidelines
Non-CPPR	Survey	7	1	14%
Non-CPPR	Site Visit	1	0	0%
CPPR	Survey	46	27	59%
CPPR	Site Visit	18	10	56%
Total	All	72	38	53%

A.10.2.1.7 Whole House Fan

The energy savings realization rate is 101%. The Evaluator utilized the CA eTRM measure, Whole House Fan for their deemed savings table with the dependencies for type of fan motor and number of household air changes. Public LA Open Data records were sourced for the home square feet to determine the home volume and manufacturer model specifications were sourced for type of fan motor and the maximum CFM per fan to estimate the number of air changes.

A.10.3 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 program participants). The program is mainly for residential owners, which make up 37% of housing unit owners in Los Angeles. Although they could, renters typically do not purchase the type of measures included in CRP.

The program runs on a fiscal year (a fiscal year, FY, is May 1 to April 30). During FY21/22 (May 1, 2021 through April 30, 2022), CRP offered rebates for seven measures covering the building envelope (3 measures), HVAC (3), and pool pumps (1) as shown in the table below. However, the program suspended attic insulation in mid-FY21/22 (in January of 2021). The program accepted applications for attic insulation only through May 2021. Participation from April 2021 through May 2022 came from applications put in prior to May 2021. Because of the removal of attic insulation, the program managers expect significantly less homes to participate in CRP next year in FY22/23.

Across FY20/21 through FY21/22 (so May 2020 to April 2022), LADWP paid 40,000 rebates for measures within CRP. Compared to FY20/21, FY21/22 saw an increase in participation for all measures except for attic insulation.

Table A-68 FY21/22 CRP: Population of Measures

Category	Measure	Rebate Amounts	# of Measures (FY20/21)	# of Measures (FY21/22))	FY21/22 as a Percentage of FY20/21
Building envelope	Attic Insulation (counted as one measure per home)	$1/sqft	19,897	12,160	61%
Pool Pump	Pool Pump and Motor	$500 each + $500 for certified installation	2,251	5,787	257%
Building envelope	Cool Roof	Up to $0.30 per square foot	433	724	167%
HVAC	Central Air Conditioner	$100-$120 per ton	203	504	248%
Building envelope	Dual Pane Windows	$2.00 per square foot	38	105	276%
HVAC	Central Heat Pump	$100 per ton	26	64	246%
HVAC	Whole House Fan	$200 each	2	4	200%

A.10.3.1 Process Evaluation Approach and Methodology

A.10.3.1.1 Document Review

The ADM team reviewed the program tracking database and the fact sheet about the program from the website.

A.10.3.1.2 Staff Interviews

Over about 30 minutes in October 2022, the evaluation team interviewed the acting supervisor for CRP with other LADWP staff in attendance (i.e., the LADWP evaluation team). This interview covered changes from the previous year and if the program was able to implement recommendations from the previous evaluation.

A.10.3.1.3 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.
- **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.

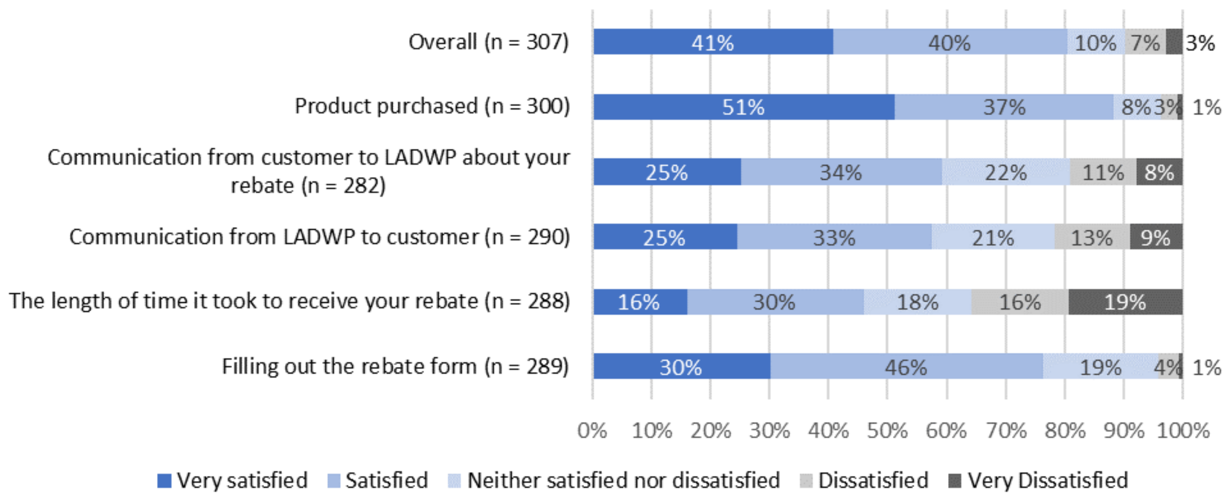
A.10.3.2 Process Evaluation Findings

As noted above, in FY21/22, the program saw increases from FY20/21 for all measures except attic insulation, which was removed from the program mid-way through the year, even though the rebate amounts did not change. CRP seems to have been the recipient of the general "COVID-retrofits" seen around the nation. That is, since many homeowners spent more time in their homes due to COVID, they began to perform more home renovations.

A.10.3.2.1 CRP Customer Satisfaction

Overall, 81% of customers were satisfied with the program overall. However, as shown above, from 4% to 36% of customers were dissatisfied with some part of the program. Most of these customers complained about the long time they took to receive the rebates, a difficulty that program managers were aware of and sought to ameliorate. Communication, either from LADWP to the customer or from the customer to LADWP were also sources of dissatisfaction for program participants. Review of the open-ended comments suggest that the issues for these customers were also the amount of time it took to receive the rebate. As illustrated in Figure A-5, the level of satisfaction is somewhat lower for specific program processes.

Figure A-5 FY21/22 CRP: Overall Program Satisfaction and for Different Program Areas



A.10.3.2.2 Satisfaction Key Driver Analysis

The Evaluator performed a key driver analysis to better understand how satisfaction with the different facets of the program related to overall satisfaction with the program and to the favorability of respondents' views of LADWP.

For these analyses, regression analysis was used to identify how strongly satisfaction with the rated program facets were related to program satisfaction and how favorably participants viewed LADWP. Specifically, overall program satisfaction and favorability of views of LADWP were regressed on the following variables:

- Satisfaction with the product purchased
- Satisfaction with communication from LADWP
- Satisfaction with the length of time to get the rebate
- Satisfaction with filling out the form
- Overall program satisfaction (only for favorability of LADWP)

Table A-69 summarizes findings of the analysis. Overall, satisfaction with the program components had a moderately high relationship to overall program satisfaction and program satisfaction overall and component satisfaction had a moderate relationship with how favorable the respondents' views of LADWP were.

Communication from LADWP and the length of time to process the rebate were equally important predictors of program satisfaction. Overall program satisfaction was the most important predictor of the favorability rating of LADWP, followed by communication from LADWP, and the experience with filling out the application form.

Table A-69 CRP: Summary of Key Driver Analysis

Program Component Satisfaction	Overall Program Satisfaction	Favorability of LADWP
Overall impact of satisfaction with program components	Moderate - High	Moderate
Importance of component satisfaction		
Overall satisfaction	n/a	High
Communication from LADWP	High	Moderate
Length of time to get the rebate	High	Not important
Filling out the form	Not important	Low
Product purchased	Not important	Not important

Key Driver Analysis Details (Overall Program Satisfaction)

In analyzing the key drivers of overall program satisfaction, and favorability ratings, the Evaluator regressed the outcome on the full set of predictors. Based on review of the results, predictors that did not have a statistically significant relationship with outcome and/or did not contribute much to the prediction of the outcome were deemed unimportant and dropped from the analysis. The results presented below are for the final modelling results.

Table A-70 summarizes the overall model statistics for the examination of the relationship between component satisfaction and overall satisfaction. The R-squared statistic is a measure of how strongly satisfaction with the program components is related to overall program satisfaction. These results indicate a moderately strong relationship.

Table A-70 CRP: Model Summary Statistics for Overall Program Satisfaction

Model Summary Statistic	Value
n	307
Adjusted R-squared	43%

Table A-71 summarizes the relationships between component satisfaction and program satisfaction. For two components, communication from LADWP and length of time to get the rebate, component satisfaction was a statistically significant predictor of overall program satisfaction. Both predictors are roughly equally important to understanding overall program satisfaction.

Table A-71 CRP: Key Driver Statistics for Overall Program Satisfaction

Importance of Component Satisfaction	Relative Importance	Standardized Coefficient	P-Value
Length of time to get the rebate	54%	0.38	0.00
Communication from LADWP	46%	0.35	0.00

Key Driver Analysis Details (Favorability Rating of LADWP)

Table A-72 summarizes the overall model statistics for the examination of the relationship between component satisfaction and how favorably respondents viewed LADWP. The R-squared statistic for this outcome is moderate, suggesting that satisfaction with the program and with communication from LADWP, have a moderate relationship to the overall view of LADWP. In other words, program component satisfaction is a better predictor of overall program satisfaction then program satisfaction is of favorability of ratings of LADWP.

Table A-72 FY21/22 CRP: Model Summary Statistics for LADWP Favorability Rating

Model Summary Statistic	Value
n	298
Adjusted R-squared	25%

Table A-73 FY21/22 CRP: Key Driver Statistics for LADWP Favorability Rating

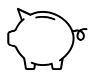
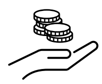
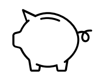
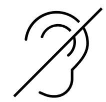
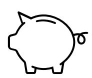
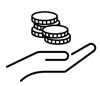
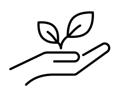
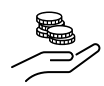
Importance of component satisfaction	Relative Importance	Standardized Coefficient	P-Value
Overall satisfaction	50%	0.27	0.00
Communication from LADWP	36%	0.22	0.00
Filling out the form	14%	0.15	0.02

A.10.3.2.3 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 (Table A-74). 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. For windows, reduced noise was the most important driver, followed by a need to replace old leaky windows.

Table A-74 FY21/22 CRP: Most Influential Reasons for Purchases

Reasons	Attic Insulation	Pool Pump	Cool Roof	HVAC	Windows
1st	 (Save on utility costs)		 (Needed new roof)		 (Reduce noise)
2nd	 (Comfort)				Old windows leaked
3rd	 (The rebate)	 (Good for the environment)			 (Comfort)

A.10.3.2.4 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-75.

Table A-75 FY21/22 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%	
Owner - Multi Family	2%		

Demographic Parameter	CRP Survey	Population for City of Los Angeles (census data)	Notes
Renter- Single Family Renter - Multi Family	10% 0%	63%	As expected, participant homeowners disproportionately obtained more rebates through CRP than renters
Income	**(n=284)**	**Owner Households***	
Low or Moderate Above Moderate Declined to Say	43% 24% 33%	44% 56% --	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)
Age	**(n=272)**	**Owner Householder****	
25-34 35-54 55-64 65+	2% 32% 27% 39%	6% 36% 25% 33%	The age of CRP participants align with the age of owner households in the population.
Self-Identified Ethnicity	**(n=257)**	**Owner Householder*****	
Caucasian (White) Hispanic (Latinx)[1] Asian Black Other	53% 23% 13% 5% 6%	47% 28% 37% 29% --%	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 ***

** 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*

Two-thirds of participants only spoke English at home. Among the remaining participants, Spanish (14.7%), Armenian (4.9%), and Persian (3.5%) were the most common languages spoken at home. We note that most participants (93.8%) either only spoke

[1] The Evaluator follows the lead of Los Angeles staff and applies the term Latinx rather than Hispanic (Housing Element 2021-2029, page 41).

English at home or preferred LADWP communications to be in English. Spanish was the second most common language[2].

Table A-76 FY21/22 CRP: Languages Spoken and Preferred

Language	Language Spoken at Home (n = 276)	Preferred Language (n = 275)
English Only / Preferred	65.6%	93.8%
Spanish	14.7%	3.3%
Vietnamese	1.1%	0.7%
Armenian	4.9%	0.7%
Mandarin	0.7%	0.4%
Korean	1.1%	0.4%
Persian (including Farsi, Dari)	3.5%	0.4%
Other	5.3%	0.4%
Tagalog	1.8%	0.0%
Russian	0.7%	0.0%

A.10.3.2.5 Previous Evaluation Recommendations

Table A-77 below includes a summary of previous recommendations and the program's response to date.

Table A-77 Previous CRP Recommendations and Program Response

Summary of Past Recommendations	Program Response
Review all application forms and update based on feedback from people not associated with the program.	CRP has streamlined the current application by removing language around attic insulation. Additionally, the program added in more FAQs to the website for Cool Roofs.
When CRP has sufficient resources, add a way for a customer to track their rebate online.	The program relies on IT to make these large changes. At this point the effort is on making applications available online (and not specifically on tracking rebates). Additionally, as of March 2022, there is a permanent and dedicated program support team that responds to customer calls and emails (which the acting supervisor expects will improve any satisfaction issues.)
Review payment process for all measures and especially for Dual Pane Windows	No longer applicable. Considered a moot recommendation as it was the now suspended

[2] We note that both program materials and the survey materials were in English which may account for English as the predominant preferred language for communications.

Summary of Past Recommendations	Program Response
	attic insulation measures that caused the previous surge. CRP cross-trained staff so that more people can process all measures. Previously, one person handled dual pane windows and with the previous back-log and need to help with attic measures, the acting supervisor thought it likely that this measure was de-prioritized.
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.	May be considered in the future.
Talk to participating CRP contractors to determine why the program is underserving Asian and Black communities.	This recommendation was not addressed due to the retirement of the previous supervisor. However, the current supervisor noted that the issue could be one of capital investment being high compared to the rebates and these areas may be lower income.

A.10.4 Recommendations

Consider providing program marketing and application materials in Spanish and other languages. Although the program materials are currently in English and participant survey was administered in English, the participant survey found that 34% of participants spoke a language other than English. Spanish was the most commonly spoken language (spoken by 14.7%). While the share of participants that prefer to speak a language other than English was small (about 6%), there may be a sizable customer base that would participate if materials were in a language other than English.

Continuing to focus on rebate processing time and communication to participants on rebate status may improve participant satisfaction. Time to get the rebate and communication from LADWP were the two factors that were most strongly predicted overall program satisfaction, and overall program satisfaction and communication from LADWP were strong predictors of how favorably participants viewed LADWP.

A.11 Efficient Product (EPM)

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.

A.11.1 Evaluation Methodology

The evaluation method for the impact savings is to first collect all available program tracking data, then determine the best approach for the determination of the energy and demand savings of each measure. Tracking data is supplemented with primary collected data from participants. The aggregated data is then used as inputs to engineering algorithms or to inform a billing analysis, to estimate the energy and demand savings.

Table A-78 below lists the data collection activities and sources of data for the EPM Program.

Table A-78 FY21/22 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.11.1.1 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-79 lists the workbooks referenced to aggregate the participant data and which was then compared to ESP measure level report data.

Table A-79 FY21/22 EPM: Program Tracking Data Sources

Workbook File Name	Participant Records
EPM_FY21-22_PQ.xlsx	10,634
Total	10,634

The Evaluator was not provided ex-ante peak kW reduction by measure and was unable to estimate program tracking data peak demand reduction.

A.11.1.1.1 M&V Sample Design

Estimation of the energy and demand savings were completed at the census level.

Estimation of the ISR and additional replacement type data were completed by surveys stratified sampled by measure. The analysis method and sampling are summarized in Table A-80.Thermostats are listed as “eligible census”, after meeting requirements for non-participation in other programs to complete a billing analysis.

Table A-80 FY21/22 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.11.1.2 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, and the replaced existing equipment type.

A.11.1.3 Ex-Ante Savings Review

Table A-81 compares ESP and program tracking ex-ante kWh and Incentive costs, and measures costs, which match for all measures. The values were found to be equal from both data sources.

Table A-81 FY21/22 EPM: ESP to Program Tracking - Savings Comparison

Measure	Energy (kWh)		Incentive ($)	
	ESP Ex-Ante	Program Tracking Ex-Ante	ESP Ex-Ante	Program Tracking Ex- Ante
Air Conditioner	8,546	8,546	$14,850	$14,850
Light Bulb	69,430	69,430	$89,969	$89,969
Power Strip	11,236	11,236	$905	$905
Refrigerator	105,586	105,586	$139,265	$139,265
Television	477	477	$70	$70

Measure	Energy (kWh)		Incentive ($)	
	ESP Ex-Ante	Program Tracking Ex-Ante	ESP Ex-Ante	Program Tracking Ex- Ante
Thermostat	1,167,043	1,167,043	$436,475	$436,475
Total	**1,362,318**	**1,362,318**	**$681,534**	**$681,534**

For lighting measures, the tracking data indicated 1.92 kWh savings for each product and did not consider the quantity of lamps per package in the field. The ex-post savings determined the number of lamps per retail package as indicated in Table A-82. There was one product model that was purchased frequently with the majority (99.3%) of the additional lamps.

Table A-82 FY21/22 EPM: Lighting Package Quantity

Lighting Model	Lamps per Package	% of all Lamps
Sylvania LED8A19/DIMO/927/13/YTL/RP4	4	99.3%
Feit ST1960/CL927CAHDRP/4	4	<1%
BULBRITE LED9BR30/840/4PK	4	<1%
Feit BPCTF60950CAFIL/2/RP	2	<1%
Feit BPG1660950CAFIL/2/RP	2	<1%
Feit BPCFC60927CAFIL/2/RP	2	<1%
Feit BPG1640927CAFIL/2/RP	2	<1%

A.11.1.4 M&V Approach

The Evaluator used engineering-based equations to calculate energy savings and peak demand reduction for advanced power strips, refrigerators, room air conditioners, televisions, and lighting. Thermostat savings were determined through analysis of utility billing data. The following sections provide calculation details for each type of equipment.

A.11.1.4.1 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 California eTRM measure, Smart Connected Power Strip SWAP010-01 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-23 and Table A-83.

$$kWh_{savings} = \frac{kWh}{strip} x\ ISR \qquad \textit{Equation A-23}$$

Table A-83 FY21/22 EPM: Advanced Power Strips Tier 2 Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
kWh/strip	Energy savings per power strip by building type and climate zone	CA eTRM Smart Connected Power Strip; SWAP010-01	185-194 kWh
ISR	In Service Rate	Participant Survey, 2021	100%

A.11.1.4.2 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 method follows the CA eTRM Refrigerator or Freezer, Residential SWAP001-02 measure. 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-24 and Table A-84.

$$kWh = (UEC_{fed\_base} - UEC_{efficient}) x\ IE\ x\ ISR \qquad \textit{Equation A-24}$$

Table A-84 FY21/22 EPM: Energy Star Refrigerator Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
UEC_{fed_base}	Unit Energy Consumption – Federal and CA state baseline	US DOE Federal Refrigerator Standards, CA Title 20	168 - 885 kWh
$UEC_{efficient}$	United Energy Consumption - efficient	US DOE Federal Refrigerator Standards, CA Title 20	121 - 805 kWh
ISR	In Service Rate	Participant Survey, 2021	100%
IE	Interactive Effects Factor by climate zone	DEER Interior Lighting	1.00 to 1.08

A.11.1.4.3 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. The method utilizes the same energy savings algorithm as the measure CA eTRM, Room Air Conditioner Residential, SWAP007-02, except the efficiency was sourced directly from the equipment, and extracted the EFLH from the study ("Residential Retrofit High Impact Measure Evaluation Report (The Cadmus Group)"), referenced by the measure. 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 original CA eTRM algorithm and specific inputs are listed in Equation A-25 and Table A-85.

$$kWh = EFLH \ x \ Capacity \ x \ \frac{\frac{1}{CEER_{base}} - \frac{1}{CEER_{eff}}}{1000} \ x \ ISR$$ *Equation A-25*

Table A-85 FY21/22 EPM: Energy Star Room Air Conditioner Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
EFLH	Effective Full Load Hours	Study with CA eTRM Room Air Conditioner	225 to 631 hours
Capacity	Capacity of new unit, BTUh	Tracking Data Model and Energy Star Database	5,000 to 22,000 BTUh
$CEER_{base}$	Normal replacement: CEER – federal baseline	US DOE Federal Regulations	9.4 – 11.0
$CEER_{base}$	Early replacement: CEER - Survey	Participant survey based on working status, age	Varies by capacity, louver, reverse cycle
$CEER_{eff}$	CEER - efficient	Tracking Data Model and Energy Star Database	10.5 – 15.0 CEER
ISR	In Service Rate	Participant Survey, 2021	100%

A.11.1.4.4 Energy Star Television

The energy savings for the purchase of Energy Star televisions were determined by the unit energy consumption (UEC) 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 UEC 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 UEC was developed for Energy Star version 8, see Equation A-26 and Table A-86.

$$kWh = \left(UEC_{base} - UEC_{eff}\right) x \ IE \ x \ ISR$$ *Equation A-26*

Table A-86 FY20/21: Energy Star Television Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
UEC_{base}	Unit Energy Consumption for baseline television	FTC Energy Guide UES	36 – 100 kWh
UEC_{eff}	Unit Energy Consumption for Energy Star television	Model data and Energy Star Database	33 - 70 kWh
ISR	In Service Rate	Participant Survey, 2021	100%
IE	Interactive Effects Factor by climate zone	DEER Interior Lighting	kWh: 1.02 to 1.08 kW: 1.22 to 1.29

Table A-87 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 UEC per diagonal inch.

Table A-87 EPM: Television UEC Baseline – FTC Data

Screen size bin, inches	UES kWh/inch
18 – 24.5	45.4
26.5 – 36.5	57.2
37.5 – 47.5	78.4
70 - 80	101.7

A.11.1.4.5 Energy Star Lighting

The program offered many types of LED lamps, including general service A-lamp, reflectors, BR, PAR, and candelabra lamps. But over 99% of the lamps purchased by participants were general service, A-19 lamps. Although the market has nearly transformed to LED lamps through CA Title 20 and Title 24 mandates, the participant survey indicated that the program reached many homes that still had less efficient lighting. Savings for early replacements and normal replacements were determined by the following equation, with difference values for the baseline watts.

$$kWh = HOU\ x \frac{(Watts_{base} - Watts_{efficient})}{1000}\ x\ IE\ x\ ISR \qquad \textit{Equation A-27}$$

The variables for the lighting equations are listed in Table A-88.

Table A-88 FY21/22 EPM: Energy Star Lighting Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
$watts_{base}$ NR	Normal replacement – baseline watts	2018 Screw in Lamp Disposition Approved LED A-Lamp Measure Definitions	25 – 150W
$watts_{base}$ ER	Early replacement – baseline watts, weighted average	Participant survey – 257 responses for two areas per home with replaced lamps	Incand 58% Halogen 5% CFL 13% LED 23% None(LED) 2%
$watts_{efficient}$	Watts per lamp	Model data and Energy Star Database	3.8 - 18 W
ISR	In Service Rate	Participant Survey, 2021	68%
IE	Interactive Effects Factor by climate zone	DEER Interior Lighting	kWh: 1.0 – 1.2 kW: 1.22 – 1.48

A.11.1.5 Billing Analysis Approach

The Evaluators 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 Section A.10.1.6.1, the Evaluators used a billing data retrofit isolation approach to evaluate EPM Smart Thermostats and EPM Web-Enabled Thermostats.

A.11.1.5.1 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 FY21/22 alone for EPM Smart Thermostats and EPM Web-Enabled Thermostats. Therefore, data from FY20/21 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. 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 the following equation:

$$Average\ Daily\ kWh = \frac{Total\ kWh}{Number\ of\ Days} \qquad \text{Equation A-28}$$

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 calendarization, customer billing data was filtered for the following criteria:

- The Evaluators 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, for Smart Thermostats, the Evaluators used a pre-installation period of January 2019 through April 2019 and August 2019 through December 2019 and a post-installation period of August 2021 through April 2021. For Web-Enabled Thermostats, the Evaluators used a pre-installation period of January 2019 through April 2019 and September 2019 through December 2019 and a post-installation period of September 2021 through April 2022.
- Participants must not have taken part in any other energy efficiency programs administered by LADWP during FY21/22 or FY21/22.
- 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 FY21/22 data for EPM Smart Thermostat and EPM Web-Enabled Thermostat. Thus, data was supplemented using FY21/22 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 Table A-89.

Table A-89 FY21/22 EPM: Smart & Web-Enabled Thermostat Participant Count

Measure	Number of Participants	Final Sample Size
Smart Thermostat	3,774	375
Smart + Web-Enabled Thermostat	3,998	433

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-29.

$$Average\ Daily\ kWh_i = \alpha + \beta_1 \cdot post + \beta_2 \cdot CDD_{i,n} + \beta_3 \cdot HDD_{i,n} + \beta_4 \cdot CDD_{i,n} \cdot post + \beta_5 \cdot HDD_{i,n} \cdot post + \varepsilon \qquad \text{Equation A-29}$$

Where:

i	=	each individual customer for each month
n	=	each iteration of base pairs
post	=	an indicator variable indicating whether the period is in the post or pre period
$CDD_{i,n}$	=	the CDD calculated for iteration n for customer i
$HDD_{i,n}$	=	the HDD calculated for iteration n for customer i
α	=	the intercept term
β_1	=	the main effect of the post period
β_2	=	the main effect of CDD
β_3	=	the main effect of HDD
β_4	=	the additional effect of CDD on the post period
β_5	=	the additional effect of HDD on the post period

ε = 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 below in Equation A-30.

$$\Delta kWh_{HVAC} = kWh_{HVAC\ Pre} - kWh_{HVAC\ Post}$$ *Equation A-30*

Because the FY21/22 billing data was truncated to the period of August through April or September through April, 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-90.

Table A-90 FY21/22 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	345	172	517	50%
Smart + Web-Enabled Thermostat	310	156	464	50%

A.11.1.5.2 Adjustment for COVID-19

As mentioned in Section A.10.1.6.2, 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 FY21/22 may inadvertently be impacted by changes due to the COVID-19 pandemic. To account for this impact, the Evaluators 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:

1. The nonparticipant 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 (May 2021 through April 2022 depending on the measure).
2. The non-participant billing data was weather normalized by optimizing the CDD and HDD bases per participant and normalizing the billing data to TMY3.
3. 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).
4. 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.
5. 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 ways:

- 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 May 2021 through April 2022. 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.11.1.6 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. A total of 240 participants completed the survey, yielding an overall response rate of 13.2%.

Table A-91 FY21/22 EPM: Summary of Survey Sample Measure Coverage

Measure	# of Customers	% of Customers	% of Measures	# of Responses	% of Responses
Light Bulb	3,106	29%	29%	135	42%
Refrigerator	2,052	20%	19%	96	30%
Smart thermostat	5,167	48%	49%	75	23%
Window Air Conditioner	274	2%	3%	12	4%
Power Strip	31	0%	0%	3	1%
Television	4	0%	0%	0	0%

A.11.2 Impact Evaluation

This section presents the findings of the impact evaluation of the EPM during the FY 21/22 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 EPM offerings.

A.11.2.1.1 Energy Star Lighting

The lighting realization rate for energy savings was 3,165%, due to three items. First, all measures in the tracking data had an ex-ante energy savings of 1.92 regardless of the number of packages. Second, the lamp quantity per package was not tracked, with over 99% of the incentivized lamps sold in a package of two to four. Lastly, the participant survey indicated a mix of baseline lamps with less efficient technology. The survey captured baseline lamps in the two primary areas of the replaced lamps, indicated 58% still with incandescent lamps, 5% halogen, 13% CFL with the remaining having an LED baseline.

A.11.2.1.2 Advanced Power Strip

The power strip energy savings realization rate was 86%. The ex-post referenced the CA eTRM Smart Powerstrip table for savings by building type and climate zone with the applicable values ranging from 185 – 194 kWh, whereas the ex-ante value of 212 kWh was not climate dependent nor building type.

A.11.2.1.3 Smart and Web Thermostat

The smart and web thermostat energy realization rate was 157% for the first-year savings, which considered the Covid-Era increased residential energy usage. The typical year savings had a realization rate of 103%. To obtain statistical significance in the billing analysis, FY 21/22 data was aggregated with prior program years' data. The COVID-19 era contributes to variation in the pre and post billing analysis periods.

A.11.2.1.4 Refrigerator

The refrigerator realization rate was 115%. 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 annual usage for each refrigerator and compared to the manufacturer refrigerator specifications annual usage.

A.11.2.1.5 Television

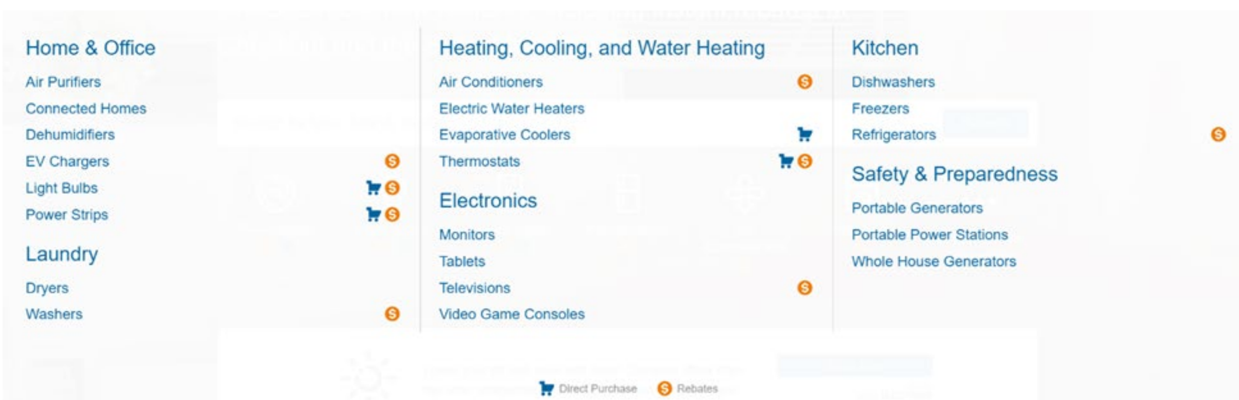
The television energy realization rate was 24%. The participation was low with a total of 7 rebated Energy Star televisions, which is reflective of the low number of manufactured Energy Star certified televisions. The ex-post savings were based on the difference of the manufacturer rating for annual energy use based on FTC Energy Guide data, using the Energy Star television Version 8 method.

A.11.3 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[3] , rebate information (for certain products), and ENERGY STAR rating (where applicable).

The program runs on a fiscal year (a fiscal year, FY, is May 1 to April 30). As of September 2022, EPM included 22 different products. Compared to the previous year (website accessed October 2021), the program kept all previous products and added evaporative coolers (direct purchase from the website). EV chargers were added in late 2021/early 2022 with customers obtaining a rebate from a different program (Residential EV Charging Station Rebate Program[4]). Of all products, customers could purchase four directly from the website and eight included LADWP rebates. (Figure A-6)

Figure A-6 FY21/22 EPM: Products



[3] 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.

[4] As such, any counts of EV chargers are included in the other program, not EPM.

More rebated products went through EPM this year (FY21/22) compared to last year (FY20/21) with the largest increase from light bulbs (a 229% increase over last year) and thermostats (a 15% increase).

Table A-92 EPM Products Rebated (FY20/21 and FY21/22)

Product Sold	Population		
	Sum of Products last year (FY20/21)	Sum of Projects this year (FY21/22)	Change from last year
Light Bulb	944	3,106	229%
Thermostat	4,488	5,167	15%
Refrigerator	1,953	2,052	5%
Window Air Conditioner	269	274	2%
Power Strip	91	31	-66%
Television	12	4	-67%
Grand Total	**7,757**	**10,360**	

A.11.3.1 Process Evaluation Approach and Methodology

A.11.3.1.1 Document Review

The evaluation team reviewed the EPM website and tracking data.

A.11.3.1.2 Staffing Interviews

Over 50 minutes, the ADM evaluation team interviewed two (2) EPM staff in October 2022 with three additional LADWP staff in attendance (i.e., the LADWP evaluation team).

A.11.3.1.3 Participant Survey

The participant survey had several uses, but for the process evaluation, the evaluation team wrote survey questions to determine:

- **Customer Satisfaction** - The level of customer satisfaction with the overall website.
- Net Promoter Score assessment – The Evaluator included questions to assess the net promoter score for the program.
- **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.

- **Assessment of response Marketing Messages used by the Program** – The survey included a random display of different messages used to promote EPM and questions on the impression the messages left.
- **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.11.3.1.4 Tracking Data Review

The evaluation team reviewed the program tracking database to determine the number of products with energy savings claimed by LADWP.

A.11.3.2 Process Evaluation Findings

Changes in FY20/21 program activity are discussed below.

Light bulbs sales showed the largest increase over last year. LADWP celebrated National LED Light Day in October 2021 and Enervee (the implementer of EPM) was able to secure a deal to provide 12-packs of LED bulbs for a low price which was a big hit with LADWP customers (as seen by the very large uptake this year compared to last year).

Thermostat sales also increased. The program managers thought this may have been due to the partnership between EPM and the LADWP Power Savers program (an LADWP demand response program). Marketing from this partnership included "go get a thermostat at no cost" and then "enroll in Power Savers program to earn even more". There was one marketing campaign in 2020/2021 and two marketing campaigns in 2021/2022 (August 21 and April 22). Additionally, a newsletter that goes out to all customers also included the thermostats/Power Save combination.

Refrigerators and Window AC rebate numbers remained steady in FY21/22. According to the program managers, refrigerator sales have ebbs and flows, some of which was caused by COVID and supply chain issues.

Power Strips and TVs rebates were low volume in both years. According to the program managers, TV rebate not really enough to move the needle – people just take advantage of the rebate if they run across it.

Additional measures for the future. In last year's discussion with program managers, the evaluation team heard that, in FY21/22, the program may add generators to the marketplace website and were considering financing as well, although neither were implemented. Within LADWP, generators were briefly discussed, but other areas took priority (e.g., Cool LA described further below). LADWP was not comfortable with the original financing described in initial discussions with Enervee but is continuing to explore this option with Enervee.

We heard from the program manager that during FY22/23, the program experienced a large increase in window ACs because of an LADWP-wide initiative called “Cool LA”[5]. LADWP put this initiative in place to help most vulnerable customers address extreme heat. EPM has been part of this initiative by providing a higher window AC rebate to low-income customers ($225 for eligible ENERGY STAR AC units compared to the regular $75 rebate) with just under 1,000 rebates over about two months. Cool LA was also the spark for adding Title 20 evaporative coolers to the website. EPM also added another small marketplace website to accommodate Window ACs for the low-income customers. The Cool LA Marketplace has window AC units and evaporative coolers as a point-of-sale credit. (https://cool-ladwp.enervee.com/). EPM verifies low-income status by requiring the customer to provide name, address, and account number to obtain a rebate. Enervee validates immediately from LADWP list. If not verified, the customer is sent to a regular marketplace website.

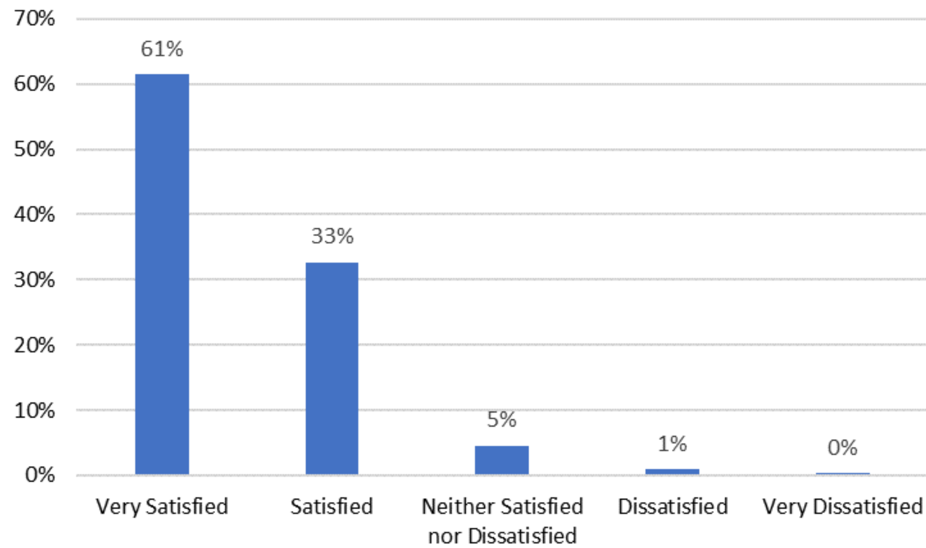
During FY22/23, the program expects to add in electrification measures as part of the Cool LA Initiative (heat pump water heaters, HP HVAC, HP Dryers, and induction cooktops). LADWP plans to offer these beginning in January 2023, but is still working through details of how going to actually implement the verification of electrification measures.

A.11.3.2.1 EPM Customer Satisfaction

Most respondents (94%) were satisfied with the LADWP Efficient Product Marketplace. The program is working well for instant rebate participants and those who submitted for a rebate after purchasing the product they submitted. Levels of satisfaction for customers who used the instant rebate service and those who submitted for a rebate after purchasing the product were not statistically different.

[5] Cool LA runs from September 1, 2022 through the December 31, 2022.

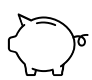
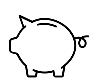
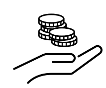
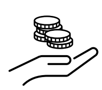
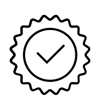
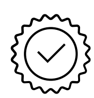
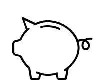
Figure A-7 EPM: Overall Satisfaction with the LADWP Efficient Product Marketplace



A.11.3.2.2 EPM Customer Satisfaction

Financial considerations, both the rebate and the utility cost savings, were top reasons for each product type (see Table A-93). Product features were a motivation for refrigerators and smart thermostats.

Table A-93 FY21/22 EPM: Most Important Reasons for Purchases

Reasons	LED Light Bulbs (n = 132)	Refrigerator (n = 88)	Smart Thermostats (n = 71)
1st	 (Save on utility costs)		
2nd	 (The rebate)	 (Product features)	
3rd	 (Good for the environment)		

A.11.3.2.3 Purchase Experience and Website

Nearly all participants thought it was easy or very easy to find what they wanted on the website. Although customers who purchased refrigerators gave lower ratings for ease of finding what they wanted on the website, most of these customers reported that it was easy to find what they wanted.

Table A-94

How easy was it to find what you wanted on the site?	All Respondents (n = 305)	LED Light Bulbs (n = 131)	Refrigerator (n = 88)	Smart Thermostat (n = 71)
Very easy	50%	55%	33%	58%
Easy	46%	44%	59%	41%
Difficult	3%	2%	7%	1%
Very difficult	0%	0%	1%	0%
Mean	3.53	3.53	3.24	3.56

** Refrigerator purchasers reported a lower average rating for ease of finding what they wanted on the site than LED and thermostat purchasers. The difference was statistically significant. Ratings are not broken out for customers who bought power strips or air conditioners because there were few of these respondents (3 and 12, respectively).*

Nearly all instant rebate purchasers also reported that completing the purchase was easy or very easy.

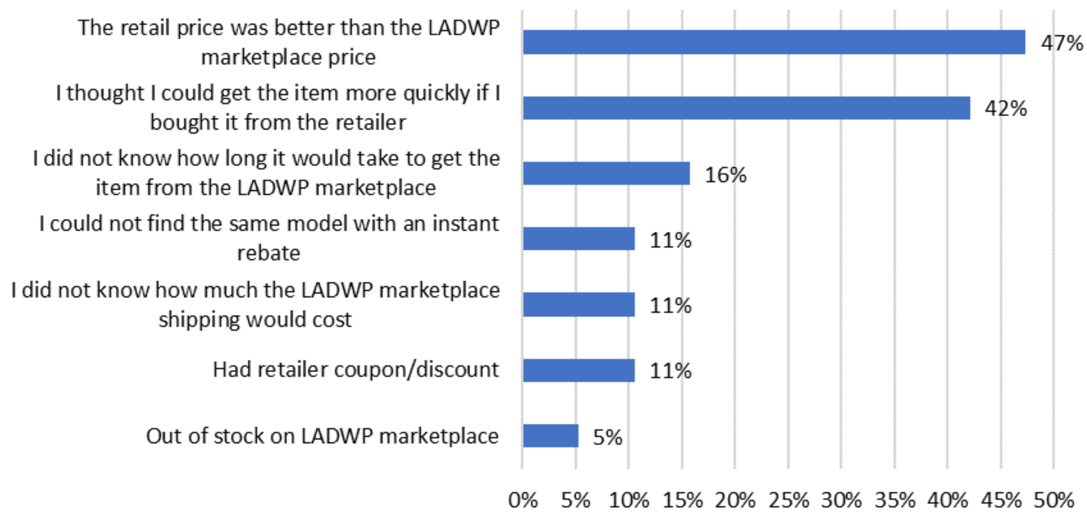
Table A-95 FY21/22 EPM: Ease Completing Instant Rebate Purchase

How easy was it to complete the instant rebate purchase for the measure?	All Respondents (n = 170)
Very easy	63%
Easy	35%
Difficult	2%
Very difficult	0%

A.11.3.2.4 Instant Rebate Feedback

Better pricing and perceived quicker times to get the measure were the main reasons customers purchased instant rebate measures without getting a rebate. Of the 19 survey respondents that did this, about half (47%) of the customers who purchased measures available for an instant rebate on their own and applied for a rebate were not aware that an instant rebate was available. Of those who were aware that an instant rebate was available, the most common reasons for not getting an instant rebate through the LADWP marketplace were that the retail price was better (47%) and that they thought they could get it more quickly from a retailer (42%).

Figure A-8 FY21/22 EPM: Reasons for Buying Instant Rebate Measures from Retailer (n = 19)



A.11.3.2.5 NPS Score

The net promoter score for LADWP's Efficient Product Marketplace is 57.[6] As shown in Table A-96, 66% of the participants were in the promoter group and a small fraction were in the detractor group (9%). There was not a difference in the share of net promoters or detractors for customers who received an instant rebate and those who did not.

Table A-96 FY21/22 EPM: Share of Respondents in Each Net Promoter Group

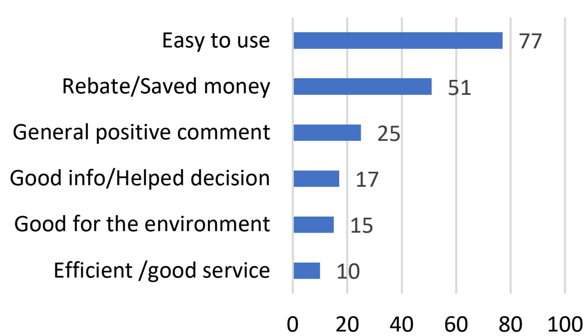
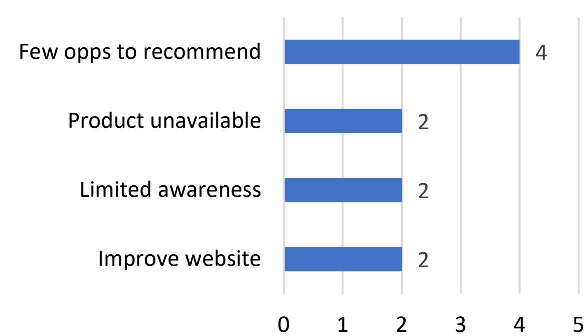
Net Promoter Group	Percent of Responses (n = 306)
Promoter	66%
Passive	25%
Detractor	9%

Ease of use and rebates were the most common reasons why promoters said they were likely to recommend the service to others. Table A-97 summarizes the most frequently mentioned reasons for respondents' likelihood of recommending the

[6] To calculate the net promoter score (NPS), the Evaluator grouped respondents into one of three net promoter groups based on their rated likelihood of recommending LADWP's Efficient Product Marketplace: Promoter (rated likelihood of 9 or 10), Passive (rated likelihood of 7 or 8), and Detractor (rated likelihood of 0 – 6). Based on these groupings the NPS score was calculated as equal to the percent of promoters minus the percent of detractors, or 66% - 9% = 57.

marketplace for promoters and detractors. As shown, the ease of using the website was the top reason why promoters would recommend the service, followed by the rebate available or that it helped them save money. Few respondents were detractors and there were few reasons given by the detractors for not recommending the service. The most common reason given did not have anything to do with the service but was related to a perceived lack of opportunities to recommend the service to others (mentioned by four respondents). Issues raised about the service, each mentioned by two respondents, were unavailable products, limited awareness of the service, and that the website should be improved.

Table A-97 FY21/22 EPM: Most Common Reason for Ratings (Count of Mentions)

<table>
<tr><th>Promoters</th><th>Detractors</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

A.11.3.2.6 Impression of Different EPM Marketing Messages

To assess how different marketing messages may affect perceptions of the LADWP Efficient Product Marketplace, each respondent was shown one of the following four messages at random and then asked to answer four questions about the impression the message had on them:

- Search and compare efficient products before you buy (shown to 78 respondents)
- Receive an instant discount on efficient products (shown to 77 respondents)
- Receive an instant rebate on efficient products (shown to 76 respondents)
- Find rebates for efficient products (shown to 75 respondents)

The message shown was related to the respondents reported interest in visiting the website, as summarized in Table A-98. Respondents who received the “receive an instant rebate on efficient products” message were more interested in visiting the website than those that saw the “search and compare efficient products before you buy” message.

Table A-98 FY21/22 EPM: Message and Interest in Visiting Marketplace Website

Message Seen	Interested in Visiting Website
Search and compare efficient products before you buy.*	78.7%
Receive an instant discount on efficient products.	87.2%
Receive an instant rebate on efficient products.*	94.8%
Find rebates for efficient products.	89.5%

**Statistically significant difference.*

However, there were no differences in the impression the message left on how much respondents thought they would save, their rated likelihood of visiting the website, or the ease of making a purchase on the website. The mean rating for these questions is shown in Table A-99.

Table A-99 FY21/22 EPM: Rated Impressions of Different Messages about the Marketplace

Message Seen	How Much Would You Save?	Likelihood of Visiting Marketplace	Ease of Purchasing on Marketplace
Search and compare efficient products before you buy.	2.8	3.9	3.3
Receive an instant discount on efficient products.	2.9	3.9	3.4
Receive an instant rebate on efficient products.	3.1	4.1	3.5
Find rebates for efficient products.	3.1	3.9	3.4

A.11.3.2.7 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. More than one-third (44%) are low or moderate income, and half (50%) are under the age of 55, Table A-100.

Table A-100 FY21/22 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 = 273)**	**Households**	
Owner - Single Family	59%	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	10%		
Renter- Single Family	20%	63%	
Renter - Multi Family	10%		

Demographic Parameter	EPM Survey	Population for City of Los Angeles (census data)	Notes
Income	**(n = 302)**	**Households***	
Low or Moderate Above Moderate Declined to Say	44% 38% 18%	64% 36% --	More than one third are low or moderate income (based on self-reported income). Note, however, that many did not provide this information.
Age	**(n = 296)**	**Householder****	
25-34 35-54 55-64 65+	10% 40% 19% 31%	17% 39% 19% 24%	EPM is being used by all ages, and in approximate proportion to the population.
Self-Identified Ethnicity	**(n = 283)**	**Householder****	
Caucasian (White) Asian Hispanic (Latinx)[7] African descent Other	51% 27% 17% 5% 6%	35% 15% 31% 7% 13%	Whites and Asians disproportionately obtain more rebates through EPM than Latinx or Other ethnicities.

**Appendix 1.1 City of Los Angeles Housing Element 2021-2029. Chart 1.1.28 Income Categories for Renters and Owners in LA City. Survey respondents with income of $100,000 were reported as low to moderate income.*

***Census data, ACS 2019, Table S2502*

Most respondents preferred communications in English (92%), although a third of respondents spoke a language other than English. Two percent of respondents preferred to communicate in Spanish.

Table A-101 FY21/22 EPM: Languages Spoken and Preferred

Language	Language Spoken at Home (n = 276)	Preferred Language (n = 275)
English Only / Preferred	65.0%	92.1%
Spanish	13.9%	2.0%
Other	7.6%	0.0%
Persian (including Farsi, Dari)	3.6%	0.7%
Korean	3.3%	1.7%

[7] The Evaluator follows the lead of LADWP staff and applies the term Latinx rather than Hispanic (Housing Element 2021-2029, page 41).

Language	Language Spoken at Home (n = 276)	Preferred Language (n = 275)
Mandarin	2.3%	0.7%
Vietnamese	2.0%	0.0%
Russian	2.0%	0.0%
Armenian	1.3%	0.0%
Tagalog	1.0%	0.0%

A.11.3.2.8 Previous Evaluation Recommendations

Table A-102 below includes a summary of previous recommendations and the program's response to date.

Table A-102 Previous EPM Recommendations and Program Response

Summary of Past Recommendations	Program Response
Create a direct link on the Solar Marketplace banner to the Solar Marketplace location.	A direct link to Solar Marketplace was added. However, Solar Marketplace was discontinued just recently (October 1, 2022) and this banner was removed from the website.
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.	LADWP cannot put water savings measures on the website as the programs are funded by an organization that is energy only (SCAPPA). The program managers briefly considered back-up batteries and lawn equipment, but these were already efficient and offered little energy savings for LADWP.
Consider targeted marketing to begin to draw in renters and 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.	The program managers considered this recommendation but stated that the program cannot readily determine these types of customers so could not do targeting. There are a small number of folks identified in the customer database who speak Spanish, but it is not inclusive. Implementing any recommendation around translating would have needed to be included in the Enervee contract. However, the contract with Enervee was already completed and translation was not in the contract. Furthermore, the program managers indicated that Enervee does not have the capability of translation, (but it may be on the Enervee roadmap for next year). While translation is not available, customer marketing emails have a link to view the messaging in Spanish and the new Cool LA Marketplace has a landing page in Spanish (not the full site, but it helps get them started).
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	The program managers considered all these options but did not make changes. Their reasons for not changing included: 1) management did not feel the links were needed, 2) it cluttered up the website, and 3) Enervee charge to implement seemed too high, 4) HEIP was not open at the time and also HEIP is very careful about generating demand because only so much they can handle.

Summary of Past Recommendations	Program Response
LADWP programs. Specific options may include the following.	

A.11.4 Recommendations

Consider providing program marketing and application materials in Spanish and other languages. Although the program materials are currently in English and participant survey was administered in English, the participant survey found that 35% of participants spoke a language other than English. Spanish was the most commonly spoken language (spoken by 13.9%). While the share of participants that prefer to speak a language other than English was small (about 8%), there may be a sizable customer base that would participate if materials were in a language other than English.

A.12 Energy Savings Assistance (ESAP)

This section 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.12.1 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.12.1.1 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.12.1.2 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.12.1.3 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-103 FY21/22 ESAP Ex-Ante Savings Source Comparison

Fiscal Year	ESP Ex-Ante kWh	Program Tracking Ex-Ante kWh	ESP Ex-Ante Peak kW	Program Tracking Ex-Ante Peak kW
FY 20/21	2,745,787	2,298,315	N/A	N/A

The Evaluator was provided with tracking data that displayed 84% of 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.12.1.4 M&V Approach

Table A-104 summarizes the data sources used in the ESAP impact evaluation.

Table A-104 FY20/21 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
Nonparticipant 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:

1. First, the Evaluator conducted an exploratory data analysis that made use of all provided participant billing data;
2. 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
3. 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.12.2 Billing Analysis

A.12.2.1 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, Section A.10.1.6. The Evaluators used a billing data regression approach to evaluate ESAP.

A.12.2.1.1 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-31.

$$Average\ Daily\ kWh = \frac{Total\ kWh}{Number\ of\ Days}$$ *Equation A-31*

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 be 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-105.

Table A-105 FY20/21 ESAP Participant Count

Measure	All Participants	Qualified Participants	All Non-participants with Billing Data	Qualified Non-participants
Whole House	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:

1. The average daily kWh annually,
2. The average daily kWh for winter (December through February),
3. The average daily kWh for spring (March through May),
4. The average daily kWh for summer (June through September), and
5. 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 be 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-106. The distributions did not significantly differ between the participant group and the comparison group, suggesting a good PSM.

Table A-106 FY20/21 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-9. 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-9 FY20/21 ESAP Pre-Treatment Equivalency

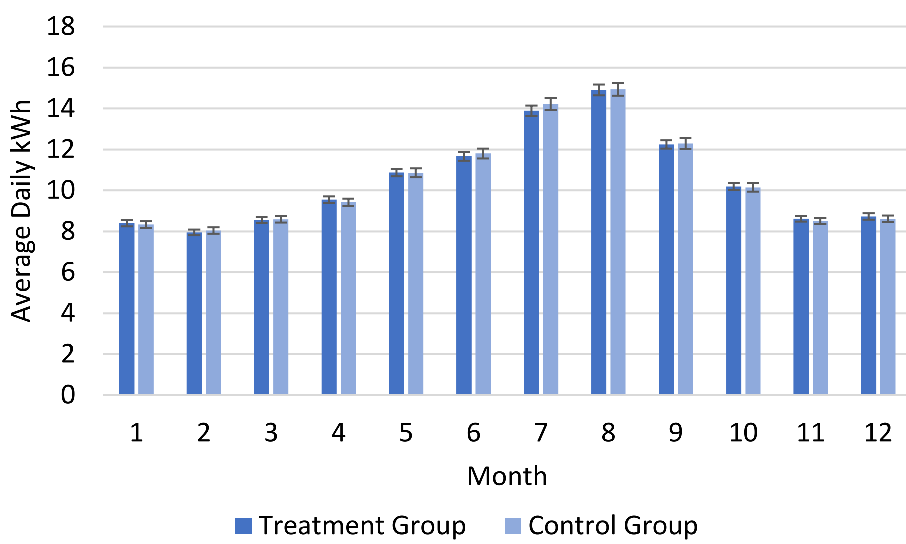


Table A-107 FY20/21 ESAP Pre-Treatment T-Test

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

Month	Participant Group (Average Daily kWh)	Non-Participant Group (Average Daily kWh)	T-value	P-value
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-108.

Table A-108 FY20/21 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-32:

$$Average\ Daily\ kWh_i = \alpha + \beta_1 \cdot post + \beta_2 \cdot CDD_{i,n} + \beta_3 \cdot HDD_{i,n} + \beta_4 \cdot CDD_{i,n} \cdot post + \beta_5 \cdot HDD_{i,n} \cdot post + \varepsilon \qquad \text{Equation A-32}$$

Where:

i	=	represents each individual customer for each month
n	=	represents each iteration of base pairs
$post$	=	an indicator variable indicating whether the period is in the post or pre period
$CDD_{i,n}$	=	the CDD calculated for iteration n for customer i

$HDD_{i,n}$	=	the HDD calculated for iteration n for customer i
α	=	the intercept term
β_1	=	the main effect of the post period
β_2	=	the main effect of CDD
β_3	=	the main effect of HDD
β_4	=	the additional effect of CDD on the post period
β_5	=	the additional effect of HDD on the post period
ε	=	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-33.

$$\begin{aligned} Average\ Daily\ kWh_i &= \alpha + \beta_1 \cdot treatment + \beta_2 \cdot CDD_i + \beta_3 \cdot HDD_i \ + \beta_4 \\ &\cdot CDD_i \cdot treatment + \beta_5 \cdot HDD_i \cdot treatment + \beta_6 \\ &\cdot pre\ usage\ winter_i + \beta_7 \cdot pre\ usage\ spring_i + \beta_8 \\ &\cdot pre\ usage\ summer_i + \beta_9 \cdot pre\ usage\ fall_i + \beta_{10} \\ &\cdot month_1 + \cdots + \beta_n \cdot month_{12} + \beta_{n+1} \cdot month_1 \\ &\cdot pre\ usage\ winter_i + \cdots + \beta_{n+x} \cdot month_{12} \\ &\cdot pre\ usage\ fall_i + \ \varepsilon \end{aligned}$$

Equation A-33

Where:

i	=	represents each individual customer for each month

$treatment$	=	an indicator variable indicating whether the customer is in the participant or comparison group
CDD_i	=	the CDD calculated for iteration *n* for customer i
HDD_i	=	the HDD calculated for iteration *n* for customer i
$pre\ usage\ winter_i$, $pre\ usage\ spring_i$, $pre\ usage\ summer_i$, and $pre\ usage\ fall_i$	=	the customer-specific pre-treatment control variables
$month_1$ through $month_{12}$	=	indicator variables indicating if the month is January through December
α	=	the intercept term
β_1	=	the main effect of the program participation
β_2	=	the main effect of CDD
β_3	=	the main effect of HDD
β_4	=	the CDD-dependent effect of program participation
β_5	=	the HDD-dependent effect of program participation
β_6 through β_9	=	the main effects of pre-treatment consumption
β_{10} through β_n	=	the main effects of month
β_{n+1} through β_{n+x}	=	the interactive effects of month and pre-treatment consumption
ε	=	the error term

The regression coefficients of interest for estimating savings are β_1, β_4, and β_5. Table A-109 provides information regarding the regression coefficients for each model and the overall model fit.

Table A-109 FY20/21 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-34.

$$Annual\ Savings = [Treatment\ Coefficient + (Treatment\ x\ CDD\ Coefficient\ \cdot \overline{CDD}) + (Treatment\ x\ HDD\ Coefficient\ \cdot \overline{HDD})] \cdot -1 \cdot 365.25$$ *Equation A-34*

Where:

$\overline{CDD}$	=	the average daily CDD for a typical weather year
$\overline{HDD}$	=	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-110.

Table A-110 FY20/21 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-111.

Table A-111 FY20/21 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.12.2.1.2 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.13 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.

The program runs during a fiscal year (a fiscal year, FY, is May 1 to April 30). HEIP was suspended for all but a few days in FY21/22 due to COVID-19 restrictions.

A.13.1 Process Evaluation Approach and Methodology

This is a concurrent summary process evaluation of FY21/22 that focused on hearing about the program from the LADWP project managers and documenting the program processes.

A.13.1.1 Document Review

The evaluation team reviewed the HEIP documentation.

A.13.1.2 Staff Interviews

Over a one-hour period, the evaluation team interviewed three (3) HEIP staff in July 2022.

A.13.1.3 Process Evaluation Findings

The information below describes HEIP as it functions when being implemented. As mentioned earlier, it was suspended for all but a few days of 2021-2022.

A.13.1.3.1 Program Staffing and Activities

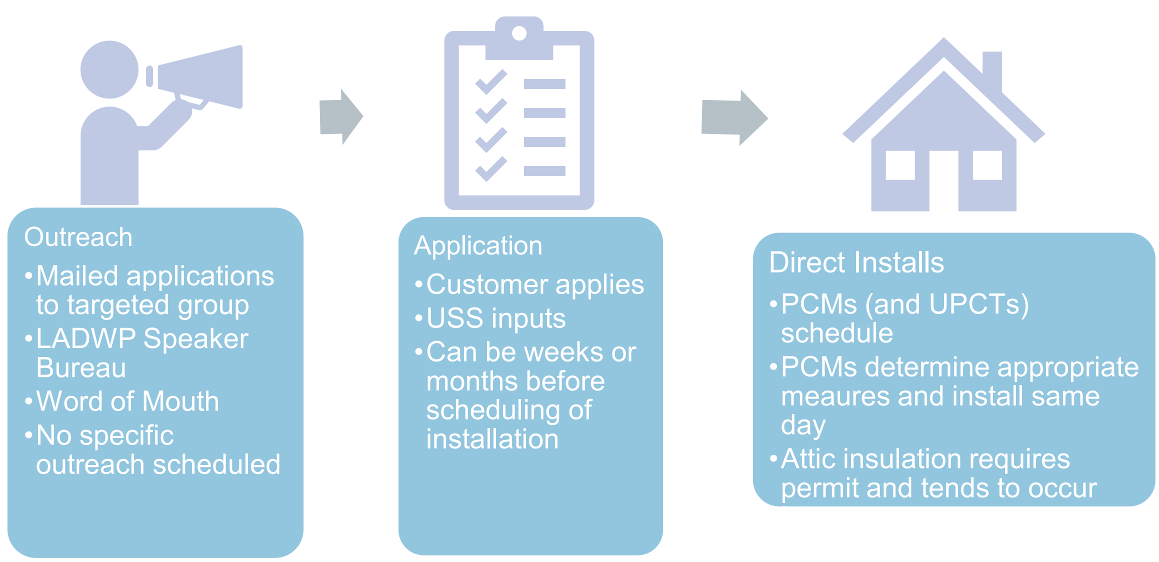
The program is fully implemented by LADWP staff. Five separate groups within LADWP are involved, but only three groups perform the day-to-day activities.

- Day-to-day activities

  - Utility Service Specialists (USS) perform the customer intake and processes customer applications.
  - Power Construction Maintenance (PCM) carpenters, roofers, and schedule and perform the direct installation of HEIP measures.
  - Utility pre-craft Trainees (UPCT) support the PCM group. UPCT staff circulate around LADWP for on-the-job training.
- Other program involvement
  - Water Conservation Group provides water products (e.g., toilets, showerheads, etc.) that are installed by the PCMs.
  - LADWP Speakers Bureau sometimes pass out HEIP flyers or applications at public events or booths.

High-level activities are shown below in Figure A-10.

Figure A-10 HEIP High Level Program Activities



According to the HEIP program managers, the program has sufficient staff for the volume of work in the pipeline. However, if the volume increases, the program manager indicated they would need more staff.

A.13.1.3.2 Program Targeting and Goals

Any LADWP dwelling that has not had HEIP measures installed in the past is eligible for the program. Since the program is dwelling based, a customer can move and request HEIP for their new address. While all customers of all income can participate, HEIP markets to and targets low-income households based on billing system Lifeline customers. HEIP obtains a list of relevant customers from the rates department and mails out applications to those already on the discounted rate.

HEIP has no specific goals for savings or number of customers. The program reports out on savings each month.

A.13.1.3.3 Program Collaborations

HEIP collaborates with two other LADWP programs. The HEIP team assesses the household for participation in the Refrigerator Exchange Program (REP) by asking about the refrigerator size criteria, whether the refrigerator is working, and customer interest in REP. These findings are placed back into the program database and HEIP sends a weekly report to the REP program manager. REP then interacts directly with the customer as needed.

Additionally, HEIP expects to collaborate with the new Comprehensive Affordable Multifamily Retrofit (CAMR) program. CAMR began in June of 2022 and HEIP had had limited interactions with the CAMR team as of our discussion with HEIP in July 2022. HEIP had heard a high-level overview in 2021 from CAMR, but nothing since CAMR was approved (as of our July 2022 discussion with HEIP program managers).

A.13.1.3.4 Program Challenges

The program continued to experience the difficulties associated with COVID and was unable to perform the direct installation of HEIP measures for all but three days of the program year. The program tried to reopen at the beginning of the program year (July 2021), but the PCMs were not yet ready to go back into the field. A soft launch was then attempted in April 2022, but only lasted for three days as a safety issue with exposure occurred and the program was again closed. As of July 2022, the program was still closed.

Prior to COVID, attic insulation was one of the program’s largest energy savers. However, there were challenges related to timing because the program requires permits for attic insulation, which can take time to obtain. As such, there is a lag between the initial determination of a need for attic insulation and when it is installed that causes customer dissatisfaction. Additionally, attic insulators only go out one time. Customers do not have the opportunity to ameliorate any issues found (such as rodents in attic or holes in the roof).

A.13.1.3.5 Program Successes

Prior to COVID, HEIP created a new application process that sought to increase the ease of installation within multifamily buildings. Previously, 60% of tenants in the same multifamily building had to apply to HEIP before the program could serve the buildings. Now the property owner applies. COVID hit before HEIP could implement this change, so the ease of application has not been tested.

The program plans to add nightlights and smart powerstrips to their existing list of free measures. PCMs will install the powerstrips to ensure savings. Nightlights, smoke alarms, and carbon monoxide detectors are all provided free of charge as safety measures (without savings).

Additionally, even though the PCMs were unable to go into the field, the USS's continued to maintain a list of customers who noted HEIP interest both before and during the pandemic. As of July 2022, there were approximately 1,600 names on the list that the USS team will hand over to the PCMs when direct installs resume.

A.14 Low-Income Refrigerator Exchange Program (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-112 shows a comparison of ESP savings and Program Tracking savings. The ESP and program tracking ex-ante kWh savings were closely aligned.

Table A-112 FY20/21 REP ESP and Program Tracking Saving Comparison

Measure	ESP Ex-Ante kWh	Program Tracking Ex-Ante kWh	ESP Ex-Ante kW	Program Tracking Ex-Ante kW
Refrigerator	121,954	105,184		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.

Then, the ENERGY STAR UEC[8] (ES UEC) for the efficient refrigerator was calculated using Equation A-35.

$$ES\ UEC = 7.26 * AV + 210.3 \qquad \textit{Equation A-35}$$

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-36.

$$Gross\ Ex\ Post\ kWh = Full\ Year\ UEC - ES\ UEC \qquad \textit{Equation A-36}$$

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

[8] 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 Administration9.

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

Table A-113 summarizes the full year UEC estimate for refrigerators during FY 21/22.

Table A-113 FY 21/22 Full Year Average UEC Estimates

Fiscal Year	Appliance Type	Average Full Year UEC
21/22	Refrigerator	1,192

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 21/22 is presented in Table A-114.

Table A-114 Retrospective Evaluation Period Per-Unit kW Reduction

Fiscal Year	Appliance Type	Per-unit kW Reduction
21/22	Refrigerator	0.099

[9] 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.

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.

A.14.3 Process Evaluation

A.14.3.1 Process Evaluation Approach and Methodology

A.14.3.1.1 Document Review

The Evaluator reviewed the program website, fact sheet, and tracking data supplied by LADWP.

A.14.3.1.2 Staff Interviews

The Evaluator interviewed two LADWP staff in April and two ARCA staff in August. The interviews provided information on program implementation processes, design, and potential future directions.

A.14.3.1.3 Participant Survey

ADM conducted telephone surveys with participants of LADWP's Refrigerator Exchange Program (REP). ADM surveyed low-income residential customers who qualify for the REP and institutional participants to gather their feedback about their experience with the program. A total of 157 residential customers and eight nonprofit institutions completed the survey.

A.14.3.2 Process Evaluation Findings

A.14.3.2.1 Overview of Program Processes

The Low-Income Refrigerator Exchange Program (LIREP) replaces older, less efficient refrigerators with new ENERGY STAR® certified models for qualified customers who are on LADWP's Low-Income or Senior Citizen/Disability Lifeline Rates at no cost to the participant. These residential customers may exchange one unit over the lifetime of their account. Multi-family or mobile home communities, civic, community, faith-based organizations, and educational institutions may also participate in the program.

The program is implemented by LADWP's 3rd party contractor, ARCA, which recycles the old units and provides the replacement units. ARCA works with a third-party contractor that performs the pickup and replacement of units.

LIREP is one of LADWP's programs that is part of the Equity Metrics Data Initiative (EMDI) adopted by the Board of Commissioners in 2016. As such, a goal of the program is to help LADWP serve all of its customers.

Participation Process

The participation processes differ for residential customers and institutional participants.

Residential Customer Participation

To enroll in the program, residential customers sign up through an online application form or by calling a service center, both of which are managed by ARCA. The call center is available to schedule replacements from 5 a.m. to 5 p.m., Monday through Friday and from 6 a.m. to 4:40 p.m. on Saturdays. Spanish and other language staff are available for customers whose primary language is not English.

ARCA uses a monthly data file provided by LADWP to verify that the applicant is an LADWP customer and is on a qualifying rate. Qualified customers can schedule the exchange appointment during the online or telephone sign up process. In a limited number of cases, the applicant may not be identified as qualified for the program. These applicants are pushed into a missing account portal. The applicants are reviewed by LADWP staff. Common reasons for not being immediately qualified are the applicant is not an LADWP customer (some from out of state apply) or the customer is not on a qualified rate. Customers determined to be ineligible for the program are sent a letter and those who are not qualified, rates are sent with an application to be put on the rate.

Once the customer has been validated as qualifying for the program, a site inspection is scheduled to determine that the unit and other site requirements are met, such as verifying that a grounded three-prong outlet is available for the refrigerator and that the building and unit are accessible to the crews. Additionally, during the site inspection, field staff determine if the replacement unit will be a 15 or 18 cubic foot model.

Upon the completion of the site inspection, the customer is added to a queue for scheduling of the replacement. The scheduling of the replacement happens “as fast as possible” but is dependent on the availability of a replacement unit. ARCA staff noted that Covid-related supply constraints have limited the availability of replacement units.

The day before the exchange appointment, the customer receives a reminder notification of the upcoming appointment and instructions for the pickup. The customer must keep the old unit plugged in for 24 hours prior to the pickup.

On the day of the pickup, the field crew verifies that the old unit is operational, removes the unit from the premise for recycling, and renders it inoperable by cutting the cord and destroying the cooling unit. The unit is then removed for recycling and the new unit is installed. Participants are also provided with two LED light bulbs.

Institutional Customer Participation

Institutional participants initiate participation by emailing program staff to obtain the application materials. To receive the service, the institutional applicants complete the application and request information. Affordable housing facilities also submit documents to show that they are affordable housing. Non-profit and civic organizations do not need to submit additional documentation to qualify them for the program. Staff noted that it is easy to determine that these organizations are qualifying based on a web search and this approach reduces the burden of participating on them. Institutional participants self-certify that the units are operable and qualify for recycling. They also confirm that they have grounded outlets for installing the new units.

Typically, civic organizations and nonprofits are replacing single units such as those in a break room. Affordable housing facilities and colleges may replace several units. Units to be recycled are placed in an accessible location for ARCA to remove the units. ARCA also leaves the new units in the same location and allows the participant to complete the installation of the unit. Institutional participants also receive two LED bulbs for each unit recycled.

Customer Education

LADWP considers customer education to be an important component of the LIREP program. Staff noted that the low-income population targeted by this program typically has other more pressing concerns and that the program is an opportunity to help educate them on how they can save energy.

Program Marketing

LADWP staff reported that they do very little marketing for the institutional program, but the key account managers are aware of the offer and can discuss it with their accounts.

The most impactful approach to market the program to residential customers identified by staff is a postcard campaign. Postcards are sent to customers about the qualified rates and staff report that they see an increase in applications in response to the mailings. Although the postcards have proved effective, staff noted that a limitation of the approach is the cost associated with the mailings. At the time of the interview, staff were posting a message about the program in the LADWP electronic newsletter to assess if this approach will be a more cost-effective means of marketing the program.

ARCA is not involved in marketing the LIREP program.

Cross Program Partnerships

LADWP has created some cross-program partnerships to support LIREP. The program partners with RLEP to provide the free LED light bulbs to customers. Additionally, the program has partnered with HEIP, which although not limited to low-income customers, targets that population. Participants in HEIP are provided information about LIREP so that they can also get their refrigerators replaced if they qualify for the program.

Quality Assurance

ARCA stated that the goal of the call center is to do their best to meet the customer's needs to schedule the replacement at a time that will work for them. All calls placed into the call center are recorded and reviewed if there are any disputes or identified customer service issues. Additionally, ARCA spot checks by listening to a selection of calls.

A third party performs the exchange of appliances in the field. The company has worked with ARCA for about 20 years and was characterized by ARCA as "an extension of the company at this point." ARCA characterized their staff as highly trained and if there are any issues, the crew, person, and time of the incident can be identified.

Program Tracking Data

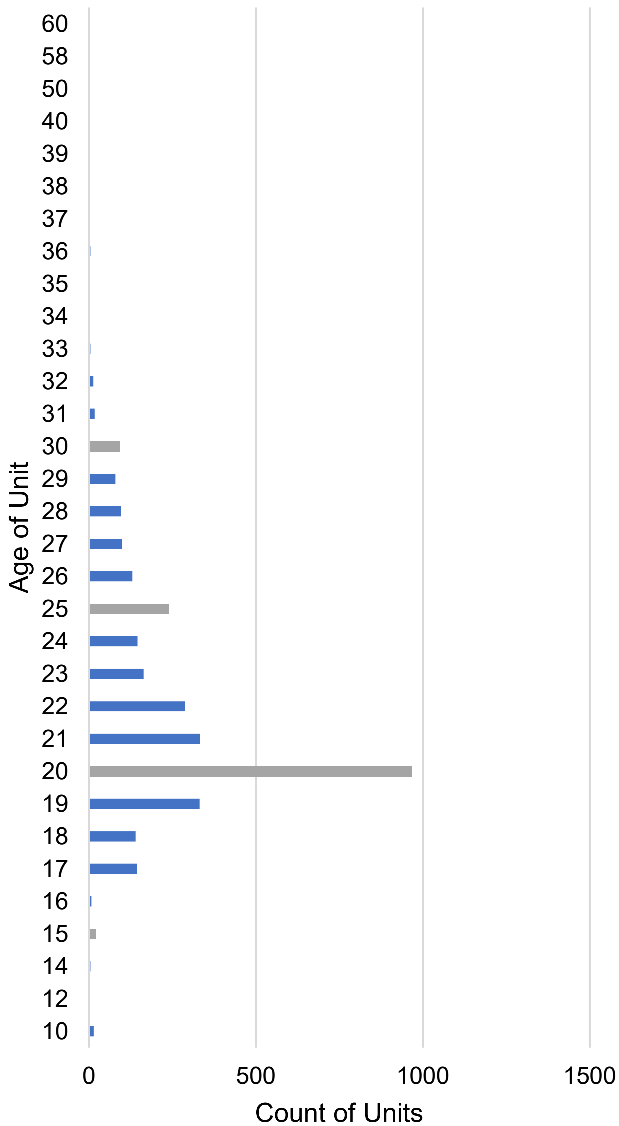
The program implementation contractor, ARCA, maintains the program database and provides access to LADWP. Staff indicated that the data system is comprehensive and meets their needs. LADWP staff noted that on "rare occasions" they need information from the system that they do not have direct access to and can obtain this by request from ARCA.

ARCA records the brand, age, size, and configuration of the old units. The age of the unit is taken from the Manufacturers plaque on the unit. If the plaque is not visible, the age of the unit is estimated based on the following indicators:

- The overall appearance of the unit (e.g., lettering is missing or faded, presence of rust on the unit, plaque with serial numbers fallen off).
- The freon type used in the unit. After 1992, R12 is not used in refrigerators.
- If the unit is very heavy, this indicates heavy metal used for the frame assembly indicative of an old design.
- The type of foam insulation used in the unit.

Figure A-11 displays the distribution of FY20/21 recycled units. The spikes in the number of units around "prototypical" numbers such as 20, 25, and 30 years of age is likely the result of estimating the age of the units.

Figure A-11 Distribution of Age of Recycled Units



The program data does not include a variable to identify whether the record is associated with an institutional or residential customer participant. Adding this information to the program data would allow the program to monitor participation by these two segments in the future.

Savings Estimation and Long-Term Outlook

LADWP estimates savings using per unit-savings values based on the two sizes of the efficient replacement refrigerators (822 kWh for 18 cu ft units and 692 kWh for 15 cu ft units). Staff reported that the values were established several years ago, and they may be revised based on the current evaluation results.

Future Challenges and Opportunities

One issue for consideration in the future is that as the older refrigerators become more recent and larger shares were produced after federal efficiency standards went into place, the savings potential will diminish. However, as shown in Table A-115, the program has been effective at replacing older units with the average age of units increasing in more recent years. The share of units manufactured before the implementation of efficiency standards in 1990 has also increased, although for FY21/22 the share of units made before 1990 declined. It is also important to note the LIREP is also important for LADWP's equity goals in addition to the energy savings it produces.

Table A-115 Age of Recycled Unit FY15/16 – FY21/22

Fiscal Year	Percent Manufactured Before 1990	Average Year of Manufacture
15/16	1%	2000
16/17	3%	1997
17/18	2%	1998
18/19	8%	1998
19/20	7%	1997
21/20	1%	1999

Note: Year of manufacture for FY20/21 is not shown due to the small number of units replaced during that year.

The availability of replacement units is a factor that has limited participation in the program. Like many areas of the economy, the program is periodically encountering Covid related supply chain issues that limit the number of units it can procure.

A potential future opportunity identified by LADWP is to offer customers an additional choice in the selection of a replacement unit. Staff noted that providing greater use in the choice of a unit may require a customer copay. Section A.14.3.2.2 presents data from a survey of CY2 participants on customer's interest in having additional choice as well as receptivity to a copay.

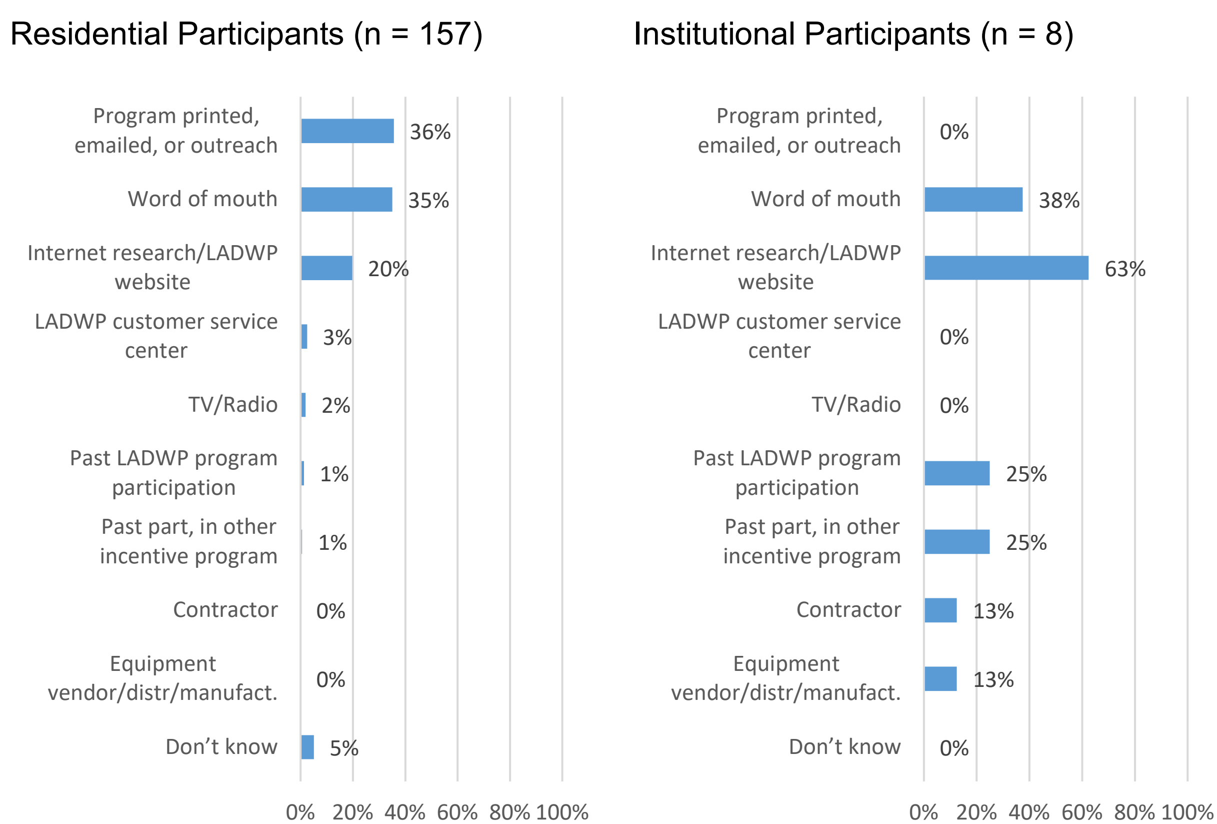
ARCA staff noted that recycling and replacing old AC units in multifamily properties is an opportunity for future program growth. We note that data from the California Residential Appliance and Saturation Survey for LADWP found that in Apartments or condominiums with five or more units, there are approximately 28,000 room AC units in multifamily properties that are more than 8 years old – 12,000 of which are 13 or more years old. However, not all of these units are installed in properties that would meet the program qualifications. Nonetheless, there may be some opportunity to include replacement of older room AC units at select multifamily properties. Furthermore, coupling the recycling of old window AC units with replacement of new window, wall, portable air conditioners, or evaporative coolers through the Cool LA promotion may present an opportunity to leverage existing program infrastructure to meet that initiatives goals.

A.14.3.2.2 Participant Survey Findings

Program Awareness & Enrollment

Program marketing and word of mouth are driving residential participation in the program, whereas participant internet research is how institutional participants are learning about the program. Printed and emailed material sent by REP was the most common way that residential customers learned about the program (cited by 36%), followed by 38% who indicated word-of-mouth referrals from friends or colleagues. Finding the program on the LADWP website or researching on the internet was the most common way that institutional participants learned about the program (cited by 63%), followed by 35% who indicated word-of-mouth referrals (see Figure A-12).

Figure A-12 Channels for Program Awareness



A majority of residential participants signed up by telephone, most of whom were aware of the online sign-up option. Among residential respondents who completed the sign-up process for the program (n = 146), 62% signed up via telephone while 38% signed up online. Seventy-eight percent of those who signed up by telephone were aware they could have signed up online but chose to use the telephone sign up because they thought it would be more convenient or just preferred to use the phone. Other reasons given for using the telephone including having questions they wanted answered about the program before deciding to sign up (8%), experiencing website technical difficulties (5%), and not have access to the internet (2%)

Residential customers who signed up online reported a positive experience with the process. Ninety-eight percent of online signups said that it was easy to find the sign-up screen, and all said the website answered all their questions about participating. Thirty-five percent of participants who signed up online ended up contacting a program representative to confirm when their appointment was scheduled.

Residential customers who signed up by telephone also had a positive experience with the sign-up process. All telephone signups reported that the representative they spoke with was courteous and could answer all of their questions.

Institutional participants generally found the information on how to complete the application to be clear. Eighty-eight percent of institutional participants completed the application forms to participate in REP and 88% completed the self-certification process to provide the information about the refrigerator to be replaced. Among those who completed the application, 71% (n = 5) indicated the information on the application was completely clear (rated the clarity as a 5 on a five-point scale), followed by 29% (n= 2) who found it mostly clear (rated the clarity as a 4 or a five-point scale).

Interactions with Program Professionals

Residential participants reported positive interactions with the crews who picked up their appliances and confirmed that the crew checked that the appliance was operating. Most (96%) of residential participants had interactions with the people who exchanged their old refrigerator. Among those who had interactions, 96% reported the person who exchanged the old appliance was professional. Ninety-three percent of residential respondents indicated the appliance was plugged in at the time of pick-up and 93% reported that the person who did the exchanged checked to see if the appliance still worked.

Value of Refrigerator Replacement

Survey responses suggest the LIREP is providing a needed service to residential customers. A plurality of respondents stated that they would be unable to replace the refrigerator if it stopped working (39%). Other respondents stated that they would need to finance a replacement (10%), try to find a used unit (8%), or contact LADWP for assistance (6%). See Table A-116 for additional details.

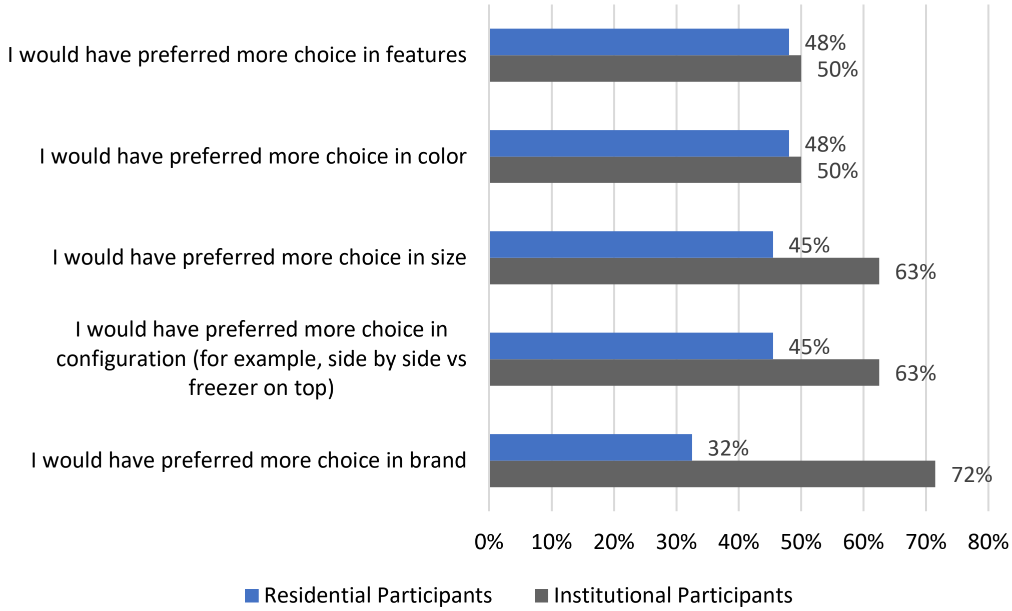
Table A-116 What REP Participants would do if the Replacement Stopped Working

Response	Percentage of Residential Customer Responses (n = 157)
Would not be able to replace the refrigerator if it stopped working	39%
Finance a new refrigerator	10%
Purchase another new refrigerator out of pocket	9%
Purchase a used refrigerator from an appliance store	4%
Purchase a used refrigerator from someone I know	4%
Would inform LADWP if new appliance stopped working	6%
Use insurance to replace non-functioning appliance	1%
Something else	2%
Unsure or preferred not to state	23%

Preferences for Refrigerator Replacement

A majority of residential participants (64%) and all of the institutional participants agreed that they would have preferred more choice on one or more aspects of the new refrigerator they received. For the majority of residential participants, there was not any one aspect of the refrigerator for which they would have preferred additional choice. About one-half of respondents would have preferred more choice in features, color, size, and configuration; one-third would have preferred more choice in brand. In contrast, brand was the aspect of the refrigerators that most respondents would have preferred more choice for.

Figure A-13 Percent Who Agree with More Choice in Refrigerator Options



In addition to preferring more choice, some participants also indicated that they would be willing to pay more for that choice. As summarized in Figure A-14, about one-third of respondents indicated that they would prefer more choice and would be willing to pay more. As shown in Table A-117, most of the respondents who would be willing to pay more would be willing to pay between $100 - $300 to have more choice. All of the institutional participants said they did not know if and how much more they would be willing to pay more.

Figure A-14 Residential Customer Preference for Additional Refrigerator Choice and Willingness to Pay More (n = 139)

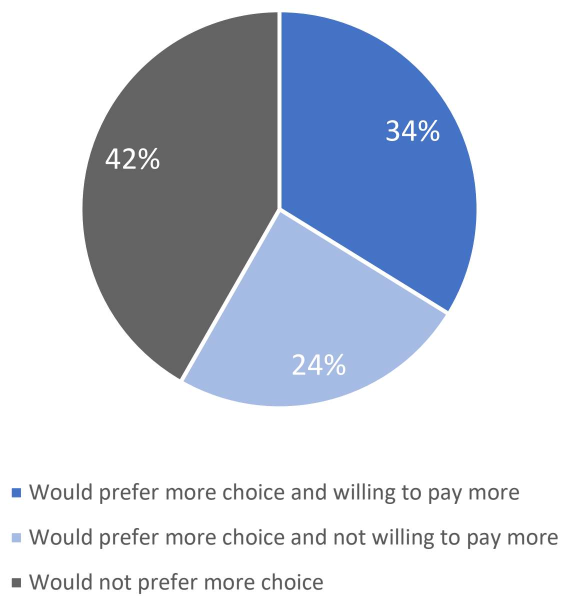


Table A-117 How Much Customers Would be Willing to Pay for Choice in Refrigerator

Response	Percentage of Residential Customer Responses (n = 53)
Less than $100	17%
$100 to $299	66%
$300 to $499	15%
$500 or more	2%

Satisfaction

Most residential and non-residential participants were satisfied with the program. Residential participants and institutional participants provided feedback on their level of satisfaction with the REP and various aspects of the program. Most residential participants and institutional participants were very satisfied with the new refrigerator they received, as well as the appliance exchange process, scheduling, and the sign-up process. Additionally, both residential customers and institutional participants were satisfied with the program overall.

Among residential customers who were dissatisfied with aspects of the program, appointment cancellations, long wait times, problems with the replacement appliance, and disappointment with the quality of the new refrigerator were all listed as complaints with the REP. For dissatisfied institutional participants, the issues noted were that the process took too long and uncertainty of when the old appliance would be picked up.

Figure A-15 Residential Participant Satisfaction

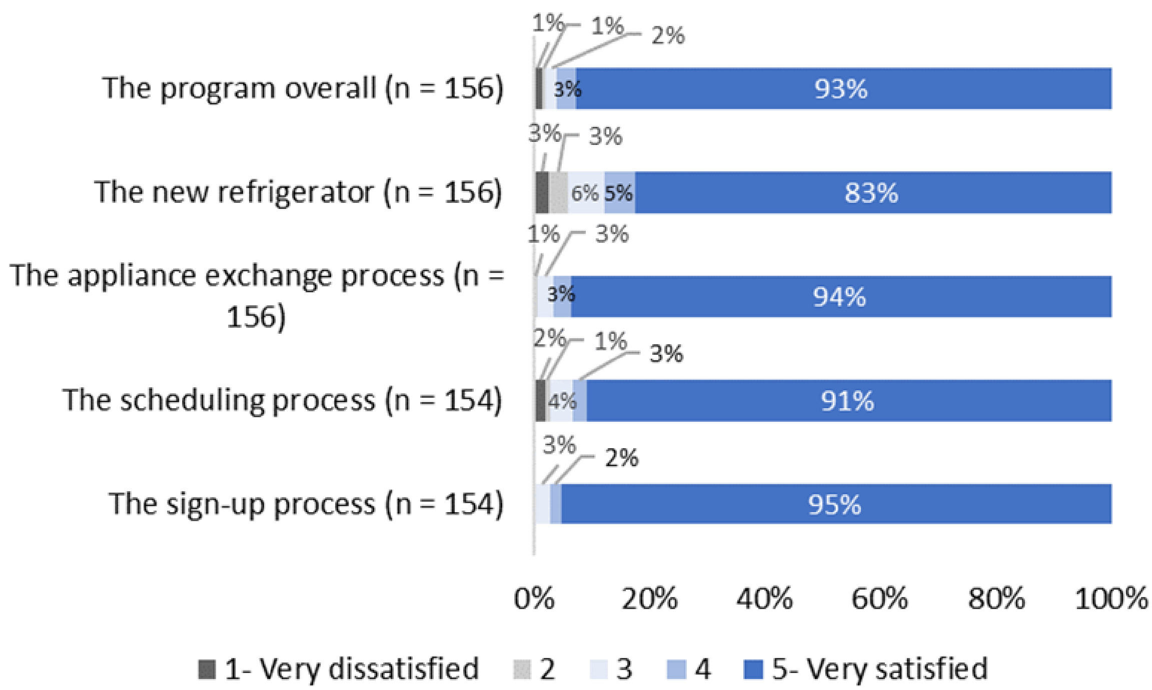
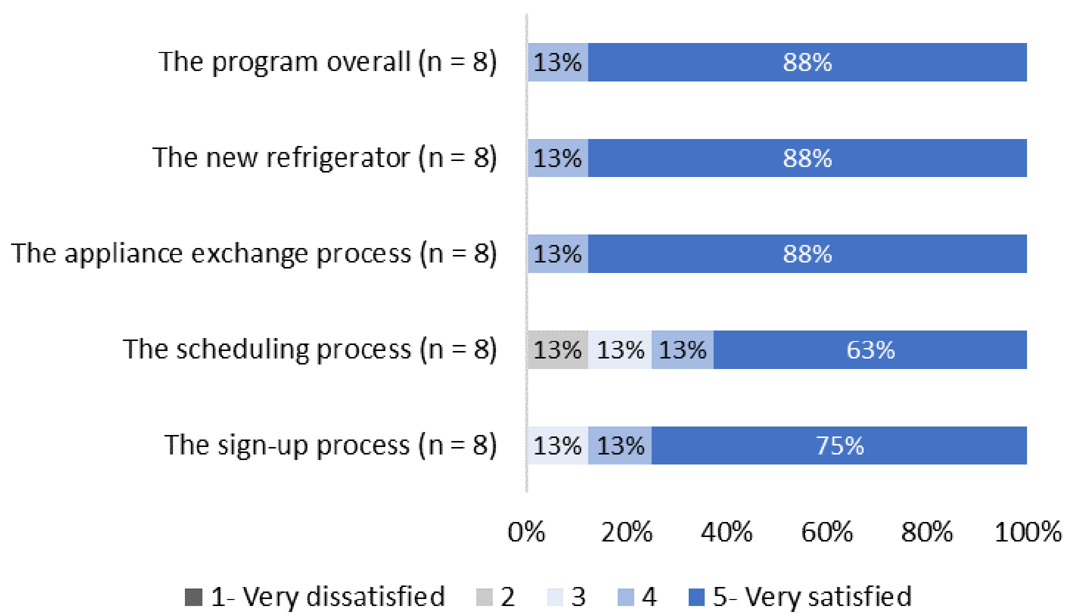


Figure A-16 Non-profit Institutions' Satisfaction



Participant Household Characteristics & Demographics

The majority of institutional participants (75%) identified their organization as nonprofit and 25% indicated they were multi-family communities.

Most REP survey respondents rented their home and use natural gas to heat their home and water. See Table A-118.

Table A-118 Home Ownership and Fuel Type

Home Ownership	Percentage of Residential Customer Responses (n = 155)
Own	19%
Rent	81%
Main Home Heating Fuel	**Percentage of Residential Customer Responses (n = 155)**
Electricity	15%
Natural gas	59%
Propane	0%
Something else	6%
Don’t heat home	5%
Don't know / prefer not to state	16%
Main Water Heater Fuel	**Percentage of Residential Customer Responses (n = 155)**
Electricity	3%
Natural gas	55%
Propane	0%
Something else (Please specify)	12%
Don’t heat home	1%
Don't know / prefer not to state	30%

Most respondents were English-only speaking households and 73% indicated they would prefer LADWP communicate in English when providing information. Thirty-four percent of respondents indicated that they speak Spanish at home and 15% would prefer LADWP communicates in Spanish when providing information. See Table A-119.

Table A-119 Language Spoken at Home and Preferences for Communication

Language Spoken at Home	Percentage of Residential Customer Responses (n = 155)
Only English is spoken	41%
Spanish	34%
Mandarin	0%
Vietnamese	0%
Tagalog	1%
Armenian	7%
Korean	1%
Russian	1%
Persian (including Farsi, Dari)	1%
Other	8%
Prefer not to state	8%
Preferred Language for LADWP Outreach and Informational Materials	**Percentage of Residential Customer Responses (n = 155)**
English	73%
Spanish	15%
Mandarin	0%
Vietnamese	0%
Tagalog	0%
Armenian	5%
Korean	1%
Russian	1%
Persian (including Farsi, Dari)	0%
Other	3%
Prefer not to state	3%

Seventy-three percent of residential respondents had one to four people residing in their homes in 2021. The age of participants ranged from 18 to 75. See Table A-120.

Table A-120 Number of Household Members and Age of Respondents

Number of People Residing in the Home in 2021	Percentage of Residential Customer Responses (n = 155)
1 person	32%
2 people	15%
3 people	14%
4 people	12%
5 people	7%
6 people	3%
7 people	0%
8 or more people	0%
Prefer not to state	17%
Age	**Percentage of Residential Customer Responses (n = 155)**
18 – 24	1%
25 – 34	11%
35 – 44	19%
45 – 54	10%
55 – 64	16%
65 – 74	13%
75 +	8%
Prefer not to answer	22%

Thirty percent of the residential respondents identified as Latino, followed by 19% who identified as Black and 15% who identified as White. See Table A-121.

Table A-121 Race and Ethnicity of Respondents

Race/Ethnicity Respondent Identified With	Percentage of Residential Customer Responses (n = 155)
American Indian or Alaska Native	1%
East Asian	7%
South Asian	2%
Black or African American	19%

Race/Ethnicity Respondent Identified With	Percentage of Residential Customer Responses (n = 155)
Hispanic, Latino, or Spanish	30%
Native Hawaiian or Other Pacific Islander	0%
Middle Eastern or North African	1%
White or Caucasian	15%
Some other race, ethnicity, or origin	4%
Prefer not to answer	23%

Forty-eight percent of residential respondents preferred not to state their annual income. Thirty percent of respondents stated that their household income was less than $25,000 per year. See Table A-122.

Table A-122 Annual Household Income

Income Level	Percentage of Residential Customer Responses (n = 155)
Under $15,000	16%
$15,000 to less than $25,000	14%
$25,000 to less than $35,000	8%
$35,000 to less than $50,000	8%
$50,000 to less than $75,000	5%
$75,000 to less than $100,000	1%
$100,000 to less than $150,000	0%
$150,000 or over	1%
Prefer not to answer	48%

A.14.3.2.3 Free Ridership Results

Consistent with common practice in the evaluation of low-income programs, the Evaluator assigned a net-to-gross ratio of 1.0 to the LIREP program.

A.14.4 Recommendations

Continue to offer a free, no cost to the customer replacement option if refrigerator choice is provided with a copay. The survey research indicates that 42% of customers would not prefer more choice in a unit and 34% would prefer more choice and be willing to pay more.

Consider tracking participant type. Currently the program data does not record participant type. Adding this information may be helpful to monitoring participation by the residential and institutional market segments.

Consider providing an email confirmation of appointment to customers who sign up online. ARCA does not currently provide an email confirmation of appointments, but 35% of those who signed up online said they contacted program staff to confirm an appointment.

Piloting room air conditioner recycling and replacement is worth consideration. Review of 2019 California RASS data indicates that there is some potential for replacing older room AC units in multifamily properties, albeit the potential may be somewhat limited. Adding this measure may fit well with the LADWP Cool LA initiative to offer high rebates for energy-efficient room and portable air conditioners and evaporative coolers. Replacing an old room AC's may be best done in conjunction with replacement of old refrigerators to manage costs.

Consider adding leave behind materials to educate participants on energy efficiency and other programs offered by LADWP. A goal of the program is to educate customers on energy efficiency. Leave-behind materials could include tips on how to save on energy costs and information on applicable programs such as HEIP.

A.15 Refrigerator Turn-in and Recycle Program (RETIRE) Program

This section presents details about the evaluation methodology and impact evaluation for the Refrigerator Turn-in and Recycle Program (RETIRE) Program.

A.15.1 Evaluation Methodology

A description of the evaluation methodology used by the Evaluator for the REP during FY 21/22 is provided in this section.

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 3,115 refrigerators, 124 freezers, and 75 air conditioners recycled during FY 21/22.

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. Table A-123 shows a comparison of ESP savings and Program Tracking savings.

Table A-123 RETIRE FY 20/21 ESP and Program Tracking Saving Comparison

Measure	ESP Ex-Ante kWh	Program Tracking Ex-Ante kWh	ESP Ex-Ante kW	Program Tracking Ex-Ante kW
Air Conditioner	3,164	3,164	3.50	19.50
Freezer	241,304	241,304	46.22	37.20
Refrigerator	6,061,790	6,061,790	1,161.02	934.50
Total	6,306,258	6,306,258	1,210.74	991.20

A.15.1.3 M&V Approach

The calculation of energy savings resulting from appliance recycling is somewhat different than most energy efficiency programs. A typical energy efficiency program generates energy savings by promoting the replacement of less efficient equipment or behaviors with more efficient equipment or behaviors. Appliance recycling, however, generates energy savings from the complete removal of less efficient equipment from the grid. There are two ways in which the removal and decommissioning of refrigerators, freezers, and room ACs produce savings:

- In participant households, the removal of an appliance may cause the participant to reduce their overall refrigeration or HVAC end-use consumption. This could reflect the participant household removing a secondary (or spare) unit that had previously been in use. It could also reflect the removal of a recently replaced primary unit that might have become a secondary unit if the program had not intervened.

- By removing working appliances from participant households, the program may also affect the level of appliance related energy consumption in non-participant households. The decommissioning of program appliances prevents their sale or transfer to other LADWP customers. With program appliances no longer available, used appliance acquirers who may have purchased a program unit in the absence of the program must now take other actions. Possible outcomes include forgoing the acquisition of a unit altogether, purchasing a new unit, or purchasing an alternative (non-program) used unit. All of these outcomes are likely to result in reduced energy use as compared to the continued use of program units.

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[10]. 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.

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 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:

[10] http://energy.gov/sites/prod/files/2013/11/f5/53827-7.pdf

1. Validating program tracking data provided by LADWP and ARCA by checking for duplicate or erroneous entries; and
2. 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.

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).

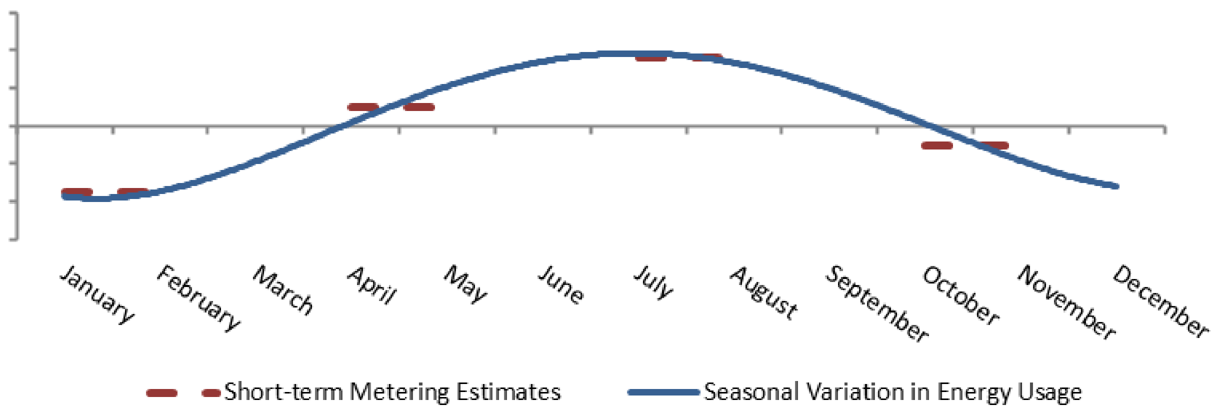
The second approach involves utilizing metered data that is collected from utility customer homes before an appliance is collected for recycling. The CA ARP protocol recommends using this in-situ (meaning “in its original place”) metering data to estimate a regression model because it accounts for environmental 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-17 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-17 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[11]. 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[12]. 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 refrigerators, and primary side-by-side refrigerators. Table A-124 provides the model for primary refrigerators with top freezers.

[11] http://www.calmac.org/publications/EM&V_Study_for_2004-2005_Statewide_RARP_-_Final_Report.pdf

[12] 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.

Table A-124 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

Operating Condition	Coefficient	Standard Error
March Dummy * App Volume * Ambient Temperature	0.0145	0.0007
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 a 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.

$$UEC = function\ of\ (V1, V2, V3, \ldots, Vn) \qquad \textit{Equation A-37}$$

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 the FY 21/22 Evaluation period provides the final full year per-unit UEC estimates.

A.15.1.3.6 Part-Use Factors and Counterfactual Action

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 will go 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 counterfactual action 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[13].

[13] 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.

A.15.1.3.8 Removal of Room Air Conditioners

The energy savings for the removal of old room air conditioners were determined by the efficiency of the old unit. This is the same method used by the DEER database and workpapers and is compliant with CA Title 20. The DEER workpapers listed aggregated savings by climate zone as show in Table A-125.

Table A-125 RETIRE Room Air Conditioner Aggregated Savings by Climate Zone

Climate Zone	kWh Usage	Peak kW Impact
6	201	0.014
7	240	0.015
8	333	0.034
9	485	0.041
10	592	0.063

A.15.2 Impact Evaluation

This section presents the findings of the impact evaluation of the RETIRE Program during FY 21/22. Ex-post gross energy savings and peak demand reduction are presented at the measure level. Topics are covered in the following order:

1. Verification of units recycled;
2. Full year UEC calculation;
3. Part-use factors;
4. Per-unit gross impacts; and
5. Overall program savings.

A.15.2.1 Verification of Units Recycled

The Evaluator reviewed program tracking data provided by LADWP and ARCA for accuracy. LADWP provided the Evaluator with excel spreadsheets summarizing the program activity for FY 21/22. In addition, detailed tracking data provided by ARCA included information about participating customers, recycled units, and specific pick-up dates. The ARCA data was comprehensively reviewed by order number, unit ID number, and identifiable customer information. No duplicate or erroneous entries were found.

Participants who responded to the Evaluator’s survey were asked to confirm whether or not they recycled an appliance(s) through LADWP’s program. They were also asked to confirm the total number of appliances and appliance type (refrigerator/freezer). Finally, respondents were asked to verify the working condition of the appliance(s) at the time of pick-up.

In order for participating appliances to accrue energy savings by being taken out of service, the units must be in working condition at the time of pick-up. Survey respondents were questioned regarding whether the recycled appliances were in working condition at the time of pick-up. If a respondent indicated that the unit was not in working condition, they were asked a follow-up question to make sure the unit was truly inoperable, as opposed to a minor flaw. Table A-126 shows the resulting verification rates by measure.

Table A-126 RETIRE Claimed vs. Verified Units in Working Condition

Measure	Survey Sample Size (n)	Program Claimed Units	Verification Rate (%)	Verified Units
Freezer	10	124	100.0%	124
Refrigerator	198	3,115	99.0%	3,084

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. Next, the full year UECs for metered units were used as the dependent variable in a regression relating unit characteristics to annual energy usage.

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-127.

Table A-127 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	

Where:

- Appliance age is the age of the refrigerator or freezer
- Manufactured pre-1990 dummy indicates unit was manufactured before 1990
- Appliance size is the size of the appliance in cubic feet
- Freezer dummy indicates unit is a freezer
- Refrigerator dummy indicates unit is a refrigerator
- Side-by-side configuration dummy indicates if a refrigerator has side-by-side configuration
- All other refrigerator configurations dummy indicates if a refrigerator is any configuration except side-by-side
- Primary usage dummy indicates if a refrigerator is a primary usage unit (freezers are all considered secondary usage)
- Secondary usage dummy indicates any unit that is used as a secondary unit

- 2006 metering cohort dummy indicates any unit that is part of the 2006 metering study
- 2011 metering cohort dummy indicates any unit that is part of the 2011 metering study
- 2014 metering cohort dummy indicates any unit that is part of the 2014 metering study

The program tracking database included information regarding appliance type, configuration, size, age, and correct pickup address for units collected during the FY 21/22. These units were used to calculate average program characteristics for calculating program UECs. Table A-128 show the average program values by appliance type.

Table A-128 RETIRE Average Program Appliance Characteristics

Coefficient	Refrigerators (n = 3,115)	Freezers (n = 124)
Average Age (Years)	20.3	23.8
Percentage of Units Manufactured before 1990	3.0%	8.9%
Average Size (Cubic Feet)	19.6	17.0
Percentage Side-by-Side	24.3%	0%
Percentage Primary Usage*	65.2%	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-128 were used in conjunction with the parameter estimates in Table A-127 calculate annual UEC estimates for program participating refrigerators and freezers. Table A-129 summarizes the full year UEC estimates for refrigerators and freezers.

Table A-129 RETIRE Full Year Average UEC Estimates

Appliance Type	Number of Units	Average Full Year UEC
Refrigerator	3,115	1,192
Freezer	114	1,128

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 UMP 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-130 shows the calculation of the part-use adjusted UECs for refrigerators and freezers when partial use is taken into account.

Table A-130 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=69)			
Not running	2.9%	0.000	0
Running part time	11.6%	0.438	522
Running all time	85.5%	1.000	1,192
Weighted Average for Secondary Refrigerators		**0.906**	**1,080**
Refrigerators – All (n=198)			
Not running	2.0%	0.000	0
Running part time	5.1%	0.450	536

Operating Status of Unit	Percentage of Recycled Units in Category	Use Factor	Calculation of UEC to Adjust for Part Use
Running all time	92.9%	1.000	1,192
Weighted Average for Refrigerators		**0.952**	**1,135**
Freezers (n=10)			
Not running	0.0%	0.000	0
Running part time	10.0%	0.083	94
Running all time	90.0%	1.000	1,128
Weighted Average for Freezers		**0.908**	**1,025**

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. This process is described in the Net-to-Gross sections that follow.

A.15.2.4 Net-to-Gross Approach

The Evaluator's net-to-gross approach was consistent with the Uniform Methods Protocol (UMP) chapter seven refrigerator recycling protocol. This approach utilizes customer self—report data to estimate what participating customers would have done with the unit in the absence of the program and what would have happened with discarded units (free ridership). The approach also incorporates the secondary market impacts that arise when a would-be buyer of a recycled unit would do given that it was not available.

A.15.2.4.1 Free Ridership

Free ridership occurs when an appliance recycled through the program would have been taken off the grid even in the absence of the program. The first step of the free ridership analysis was to ask participants if they had considered discarding the program appliance before learning about the program. If the participant indicated no previous consideration of unit disposal, they are categorized as non-free-riders and removed from the subsequent free ridership analysis.

Next, the remaining participants (i.e., those who had previously considered discarding the program appliance) were asked a series of questions to determine the distribution of program appliances that would have been kept within participant households versus those that would have been discarded. If one considers the counterfactual scenario where there is no program intervention, there are essentially three outcomes for participating appliances:

1. The appliance would have been kept in use by the participant household.
2. The appliance would have been discarded in such a way that it was transferred to another customer for continued use.
3. The appliance would have been discarded in such a way that it would be taken out of service.

Of the three outcomes, participants who respond that their appliance would have been discarded and taken out of service is indicative of free ridership. This is because the recycled units would have been removed from the grid even without program intervention.

A.15.2.4.2 Secondary Market Impacts

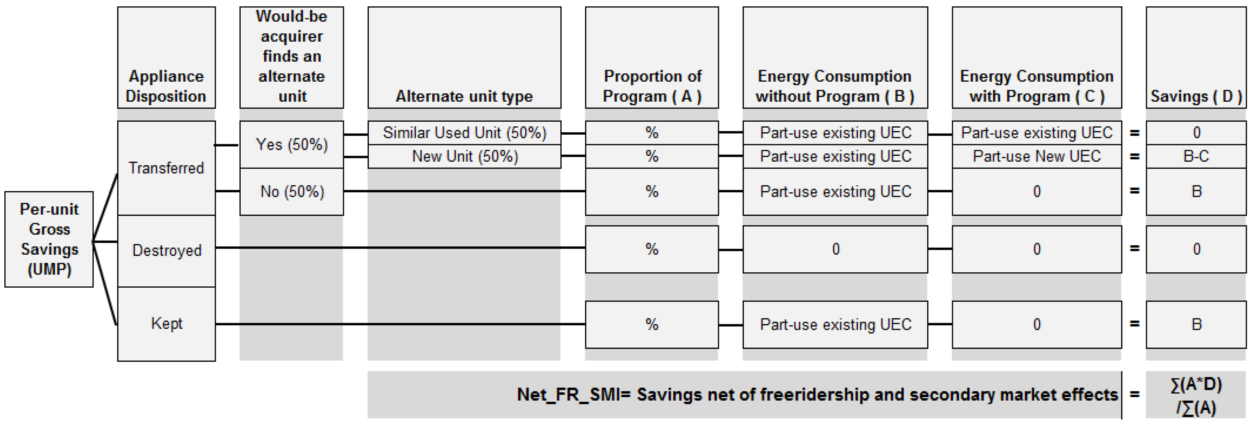
Secondary market impacts refer to the effect the program has on would-be acquirers of program participating units. In the event that a program unit would have been transferred to another customer (sold, gifted, donated), the question then becomes what other appliance acquisition decisions are made by the would-be acquirer of the program unit now that it is decommissioned and unavailable. The would-be acquirer could:

- Not purchase/acquire another unit.
- Purchase/acquire a different non-program, used appliance.
- Purchase a new appliance instead.

Ultimately, the true market-level outcome in the absence of the program is difficult to assess. As a result, this evaluation took a midpoint approach, as recommended by the UMP protocol. That is, 50% of would-be acquirers of program avoided transfers are assumed to find an alternate unit. The next question of interest is whether the alternative units acquired would be used (similar to those recycled by the program) or new. Again, this market distribution is difficult to estimate with any certainty. This evaluation took the UMP recommendation and assumed that 50% of the alternative units would be used and 50% would be new, standard efficiency units.

Figure A-18 summarizes the complete net-to-gross calculation that will be used in the evaluation of the program. Note that this diagram depicts net savings as calculated under the UMP gross savings definition.

Figure A-18 Net Savings Estimation



A.15.2.4.3 Net-to-Gross Results

Net savings were calculated using a decision tree. The decision tree is populated with estimated percentages of appliance disposition in the absence of the program based on responses to the participant survey. In other words, participants' actions concerning discarded equipment were used to estimate savings values under the possible scenarios. The savings under these scenarios were then used to calculate the net savings attributable to the program.

Participant survey respondents were first asked if they had considered discarding the program appliance before learning about the program. Respondent answers to this question are shown in Table A-131.

Table A-131 Prior Consideration of Disposal

	Measure	Response	Percent of Respondents (n=198 (ref), 10 (frz), 2(AC))
Had you already considered disposing of the [refrigerator, freezer, air conditioner] before you heard about LADWP's appliance recycling program?	Refrigerator	Yes	80%
		No	18%
		Don't know	2%
	Freezer	Yes	100%
		No	0%
		Don't know	0%
	Air Conditioner	Yes	50%
		No	50%
		Don't know	0%

Respondents who indicated they had not considered disposal before learning about the program were considered non-free riders. That is, for these respondents, it was assumed they would have kept the appliance in use absent the program, since they had not considered disposal before learning about the program. Respondents who indicated they had considered disposal or “didn’t know” if they had considered disposal, were asked additional questions to determine what they would have likely done with the unit if the program was not available. The responses were used to determine if the recycled appliance would have been kept, transferred to another part for continued use, or destroyed.

Table A-132 shows refrigerator disposition based on participant survey responses. Table A-133 shows the same calculation for freezers, and Table A-134 shows the results for air conditioners.

Table A-132 Refrigerator Discard/Keep Distribution

Discard/Keep	Proportion of Participant Sample (n = 198)	Discard Scenario	Proportion of Discards	Overall Proportion
Discard	77%	Transfer	56%	43%
		Destroy	44%	33%
Keep	23%			23%

Table A-133 Freezer Discard/Keep Distribution

Discard/Keep	Proportion of Participant Sample (n = 10)	Discard Scenario	Proportion of Discards	Overall Proportion
Discard	89%	Transfer	75%	67%
		Destroy	25%	22%
Keep	11%			11%

Table A-134 Air Conditioner Discard/Keep Distribution

Discard/Keep	Proportion of Participant Sample (n = 2)	Discard Scenario	Proportion of Discards	Overall Proportion
Discard	50%	Transfer	100%	50%
		Destroy	0%	0%

Discard/Keep	Proportion of Participant Sample (n = 2)	Discard Scenario	Proportion of Discards	Overall Proportion
Keep	50%			50%

As shown in the tables above, some of the participants believed they would have transferred the units they recycled to another party if the program was not available. Secondary market impacts account for program effects on would-be acquirers of program units (since they are no longer available to acquire program units). Only units that would have been transferred absent from the program are considered in the secondary market impact analysis. As detailed in Section A.15.3.2.3, the Evaluator took a midpoint approach in this evaluation, based on the recommendation of the UMP protocols. That is, 50% of would-be acquirers of program avoided transfers were assumed to find an alternate unit. Of those who were assumed to find an alternative unit, 50% are assumed to find a similar used unit, while 50% are assumed to purchase a new unit.

The Evaluator determined net savings as UMP gross savings less free-ridership, secondary market impacts, and including induced replacement. Figure A-19 depicts the complete net-to-gross ratio calculation for refrigerators. Figure A-20 shows the same calculation for freezers and air conditioners.

Figure A-19 Net-to-Gross Calculation – Refrigerators

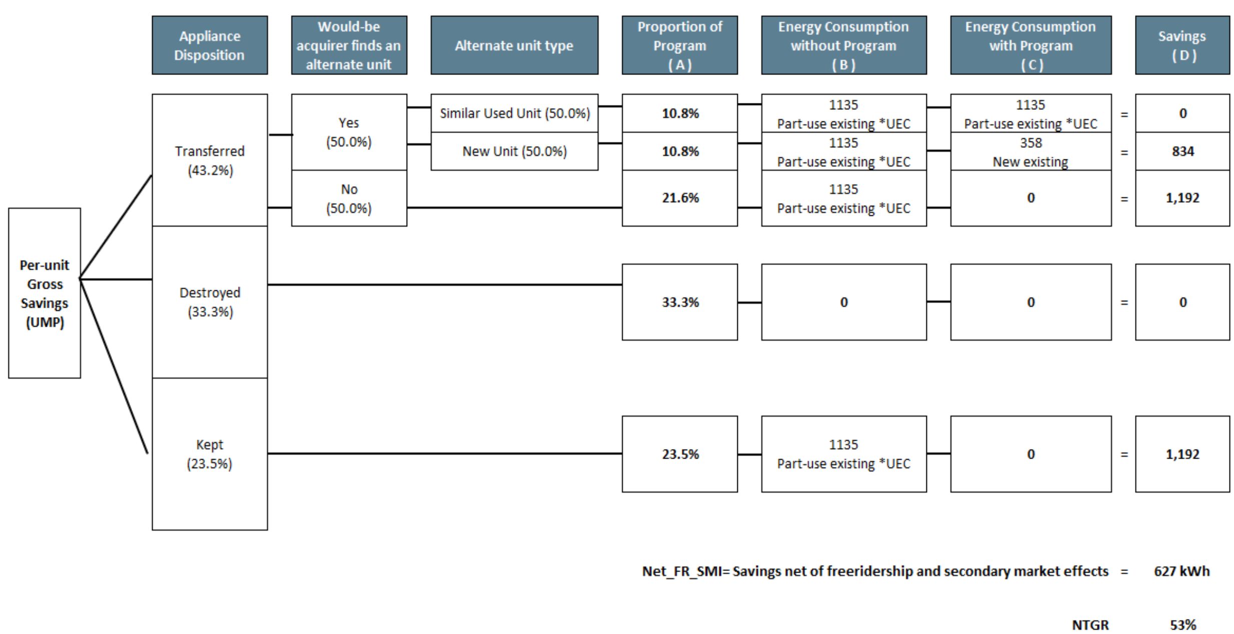
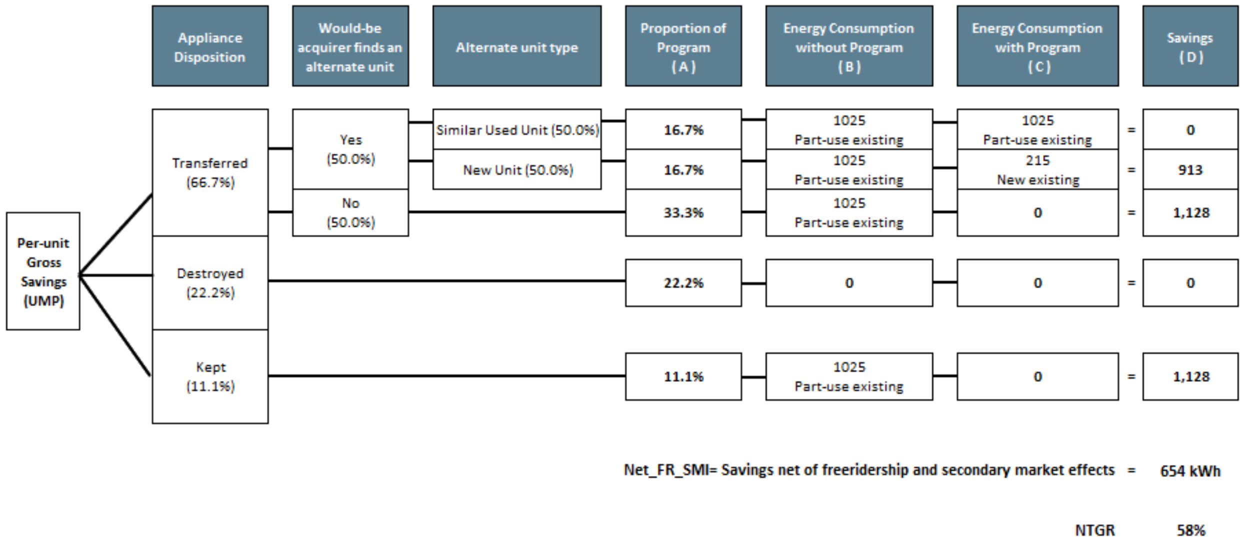


Figure A-20 Net-to-Gross Calculation – Freezers



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-135.

Table A-135 Part-use Adjusted UEC Estimates

Appliance Type	Number of Units	Part-use Adjusted UEC
Freezer	124	654
Refrigerator	3,115	627

A.15.2.4.4 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 savings attributable to a recycled refrigerator occurs during the on-peak period. Per-unit gross peak demand reduction for refrigerators and freezers for FY 21/22 is presented in Table A-136.

Table A-136 RETIRE Per-Unit kW Reduction

Appliance Type	Number of Units	Per-unit kW Reduction
Freezer	124	0.077

Appliance Type	Number of Units	Per-unit kW Reduction
Refrigerator	3,115	0.073

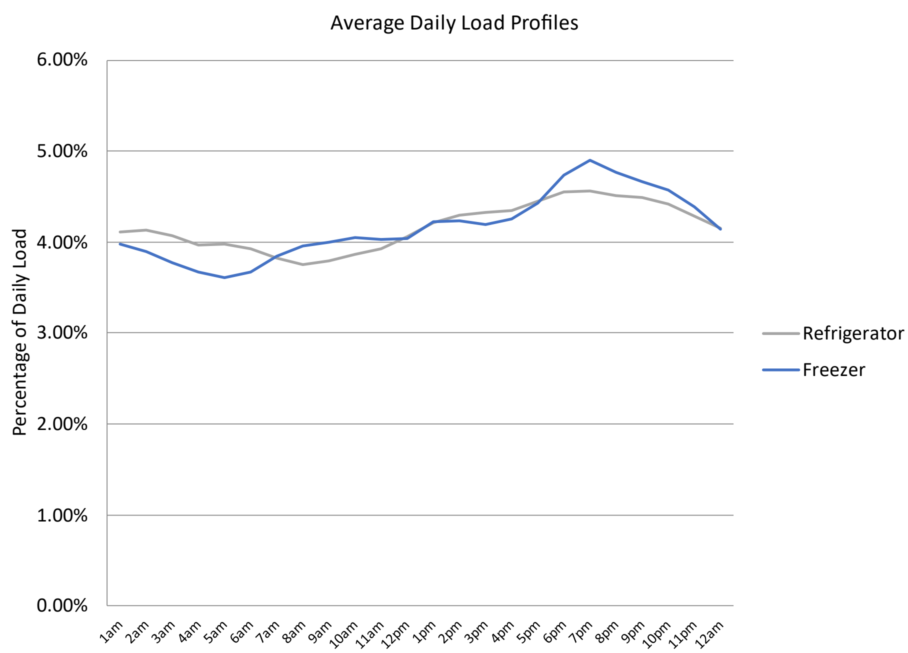


Figure A-21

A.15.2.5 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 -8,483 kWh.

A.15.3 Process Evaluation

A.15.3.1 Process Evaluation Approach and Methodology

A.15.3.2 Document Review

The Evaluator reviewed the program website, fact sheet, and tracking data supplied by LADWP.

A.15.3.2.1 Staff Interviews

The Evaluator interviewed two LADWP staff in April and two ARCA staff in August. The interviews provided information on program implementation processes, design, and potential future directions.

A.15.3.2.2 Participant Survey

The Evaluator conducted an online survey of RETIRE program participants, which was administered in June 2022. The purpose of the online survey was to gain insight into participants' experiences and satisfaction with the RETIRE program. A total of 210 RETIRE program participants completed the survey. The following is a summary of the key findings from the survey results.

A.15.3.2.3 Net-to-Gross Approach

The Evaluator's net-to-gross approach was consistent with the Uniform Methods Protocol (UMP) chapter seven refrigerator recycling protocol. This approach utilizes customer self—report data to estimate what participating customers would have done with the unit in the absence of the program and what would have happened with discarded units (free ridership). The approach also incorporates the secondary market impacts that arise when a would-be buyer of a recycled unit would do given that it was not available.

Free Ridership

Free ridership occurs when an appliance recycled through the program would have been taken off the grid even in the absence of the program. The first step of the free ridership analysis was to ask participants if they had considered discarding the program appliance before learning about the program. If the participant indicated no previous consideration of unit disposal, they are categorized as non-free-riders and removed from the subsequent free ridership analysis.

Next, the remaining participants (i.e., those who had previously considered discarding the program appliance) were asked a series of questions to determine the distribution of program appliances that would have been kept within participant households versus those that would have been discarded. If one considers the counterfactual scenario where there is no program intervention, there are essentially three outcomes for participating appliances:

- The appliance would have been kept in use by the participant household.
- The appliance would have been discarded in such a way that it was transferred to another customer for continued use.
- The appliance would have been discarded in such a way that it would be taken out of service.

Of the three outcomes, participants who respond that their appliance would have been discarded and taken out of service is indicative of free ridership. This is because the recycled units would have been removed from the grid even without program intervention.

Secondary Market Impacts

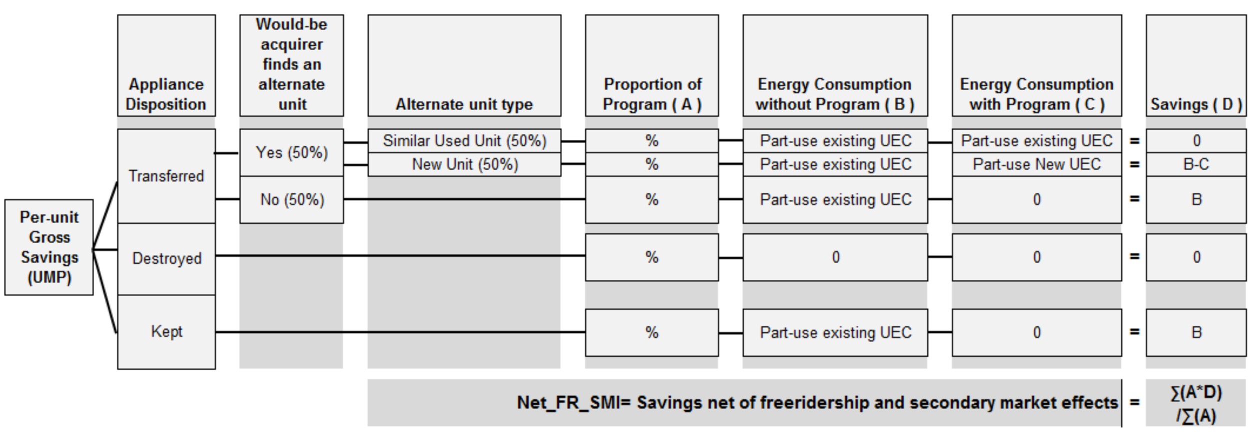
Secondary market impacts refer to the effect the program has on would-be acquirers of program participating units. In the event that a program unit would have been transferred to another customer (sold, gifted, donated), the question then becomes what other appliance acquisition decisions are made by the would-be acquirer of the program unit now that it is decommissioned and unavailable. The would-be acquirer could:

- Not purchase/acquire another unit.
- Purchase/acquire a different non-program, used appliance.
- Purchase a new appliance instead.

Ultimately, the true market level outcome in the absence of the program is difficult to assess. As a result, this evaluation took a midpoint approach, as recommended by the UMP protocol. That is, 50% of would-be acquirers of program avoided transfers are assumed to find an alternate unit. The next question of interest is whether the alternative units acquired would be used (similar to those recycled by the program) or new. Again, this market distribution is difficult to estimate with any certainty. This evaluation took the UMP recommendation and assumed that 50% of the alternative units would be used and 50% would be new, standard efficiency units.

Figure A-22 summarizes the complete net-to-gross calculation that will be used in the evaluation of the program. Note that this diagram depicts net savings as calculated under the UMP gross savings definition.

Figure A-22 Net Savings Estimation



A.15.3.3 Process Evaluation Findings

A.15.3.3.1 Overview of Program Processes

RETIRE is designed to target LADWP residential customers that have either made a retail purchase of a new refrigerator and/or those that have two or more refrigerators in the household. This program offers a monetary incentive ($50) to residential customers to turn in old refrigerators and freezers. The program also offers recycling of room air conditioning units. Customers recycling a freezer or refrigerator can also recycle old room air conditioner units year-round. The program will recycle air conditioners alone during limited periods in the summer and LADWP tries to push customers into the EPM program that provides rebates for efficient new units. 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. The customer also benefits from up to $192 per year in energy savings.

Customers can recycle up to two refrigerators/freezers and four room air conditioners, per year.

Participation Process

To enroll in the program, customers sign up through an online application form or through the call center, both of which are managed by ARCA. The call center is available to schedule replacements 5 a.m. to 5 p.m., Monday through Friday and from 6 a.m. to 4:40 p.m. on Saturday's. Spanish and other language staff are available for customers whose primary language is not English.

ARCA uses a monthly data file provided by LADWP to verify that the applicant is an LADWP customer. Qualified customers can schedule the pick-up appointment during the online or telephone sign up process. Once the customer has been validated as qualifying for the program, the customer answers questions about the age and working condition of the unit to screen it for eligibility. If qualified, the customer can schedule the pick-up appointment. Customers who sign up online receive an email confirmation of their appointment.

The day before the pickup appointment, the customer receives a reminder notification of the upcoming appointment and instructions for the pickup. The customer must keep the old unit plugged in for 24 hours prior to pick-up. Typically, the customer needs to be at home on the day of the pickup, but exemptions may be granted on a case-by-case basis.

On the day of the pickup, the field crew verifies that the old unit is operational, removes the unit from the premise for recycling, and renders it inoperable by cutting the cord and destroying the cooling unit. The unit is then removed for recycling.

Customer Education

Customer education is an important component of the program that LADWP identified. Part of this education is to help customers understand how destroying their old appliance can help them save energy. To support this, the program website provides links to the ENERGY STAR® refrigerator website and a fact sheet that discusses how removing the old unit can impact the customers' utility bills.

Program Marketing

The most impactful approach to market the program to residential customers identified by staff is a post-card campaign. Postcards are sent to customers that explain the qualified rates and staff report that they see an increase in applications in response to the mailings. Although the postcards have proved effective, staff noted that a limitation of the approach is the cost associated with the mailings. At the time of the interview, staff were posting a message about the program in the LADWP electronic newsletter to assess if this approach will be a more cost-effective means of marketing the program.

ARCA implements a paid search campaign through Google Ads to promote the program.

The program has tried promoting the program through Home Depot in the past. This involved education of sales representatives about the program and providing tear sheets alongside the new appliances. However, the effect of this was small and LADWP concluded that the benefits of promoting the program through this channel were not worth the benefits.

Cross Program Partnerships

LADWP has cross-linked the RETIRE program to the Efficient Products Marketplace program which provides rebates for energy efficient refrigerators and air conditioner units. Table A-137 summarizes the participation across the two programs. As shown, 15% of customers in RETIRE also participated in EPM. Moreover, 13% of customers who recycled a refrigerator through RETIRE also received an incentive for a new refrigerator through EPM.

Table A-137 FY21/22: RETIRE and EPM Cross Participation

Metric	Percent of Customer Accounts
Percent of RETIRE Participants who Participated in EPM	15%
Percent of RETIRE Participants who Recycled a Refrigerator and Received an EPM Incentive for a Refrigerator	13%

Quality Assurance

ARCA stated that the goal of the call center is to do their best to meet the customer's needs to schedule the replacement at a time that will work for them. All calls placed into the call center are recorded and reviewed if there are any disputes or identified customer service issues. Additionally, ARCA spot checks by listening to a selection of calls.

A third party performs the pick-up of appliances. This company has worked with ARCA for about 20 years and was characterized by ARCA as "an extension of the company [ARCA] at this point." ARCA characterized their staff as highly trained and if there are any issues, the crew, person, and time of the incident can be identified.

Program Tracking Data

The program implementation contractor, ARCA, maintains the program database and provides access to LADWP. Staff indicated that the data system is comprehensive and meets their needs. LADWP staff noted that on "rare occasions" they need information from the system that they do not have direct access to and can obtain this by request from ARCA.

ARCA records the brand, age, size, and configuration of the old units. The age of the unit is taken from the manufacturer's plaque on the unit. If the plaque is not visible, the age of the unit is estimated based on the following indicators:

- The overall appearance of the unit (e.g., lettering is missing or faded, presence of rust on the unit, plaque with serial numbers fallen off).
- The freon type used in the unit. After 1992, R12 is not used in refrigerators.
- If the unit is very heavy, this indicates heavy metal used for the frame assembly indicative of an old design.
- The type of foam insulation used in the unit.

Savings Estimation and Long-Term Outlook

LADWP estimates savings using per unit-savings values for each appliance type. The value applied to refrigerators and freezers is 1,946 kWh. Most room air conditioners are assigned a savings value of 44.5 kWh. Staff reported that the values were established several years ago, and they may be revised based on the current evaluation results.

Future Challenges and Opportunities

One issue for consideration in the future is that as the older refrigerators become more recent and larger shares were produced after federal efficiency standards went into place, the savings potential will diminish. However, as shown in Table A-138, the program has been effective at replacing older units and the average year of manufacture has not increased substantially since FY15/16. However, the share of units recycled that were manufactured before 1990 declined in FY21/22.

Table A-138 Age of Recycled Unit FY15/16 – FY21/22

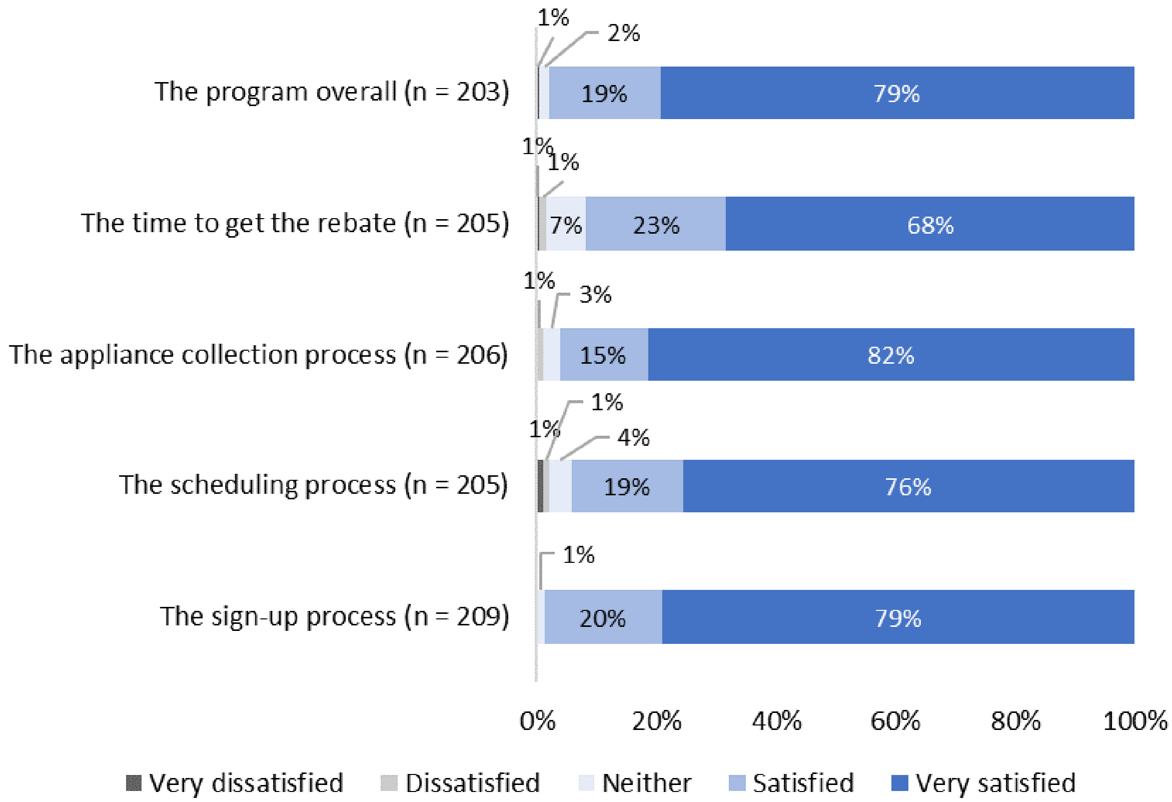
Fiscal Year	Percent Manufactured Before 1990	Average Year of Manufacture
15/16	5%	2000
16/17	10%	1998
17/18	6%	2000
18/19	8%	2000
19/20	6%	2001
21/22	3%	2001

Note: Age of units for FY20/21 is not shown due to the small number of units replaced during that year.

A.15.3.3.2 Participant Survey Findings

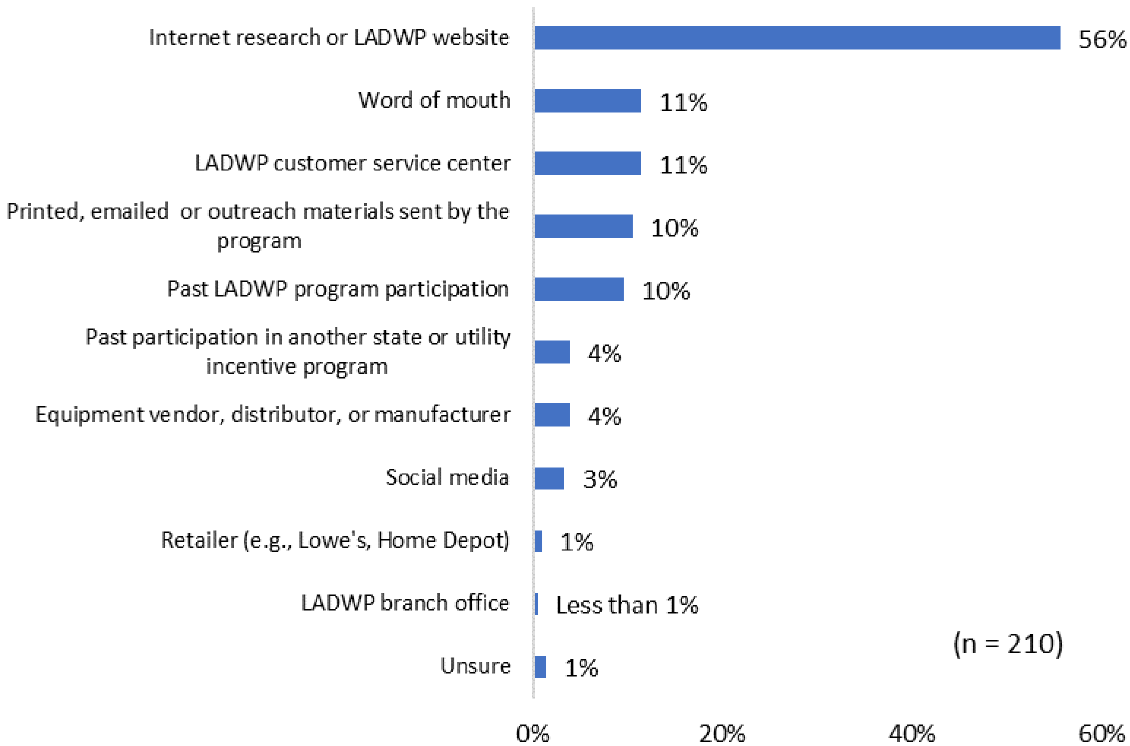
Participants were satisfied with the program. Most respondents (98%) were somewhat or very satisfied with their overall experience with the RETIRE program. Additionally, program participants were largely satisfied with the time it took to get their rebate, the process for collecting appliances, the scheduling, and the sign-up process (see Figure A-23). For the residential respondents who were dissatisfied, which was limited to 3% of the respondents, the most common reason for their dissatisfaction was the time it took for their appliance to be collected to receive their rebate. Also, some participants complained that the people who collected their appliances were not professional.

Figure A-23 Participant Satisfaction with RETIRE



Program participants often learned about the RETIRE program through internet searches, the LADWP website, word of mouth, and customer service. More than half of survey respondents (56%) indicated they learned about the RETIRE program through an internet search or visiting LADWP's website. Word of mouth, the LADWP customer service center, printed/emailed/outreach materials, and past participation were less common ways that participants learned of the program. Figure A-24 summarizes the results.

Figure A-24 How RETIRE Participants Learned of the Program



Cash incentives and the benefit of environmentally safe disposal were the most common motivations for participating in the program. About a third of survey respondents indicated the main reason they chose to get rid of the old appliance was for the cash incentive payment, followed by those who liked that it was an environmentally safe way to dispose of an appliance. Some participants were motivated by the free pick-up service or that it was convenient. See Table A-139 for a summary of the results.

Table A-139 Motivation for Participation in the RETIRE Program

Response	Percent of Respondents (n = 210)
Cash incentive payment	32%
Environmentally safe disposal, recycled, and/or good for environment	29%
Free pick-up service, others don't pick up, or don't have to take it myself	19%
Easy way, convenient	11%
Recommendation of a friend or relative	3%
Utility sponsorship of the program	3%
Something else	2%

Response	Percent of Respondents (n = 210)
Never heard of any others or only one I know of	1%
Recommendation of retailer or dealer	1%
Unsure	1%

The online sign-up process is working well for participants. Eighty percent of respondents signed up online. Ninety-six percent of participants found that it was easy to find the sign-up screen on the website and 94% indicated the website answered all their questions about the program. Twenty-two percent of survey respondents contacted a program representative after signing up online to confirm their appointment, while 3% had to cancel or reschedule their appointment. ARCA reported that a confirmation email is sent to participants after they schedule a pickup appointment.

The telephone sign-up process is working well for participants. Everyone who signed up by phone indicated the representative was courteous and answered all their questions. Among customers who signed up by telephone, 57% were aware they could sign up via the program website. Among that group, 48% had questions they wanted answered before signing up, 33% found signing up by phone to be more convenient, and 14% experienced website technical difficulties when attempting to sign up.

Interaction with Program Staff and Rebate Wait Times

Most program participants had an interaction with the person who picked up their appliance and found them to be professional. Seventy-two percent of program participants indicated they had some interaction with the people who collected their old appliance. Among those who had interactions, 99% indicated the people were professional.

Not all participants recalled that their old unis were plugged in at the time of pickup or checked to see if they were operating. Twenty percent of respondents who interacted with the pick-up crews said the unit was not plugged in at the time of pickup. Additionally, 14% said that the pick-up crew did not check that the unit was working.

Wait times for rebates varied but participants typically received it within six weeks or less. Forty-six percent of surveyed respondents indicated they waited 2 – 4 weeks for their rebate to arrive after the appliance was picked up, followed by 30% who waited 4 – 6 weeks (see Table A-140). Less than 10% of surveyed respondents waited six or more weeks for their rebate. Among the program participants who waited less than 2 weeks for their rebate, they tended to rate their satisfaction with different components of the RETIRE program higher compared to those with longer wait times. Within the group who waited less than 2 weeks, 100% were very satisfied with the program overall compared to 25%

who waited more than eight weeks. This finding could suggest that rebate wait times impacts participants' satisfaction with the program.

Table A-140 Rebate Wait Times

Response	Percent of Respondents (n = 205)
Less than 2 weeks	15%
2 – 4 weeks	46%
4 – 6 weeks	30%
6 – 8 weeks	5%
More than 8 weeks	4%

Participant Household Characteristics & Demographics

Table A-141 provides information on respondent home ownership and space heating and water heating fuel. A majority of respondents were homeowners.

Table A-141 Home Ownership and Fuel Type

Home Ownership	Percent of Respondents (n = 205)
Own	66%
Rent	32%
Own and rent to someone else	2%
Main Home Heating Fuel Ownership	**Percent of Respondents (n = 204)**
Electricity	34%
Natural gas	61%
Propane	0%
Something else (solar)	1%
Does not heat home	5%
Main Water Heating Fuel	**Percent of Respondents (n = 199)**
Natural gas	85%
Electricity	13%
Propane	0%
Do not have hot water	1%

Unsure	2%

Over half of surveyed participants indicated they only speak English in the home, followed by 22% who speak Spanish. Most (83%) prefer that LADWP uses English in communications with them (e.g., outreach materials or emails). See Table A-142 for a summary of the findings.

Table A-142 Language Spoken in Home and Preferences for Communication

Language Spoken at Home	Percent of Respondents (n = 200)
Only English is spoken	57%
Spanish	22%
Mandarin	2%
Vietnamese	1%
Tagalog	3%
Armenian	3%
Korean	5%
Russian	2%
Persian (including Farsi, Dari)	3%
Other	6%
Prefer not to answer	3%
Preferred Communication Language	**Percent of Respondents (n = 71)**
English	83%
Spanish	9%
Mandarin	1%
Vietnamese	0%
Tagalog	0%
Armenian	0%
Korean	6%
Russian	0%
Persian (including Farsi, Dari)	1%
Other	0%

Table A-143 summarizes the number of household members and the age of respondents.

Table A-143 Number of People Residing in the Home

Response	Percent of Respondents (n = 201)
1 person	18%
2 people	30%
3 people	16%
4 people	19%
5 people	7%
6 people	2%
7 people	2%
8 or more people	0%
Prefer not to state	6%

Response	Percent of Respondents (n = 201)
18 - 24	2%
25 – 34	13%
35 – 44	22%
45 – 54	19%
55 – 64	18%
65 – 74	11%
75 +	7%
Prefer not to answer	9%

A third of respondents identified as White (36%), followed by 26% who identified as Latino and 10% who identify as Black.

Table A-144 Race/Ethnicity of Survey Respondents

Response	Percent of Respondents (n = 201)
American Indian or Alaska Native	1%
East Asian	14%
South Asian	2%
Black or African American	10%
Hispanic, Latino, or Spanish	26%
Native Hawaiian or Other Pacific Islander	0%

Response	Percent of Respondents (n = 201)
Middle Eastern or North African	3%
White or Caucasian	36%
Prefer not to answer	13%

Household income levels varied among the survey respondents, with 33% of households earning $100,000 or more.

Table A-145 Household Income Level

Response	Percent of Respondents (n = 201)
Under $15,000	7%
$15,000 to less than $25,000	8%
$25,000 to less than $35,000	9%
$35,000 to less than $50,000	14%
$50,000 to less than $75,000	6%
$75,000 to less than $100,000	10%
$100,000 to less than $150,000	12%
$150,000 or over	11%
Prefer not to answer	24%

A.15.3.3.3 Net-to-Gross Results

Net savings were calculated using a decision tree. The decision tree is populated with estimated percentages of appliance disposition in the absence of the program based on responses to the participant survey. In other words, participants' actions concerning discarded equipment were used to estimate savings values under the possible scenarios. The savings under these scenarios were then used to calculate the net savings attributable to the program.

Participant survey respondents were first asked if they had considered discarding the program appliance before learning about the program. Respondent answers to this question are shown in Table A-146.

Table A-146 Prior Consideration of Disposal

	Measure	Response	Percent of Respondents (n=198 (ref), 10 (frz), 2(AC))
Had you already considered disposing of the [refrigerator, freezer, air conditioner] before you heard about LADWP's appliance recycling program?	Refrigerator	Yes	80%
		No	18%
		Don't know	2%
	Freezer	Yes	100%
		No	0%
		Don't know	0%
	Air Conditioner	Yes	50%
		No	50%
		Don't know	0%

Respondents who indicated they had not considered disposal before learning about the program were considered non-free riders. That is, for these respondents it was assumed they would have kept the appliance in use absent the program, since they had not considered disposal before learning about the program. Respondents who indicated they had considered disposal or "didn't know" if they had considered disposal, were asked additional questions to determine what they would have likely done with the unit if the program was not available. The responses were used to determine if the recycled appliance would have been kept, transferred to another part for continued use, or destroyed.

Table A-147 shows refrigerator disposition based on participant survey responses. Table A-148 shows the same calculation for freezers, and Table A-149 shows the results for air conditioners.

Table A-147 Refrigerator Discard/Keep Distribution

Discard/Keep	Proportion of Participant Sample (n = 198)	Discard Scenario	Proportion of Discards	Overall Proportion
Discard	77%	Transfer	56%	43%
		Destroy	44%	33%
Keep	23%			23%

Table A-148 Freezer Discard/Keep Distribution

Discard/Keep	Proportion of Participant Sample (n = 10)	Discard Scenario	Proportion of Discards	Overall Proportion
Discard	89%	Transfer	75%	67%
		Destroy	25%	22%
Keep	11%			11%

Table A-149 Air Conditioner Discard/Keep Distribution

Discard/Keep	Proportion of Participant Sample (n = 2)	Discard Scenario	Proportion of Discards	Overall Proportion
Discard	50%	Transfer	100%	50%
		Destroy	0%	0%
Keep	50%			50%

As shown in the tables above, some of the participants believed they would have transferred the units they recycled to another party if the program was not available. Secondary market impacts account for program effects on would-be acquirers of program units (since they are no longer available to acquire program units). Only units that would have been transferred absent from the program are considered in the secondary market impact analysis. As detailed in Section A.15.2.4, the Evaluator took a midpoint approach in this evaluation, based on the recommendation of the UMP protocols. That is, 50% of would-be acquirers of program avoided transfers were assumed to find an alternate unit. Of those who were assumed to find an alternative unit, 50% are assumed to find a similar used unit, while 50% are assumed to purchase a new unit.

The Evaluator determined net savings as UMP gross savings less free-ridership, secondary market impacts, and including induced replacement. Figure A-25 depicts the complete net-to-gross ratio calculation for refrigerators. Figure A-26 and Figure A-27 show the same calculation for freezers and air conditioners.

Figure A-25 Net-to-Gross Calculation – Refrigerators

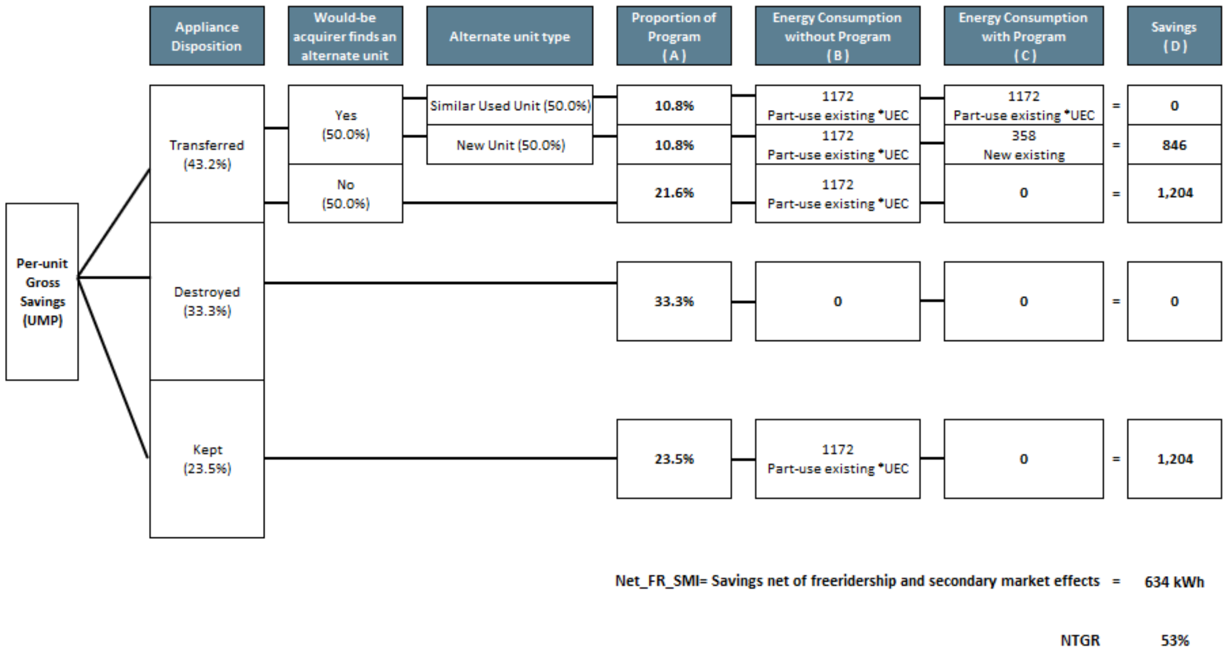


Figure A-26 Net-to-Gross Calculation – Freezers

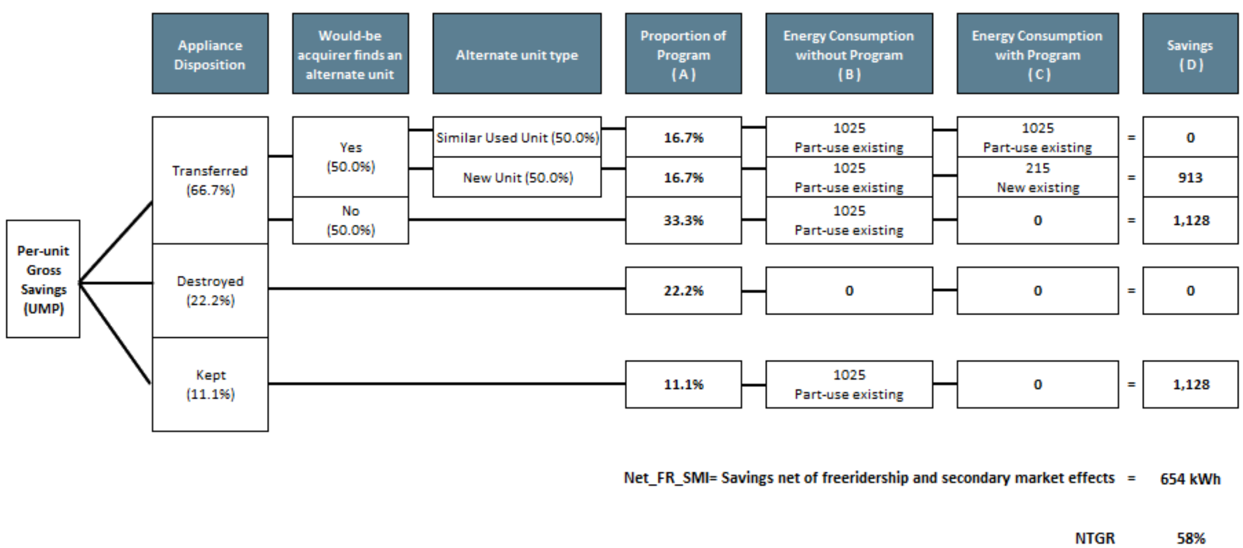
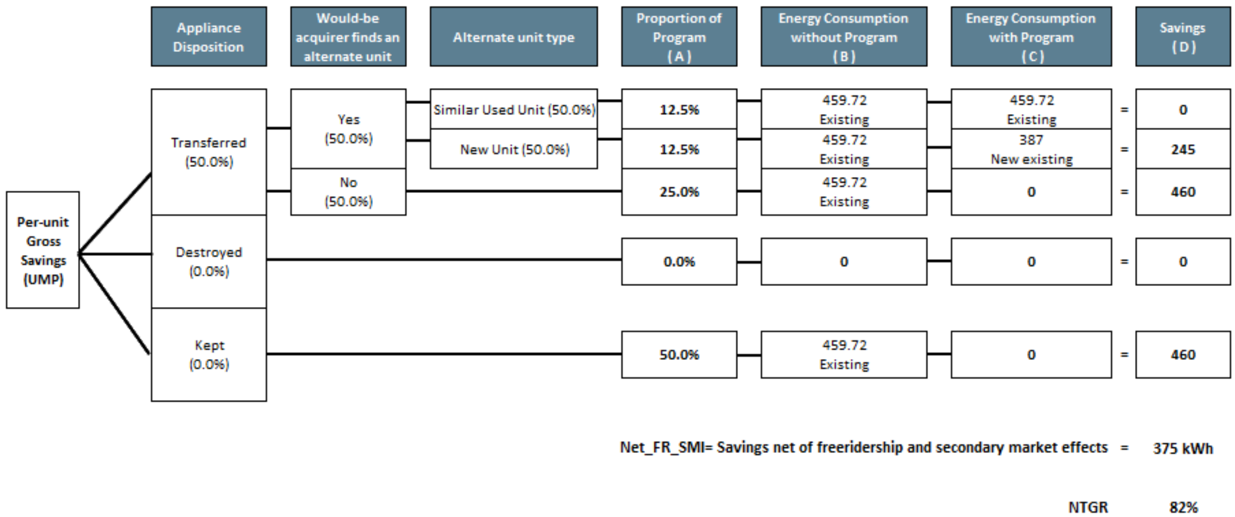


Figure A-27 Net-to-Gross Calculation – Air Conditioners



A.15.3.4 Recommendations

Revise estimated savings values to differentiate between the savings associated with refrigerators and freezers. Freezers typically have lower savings than refrigerators. The ex-post savings values should be used to update the estimated savings from appliances.

Review pickup procedures with field crew managers. Program procedures are for participants to keep their unit plugged in at the time of pick-up and for field crews to verify that the old units are producing cold air and operating. However, 20% of respondents who interacted with the pick-up crews said the unit was not plugged in at the time of pickup. Additionally, 14% said that the pick-up crew did not check that the unit was working.

Monitor savings over longer term but consider customer satisfaction benefits when assessing the viability of RETIRE. The age of appliance manufacture has increased since FY15/16, but not at a rate commensurate with the number of years that have passed. Nonetheless, as newer appliances are recycled the energy savings will decrease. The program should monitor these changes and continue to focus marketing efforts to target older appliances. When making decisions about the program, LADWP should consider the benefits of customer satisfaction. Appliance recycling programs tend to be popular with customers and participants in RETIRE were satisfied with the program overall. Additionally, because customers can participate without any cash-outlay, the program is accessible to a large number of customers.

A.16 Residential Lighting Efficiency Program (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-150 FY21/22 RLEP: Program Evaluation Data Collection

Source	Data Types
Program tracking data	Distribution channel and quantity
General population survey	Survey from Retrospective period leveraged for FY21/22
2019 RASS Study	LADWP service territory data for existing lamps
LA Assessor Data	Housing types – single family, multifamily by climate zone
LED Manufacturer Specification Sheet	Wattages, lumens, lifetime hours

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-151.

Table A-151 FY21/22 RLEP: Tracking Data Document List

File Name	LED Kits Distributed
Energy Savings Portfolio data export	NA
LADWP Program Activity Emails	3,533

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 21/22 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-152.

Table A-152 FY21/22 RLEP: General Population Survey from Retrospective Period

Strata	Number of LED Kits	Gen Pop Survey Sample Deployed
FY17/18-FY19/20 General Population Survey	4,102,476	14,716
FY21/22 Participants	3,533	0

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 for the existing lamp technology in the home for interior and exterior lamps, then applied the mix of interior and exterior lamps from the General Population Survey. The proportion of each lamp type and the equivalent wattage to a 1175 lumen lamp determined the weighted baseline wattage. The remaining life of the baseline lamps was estimated by the stock of two existing lamps and the life of the lamp technology mix from the 2019 RASS survey. After the midlife shift, the energy savings are reduced significantly, as the baseline wattage drops to 15 watts from 30 watts.

Table A-153 FY21/22 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	30		

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 Equation A-38 and Equation A-39 below, respectively:

$$kWh = \#LED\ kits\ x\ 2\frac{lamps}{kit}\ x\ \frac{(Watts_{base} - Watts_{LED})}{1000W/kW}\ x\ HOU\ xISR \qquad \textit{Equation A-38}$$

$$kW = kWh_{savings}\ x\ CDF \qquad \textit{Equation A-39}$$

A description of the savings inputs is presented in Table A-154 below.

Table A-154 FY21/22 RLEP Ex-Ante Energy Savings Algorithm Inputs

Factor	Description
kWh	Annual energy savings
kW	Not calculated in tracking nor ESP database
#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
CDF	Coincident demand factor; 0.000105355

Table A-155 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-155 FY21/22 RLEP ESP and Program Tracking Savings Comparison

Measure	ESP Ex-Ante kWh	Program Tracking Ex-Ante kWh	ESP Ex-Ante Peak kW	Program Tracking Ex-Ante Peak kW
LED Deliveries Completed W/ Refrigerator Exchanges	122,996	122,996	NA	NA
Total	**122,996**	**122,996**	**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.

$$kWh = Qty_{ver} x\ HOU\ x\left(Watts_{base} - Watts_{efficient}\right) x \frac{IE_{kWh}}{1000\frac{Watt}{kW}} x\ ISR$$ *Equation A-40*

$$kW = kWh\ x\ \ CDF$$ *Equation A-41*

Table A-156 FY21/22 RLEP: ENERGY STAR Lighting Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
$Kits_{ver}$	Quantity verified in tracking data to ESP data	RLEP tracking data	Variable
Lamps/kits	LED lamps per kit	RLEP tracking data	2
HOU_w	Weighted Annual hours of use	RLEP General Population Survey, 2021	Interior: 716 hours Exterior: 2,884 hours HOU_w: 1,060 hours
$Watts_{base}$ ER	Early replacement: Weighted baseline mix of existing lamps	California Statewide Residential Appliance Saturation Study 2019	LADWP service area weighted baseline mix: 30 W
$Watts_{base}$ NR	Normal replacement: Lumen equivalent wattage	CA Title 20, 24: SLED & Modern Appliance Database listed lamps	14.7 W
$Watts_{efficient}$	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	14,716 Surveys Deployed
CDF	Coincident Diversity Factor	LA Assessor Data & DEER Lighting Interactive Factors	Weighted by population of climate zone
RUL	Remaining Useful life	2 stored lamps x Lamplife/Annual Hours of Use	2.8 years
EUL	Effective Useful Life	DEER Resources	16 years

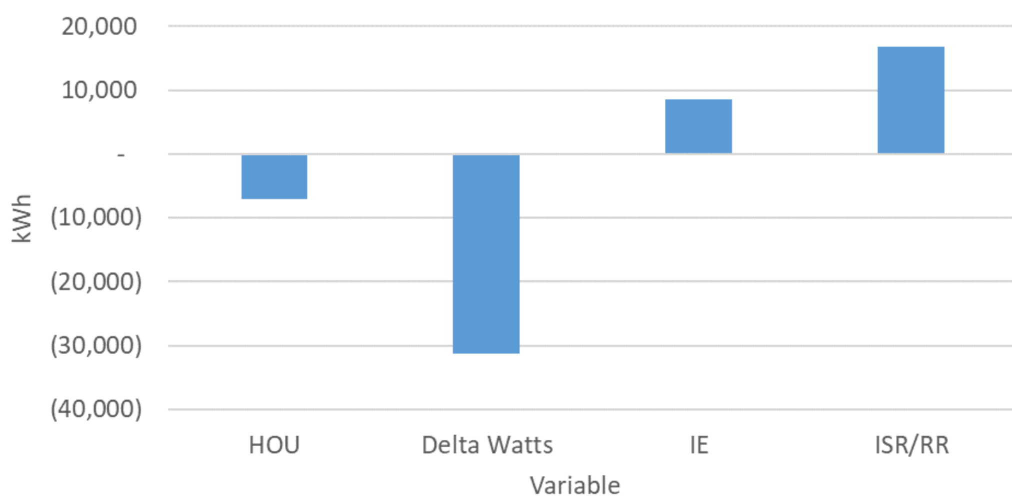
A.16.2 Impact Evaluation

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-153. The peak demand reduction calculation utilized the same CDF value as the ex-ante estimation.

A.16.2.1 Description of Factors Affecting Gross Realized Savings

Figure A-28 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. This method estimated the baseline at 30W, for a delta watt of 18W, less than the ex-ante delta watts of 24W. This difference was the primary difference in realized savings, with the remaining factors also listed in the following figure.

Figure A-28 FY21/22 RLEP: Realized Savings Factors



A.16.3 Process Evaluation

The Residential Lighting Efficiency Program (RLEP), launched in September 2016, provides free nine-watt A19 omni-directional light-emitting diode (LED) bulbs to customers to assist in reducing their home electrical use. The program runs during a fiscal year (a fiscal year, FY, is July 1 to June 30).

A.16.3.1 Process Evaluation Approach and Methodology

This is a concurrent summary process evaluation of FY21/22, including only a small level of document review and a staff interview.

A.16.3.1.1 Document Review

The ADM team reviewed an Excel program tracking spreadsheet of lamps distributed.

A.16.3.1.2 Staff Interviews

Over a half-hour period in October 2022, the evaluation team interviewed the RLEP program manager.

A.16.3.2 Process Evaluation Findings

The program distributes bulbs through three channels: 1) door to door distributions, 2) customer events, and 3) the Refrigerator Exchange Program (REP). For events and the REP, the program provides the bulbs that are then distributed by others.

- Door to door distribution has been on hold since 2020 due to COVID (although may start back up in 2023).
- The program provides bulbs for distribution during events that are typically run by community grantees. Each grantee can provide customers with one or more bulbs during their events.
- REP and LIREP distribution have been ongoing. Each participant in the REP/LIREP is provided with a kit that includes two bulbs. The number of kits being provided to customers depends on the number of actual refrigerators exchanged. From July 2021 through June 2022, REP/LIREP handed out 3,533 kits (for 7,066 lamps and an estimated 122,996 kWh in savings).

Historically, the program also provides some bulbs to the Home Energy Improvement program (HEIP). When lamps are sent to HEIP, their savings accrue to HEIP. HEIP has been on hold due to COVID.

A.16.3.2.1 Future of RLEP

According to the program manager, even prior to COVID, the program was most likely going to sunset in terms of claiming energy savings because of the federal 45 lumen/watt requirement (and therefore the LED lamps in the program having the same efficiency as similar LED lamps available in the market). But because of COVID, the program is now planning use of the program inventory (~80,000 bulbs as of October 2022) not for energy savings, but to provide public benefits for LADWP customers.

While there have been no specific discussions yet within LADWP, the most likely scenario would be to either continue the program with different bulbs (e.g., nightlights or candelabra) or shutter the program until a new technology comes forward.

A.17 Air Condition Optimization (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 with 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

Table A-157 below summarizes discrepancies the Evaluator found when 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 presented in Table A-157 below.

Table A-157 FY21/22 Ex-Ante Savings Summary

Measure	ESP Ex-Ante kWh	Program Tracking Ex-Ante kWh	ESP Ex-Ante kW	Program Tracking Ex-Ante kW
Commercial	415,631	415,631	0.00	405.50
Multifamily	9,548,325	9,548,325	0.00	11,234.43
Single Family	3,200,219	3,200,219	0.00	4,504.60
Mobile Home	10,420	10,420	0.00	14.10
Total	**13,174,595**	**13,174,595**	**0.00**	**16,158.63**

A.17.1.3 M&V Approach

Table A-158 summarizes the data sources used in the ACOP impact evaluation.

Table A-158 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
Nonparticipant 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:

1. First, the Evaluator conducted an exploratory data analysis that made use of all provided participant billing data.
2. 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.
3. 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 below.

A.17.1.4 Billing Analysis Approach

The Evaluators performed a billing analysis to evaluate the energy savings for the ACOP program. Billing analyses provide savings estimates at the premise level. Therefore, customer measures were grouped by name and address, and Evaluators 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. Propensity score matching (PSM), a method which attempts to develop a comparison group for billing analysis from non-participant customers based on pre-treatment characteristics, is often unsuited to commercial billing data analysis due to the increased variability in commercial billing data and lack of homogeneity in commercial processes. Similarly, 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 446 Commercial premises participated in the FY21/22 ACOP program, however, only 187 customers had sufficient post-installation data to be used in a regression analysis. 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 FY21/22 participants from FY17/18, FY18/19, FY19/20, and FY 20/21 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-42.

$$Average\ Daily\ kWh = \frac{Total\ kWh}{Number\ of\ Days}$$ *Equation A-42*

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-159. 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-159 FY21/22 ACOP Commercial Participant Count

Measure	All Participants	Qualified Participants	Final Sample Size
ACOP Commercial	446	187	2,241

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-43 :

$$Average\ Daily\ kWh_i = \alpha + \beta_1 \cdot post + \beta_2 \cdot CDD_{i,n} + \beta_3 \cdot HDD_{i,n} + \beta_4 \cdot CDD_{i,n} \cdot post + \beta_5 \cdot HDD_{i,n} \cdot post + \varepsilon$$

Equation A-43

Where:

i = represents each individual customer for each month

n = represents each iteration of base pairs

$post$ = an indicator variable indicating whether the period is in the post or pre period

$CDD_{i,n}$ = the CDD calculated for iteration *n* for customer i

$HDD_{i,n}$ = the HDD calculated for iteration *n* for customer i

α = the intercept term

β_1 = the main effect of the post period

β_2	=	the main effect of CDD
β_3	=	the main effect of HDD
β_4	=	the additional effect of CDD on the post period
β_5	=	the additional effect of HDD on the post period
ε	=	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-44. 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-44

Where:

i	=	represents each individual customer for each month
$post$	=	an indicator variable indicating whether the observation is in the pre-treatment period or post-treatment period
CDD_i	=	the CDD calculated for iteration *n* for customer *i*
HDD_i	=	the HDD calculated for iteration *n* for customer *i*
$month_1$ through $month_{12}$	=	indicator variables indicating if the month is January through December
α_i	=	the customer-specific intercept term
β_1	=	the main effect of the program participation
β_2	=	the main effect of CDD
β_3	=	the main effect of HDD
β_4	=	the CDD-dependent effect of program participation
β_5	=	the HDD-dependent effect of program participation
β_6 through β_n	=	the main effects of month
ε	=	the error term

The regression coefficients of interest for estimating savings are β_1, β_4, and β_5. Table A-160 provides information regarding the regression coefficients for the model and the overall model fit.

Table A-160 FY21/22 ACOP Commercial Regression Coefficients

Term	Regression Coefficient	Standard Error	T-value	P-value	Adjusted R-squared
Post	-1.693	0.370	-4.575	0.000	0.947
Post x HDD	-0.416	0.071	-5.852	0.000	0.947
Post x CDD	0.036	0.064	0.562	0.574	0.947

The savings for each fiscal year were then calculated using the formula presented in Equation A-45.

$$\begin{aligned} Annual\ Savings \\ &= [Post\ Coefficient \\ &+ (Post\ x\ CDD\ Coefficient\ \cdot \overline{CDD}) \\ &+\ (Post\ x\ HDD\ Coefficient\ \cdot \overline{HDD})] \cdot -1 \cdot 365.25 \end{aligned}$$

Equation A-45

Where:

$\overline{CDD}$ = the average daily CDD for a typical weather year

$\overline{HDD}$ = 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-161.

Table A-161 FY21/22 ACOP Commercial Weighted Average TMY3 HDD and CDD

Measure	Average Daily HDD	Average Daily CDD
ACOP Commercial	2.471	2.011

Savings per household, 90% confidence intervals, and relative precision at the 90% confidence level are presented in Table A-162.

Table A-162 FY21/22 ACOP Commercial Average Savings per Household

Measure	Annual kWh Savings	90% Confidence Interval		Relative Precision (90% CL)
		Lower Bound	Upper Bound	
ACOP Commercial	855	705	1,005	18%

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 Evaluators 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 September 2021 to April 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 April 2019 and September 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 FY21/22 and FY21/22.
- 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 Table A-163 below.

Table A-163 FY21/22 ACOP Residential Participant Count

Strata	Number of Participants	Final Sample Size
ACOP Multi-Residential	25,991	221

Strata	Number of Participants	Final Sample Size
ACOP Single Family & Mobile Homes	6,616	376

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-46.

$$Average\ Daily\ kWh_i = \alpha + \beta_1 \cdot post + \beta_2 \cdot CDD_{i,n} + \beta_3 \cdot HDD_{i,n} + \beta_4 \cdot CDD_{i,n} \cdot post + \beta_5 \cdot HDD_{i,n} \cdot post + \varepsilon \quad \textit{Equation A-46}$$

Where:

i	=	each individual customer for each month
n	=	each iteration of base pairs
$post$	=	an indicator variable indicating whether the period is in the post or pre period
$CDD_{i,n}$	=	the CDD calculated for iteration *n* for customer i
$HDD_{i,n}$	=	the HDD calculated for iteration *n* for customer i
α	=	the intercept term
β_1	=	the main effect of the post period
β_2	=	the main effect of CDD
β_3	=	the main effect of HDD
β_4	=	the additional effect of CDD on the post period
β_5	=	the additional effect of HDD on the post period
ε	=	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 loads 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

The difference in pre and post weather-dependent load was treated as the savings for each customer, as represented in Equation A-47.

$$\Delta kWh_{HVAC} = kWh_{HVAC\ Pre} - kWh_{HVAC\ Post} \qquad \textit{Equation A-47}$$

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-164.

Table A-164 FY21/22 ACOP Residential Participant-Level Savings

Strata	Annual kWh Savings	90% Confidence Interval		Relative Precision (90% CL)
		Lower Bound	Upper Bound	
ACOP Multi-Residential	344.56	251.78	437.35	27%
ACOP Single Family & Mobile Homes	479.80	311.98	647.61	35%

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 FY21/22 may inadvertently be impacted by changes due to the COVID-19 pandemic. To account for this impact, the Evaluators 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 nonparticipant data was separated into a typical period (January 2019 through December 2019) and COVID-19-impacted period. The COVID-19 period was estimated as May 2021 through April 2022 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 the best approximation of the impact of COVID-19 on ACOP Gross ex-post for commercial customers.

A.17.1.5 Process Evaluation

A.17.1.5.1 Process Evaluation Approach and Methodology

The process evaluation for this program consisted of interviews with program and implementer staff, interviews with participating HVAC technicians, ride-alongs with HVAC technicians, and a survey of program participants. We used data from these sources to answer the research questions identified in Table A-165.

Table A-165 Process Evaluation Research Questions and Sources

Research Question	Information Sources				
	Project Tracking Data Review	Staff and implementer interviews	HVAC technician interviews	HVAC technician ride-alongs	Participant survey
Are efficiency gains related to customer maintenance practices or do they vary by contractor?	✓				✓
What are the procedures for measuring and recording unit efficiency? Can that process be improved to reduce paperwork or reduce the risk of incorrect data entry?			✓	✓	
What are participation processes?		✓	✓		✓
Are program implementation procedures consistent with the planned program operations procedures and targets/objectives?		✓			
Did the delivery of services meet customers' expectations in terms of scheduling, length of the appointment, professionalism of the contractor?					✓
How are services distributed across the multifamily and single-family markets? Do contractors prioritize one market over another?	✓	✓	✓		
How do contractor seasonal workloads affect provision of program services? Do seasonal workloads act as a barrier to delivery of the service and can program changes reduce that impact?		✓	✓		
What were the maintenance practices of participating customers? What share had existing maintenance contracts with the contractor?					✓

A.17.1.5.2 Staff Interviews

The Evaluator interviewed two LADWP program staff members and two program management staff members from Proctor Engineering, the ACOP implementer. The LADWP staff were the day-to-day Program Manager, who manages one other program, and the Program Supervisor, who supervises multiple LADWP programs. Both are LADWP veterans. From Proctor, we interviewed the day-to-day Program Manager and one of the company owners, who worked with LADWP to design the program and roll it out and helps with day-to-day management. Interviews covered program management; communication between LADWP and Proctor; program design, objectives, and progress; recruitment of HVAC technicians; program marketing; the participation process, including the assignment of tune-ups to HVAC technicians; and project review and tracking.

A.17.1.5.3 Project Data Review

The Evaluator reviewed FY21/22 program tracking data. Our data review addressed these research questions:

- *How are services distributed across the multifamily and single-family markets?*
- *Do contractors prioritize one market over another?*
- *Do efficiency gains vary by contractor?*

A.17.1.5.4 Participant Survey

We conducted a mixed-mode (email-push-to-web, letter-push-to-web) survey of single-family residential householders who participated in the Air Conditioning Optimization Program. The survey assessed program awareness and influence and details of respondents' program experience, including satisfaction.

We received a data file with all customers that received tune-ups through the program from July 2021 through June 2022. A total of 6,693 single-family householders participated during that period.

Email recruitment to a web survey was the primary survey mode because of its cost-effectiveness. Assuming a maximum 3.5% response rate, we drew a random sample of 1,500 program participants with available email addresses and sent them an email invitation to take the survey, with two follow-up emails. Each email explained the purpose of the survey, provided a contact name for verification of the survey, and included a link to the web survey. We also sent letter survey invitations by postal mail to 425 single-family participants without available email addresses. The letters contained the same information that was in the email. It asked recipients to copy the survey link into an internet browser to take the survey.

A total of 219 program participants completed the survey: 203 (93%) were in response to the email invitation, and 16 (7%) were in response to the letter invitation. By contrast, participants with available email addresses made up 33% of the participant population. We examined the participant population to assess any differences between those with and without available email addresses, to determine whether their differential contribution to the pool of survey respondents might make the results nonrepresentative. The two groups were generally comparable, except that relatively fewer of those with email addresses had smart thermostats installed (34% vs. 44%). That group's disproportionate representation in survey completions resulted in a disproportionately low percentage of completions with participants that had smart thermostat installations: 29.7% of survey respondents had smart thermostats installed, compared to 42.0% of the total program population. To offset any possible resulting bias, we weighted survey responses differently for those with smart thermostat installations (.420/.297 = 1.41) and those without smart thermostats (.581/.703 = 0.83). The tables below show both weighted and non-weighted counts but only weighted percentages; in most cases, weighting had minimal impact on results.

A.17.1.5.5 General Population Survey

As part of a representative survey of 570 LADWP residential customers, ADM assessed the saturation of residential central air conditioning as well as the age of extant central air conditioning systems. The purpose was to provide information that may be useful for ACOP planning.

A.17.1.5.6 HVAC Technician Interview Summary

We recruited technicians via email and phone and asked them to participate in a 30-minute phone interview or participate in a ride-along (discussed below). We sent the email request to one technician from each of the 48 contractor firms, selecting the technician that had done the most ACOP projects for that firm. We conducted phone follow-up with the technicians who did not complete the interview or a ride-along as a result of the email contact.

A total of 10 technicians completed the interviews, two from the email recruitment and the other eight from phone recruitment. Each interviewee represented a separate firm. Of the other 38 HVAC firms:

- One completed a ride-along but not an interview.
- 10 expressed interest in the interview but did not complete one – they were no-shows or could not be scheduled.
- One refused.
- Two were not eligible as they reported they no longer work with ACOP.
- 24 could not be contacted.

We conducted interviews with the Microsoft Teams platform, recording all interviews with participant permission.

A.17.1.5.7 HVAC Ride-Along Observations

An analyst with the Evaluator accompanied ACOP HVAC technicians on service calls (conducted “ride-alongs”) to observe tune-up procedures. The analyst conducted ride-alongs with two technicians that serviced a total of 15 residences: one serviced 13 units with heat pumps at a multifamily property and the other serviced two single-family residences with standalone air conditioning systems.

As described above, we carried out a single recruitment effort for ride-alongs and interviews. Technicians from two HVAC firms agreed to a ride-along, one of whom also agreed to the interview.

For each residence serviced, the analyst recorded the address, type of residence, and whether the following activities were performed:

1. Diagnostic test
2. Condenser coil cleaning (and method)
3. Filter replacement
4. Refrigerant charge
5. Smart thermostat or Western Cooling Control installation
6. Qualified system repairs
7. Any of system repairs

The analyst also recorded the following information:

- Existing thermostat schedule
- Whether the participant was offered training in use of the smart thermostat
- Whether the smart thermostat was scheduled for time of day and temperature or using occupancy sensor
- The setback temperatures programmed

A.17.1.6 Process Evaluation Findings

A.17.1.6.1 Staff Interview Findings on Program Design and Operations

Program Management

Interviewees reported that ACOP is located within the Customer Services group, although the Efficiency Solutions group holds the budget. Program staff coordinate with the Corporate Communications group for program marketing as well as with the Efficiency Engineering group, which estimates savings and develops new measures. Proctor recruits, screens, and trains HVAC technicians; conducts quality control (QC); pays technicians for completed tune-ups; and responds to customer complaints. Proctor also “keeps apace” of developments in the industry and presents ideas for program measures to the LADWP program management staff.

Communication

Interviewees reported that LADWP and Proctor hold biweekly meetings to present program updates and discuss any potential issues. Proctor provides weekly and monthly reports of program activity (customers and systems served) to LADWP as well as weekly emails relating to funding. Monthly reports include information on customers served from disadvantaged communities, QC, results of customer satisfaction assessments. In addition, there is ongoing email communication between LADWP program management staff and the Proctor Program Manager. Interviewees from both sides reported that communication is very good, with LADWP staff noting that Proctor is “very thorough” and “very responsive” and Proctor respondents reporting that LADWP staff “are so easy to work with, very responsive.”

ACOP staff also reported good communication with other LADWP and groups, although they noted that it sometimes requires multiple requests to get needed marketing support. This reportedly is not specific to ACOP requests but is department wide.

Program Design and Objectives

Both groups of informants confirmed our understanding of the program design and objectives as documented in Section 1.2.3.1. Interviewees provided the following additional insights and details:

- LADWP’s decision to limit participation to once every two years was a matter of resource allocation, to allow broader participation.
- The program added the $1,200 incentive for replacing inefficient furnaces to encourage participation by HVAC technicians who were not interested in doing tune-ups alone.
- Late in 2021, LADWP asked Proctor to add an electrification component to the program, whereby customers with electric air conditioning but a gas furnace would be encouraged to replace their system with an all-electric heat pump. Since November of 2021, the program has installed 140 heat pumps at the time of the interview.
- According to the implementer, the program was initially geared toward single-family homes, but they have been targeting multifamily customers in disadvantaged communities since the COVID-19 pandemic began.

Program Progress and Future Potential

While the implementer contacts reported that the program is going “pretty well,” the program staff contacts did note that it is not currently on track to meet goals. This is largely because the program was closed from March 2020 to the end of June 2021 because of the COVID-19 pandemic. Staff also noted, however, that the unusually cool summer had reduced demand, as demand is tied to the need for air conditioning.

Program staff further indicated they were not quite sure what the program penetration is as they do not have data on the existing stock of qualifying air conditioning systems. That, according to the contacts, is the program’s only short-term challenge: trying to figure out the stock. They reported that, once they get a better handle of where the air conditioning units are, they do not see any long-term challenges.

Recruitment and Training of HVAC Technicians

The implementer is responsible for recruiting contractors and training HVAC technicians. An implementer contact reported being driven by LADWP's "number 1 objective" to improve customer satisfaction. To this end, the implementer said the priority was "to deal only with legit businesses." To participate, a contractor has to have been in business at least 6 months, have a current California HVAC contractors (C20) license, adequate insurance, and a properly licensed "brick-and-mortar" business facility within 50 miles of LADWP's service area.

The implementer contact reported that they held a kick-off meeting at a hotel ballroom at the beginning of the program cycle, to which they had invited all licensed contractors with a brick-and-mortar shop and no bad online reviews. Following the kick-off meeting, the implementer company's owner then met with contractor companies. A full-time contractor liaison then signed the interested companies up. The contact noted that some contractors have objected that the brick-and-mortar requirement is not fair, but that they had assured LADWP they will always be consistent in enforcing this requirement.

Once a new contractor has been signed up, the contractor must submit a training request form, providing information about the technicians and proving that they have the proper equipment to conduct the program tune-ups. After that has been completed, the implementer conducts two-day, small-group training (four or fewer technicians) at the contractor's shop. The first day consists of reviewing the tune-up equipment and metering. The second day consists of more classroom training on how to install smart thermostats and the Western Cooling Control air conditioner optimizer (an alternative to a smart thermostat). Overall, half of the training consists of field work on air conditioning units. Training is pass/fail; the implementer contact reported that at least 90% of trainees pass.

After training is completed, technicians must perform tune-ups on 10 air conditioning systems within 60 days to be certified. The implementer's goal is for each technician to complete the certification within 30 days after finishing training.

Program Marketing and Customer Recruitment

Program staff and implementer contacts provided details on program marketing and customer recruitment. Contractors are not allowed to market the program through cold calls. They may ask existing customers to refer the program to others, but any referred customer must make the first contact. Contractors may follow-up with customers they have serviced through the program: an implementer contact indicated that some of the contractors keep track of who has participated and reach out to them every two years. The implementer reported that contractors had asked for permission to market the program through social media and print, but LADWP has not granted such permission.

The implementer conducts program outreach to multifamily property managers. An implementer contact reported that they have “been beating on doors” at multifamily properties in disadvantaged communities since the start of COVID-19 pandemic.

An implementer contact explained that if a multifamily customer signs up on the program website, they are directed to contact the implementer. In large properties, the implementer conducts a pre-screening to ensure that it is a property that would be suitable for program services. Reasons for rejecting properties as not suitable include air conditioning systems that are very old or in poor condition or keeping a store of refrigerant that is not designed for the system. The latter exclusion is to prevent is situation in which program contractors mix the proper refrigerant with the existing, improper refrigerant. The contact noted that they do not exclude very many multifamily properties.

During the pre-screening, the implementer also checks to determine whether the thermostat wiring does have a common wire, which is required for installation of the smart thermostat. If there is no common wire, the property manager must add it before smart thermostats can be installed. The contact noted that they do not exclude very many multifamily properties.

Project records showed that the four most active technicians had done two-thirds of the tune-ups this year and 12 had done fewer than 25 tune-ups each. A distribution that contacts reported is “by design.” That high activity level comes from servicing multifamily properties. The contact said that there are very few contractors that are capable of doing that type of service: such contractors need to be very organized not to cause problems for the property management firm. The contact described one such firm as “a well-oiled machine” that works with local property staff, sets up a vacant apartment to store equipment on site, and works with the property managers to give tenants notification two days in advance of tune-ups.

Program staff and implementer contacts agreed that most work is generated by contractors marketing the program to their existing single-family customers and through word of mouth. An implementer contact said that “probably less than 25%” go to the program website to find a contractor.

Program staff reported they had planned to conduct a social-media-based marketing campaign for the program in May of 2022, targeting geographic areas that appeared to be underrepresented. However, that campaign was superseded by a planned press event by the LADWP General Manager that would include mention of ACOP. Program contacts reported they expected the press event to produce a lot of sign-ups, and that they would “circle back” to the idea of a more targeted social media campaign closer to winter. They also reported they were considering doing targeted email blasts about the program to LADWP customers. As of late October, however, the press event had not occurred, and the program has not yet conducted targeted outreach.

Participation Process

Contacts reported that the participation process works well.

Customers may sign up for the program on the program website or by calling the implementer’s call center. In either case, they will get a list of contractors in their area to contact to schedule participation. Customers referred to a contractor by another customer may contact that contractor directly.

For tune-ups done at single-family residences, the homeowner must complete an authorization form.

Every customer who participates receives a mailing afterward showing the initial condition of the air conditioning equipment, what activities the technician performed, and the equipment’s final condition. This includes information on anything the technicians do not deal with as part of their tune-up, such as faulty capacitors or electrical contacts.

An implementer contact clarified that technicians are not required to provide customers with any information about ongoing maintenance of their air conditioning systems other than to change the filter regularly. Prior to the start of the COVID-19 pandemic, the implementer had been in the process of creating a leave-behind for participants, with information on proper air conditioning settings and other related information, but they had not been successful at getting it approved by LADWP’s marketing group.

Project Review and Tracking

Contacts reported several project review activities:

- Random inspections (10%) of tune-ups performed by newly trained technicians.
- Random inspections (10%) of tune-ups performed by high-volume technicians.
- Examine tune-up tracking data to identify “outliers” for follow-up.
- Send brief (four-question) satisfaction survey by postcard to all customers within two weeks after service. The survey achieves a 2% to 3% response rate.
- Outbound follow-up calls to 10% of customers to assess satisfaction with the program and the technician.

Contacts reported that technicians who performed poor customer service, lied to the implementer about the service, or violated marketing rules have been removed. This does not occur often: one contractor was removed in 2021.

A.17.1.6.2 Findings from Review of Project Data

Distribution of Services Across Markets

As Table A-166 shows, three-quarters of the projects in the year leading up to the evaluation were in multifamily properties and about one-fifth were in single-family residences other than mobile homes. The latter and commercial properties made up small shares of the projects.

Table A-166 Distribution of Service Type Across Markets

	Market				
	All	**Multifamily**	**Single-family**	**Mobile home**	**Commercial**
Count	37,576	28,087	8,081	33	1,375
Percent of Projects	100.0%	74.7%	21.5%	0.1%	3.7%
Service Type					
Diagnostic testing	98.8%	99.7%	95.6%	93.9%	99.1%
Condenser coil cleaning	98.8%	99.7%	95.7%	90.9%	99.4%
Filter replacement	96.7%	98.5%	90.9%	87.9%	94.2%
Refrigerant charge	37.2%	38.7%	36.7%	36.4%	10.9%
Smart thermostat	61.0%	69.6%	41.4%	39.4%	0.1%
Western Cooling Control	0.4%	0.0%	0.2%	0.0%	9.1%
System repair	9.9%	8.3%	15.7%	12.1%	9.6%
Electric heat pump installs	0.4%	0.1%	1.7%	0.0%	0.1%
Furnace early replacement	0.2%	0.0%	1.0%	3.0%	0.1%

The above table also shows that several specific service elements were distributed unequally across sectors. Generally, tune-ups done in the multifamily and commercial sectors tended to be more comprehensive than those done in the single-family sector. That is, a higher percentage included diagnostic testing, condenser coil cleaning, and filter replacement. An exception to the above is that the commercial sector showed by far the lowest prevalence of refrigerant charge.

Smart thermostat installation by far had the greatest prevalence in multifamily residences and the lowest in commercial buildings.

By contrast, projects done in single-family residences and mobile homes were notably more likely to include system repairs than were those done in multifamily residences and commercial buildings. The same was true for both electric heat pump installations and furnace early replacements, although both had low overall prevalence.

A.17.1.6.3 Program Marketing and Outreach

Contractor Prioritization of Markets

Contractors clearly varied in terms of the markets they prioritized. As Table A-167 shows, about one-fifth of contractors did no more than 5% of their projects in the multifamily sector, while about the same share did more than 60% of their projects in that sector. This table also shows the mean percentage of projects done in the other commonly served sectors, by share of projects in the multifamily sector. For example, contractors who did no more than 5% of their projects in multifamily properties did, on average, 73% in single-family residences and 26% in commercial buildings. As expected, the mean percentage of projects done in both the single-family and commercial sectors decreases as the multifamily share of projects increases.

Table A-167 Distribution of Contractors by Percentage of Projects in Multifamily Sector, with Mean Percentage Done in Other Sectors at Each Level

Percentage of Projects in Multifamily Sector		Mean Percentage of Projects Done in Other Sectors	
Range	Percentage of Contractors	Single-family	Commercial
Up to 5%	19%	73%	26%
>5% to 10%	11%	78%	14%
>10% to 20%	17%	81%	5%
>20% to 40%	19%	63%	5%
>40% to 60%	13%	47%	5%
>60% to 100%	21%	16%	3%

Contractor Variation in Efficiency Gains

There is considerable variability across contractors in the mean level of kWh savings per project, ranging from about 55.9 to about 247.4 kWh per project. Several factors contribute to a project's savings. Those that likely account for most of the variability in the contractors' mean per-project savings are the capacity of the cooling equipment, the residence's heating type, and whether the project included installation of a smart thermostat. These are the items that both are clearly related to mean per-project savings levels and show an appreciable amount of variability among contractors (Table A-168).

Table A-168 Factors Most Affecting Project Savings

Saving-Impact Factor	Mean Project kWh Savings	Percent of Projects, by Sector*		
		Multifamily	Single-family	Commercial
Air Conditioning Capacity (Tons)				

Saving-Impact Factor	Mean Project kWh Savings	Percent of Projects, by Sector*		
		Multifamily	Single-family	Commercial
Up to 1.5	80.3	39.9%	2.5%	5.8%
>1.5 to 2.0	113.1	39.2%	4.9%	14.1%
>2.0 to 3.0	132.6	18.8%	29.0%	29.4%
>3.0	161.0	2.2%	63.6%	50.7%
Natural Gas Space Heat				
Yes	125.1	13.5%	94.9%	38.2%
No	111.0	86.5%	5.1%	61.8%
Smart Thermostat Installation				
Yes	138.5	69.6%	41.4%	0.1%
No	79.6	30.4%	58.6%	99.9%

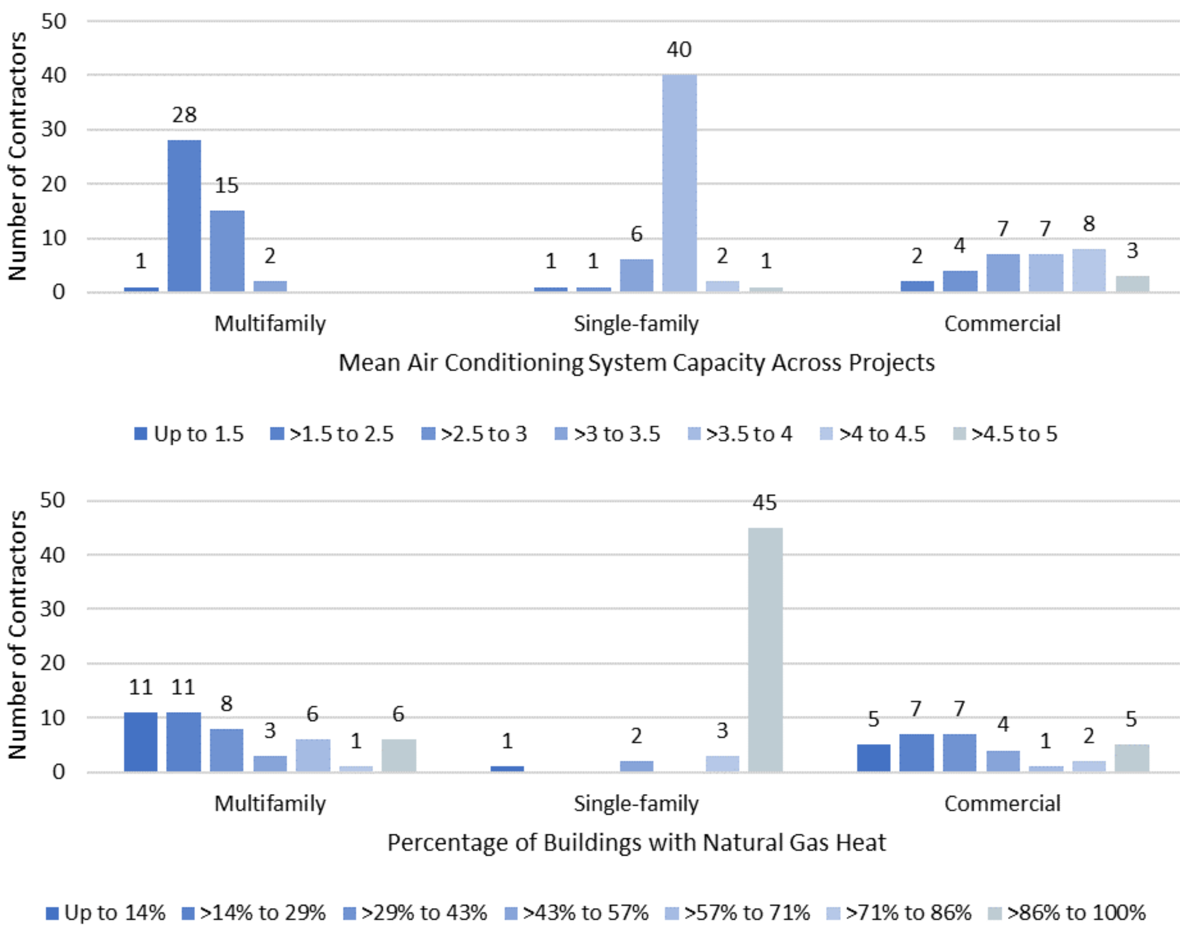
**Excludes mobile homes, as these make up a very small percentage of projects.*

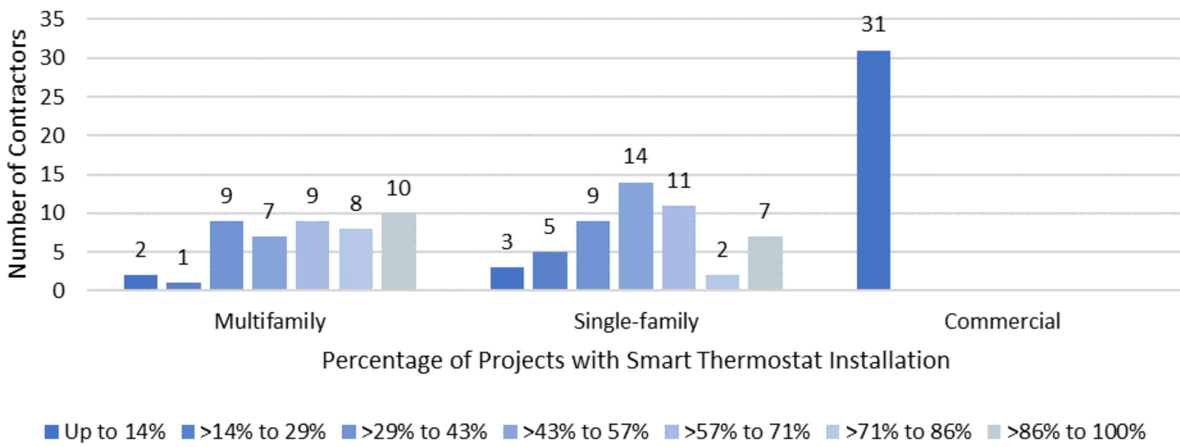
The distribution of the above savings-impact factors varies considerably by sector. Air conditioning systems in single-family residences and commercial buildings tend to be larger than those serving multifamily residences. This also explains why natural gas heat is associated with greater per-project savings, as it is more common in single-family residences and commercial buildings than in multifamily residences and, therefore, also is associated with larger systems. However, while single-family residences are also more likely than commercial properties to include installation of smart thermostats, which also are associated with greater savings, they are much less likely to include these than are multifamily properties. The greater air conditioning system capacity in single-family residences offsets the greater prevalence of smart thermostats in multifamily residences, such that contractors that do a greater share of their project work in single-family residences tend to have higher per-project savings ($r = .36$, $t = 2.73$, $p < .005$).

As the distribution of the above savings-impact factors varies by sector, we examined how the contractors that worked in each sector were distributed in relation to those factors within sectors. This provides a picture of how many contractors, within each sector, tended to service smaller-than-average capacity air conditioning systems or serviced fewer than average buildings with natural gas heat or installed fewer than the average number of smart thermostats. The top part of Figure A-29 shows a fairly tight distribution regarding size of serviced systems in the multifamily sector, with most contractors servicing systems that averaged from about 1.5 to 3 tons. One contractor in that sector serviced systems that averaged 1.5 tons or smaller, and two serviced systems that averaged 2.5 to 3.0 tons.

By contrast, the distribution of contractors in the single-family sector was highly peaked, with 40 (about 80%) servicing systems that averaged 3.5 to 4.0 tons, but eight contractors serviced systems that were smaller than that, on average, and three serviced systems that were larger, on average. The contractors that worked in the commercial sector were much more evenly distributed.

Figure A-29 Distribution of Contractors by Savings-Impact Factors





With regard to the percentage of buildings with natural gas heat, contractors in both the multifamily and commercial sectors were fairly evenly distributed. The great majority of those working in the single-family sector almost exclusively serviced residences with natural gas heat. For only one contractor did residences with natural gas heat represent a clear minority of projects.

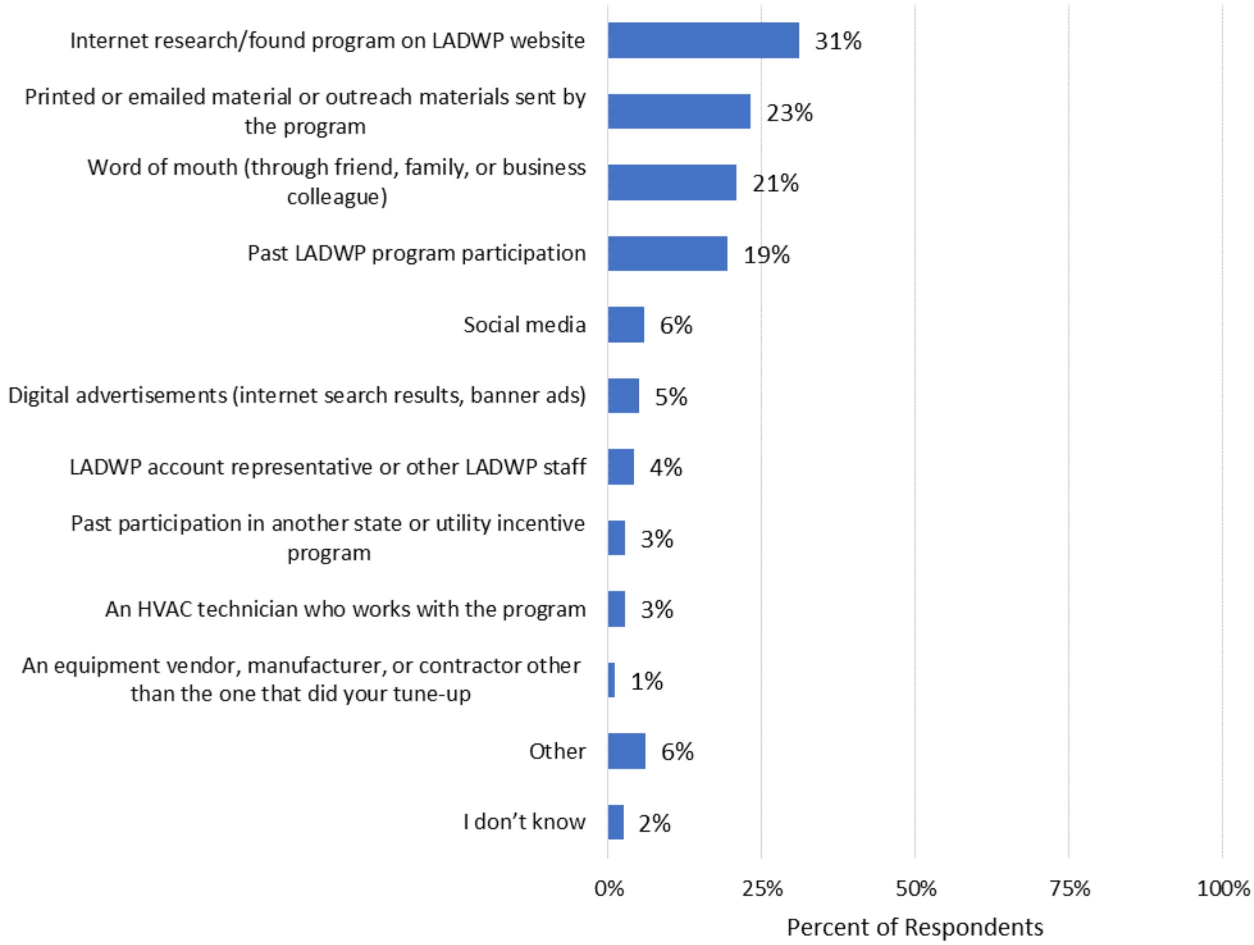
Finally, the bottom part of the figure shows the distributions of the percentage of projects with smart thermostat installations. The notable findings from this are that three contractors seem to be outliers on the low side, in terms of smart thermostat installations in the multifamily sector and perhaps eight are outliers in the single-family sector. These contractors installed smart thermostats in less than 30% of the residences they served, and about half of them did so in less than 15%. While contractors can install the smart thermostats only if the resident agrees to have them, such a low percentage may suggest a weak effort to convince customers of the benefits of the smart thermostats.

A.17.1.6.4 Participant Survey Findings

Program Awareness and Influence

Survey respondents most commonly learned about the Air Conditioning Optimization Program from internet research/LADWP website, printed or emailed materials sent by LADWP, past LADWP program participation, and word of mouth (Figure A-30).

Figure A-30 Sources of Information about ACOP



The fact that only 3% of respondents reported learning about the program through a program-affiliated HVAC technician/contractor seems at variance with the program staff and implementer's reports that contractor outreach is a primary source of projects. This may be at least partly explained by the fact that the surveyed participants were all single-family residential customers. As discussed in Section A.17.1.6.3, HVAC contractors that focused on the single-family sector tended more to cite the program portal than their own outreach as their primary source of tune-up customers. By contrast, those who focused more on the multifamily sector tended to say outreach to existing customers was their primary method of getting tune-up jobs. While residential customers made up 96% of customer contacts, multifamily projects made up nearly 80% of all projects done in the past year. (The customer contacts for multifamily projects were a limited population of property owners or managers.) Thus, even if contractor outreach accounts for a small percentage of single-family residential projects, as seen in this survey, it may account for a large share of all projects.

Does the ACOP result in more air conditioning tune-ups than would be done without the program?

Few respondents (7%) indicated they had a maintenance contract to regularly service their air conditioning system. Nearly all (94%) of those said tune-ups were done about once a year or more frequently. Three-quarters of them said the maintenance contract was not with the ACOP contractor that did their tune-up.

Fewer than half of respondents (40%) said a heating and cooling contractor had ever done a tune-up on their air conditioning before they participated in ACOP, and more than half of those indicated the tune-up had been done at least two years previously (Table A-169).

Table A-169 How Long Since Last Air Conditioning Tune-Up Before Program

Response	Weighted Count	Percent of Responses
One year	30	38%
Two or more years	46	58%
Don’t know	1	1%
No response	2	3%

When asked what their tune-up plans had been before learning about the program, more than half said they did not have plans to have their air conditioning tuned up or that they did not know if they had plans (Table A-170). Further, one-third (33%) of those who said they had prior air conditioning tune-up plans said that they would have had the funds to pay for such a tune-up outside the program. Thus, about one in seven respondents indicated they had tune-up plans and had the funds to pay for a tune-up.

Table A-170 Had Plans for AC Tune Up Before Learning About ACOP

Response	Weighted Count	Percent of Responses
Yes	91	45%
No	98	48%
I don’t know	14	7%

Together, the above findings suggest that the program does result in more tune-ups than would have occurred without it.

Smart Thermostat Installation

The program offers installation of a free Wi-Fi-enabled smart thermostat to tune-up recipients who have wireless internet connection and do not already have a smart thermostat. Alternatively, customers who do not have wireless internet or prefer a smart thermostat other than what is provided in the program, they may apply for a $75 rebate for a different model via the LADWP Efficient Product Marketplace.

Of the 219 survey respondents, 149 did not have smart thermostats installed during the tune-up. A large percentage (86%) of those respondents said they already had a smart thermostat when they received their tune-up[14]. The remaining 22 respondents provided a variety of reasons, which are summarized below.

- The most common (nine respondents) was that they did not know they could get one through the program, although three additional respondents three said they did not know why no smart thermostat was installed, which may imply lack of awareness of its availability.
- Three respondents said they preferred not to have a smart thermostat.
- Two reported that installing the smart thermostat would have cost additional money – one explicitly referenced the cost to install additional wiring, while the other simply said the technician “wanted extra money to upgrade the thermostat.”
- One each reported having decided to buy one through the Efficient Product Marketplace or a non-program retailer.
- One respondent indicated that the previous homeowner had received a smart thermostat through the program (and so the air conditioning system was not eligible for a new one) but that the previous owner had taken the smart thermostat after selling the house.
- Four offered responses that did not clearly answer the question: one said they had bought a new air conditioner and furnace unit that year but did not indicate what type of thermostat they had; one said the technician did not know how to install the Western Cooling Control device but did not explain why a smart thermostat was not involved; one said that “no 2 speed thermostats were offered”; and one simply said the heater did not work.

Of the 23 respondents who had a smart thermostat installed, two-thirds said they had not had plans to install a smart thermostat before learning about the program (n = 15) or did not know whether they had had plans (n = 1). Of the eight who reported prior plans to install a smart thermostat, five said they installed the smart thermostat sooner than they would have if they had not participated in ACOP. Thus, for all but three of those who had a smart thermostat installed, the program induced a smart thermostat installation where one would not have otherwise been installed or resulted in an earlier installation of one that would otherwise have occurred.

[14] Two of those reported that they had received the smart thermostat at the time of a previous tune-up received through the program. One respondent reported they already had a smart thermostat but that “it is not working as far as the smart ap feature.”

Tune-Up Experience

A large majority (84%) of survey respondents indicated that the technician providing the tune-up went over what the tune-up would entail. Of those respondents who said the technician provided details about the tune-up, the most identified activities were checking the refrigerant charge, cleaning the outdoor coils, and replacing or cleaning the air filters (Table A-171). Fewer respondents recalled the electronic diagnostic.

Table A-171 Tune-Up Activities Respondent Recalled

Response	Weighted Count	Percent
Checking the refrigerant charge	147	84%
Cleaning the outdoor coils	137	78%
Replacing or cleaning air filters	136	78%
Doing an electronic diagnostic of your air conditioning system	113	64%
Other	13	7%
Don’t know	5	3%

A large majority of respondents also reported either that the technician did not recommend they visit LADWP’s website for more information (48%) or that they did not recall the technician making such a recommendation (25%). Overall, just under half of the respondents (48%) indicated they did visit the website to learn more about the benefits of a tune-up, but the percentage was greater among respondents who said the technician recommended it (67%) than among those who did not confirm the technician recommended it (41%)[15].

Program staff had reported that technicians are not required to provide customers with information on how to maintain their air conditioning systems between tune-ups (Section A.17.1.6.1). Nevertheless, about half of respondents said that the technician provided some such information (Table A-172). The survey did not ask respondents to provide details on the information that was provided, however.

Table A-172 Technician Provided Information on How to Maintain Air Conditioning System

Response	Weighted Count	Percent
Yes	111	53%
No	63	30%
Don’t know	34	16%
No response	2	1%

[15] Difference tested by two-sample z-test for proportions; z = 3.30, p = .002.

Tune-Up Results

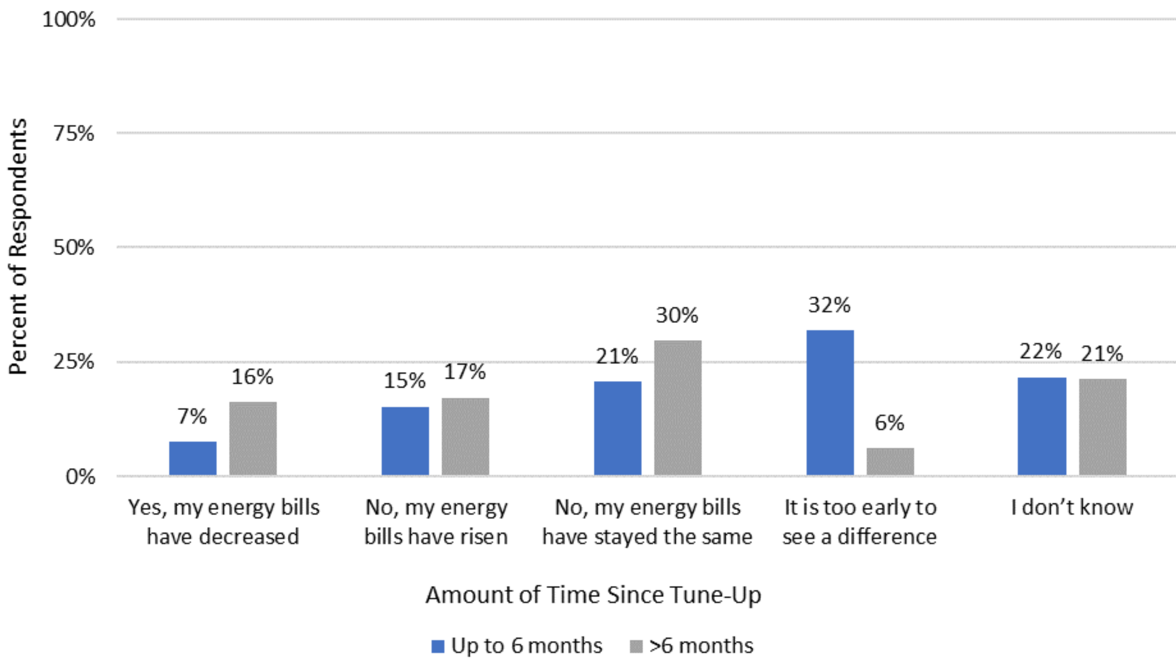
There was no consensus among respondents that energy bills decreased after the tune-up (Table A-173).

Table A-173 Have Energy Bills Decreased Since Tune-Up?

Response	Weighted Count	Percent of Responses
Yes, my energy bills have decreased	28	14%
No, my energy bills have risen	36	18%
No, my energy bills have stayed the same	58	28%
It is too early to see a difference	35	17%
I don't know	47	23%

It may take time for customers to experience the effects of the tune-up, especially if the tune-up occurred just before the beginning of cooling season. Therefore, we split the sample between those who had had their tune-up within the 6 months before the survey (n = 83) and those who had the tune-up more than 6 months before the survey (n = 136). Figure A-31 shows that one-third of respondents in the first group said that it was too early to see a difference in their energy bills, compared to about one in 16 respondents in the second group. This confirms that program participants tend to recognize that it takes time to realize the energy impacts of their participation.

Figure A-31 Perceived Tune-up Impact on Energy Bills by Amount of Time Since Tune-up



A greater interval since the tune-up was associated in the sample with a greater likelihood of reporting decreased energy bills as well as a greater likelihood of reporting that energy bills had remained the same. Neither of these differences was statistically significant at the commonly recognized criterion of $p \leq .05$, although both differences approached that criterion[16].

Many factors can affect home energy consumption (season, changes in home occupancy, changes in behavior), which can make it difficult to recognize the efficiency gains from an air conditioning tune-up. Therefore, a perceived decrease in energy bills may not be the most meaningful indicator of program success.

If respondents differed in their perception of the tune-up's impact on their energy bill, they were more consistent about the impact on home comfort. More than half agreed that their home was more comfortable since having their air conditioning tuned up through LADWP's program, while 6% disagreed (Table A-174).

Table A-174 Home Feels More Comfortable

Response	Weighted Count	Percent of Responses
1 – Completely disagree	12	6%
2	2	1%

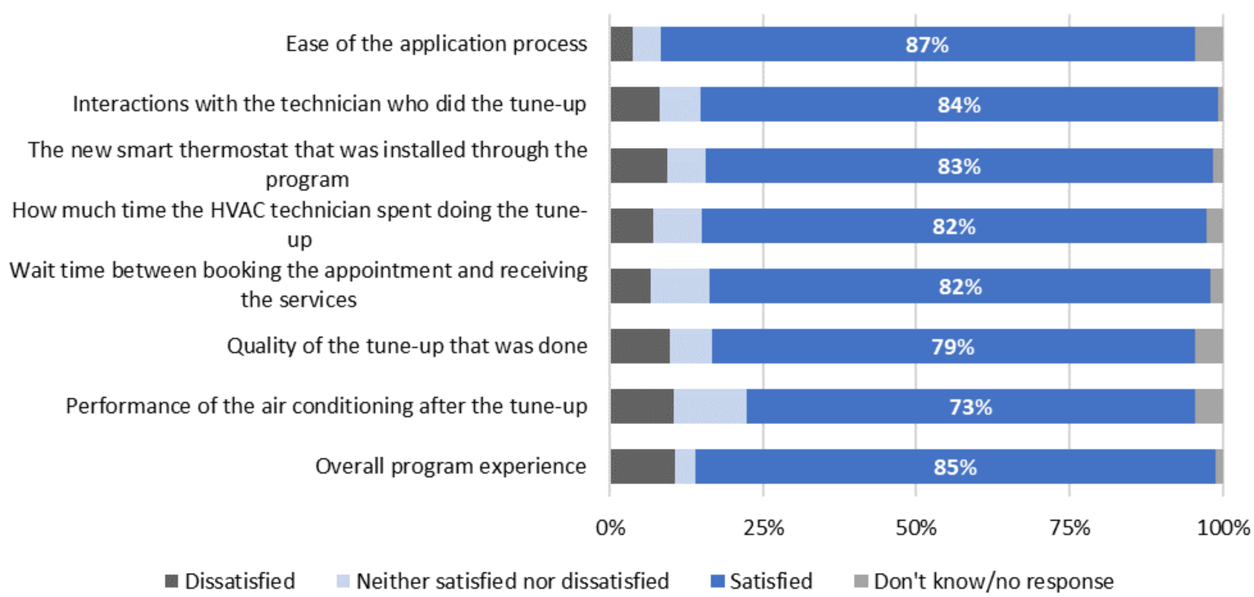
[16] Difference tested by two-sample z-test for proportions. For "energy bills have increased," $z = -1.88$, $p = .06$; for "energy bills have stayed the same," $z = -1.46$, $p = .14$.

Response	Weighted Count	Percent of Responses
3	57	28%
4	57	28%
5 – Completely agree	57	28%
I don't know	16	8%
No response	1	0%

Satisfaction

Customers generally reported satisfaction with their tune-up experience (Figure A-32), particularly with the application process, interactions with the technician, the new smart thermostat, the amount of time the tune-up took, and the wait time to get the tune-up. Respondents were less satisfied with the tune-up quality and performance of their air conditioning after the tune-up – reasons for dissatisfaction are discussed further below.

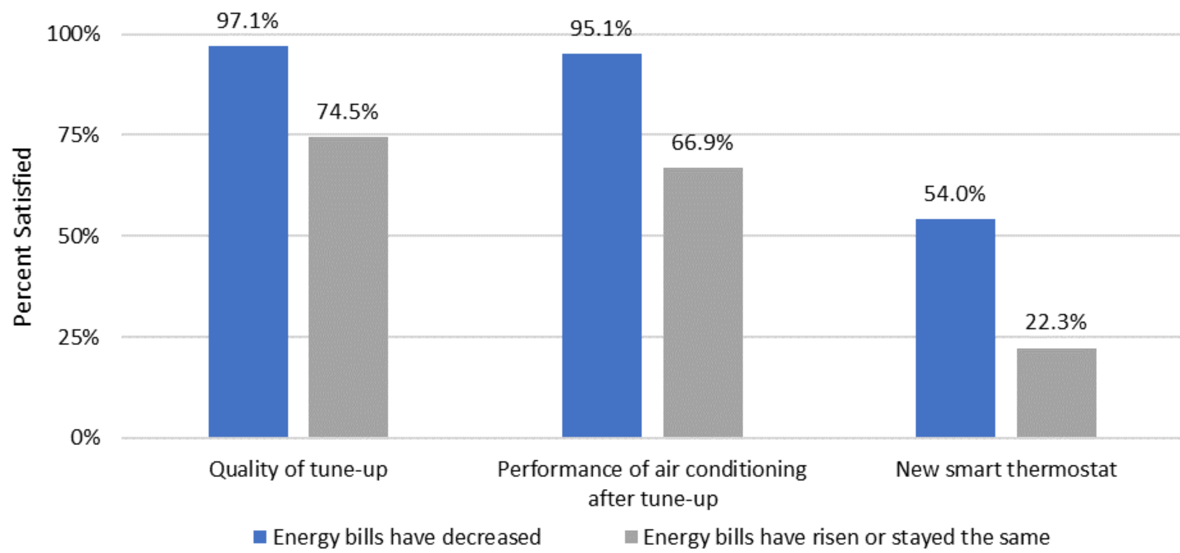
*Figure A-32 Satisfaction**



* Respondents rated satisfaction on a scale from 1 (very dissatisfied) to 5 (very satisfied). For this graphic, we categorized responses as dissatisfied (1 or 2), neither satisfied nor dissatisfied (3), or satisfied (4 or 5).

We examined whether respondents who reported that their energy bills had decreased after the tune-up reported greater satisfaction than did those who reported bills had not changed or had risen on certain indices. Specifically, we anticipated a participant's experience with energy bills after the tune-up would be most closely related to satisfaction with the quality of the tune-up, performance of the air conditioning after the tune-up, and the new smart thermostat that was installed. Respondents who reported that bills decreased reported greater satisfaction on all three indices (Figure A-33)[17].

Figure A-33 Relationship of Satisfaction to Experience with Energy Bills After Tune-up



Consistent with the generally high satisfaction levels, a large percentage (90%) of respondents either reported they had recommended the program to others (78%) or were likely to do so (12%). Further, nearly three-quarters (72%) of respondents indicated that their program participation improved their attitudes towards LADWP, and most of the rest reported no impact (Table A-175).

Table A-175 What impact did your participation in the Air Conditioning Optimization Program have on your attitude toward LAWDP?

Response	Weighted Count	Percent of Responses
Improved my attitude toward LAWDP	150	72%
No impact	49	24%
Worsened my attitude toward LADWP	9	4%

Forty-two of the 219 (19%) respondents indicated dissatisfaction with any aspect of the program. All of those who said their participation in the program were among those who reported dissatisfaction. The survey provided those 42 respondents with an opportunity to explain their dissatisfaction or why their participation worsened their attitudes.

[17] The difference between the two groups in the percentage of respondents providing a satisfaction rating of 4 or 5 was tested by two-sample z-test for proportions. For “quality of tune-up,” z = 2.54, p = .01; for “performance of air conditioning,” z = 2.90, p = .004; for “smart thermostat,” z =3.15, p = .002.

The two most common types of comments, made by 11 respondents each, were specific issues about the technical quality of the service or complaints that the technician charged extra for some service or attempted to get them to pay extra for something they did not think was needed.

The most common of the cost-related complaints was simply that the technician recommended replacing the air conditioning unit, an observation that five respondents made. In one case, the respondent reported that the existing air conditioner was "fairly new." One commented that "My air HVAC worked just fine throughout summer, and I was able to save thousands of dollars by not agreeing" to upgrade the air conditioning.

Other cost-related complaints varied. One respondent reported that the technician said rust must be removed from inside the unit before it could be tuned up and charged the participant $175 to spray rust remover on it. The remaining comments were less specific about the cost item:

- One reported that technicians said the participant must pay "outrageous" amounts of money for services (unspecified by the participant) that were supposed to be included free in the program and refused to install a smart thermostat or add refrigerant until the amount was paid.
- One reported the technician said the participant did not qualify for free maintenance and charged participant for the tune-up.
- One reported the technician said the participant needed "a whole bunch" of coolant and had to buy it from the technician. A separate air conditioning contractor said the coolant was adequate.
- Two simply said it "seemed like the technician was here to sell and not help" or the technician was "trying to talk me into doing extra work for extra money."

Regarding the technical quality of the service, respondents identified the following issues – each item was identified by one respondent unless otherwise indicated:

- The technician disconnected furnace fan and attic light, neither of which were reported and not noticed until much later.
- The technician did not have air filters (two respondents).
- The technician added too much coolant (discovered in QC audit).
- The technician did not add needed coolant (discovered later either in QC audit or when air conditioning failed, and respondent hired different contractor).
- The technician removed Western Cooling Control device without advising customer; follow-up visit by another technician failed to connect it properly.
- The technician did not know how to install smart thermostat.

- The technician did not have smart thermostat available.

Six additional participants did not identify a specific technical issue but made comments suggesting that something was technically wrong with the tune-up or that it did not meet expectations. Three said that their air conditioning failed shortly after the tune-up. Three said they did not notice any difference in how their air conditioning functioned after the tune-up.

Seven participants (some of whom cited specific technical issues) made a variety of non-technical or more general complaints about the technician:

- The technician did not wear a mask or shoe coverings and tracked dirt inside home.
- The technicians were rude.
- The technician did not show for appointment.
- Scheduling was difficult and/or it took a long time to make an appointment (two respondents).
- Technician was in a hurry and "didn't do much."
- Technician cited a "technical reason" for not performing the tune-up.

Five respondents, including four that reported complaints about the technician, cited problems with service or follow-up from LADWP, the implementer, or the HVAC contractor. Two reported that they had contacted LADWP about service issues (the one who reported the nonworking thermostat and the one who said the technicians were rude) but that LADWP did not help with that issue but just referred the respondent back to the contractor. One commented that LADWP uses contractors that "do not complete their jobs." One commented about lack of interaction with "a live person." Finally, one reported having tried to contact the HVAC contractor because that participant's furnace stopped working after the tune-up but nobody from the company has returned the participant's calls.

Two respondents who reported dissatisfaction with the time interval between scheduling and conducting the tune-up simply reiterated that concern.

Finally, one respondent each commented on LADWP billing errors and continued high energy bills despite having received upgrades.

We were able to identify the technician associated with each surveyed participant's tune-up, which allowed us to assess whether certain technicians seemed to get an unusual number of complaints. Overall, we identified 33 technicians, each associated with from one to 32 survey respondents. We examined the number of surveyed participants each of those provided tune-ups to and the number of those participants who provided at least one "dissatisfied" response to any of the five satisfaction items that specifically referenced the contractor – that is, all of the satisfaction items except the ease of the application process and the overall program satisfaction.

Eighteen of those 33 technicians, just over half, were associated with at least one dissatisfied response to one of those items. Of those 18, five had dissatisfied responses from about one in 10 or fewer of the respondents they served. In only two of those cases did a participant provide a reason for being dissatisfied. In neither of those was the dissatisfaction with the technician in particular: in one, it was about continued high bills despite many energy conservation and efficiency actions; in the other, the dissatisfaction was about not having received a rebate for HVAC replacement.

The remaining 13 technicians (or 39% of the technicians associated with a survey respondent) accounted for nearly all of the complaints. Table A-176 summarizes the information relating to these 13 technicians. It is sorted in terms of the number of reasons for dissatisfaction provided, from most to least. Of particular concern is Technician 7: both of the surveyed respondents who were served by this technician reported that their air conditioning failed within two weeks after that technician's visit. This may well be a coincidence but, if not, this could suggest a serious problem for the program.

Table A-176 Technicians Accounting for Complaints

Technician	Number of Survey Respondents Served	Number (%) of Respondents Identifying Dissatisfaction	Reasons for Dissatisfaction
1	4	3 (75%)	▪ Lag time between appointment and service (was long). ▪ Had to pay someone to come fix air conditioning after tune-up when it was working perfectly before. ▪ Technician recommended replacing the unit, which was "fairly new"; company had poor follow-up; tune-up did not have significant impact on system.
2	9	3 (33%)	▪ Technician required rust removal at cost of $175. ▪ Technician disconnected furnace fan and attic light, not discovered until months later; thermostat stopped working. ▪ (One respondent did not provide reason.)
3	9	3 (33%)	▪ Inexperienced technician did not know how to install thermostat, requiring visit by another technician; furnace no longer works since visit.

Technician	Number of Survey Respondents Served	Number (%) of Respondents Identifying Dissatisfaction	Reasons for Dissatisfaction
			▪ Technician pushed for HVAC replacement, although air conditioning worked through summer. ▪ (One respondent did not provide reason.)
4	5	2 (40%)	▪ Later inspection revealed issue with duct the technician had not fixed or mentioned ▪ “Sketchy” technician said they had to buy more refrigerant or he would alert LADWP; independent consultant later told them refrigerant level was good.
5	9	2 (22%)	▪ Technician failed to show up for appointment. ▪ Technician said respondent did not qualify for free maintenance and charged for services.
6	4	2 (50%)	▪ Technician “tried to upsell” a new air conditioning and furnace system. ▪ Smart thermostat did not function correctly. (Not sure if the tune-up was the cause.)
7	2	2 (100%)	▪ Air conditioning failed two weeks after tune-up. ▪ Air conditioning stopped working one week after tune-up.
8	6	2 (33%)	▪ Technician “was here to sell and not help.” ▪ Technician did not have filter, did not check unit in attic, did not check whether air conditioning worked; entire process took five minutes.
9	7	2 (29%)	▪ Technician added too much coolant, discovered during later inspection; air conditioning now “struggles” to come on an makes “weird high-pitched noises.” ▪ (One respondent did not provide reason.)
20	13	3 (23%)	▪ The technician did not wear mast or shoe coverings, left dirt inside home, did not have air filters. ▪ (Two respondents did not provide reason.)
11	20	6 (30%)	▪ Need more interaction with a live person. (Not sure who this is directed to.) ▪ (Five respondents did not provide reason.)

Technician	Number of Survey Respondents Served	Number (%) of Respondents Identifying Dissatisfaction	Reasons for Dissatisfaction
12	3	1 (33%)	▪ Technician "was in a hurry and didn't do much."
13	1	1 (100%)	▪ Technician said no refrigerant was needed, but had to pay a different HVAC contractor $200 two months later to add refrigerant to make air conditioning work.

Air Conditioning Replacement Incentive

Tune-up recipients whose air conditioning system operates at 9.0 SEER or lower are eligible for an incentive of up to $1,200 to replace their system with an ENERGY STAR® rated system. When survey respondents who were identified as eligible for that incentive (n = 135) were asked about it, one-quarter said they did upgrade or plan to upgrade using the program incentive (Table A-177). Most of the rest reported no plans to use the program incentive or reported no recollection of being told they were eligible for an incentive. The fact that nearly one-third could not recall being told about the incentive may suggest a need for clearer communication of eligibility for the replacement incentive.

Table A-177 Use of Planned Use of Air Conditioning Replacement Incentive

Response	Weighted Count	Percent of Responses
Replaced air conditioning system with the program incentive	8	6%
Plan to replace air conditioning system with the program incentive	26	19%
Do not plan to replace air conditioning system with the incentive	44	33%
Do not recall being told was eligible for the incentive	40	30%
Don't know	16	12%

When those who knew about the incentive but still had no plans to replace their air conditioning system were asked the reason, the most common responses were that their air conditioning runs fine and that it still costs too much even with the program incentive (Table A-178). These responses suggest a need to communicate more clearly the benefits of replacing inefficient air conditioning as well as providing information about, or avenues for, financing.

Table A-178 Reasons for No Plan to Replace Air Conditioning with the Program Incentive (Multiselect)

Response	Weighted Count	Percent of Responses
Air conditioning runs fine	28	63%
Not yet needed air conditioning	25	57%
It costs too much to replace air conditioning even with the incentive	3	6%
Landlord's responsibility	2	5%
Have not yet decided what to replace it with	1	2%
Have not had time to do it yet	1	2%

Respondent Demographics

Nearly all (97%) of the survey respondents reported residing in a single-family, detached home, with the others reporting residing in an attached home or a single-family home with an accessory dwelling unit or declining to answer. A large majority (92%) reported being homeowners, with the rest split between renters and those who declined to respond.

Respondents tended to report living in mid-century or older, moderately sized homes that predominantly use natural gas for space and water heat (Table A-179).

Table A-179 Home Vintage and Size

Response	Weighted Count	Percent of Responses
Home Vintage		
Before 1950	57	28%
1950 to 1959	69	34%
1960 to 1969	34	16%
1970 to 2020	38	18%
Don't know	6	3%
No response	2	1%
Home Size (Square Feet)		
Less than 1,000	8	4%
1,000-1,999	123	60%
2,000-2,999	47	22%
3,000 or more	22	11%
Don't know	7	3%
Space Heating Fuel		
Electricity	33	16%
Natural gas	162	78%

Response	Weighted Count	Percent of Responses
Don’t know	10	5%
No response	2	1%
Water Heating Fuel		
Electricity	15	7%
Natural gas	175	85%
Both electricity and natural gas	2	1%
Don’t know	9	5%
No response	6	3%

Respondents were somewhat more likely to be male than female. They varied broadly in age and education level, were predominantly Caucasian/white, Asian-American, or Hispanic/Latino, and generally resided with one or two other persons (Table A-180).

Table A-180 Respondent Characteristics

Response	Weighted Count	Percent of Responses
Respondent Gender		
Male	110	54%
Female	73	36%
No response	21	10%
Respondent Age (Years)		
Up to 34	10	5%
35-44	35	17%
45-54	39	19%
55-64	45	22%
65-74	45	22%
75 or older	20	10%
No response	14	7%
Respondent Education Level		
Up to high school graduate/GED	16	8%
Associates degree, voc/tech school, or some college	32	15%
Four-year college degree	60	29%
Graduate or professional degree	78	38%
No response	19	9%
Respondent Race/Ethnicity (Multiselect)		

Response	Weighted Count	Percent of Responses
Asian	43	21%
Black/African American	8	4%
Caucasian/White	99	48%
Hispanic or Latino	28	14%
Native American or Alaska Native	2	1%
Pacific Islander or Native Hawaiian	1	<1%
Middle Eastern or North African	2	1%
Mixed race, not specified	1	<1%
No response	33	16%
Household Size		
One person	20	10%
Two or three people	104	50%
Four or five people	34	17%
More than five people	10	5%
No response	39	19%

A.17.1.6.5 General Population Survey Findings

This section presents findings from the general population survey to provide information that may be useful for ACOP planning.

Survey results indicate that about 54% of LADWP residential customers have central air conditioning. The air conditioning is not working in about 4% of cases (2% of all residential customers). The reported age of the system varies widely, with nearly half reporting their air conditioning is at least eight years old (Table A-181).

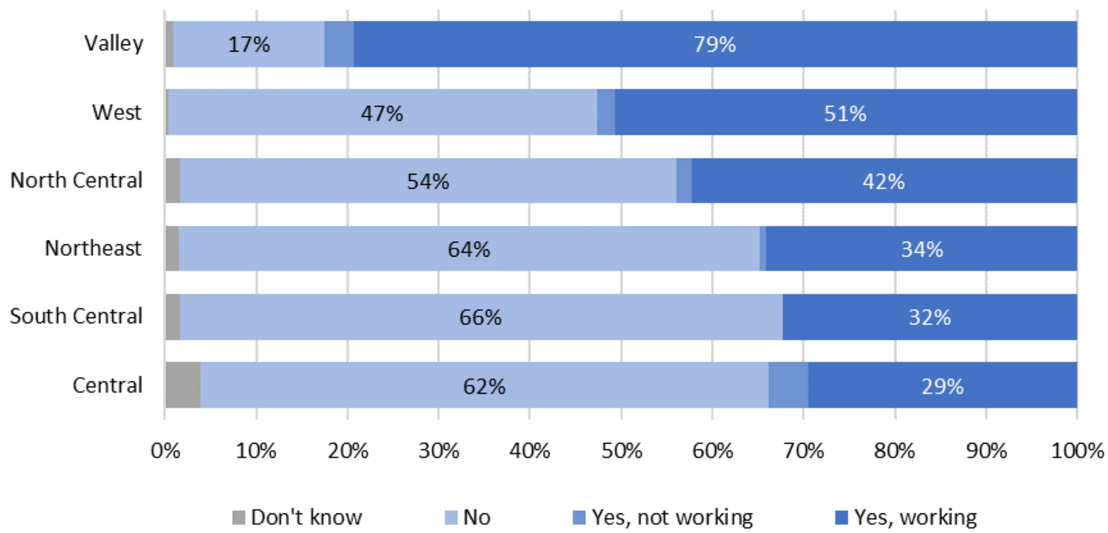
Table A-181 Age of Central Air Conditioning (n = 570)

Age	Weighted Count	Percent of Responses
Less than 1 year	16	5%
1 to 3 years	52	17%
4 to 5 years	53	18%
6 to 7 years	31	10%
8 to 10 years	66	22%
11 to 20 years	59	20%
More than 20 years	18	6%

Age	Weighted Count	Percent of Responses
Don't know	7	2%

We binned all respondents into six regions based on zip code. As Figure A-34 shows, central air conditioning was much more prevalent in the Valley than in other regions. It was least prevalent in Northeast, South Central, and Central Los Angeles.

Figure A-34 Prevalence of Central Air Conditioning, by Region (n = 570)



The oldest central air conditioning systems were in the North Central, Valley, and Central regions. Other regions had comparably new systems, with at least half the existing systems being five years old or less.

Figure A-35 Age of Central Air Conditioning, by Region (n = 330)

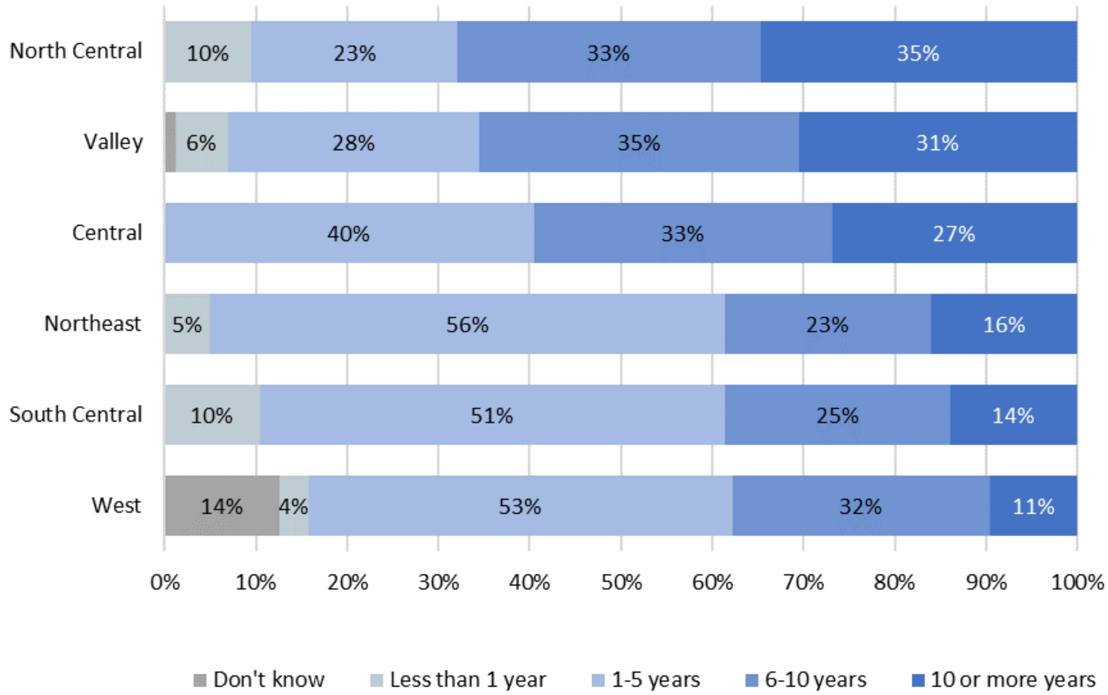
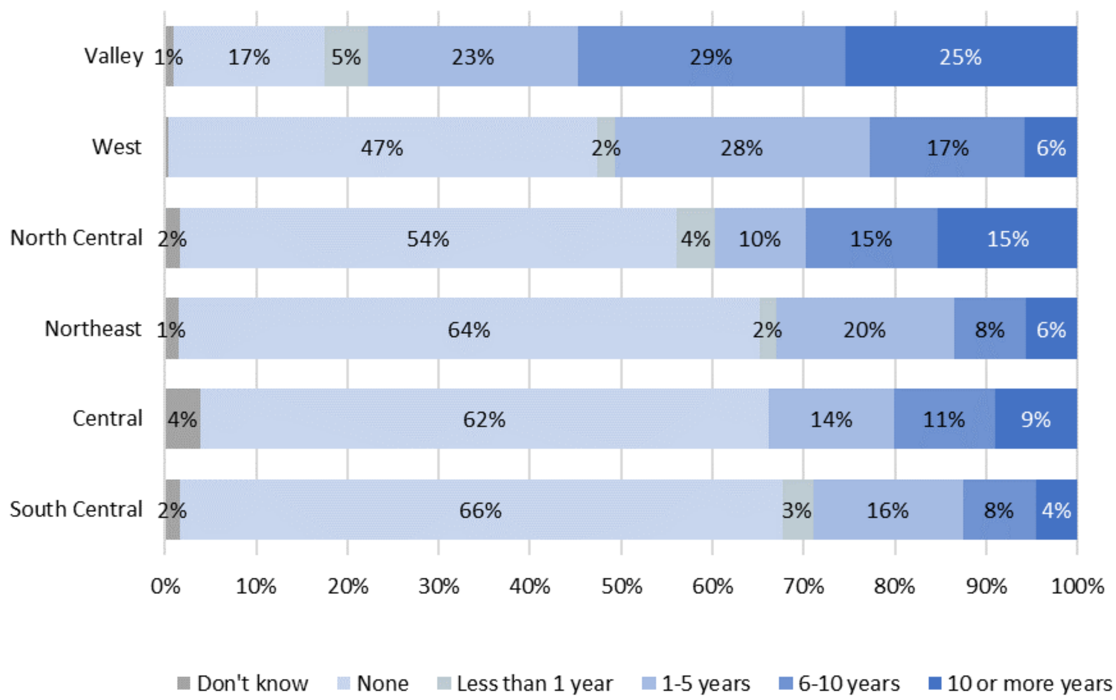


Figure A-36 shows the information on prevalence and age combined. In this case, the percentages for air conditioning age represent the percentage of all respondents, not the percentages of respondents reporting air conditioning (as seen in Figure A-35). This makes it clear that the relative differences in the prevalence of air conditioning are not the same as the relative differences in the prevalence of old or new air conditioning.

Figure A-36 Prevalence and Age of Central Air Conditioning, by Region (n = 330)

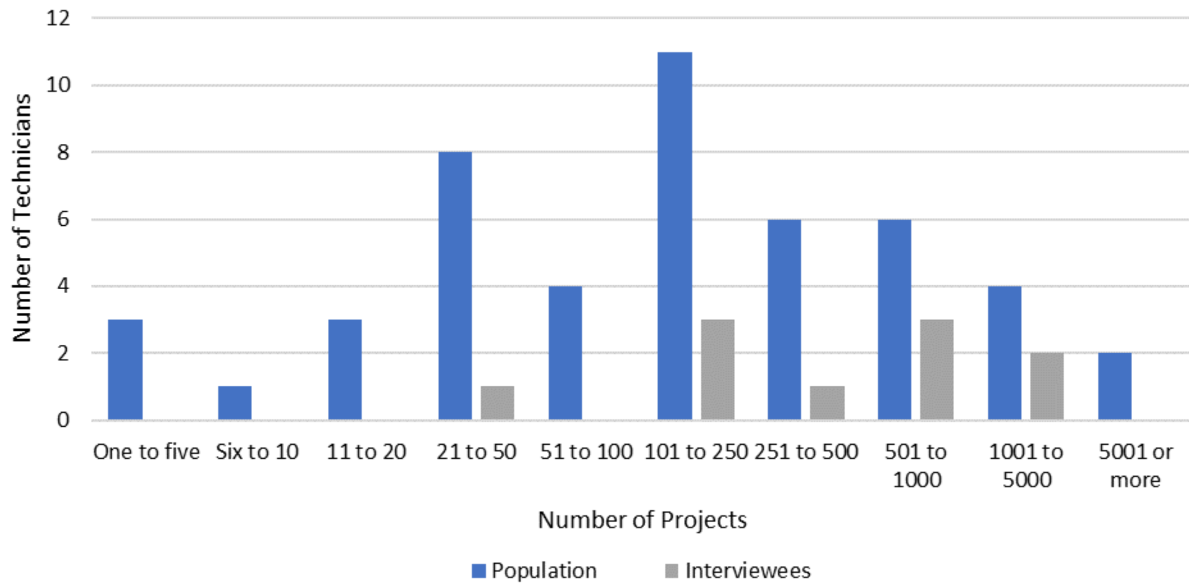


A.17.1.6.6 HVAC Technician Interview Findings

Respondent Characteristics

As planned, the 10 firms represented in the interviews varied in their level of program activity but tended to be toward the higher end of the distribution. Specifically, interviewees' firms completed from 42 to 3,351 projects, with a median of 463, compared to a range of 1 to 10,675 projects, with a median of 160, for the population of 48 contractor firms. This can be seen in Figure A-37.

Figure A-37 Distribution of Completed Projects for Interviewees, Compared to Population



All interview respondents provide comprehensive HVAC services – including installation, repairs, tune-ups, and replacement services. All but one work across both residential (single and multifamily) and commercial customers. Of those who work in the residential sector, five technicians spend more than half of their time working with single-family units, while one respondent indicated that they spend more than half of their time focusing on multi-family units.

Program Tenure and Background

All 10 respondents had been participating in ACOP anywhere from a few months to five years, with eight indicating they had been involved in ACOP less than four years. One noted that they had learned about the program about five years ago but that COVID-19 shut them down in 2020 and so they just recently became involved. Another respondent indicated that they just got involved with the program within the last year.

Motive for Participation

The primary motive for participating in ACOP was the potential for increasing business and brand awareness. Seven respondents noted that they hoped to increase their customer base through program participation. Three interviewees also identified the ability to serve low-income communities and underserved customers, while four noted learning more about air conditioning tune-ups, were additional motives for participating.

Customer Recruitment

Interviewees generally obtained tune-up customers through some combination of the LADWP program portal, word-of-mouth referrals, and conducting outreach to existing customers. The mix varied among the interviewees. The program portal was most commonly cited as the primary source, with three interviewees identifying it as the source for almost all projects and two others identifying it as one among more-or-less equally common sources. Two interviewees indicated that they get most of their work through outreach to existing customers, with three others citing it as a common source.

Five interviewees mentioned word of mouth, but interviewees did not always make it clear whether they meant that a word-of-mouth referral to the program led the customer to the program portal and, hence, to the contractor or that a customer got a word-of-mouth referral directly to the contractor. In at least two cases, the former appeared to be more common, as those interviewees also mentioned the portal as a chief source of jobs. One interviewee, however, said that all jobs arose from word-of-mouth referrals from current customers that led others to contact the interviewee, and that the program itself has not provided them with any referrals.

The primary mode of customer recruitment appears to be related to the contractors' sector focus. Those who did relatively more work in the multifamily sector also tended to report that marketing to existing customers generated a higher share of projects than other recruitment channels. By contrast, those who focused more on the single-family sector were the most likely to say that a major share of jobs came through the program portal.

Integration of ACOP Into Other Business Services

Six interviewees noted that balancing ACOP work and non-ACOP business services were typically not an issue. Two technicians did, however, emphasize that they prioritize non-ACOP business services during their busy season (summer months). One other noted that they have a designated team that focuses solely on ACOP tune-ups.

Comprehensiveness of Program and Non-program Tune-ups

When asked how the ACOP tune-ups compare to those they perform outside the program, respondents most commonly indicated that the program tune-ups are more comprehensive than tune-ups down outside of the program, with six respondents suggesting this. In explanation, various respondents noted that the program requires coil cleaning, filter replacement, smart thermostat installation, and recording energy efficiency metrics.

Two technicians said that the ACOP tune-up is not as comprehensive as the tune-ups they provide outside of the program, citing the lack of outside ductwork and the fact that the program inspection is not as comprehensive as their own inspections. One interviewee said that the program tune-ups and tune-ups done outside of the program do not differ.

Installation of Smart Thermostats in Non-program Tune-ups

Nine out of the 10 respondents noted that their non-ACOP tune-ups do not typically include installing smart thermostats. Four mentioned that they will recommend a smart thermostat in tune-ups they do outside the program but it is not required. Two respondents, including one who reported they recommend smart thermostats in non-program tune-ups, indicated that most customers are not interested in smart thermostats.

Project Tracking and Paperwork

Interview participants were asked about challenges regarding recording the required information to submit their ACOP projects. Challenges included trouble finding or accessing meters (especially for commercial & multifamily properties), as well as general field coordination (i.e., coordinating appropriate number of technicians and in-unit entries). One participant noted that working on multifamily units, which often requires more than one technician, can become a logistical challenge in terms of scheduling and timeline. They also mentioned that the program incentives amounts do not reflect the cost of more than one technician.

Barriers to Performing More Program Tune-ups

The largest barrier to participation is the lack of marketing. Six interview respondents commented on requirements that prevent them from marketing the program (five) and/or the general lack of dissemination of information about the program (three). Two specifically indicated a desire to be able to market the program on their business website and send out email marketing campaigns.

Other barriers were noted by one respondent each:

- Organizing in-unit entry.
- The cap of 100 units per month, which affects the ability to service multifamily properties. For example, servicing a 400-unit complex would require splitting the work across four months.
- The reimbursement structure is disadvantageous for servicing condos, as it takes two technicians, but they are reimbursed at the same rate as for single-family detached residences, which require only one technician. Thus, the reimbursement structure limits the number of condos they can service.

Program Improvement

Several respondents identified areas in which program services or implementation could be improved.

Four identified a variety of cost-related issues. Two of those commented on the refrigerant cost. One respondent suggested that the program should provide contractors with incentives to cover diagnostic services in commercial buildings, to identify the units that can and cannot be serviced. Finally, one simply commented that the contractor reimbursement should be adjusted, as “the program hasn't adjusted rate to the contractors even though contractors pay for everything.”

Three respondents commented adversely on the Nest smart thermostats. All three referred to “compatibility issues” of some sort, one explicitly stating that, “The problem with the program is they use the worst smart thermostat on the market. ... You can’t install [it] if there’s no common wiring. If you are installing a smart thermostat as part of maintenance, it’s an add-on.”

One respondent explained that the early replacement rebates are not evenly distributed between homeowners who have package versus split systems.

Finally, one respondent noted that customers often call thinking they can receive free repairs through the program, indicating a need to clarify or manage program expectations.

A.17.1.6.7 HVAC Ride-Along Observations

The filter was replaced at all sites. The analyst recorded that the condenser coil was cleaned at all sites, but that, at the multifamily property, the cleaning was done the day before the ride-along. At that property, the cleaning was done with a cleaner chemical. The coils were cleaned using water at the single-family residences.

Refrigerant was added at seven of the multifamily units, with two pounds added in each case. At one multifamily unit, 11 ounces of refrigerant was removed. Refrigerant was not charged at the other five multifamily units or the two single-family residences.

A smart thermostat was installed at all sites. Before the smart thermostats were installed, the multifamily property used programmable thermostats, but they were not programmed to any schedule – they were “used manually as needed.” The two single-family residences had manual thermostats before the smart thermostats were installed.

The technician that serviced the multifamily property reported that he trained the multifamily property site manager to help each tenant if needed, but the smart thermostats were “left for the tenant to program.” The technician that serviced the single-family residences did not offer training. That technician told the analyst that the smart thermostat “will make its own schedule based on how the homeowner uses it.”

No other repairs were performed at any of the sites.

A.17.1.7 Process Evaluation Conclusions

- ACOP results in more tune-ups than would have occurred without it. Few tune-up recipients have ongoing air conditioning maintenance contracts and fewer than half reported ever having had their air conditioning tuned up. A large majority said that they did not have plans to have their air conditioning tuned up and/or did not have the funds to pay for a tune-up before learning about ACOP.

- Despite the fact that the program website provides detailed information about program rules and requirements, some participants have incomplete or inadequate understanding of the program rules, requirements, and services. Such incomplete or inadequate understanding may lead to dissatisfaction (see Conclusion 4) or may prevent some tune-up participants from using the early replacement rebate to replace old and inefficient air conditioners, resulting in missed opportunities for savings.
- ACOP technicians generally do a good job of explaining the tune-up process but may not communicate other valuable information effectively. Most may not advise their customers to visit the LADWP website for more information, but doing so significantly increases customer visits. Further, some may not effectively communicate to customers about the early replacement rebate for qualifying air conditioning systems or the availability or advantages of smart thermostats.
- Although ACOP participants generally are satisfied with several program aspects and the program overall, it appears that some participants received subpar service. The fact that one in five surveyed respondents were sufficiently moved to provide a written complaint that the technician charged or attempted to charge them for services they believed were free, performed the service badly or in a rushed manner, or was rude or otherwise disrespectful or difficult to deal with is a matter of concern. As noted above, some of these responses may reflect incomplete or inadequate communication of the program rules and requirements, program services, or reasons for replacing an operating air conditioning system, but others seem to reflect improper behavior on the part of the technicians as well as lack of responsiveness from LADWP and/or the implementer. Further, it appears that some dissatisfied participants do not receive adequate response to complaints made to LADWP and/or the implementer. Fewer than half the technicians that serviced surveyed participants accounted for nearly all the technician-related respondent complaints. Of particular concern, both respondents served by one specific technician reported that their air conditioning failed within two weeks after being serviced by that technician.
- It is important to manage participants' expectations about the outcome of a tune-up. Relatively few participants observe a decrease in energy bills after their tune-up, even up to a year later. While many recognize that it may be too early to see a difference in energy bills after a few months, those who do not experience an energy bill decrease are less satisfied than others with the tune-up quality, their air conditioning performance, and their new smart thermostat (if one is installed). Lack

of satisfaction with outcomes may prevent repeat participation, potentially undermining program savings in the long run.

A.17.2 Recommendations

- LADWP should revise the program website to list any potential costs that may be required. At a minimum, the website should make it clearer that participants may be charged for the refrigerant if more than two pounds are needed. Currently, the website states only that the program provides up to two pounds, and this is stated in small print that can easily be missed.
- LADWP and the implementer should work to ensure that all communication with signed-up customers should reiterate the program rules, requirements, and services, specifying what is and is not covered in the program.
- The implementer should revisit its training procedures to address the following: 1) technicians should advise ACOP participants to visit the program website and other LADWP websites for more information about this and other programs; and 2) technicians should always tell eligible participants about the early replacement rebate and explain that inefficient air conditioners waste energy even if they seem to be operating well.
- The implementer should seek information to explain why some contractors have a lower-than-average percentage of smart thermostat installations and consider provide additional training to ensure that such contractors are able to explain the benefits of smart thermostats to their customers.
- LADWP should provide participants with explicit information on whom to contact with any program dissatisfaction: this information should be provided on the program website and on any written communication with signed-up customers.
- The implementer should carry out a higher degree of QC for the technician associated with a higher-than-expected incidence of post-tune-up air conditioning failure. ADM will provide LADWP with the name of that technician.
- LADWP should provide participants with information to help manage expectations about the results of a tune-up, such as the fact that many factors may affect their energy bill from one month to the next.

A.18 City Plants (CP) Program

This section presents details about the evaluation methodology and impact evaluation for the CP Program.

A.18.1 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.18.1.1 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.18.1.2 Ex-Ante Savings Review

Table A-182 summarizes the savings comparisons the Evaluator found between the reported ESP ex-ante kWh and Peak kW savings and the ex-ante kWh and Peak kW savings presented in the tracking data delivered by LADWP.

Table A-182 CP Program 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
21/22	6,896,107	6,896,107	0.00%	NA	NA	NA

The tracking ex-ante kWh savings were found to be the same as ESP ex-ante savings. However, program data did not provide ex-ante kW.

A.18.1.2.1 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 incorporates the following models, all also developed by the USFS:

- Tree growth models by species
- Shadow model
- Building model

- Heat run model

The original model was a research effort with all these component models in a single software package (code set). This model was tested based on standard ASHRAE formulations by comparing its results with MICROPAS for identical buildings and shade from trees for different tree locations and building vintages. KWHr savings from these models were within 4% for all of the tree locations.

The EcoLayers implementation of the model makes it user friendly and more widely applicable to real-life projects. However, the same original code set has been used (no code changes) to preserve the integrity of the original model. Only selective and specific data items have been modified to adapt the model for the LADWP shade tree program.

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%, Widow/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-183 below.

Table A-183 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.18.1.2.2 Indirect Savings

The indirect savings are calculated by applying a factor of 36% to the direct savings discussed in the previous section. Table A-184 shows CP Program ex-ante savings summary for FY 21/22.

Table A-184 FY 21/22 City Plants 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 21/22	5,634,075	2,028,267	7,662,341	6,896,107

** Includes 10% reduction based on street tree mortality rates found in Fall 2018 sampling*

A.18.1.3 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.18.2 Impact Evaluation

This section presents findings from the impact evaluation efforts to verify annual energy savings from EcoLayers' software tool.

A.18.2.1 On-Site Verifications

As part of validation of the EcoLayers model results, ADM performed on-site verifications of a sample of projects of planted program trees. These verifications were performed by conducting drive-by surveys. 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. Table A-185 presents the results of these on-site surveys. A total of 14 sites were visited. The database provided by LADWP reported 28 trees planted at these sites. However, the survey found that a total of 19 trees (68%) were alive and well at 12 different sites. The remaining nine trees either died or there was no evidence of trees being planted.

Table A-185

Total Sites Visited	14
# of Trees reported in LADWP database	28
# of Trees found alive & well	19
# of Trees planted but died	5
# of Trees missing or no evidence of being planted	4

The following parameters were used in energy saving calculations performed by the Evaluator, using i-tree Design software. The details on on-site verification of these sampled projects are provided in Table A-186 below.

Table A-186 Details on In-Person Verified Shade Tree Projects

Project	Zip Code	# Of Trees	Orientation	Species	Height (ft.)	Spread (ft.)	Spread (ft.)
Project 1	90004	1	West	Platanus acerifolia/London Plane	6	4	15
Project 2	90016	2	East	African Sumac	15	8	15
Project 3	90018	2	West	African Sumac	12	7	8
Project 4	90036	1	North	Tristania conferta/Brisbane Box	15	8	15
Project 5	90037	2	South	Brisbane Box	10	5	10
Project 6	90037	1	West	Brisbane Box	15	8	20
Project 7	90044	2	South	Chinese Elm	8	4	30
Project 8	91331	1	North	Koelreuteria bipinnata/Chinese Flame	7	3	35
Project 9	91331	1	Southwest	Pistacia chinensis/Chinese Pistache	12	10	30
Project 10	91331	2	North	Tristania conferta/Brisbane Box	13	4	30
Project 11	91342	2	North	Lagerstroemia indica/Crape Myrtle	8	5	15

Project	Zip Code	# Of Trees	Orientation	Species	Height (ft.)	Spread (ft.)	Spread (ft.)
Project 12	91605	2	East	Tristania conferta/Brisbbane Box	12	5	25

A.18.2.2 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.18.2.2.1 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 used on-site survey data from 12 randomly sampled sites from the City Plants dataset. The Evaluator used i-Tree Design software, developed by USDA, to calculate the savings for the sampled 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-38 portrays a picture of a Brisbane Box tree planted on right side of the house, through the CP Program. The house faces east.

Figure A-38: Brisbane Box Tree Planted through CP Program

Figure A-39 portrays the screen capture of i-Tree Design model of the same house shown from above. A Brisbane Box tree on the right side marks the location of the tree. The canopy spread of these trees were visually inspected, which were used as an input to the model.

Figure A-39: Capture of i-Tree Design Model

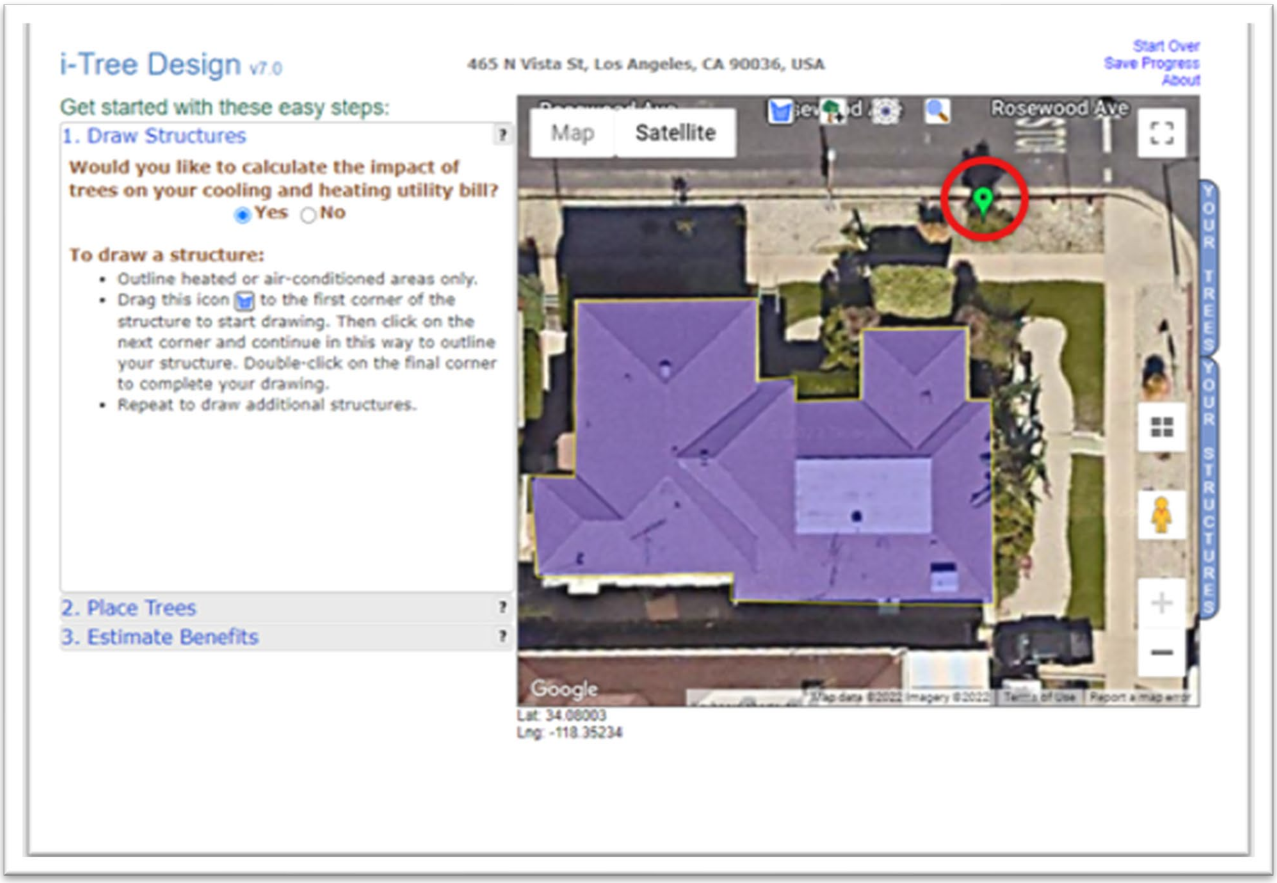


Table A-187 presents energy savings for 12 modeled projects during the summer and winter seasons. The summer savings (kWh) are associated with cooling energy and winter savings (Therms) with the heating energy. It is noticeable that winter savings are negative in most cases, which means there is a penalty 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 and consequently provide shade to the house, resulting in higher heating load.

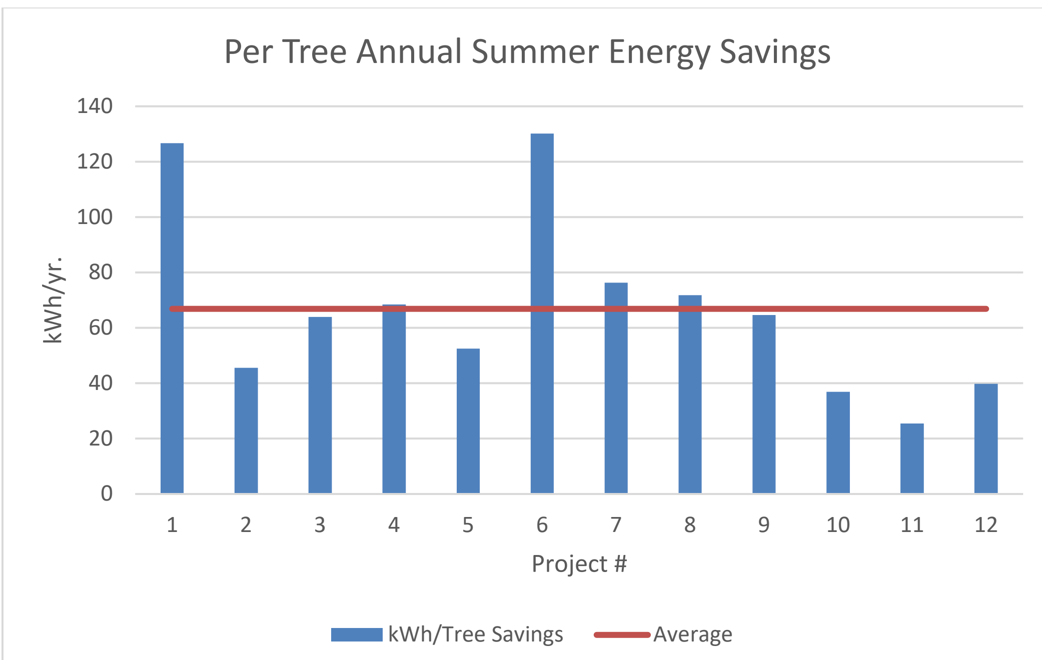
Table A-187 Energy Savings during the Summer and Winter seasons

Project	Number of Trees	Summer Energy Savings (kWh)	Winter Energy Savings (Therms)
Project 1	1	126.7	-2.1
Project 2	2	91.2	-1.3
Project 3	2	127.9	8.7
Project 4	1	68.5	-0.5
Project 5	2	104.9	-3.2

Project	Number of Trees	Summer Energy Savings (kWh)	Winter Energy Savings (Therms)
Project 6	1	130.2	-5.9
Project 7	2	152.6	-4.9
Project 8	1	71.8	0.2
Project 9	1	64.6	-0.3
Project 10	2	73.9	1.6
Project 11	2	50.9	2.6
Project 12	2	79.6	-3.1
Average	1.6	95	-0.68

Figure A-40 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 67 kWh. Note that a project may have more than one tree, but the savings presented in Figure A-40 are normalized on per tree basis for each project.

Figure A-40 i-Tree Design Per Tree Annual Summer Savings



Similarly, Figure A-41 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 0.7 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-41 i-Tree Design Per Tree Annual Winter Savings

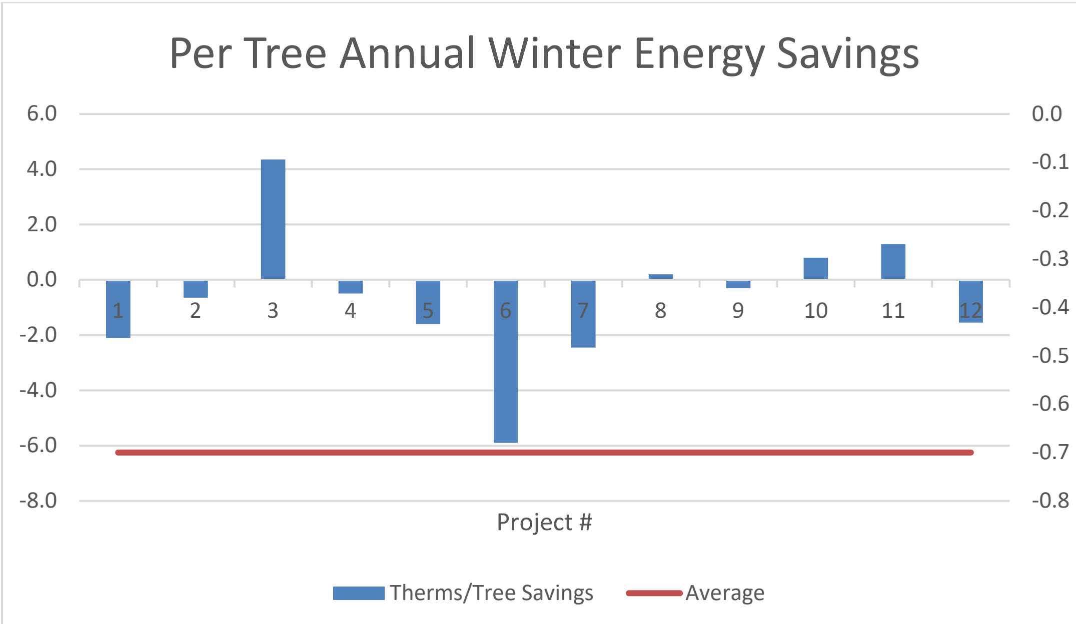


Figure A-42 shows the impact of orientation on the energy savings along with an average of savings for all trees. The average annual energy savings for all trees is 62 kWh/yr. per-tree. As evident from this chart, West orientation is the best for planting shade trees, followed by south and Southwest orientations. North orientation is the least desired, among the simulated sample of trees.

Figure A-42 i-Tree Design Per Tree Energy Savings by Orientation

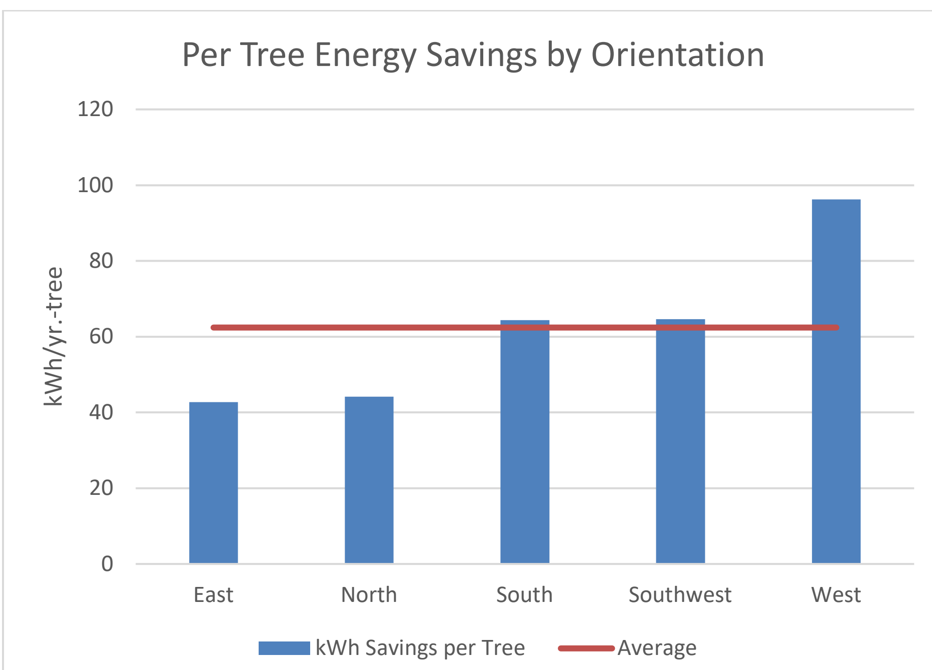
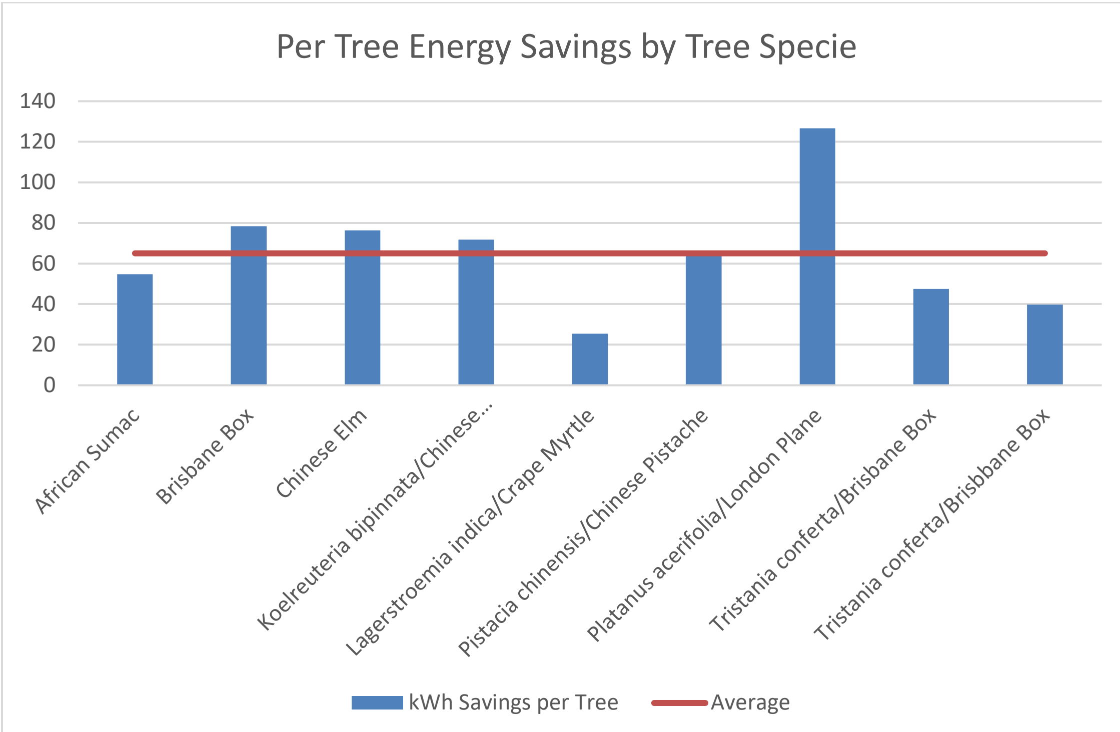


Figure A-43 shows the impact of different tree species on the energy savings. The average annual energy savings for all trees is 65 kWh/yr, per tree.

Figure A-43 i-Tree Design Per Tree Energy Savings by Tree Species



A.18.2.2.2 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 Figure A-43 above. In the current eQuest model, the parameters belonging to 1950-80 building vintage were considered, because most of the houses (53%) benefiting 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-188 shows eQuest results on per-tree energy savings by orientation, under the two different weather zones.

Table A-188 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.18.2.2.3 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.[18] 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[19]).

Akbari et al[20]. 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).

[18] https://www.tandfonline.com/doi/abs/10.3846/13923730.2015.1111934

[19] https://www.researchgate.net/publication/280755913_Technical_Advances_in_the_EU_Cool_Roof_Project

[20] https://www.osti.gov/servlets/purl/860475

Taha et al[21]. 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 K to 1K 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 m2 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[22]. 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)[23] 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-189.

Table A-189 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

21 https://www.osti.gov/servlets/purl/860475

22 https://www.sciencedirect.com/science/article/abs/pii/S0169204615001553

23 https://www.sciencedirect.com/science/article/abs/pii/S1618866704700254

Weather/ Orientation	South	East	West	North	Average	Climate Only
Average	25.0	25.5	41.5	-	30.7	20.5

A.18.2.2.4 Comparisons of Energy Savings Results

Table A-190 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-190 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)
EcoLayers					41.3	14.9
i-Tree Design	64.4	42.70	64.1	33.1	51.1	not calculated
eQuest Simulation	44.5	59.2	92.5	25.6	55.5	not calculated
Secondary Research	25.0	25.5	41.5		30.7	20.5
Average (2,3,4)	44.6	42.5	66.1	29.4	45.7	20.5

** EcoLayers' results include 10% reduction based on street tree mortality rates found in Fall 2018 sampling*

A.18.3 Process Evaluation

A.18.3.1 Process Evaluation Approach and Methodology

A.18.3.1.1 Program Staff Interviews

ADM completed interviews with the LADWP program manager (PM) and the executive director (ED) of City Plants, the nonprofit organization created to implement the program. The purpose of these interviews was to clarify our understanding of the program design and procedures developed from the review of program documentation and to document program successes and challenges. Topics included interviewees' roles and responsibilities, program design, program marketing and outreach, progress toward goals, successes and challenges, quality control (QC), and project tracking. The interviews also covered the criteria used for selecting trees for customers' sites, processes for communicating planting requirements to participants, and activities related to confirming that the trees are planted and properly sited.

A.18.3.1.2 Participant Survey

We surveyed 192 program participants about their experience with the program. The survey covered program awareness and motives for participation, tree delivery and planting, and program satisfaction.

Program staff provided separate data files for trees planted, delivered, or picked up by customers from May 2021 through April 2022. We combined this information to create a single sample frame for the survey.

The tracking data did not include a unique customer identifier (e.g., account number). We could not use an address as a unique customer identifier, as a given customer could order or pick up trees for planting at multiple addresses. As we planned to recruit customers by email, we deduplicated the records on email address. However, this alone was not necessarily sufficient to identify every tree provided to a given customer with an available email address: it was possible for customers to order or pick up trees at different times and to provide different email addresses or to provide an email address one time and a phone number another. To ensure we identified all trees acquired by a given customer, we identified all records that shared a phone number or physical address for a given email address and associated the trees for those records with that email address.

We identified 4,077 unique email addresses, which accounted for 88% of the trees distributed through the program. We drew a random sample of 1,350 records with email addresses and sent emails with links to the survey. A total of 192 customers responded to the survey.

We assessed whether respondents represented the population in terms of how trees were obtained. As noted above, any given customer could obtain trees either by having them delivered to a residence or business, picking them up at an event (“adopting” them), or having them planted on the street in front of their residence or business. A single customers could get trees in more than one way, and multiple combinations did occur. After reviewing the various potential groupings, we sorted all customers into three groups: 1) those who got trees only through delivery to a residence or business; 2) those who adopted trees (and may also have gotten them through delivery) but did not have trees planted on the street; and 3) those who had trees planted on the street (and may have gotten them one of the other ways). These three groupings are summarized in Table A-191.

Table A-191 Tree Acquisition Groupings

Group 1 (n = 1,656)	Group 2 (n = 2,097)	Group 3 (n = 289)
Delivered only	Adopted only or Adopted and delivered	Street only Or Street and delivered or Street, delivered, and adopted

As Table A-192 shows, those in the first and third groups were somewhat over-represented, while those in the second group were somewhat underrepresented. We weighted the survey data so that the responses were representative of the population, calculating each weight as the ratio of the percentage of the population to the percentage of survey respondents. The survey findings present the results from the weighted data.

Table A-192 Sample Representativeness and Weighting

How Trees Were Obtained	Unweighted Percent of Population	Unweighted Percent of Sample*	Weight
Only through delivery to a residence or business	34.6%	43.2%	0.801
Adopted trees or got them through delivery	58.6%	43.2%	1.354
Had trees planted on the street	6.8%	13.5%	0.504

**185 respondents who provided information to confirm how they got trees.*

The project tracking data did not indicate whether customers ordered or picked up trees for a residence or business, and the survey as initially designed did not ask this. We sent a follow-up email invitation to all survey respondents asking them to provide that additional information. The 57 who responded (30% of all respondents), all said the trees were for a residence, with two saying they also were for a business. Those who responded to that one question follow-up were similar to those who did not respond across all survey variables, including demographics. Therefore, it is likely that the survey results as a whole apply to customers who obtained trees for a residence. We cannot conclude what the survey results say about the proportion of customers in the population that obtained trees for residences or businesses: it is possible that the results reflect greater response by residential than business customers.

A.18.3.2 Process Evaluation Findings

The Evaluator completed a process evaluation of the City Plants program based on data collected from program staff and a survey of program participants. We present a summary of the conclusions of the process evaluation below, followed by a presentation of the detailed findings.

- The program application and data tracking system may hamper the effectiveness with which LADWP and City Plants are able to manage the program. The online application has several imperfections, which appears to result in lost opportunities for enrollments, a fact that both LADWP and City Plants contact recognized. Further, the data management system seems inefficient. Data from the three tree request channels (street, delivery, and adoption) are tracked separately, with no unique customer identifier for tracking participation across channels or for tying a given customer to multiple addresses. Further, there does not appear to be a mechanism for tracking whether a given request was for a residence or business.
- The ease of program participation and the personal benefits of shade trees, such as shade and the availability of fruit, are more influential arguments for program participation than are messages touting environmental benefits.
- Cross-program marketing and word of mouth are the most common individual sources of program awareness but, taken together, the City Plants activities are second only to LADWP cross-marketing.
- About one-third of recipients plant their trees too close to or too far away from structures for optimal energy savings.
- Although program satisfaction was generally high, there is some dissatisfaction with aspects of the tree delivery process, including the overall delivery time as well as lack of communication about tree delivery. City Plants staff understand the issue with the delivery schedule, which has been slowed because of staff turnovers.
- The current cap of seven trees per customer is reasonable, as most participants would not plant more trees if the cap were increased beyond seven.

A.18.3.2.1 Program Staff Interview Findings

Program Staffing and Roles

The PM heads the LADWP Community Partnership Outreach Grants Program (the “Partnerships Program” or “Partnerships”). Partnerships, which is located within the Efficiency Solutions group, provides grants to nonprofit organizations to support sustainability efforts by leveraging the nonprofits’ existing programs and networks to encourage behavior change in populations that may not be reached through more traditional communication strategies. The City Plants program is one such effort. It operates under the Board of Public Works (BPW), with LADWP providing the majority of the funding through a Memorandum of Understanding (MOU) with BPW. The PM oversees LADWP’s support of City Plants. In addition to interacting with the City Plants ED, the PM coordinates with LADWP’s Corporate Strategy and Communications group on program marketing; the Department of Public Works Bureau of Street Services, Urban Forestry Division; and a consultant that helps estimate savings.

The City Plants ED has overall oversight of the program. The ED described her primary functions as stewardship of LADWP funds, delivering on program goals, and "brainstorming" on how to improve the program based on feedback from stakeholders and policymakers. Specific responsibilities include coordination with LADWP and BPW as well as other agencies that "touch" trees, such as the Mayor's Office, and with planting partners; report preparation; and grant writing and other fundraising. The ED manages a staff of up to 12 individuals, including five full-time staff and a "steady rotation" of interns. She described the team's internal communication as "pretty solid – feels like we are all on a pretty similar mission."

The PM and ED meet every two weeks as well as during ad hoc "events" held to promote the program (see below). The ED "touches base" with the PM to go over what City Plants is going to say at the event, and the PM will give input about what LADWP would like to communicate. For example, LADWP always wants to mention the continuing drought.

The PM and ED also interact as part of the semi-annual billings, which include a report of all activities. This provides an opportunity to work with City Plants staff to get detailed information on what trees have been planted.

The City Plants ED also holds monthly meetings with the planting partners. The purpose of these meetings is to share management best practices – what is and is not working and how to do better; make sure the partners are on track to send out their quarterly allocation of trees to inform a performance assessment of the partners; and to build camaraderie.

Program Design

The LADWP PM and City Plants ED confirmed details of program design, administration, and implementation.

The Program provides Los Angeles residents and property owners shade trees to plant on their property or in a parkway in front of their house or business, which the recipients must commit to watering for three years. The program limits each customer to seven trees for planning on their property, although City Plants may override the seven-tree limit on a case-by-case basis. For trees planted on parkways ("street trees"), City Plants will plant as many as will fit based on city guidelines.

City Plants works with multiple organizations, called planting partners, that procure, distribute, and plant trees. One partner, the LA Conservation Corp, does most of the tree procurements and delivery.

A given customer may obtain trees either by having them delivered to a residence or business, picking them up at an event ("adopting" them), or having them planted on the street in front of their residence or business. A single customer may get trees in more than one way.

The ED noted that the program is changing the service model to provide more planting assistance. The original model was to just drop off trees, leaving residents with planting instructions. However, for residents that need more assistance, the program is offering some additional assistance with tree selection, site selection, and planting. In low-canopy areas, the program is also now offering an option to have someone from City Plants do the planting. The ED estimated that about 10% of the participants will get this service.

Program Promotion, Marketing, and Outreach

The LADWP PM and City Plants ED identified several channels of program promotion, marketing, and outreach:

- Public events. These may be held by City Plants staff as well as other Community Partnership Outreach Program grantees. City Plants events include Arbor Day and Earth Day events.
- Social media posts, including on Facebook, Instagram, Twitter, and TikTok.
- The LADWP customer newsletter.
- Cross-marketing between City Plants and two other LADWP programs it “dovetails” with:
    - The Home Energy Improvement Program, in which LADWP staff carry out weatherization and other improvements in residential customer homes.
    - The Turf Replacement Program, which replaces turf with more drought-resistant plants.
- Media coverage (e.g., in Outside magazine, Los Angeles Times, Catholic Worker).
- The Tree Ambassador Program, which enlists community members to do door-to-door outreach.

The ED reported that the program has “really ramped up” marketing in the past few years, with LADWP providing funding for collateral. Social media has been effective, particularly Facebook and Instagram. City Plants works with agencies that can target ads by zip code and demographic, allowing them to target investment to low-canopy demographics. The ads are fully bilingual (English/Spanish). Customers can click on the ads to get to an online application for trees. The program also created a mascot called “Leafy” a few years ago in an effort to make the brand approachable.

The program staff can assess the effectiveness of the social media ad by tracking program activity after it started and by the number of clicks made on ads to reach online applications. The ED reported that the program has “gained quite a following” through these efforts, with the name getting recognized throughout the city.

The Tree Ambassador Program was new. At the time of the interview, City Plants had just completed the first pilot round. Nine community members were hired in low-income and low-canopy communities and trained through a curriculum that the tree planting partners had developed. The ambassadors go door-to-door to generate enrollments, with a target of 30 street trees and 30-yard trees per ambassador. The ED reported the belief that those targets were being met and reported that LADWP intends to continue the program, possibly in an expanded form, under the new MOU.

In addition to the above, the ED reported two additional marketing efforts the City Plants would like to try: 1) a radio PSA ad (which City Plants has recorded but has not had the budget to run); and 2) bus shelter ads.

Application Process

Customers may request trees for planting or delivery by completing an online request form, contacting City Plants by phone, or signing up at a planting partner's event. There are separate online application forms to request trees to be planted on parkways and to request trees to be delivered to the customer's property. When customers contact City Plants, staff field questions about program rules and processes. Customers may also contact a planting partner, which will refer them to City Plants.

The ED noted that planting partners signing people up at events use a tablet to access the online application. In such cases, there may be more time pressure for completing applications. As a result, those staffing the events may capture less complete customer information.

The City Plants ED noted that the online application for delivered trees "is not as user friendly as it could be." The application works only with certain browsers, it sometimes is necessary to clear the browser's cache before completing the application, and certain aspects of the interface are not very clear. Further, the application is not yet fully available in Spanish. As a result, some people do not make it through the whole application process. Program staff understand the issue and are trying to resolve it through the contractor that developed the application.

One problem that was identified, which has been resolved is that, for a long time, there was no automated way of validating residence in Los Angeles. The program used to get many applications from people who live in the county but not the city. That has been resolved now through validation by zip code.

The ED reported that the online application for street trees application is more straightforward than that for delivered trees, but the street trees application does not include zip code validation and so it is still necessary to weed out people who are outside of the city.

Based on the information in the application, City Plants determines which partner will plant each tree. In the case of street tree requests, City Plants staff review locations on Google Earth to determine whether the requested location is accessible. If a street tree is requested for a location with no open parkway to plant (i.e., the area between lanes is concrete), they look for grants to cut wells.

Every few weeks, City Plants sends a list of tree requests to planting partners. Someone walks every site where a street tree is planned and calls DigAlert® (a service that provides information on underground utility facilities).

The entire process used to take three to six months, but now takes six to 12 months. This is partly because of staffing capacity: the program has seen “a lot” of turnover recently.

Customers get automated emails up to a year after receiving their tree(s), reminding them to care for the trees, and then get a “happy birthday” email after the first year.

Program Progress Toward Goals

The City Plants ED confirmed the goals for the current fiscal year stated in the most recent draft business plan (7.2 GWh energy savings and 2,294 metric tons of CO_2 sequestered). The ED noted that, in addition to the above metrics, there are elements of combatting urban heat island, cooling communities, and increasing resilience in the program’s goals.

She said that, based on activity level, the program might be running “just a little bit behind” energy savings goals. The primary reason was the COVID-19 pandemic, which slowed tree adoptions because City Plants was not doing public tree adoption events as it had done before the pandemic. The program did not completely abandon adoption events but changed to events that allow customers to drive up and pick up trees.

The ED noted that the easy places for tree planting are getting harder and harder to find. Most of the participants that are willing and physically able have been found already. The ED expressed hope that the Tree Ambassador Program will have success in finding new participants.

Quality Control (QC)

The City Plants ED reported that the program carries out a random “survival study” of both street and yard trees every two years. Based on the number of trees distributed, they randomly survey 200 to 350 participants each year. This sample size offers a 95% confidence interval of ±5%.

Data Tracking

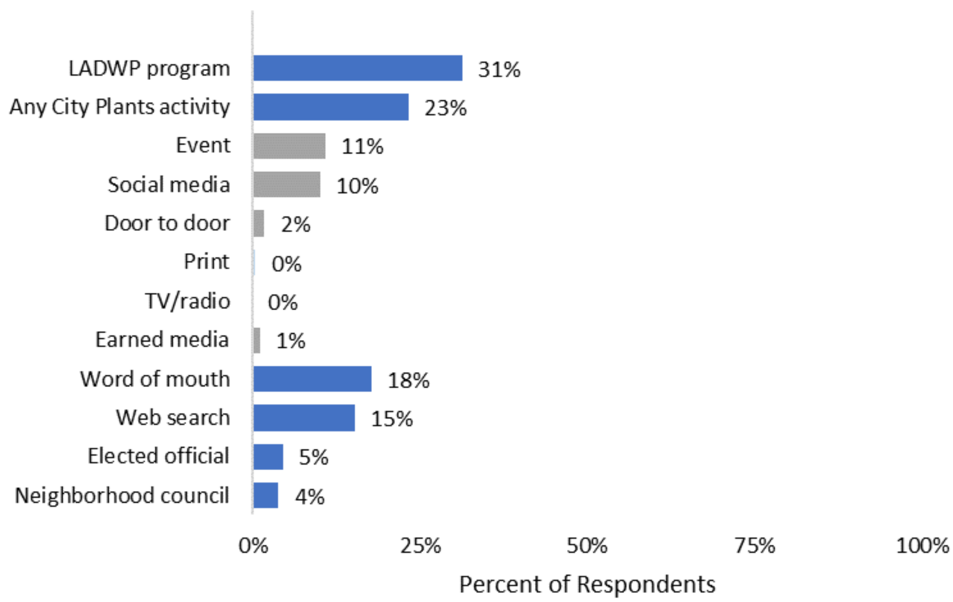
City Plants staff manage the tree request data and provide it to LADWP every six months as part of its reporting. Data from each tree request channel (street trees, delivered trees, adopted trees) are in a separate file.

A.18.3.2.2 Participant Survey Findings

Program Awareness and Motivation

Survey respondents who participated in the City Plants Program most frequently learned about the program through LADWP cross-marketing or word of mouth, followed by internet searches, public events, and social media (Figure A-44). Considered together, however, the activities carried out by City Plants staff were second only to LADWP program cross-marketing.

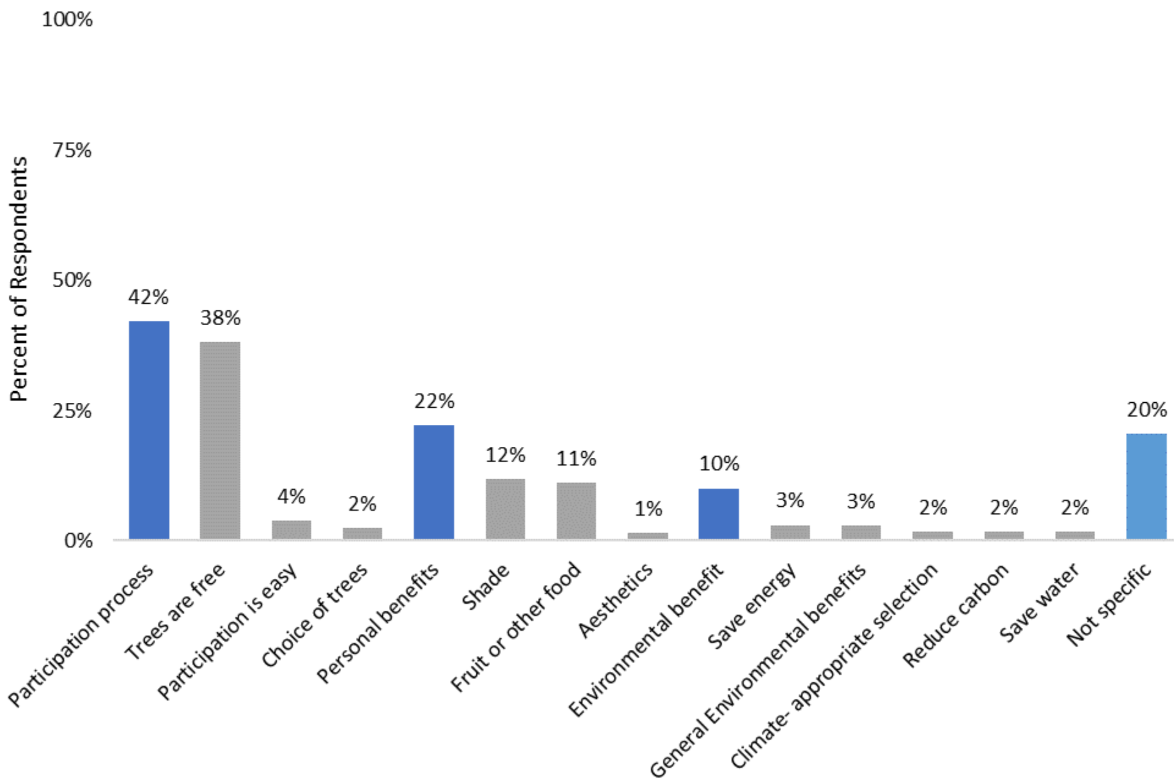
*Figure A-44 Source of Program Awareness**



*Grey bars represent activities carried out by City Plants staff. Blue bars represent other activities.

Respondents who identified the factors that influenced them to participate in the program (n = 156) most frequently identified some aspect of the participation process or requirements, particularly the fact that the trees are of no cost to them (Figure A-45). Respondents somewhat less frequently identified personal benefits, including shade, provision of food, and aesthetics. Respondents were generally least influenced by the environmental benefits of planting trees, including saving energy, saving water, reducing carbon, and general environmental benefits. Thus, participants are most driven to participate by non-energy-related or environmental factors.

*Figure A-45 Influential Messaging**



*The grey columns represent the initial categorization of responses. The darker blue columns represent higher-level categories that incorporate all responses. For example, the high-level category participation process includes trees are free, participation is easy, and choice of trees. Not specific includes comments that did not point to any specific message, such as "They said it was a great program," "My neighbor had gotten city trees … and told me about it," "We did not need convincing. We asked for the trees."

Consistent with the above, when asked their reasons for participation, respondents most commonly mentioned providing more shade on their property and making their property more attractive by adding trees, whereas reducing their energy bills was not a top desire for customers (Table A-193).

Table A-193 Desired Outcome

Response	Count	Wtd. Percent
Creating more shade in property	146	80%
Making property more attractive	134	73%
Making community a better place	107	57%
Keep home/building cooler	96	53%
Reducing energy bills	66	36%
Other	30	20%

Tree Delivery

The amount of time it took to deliver trees varied anywhere from less than two weeks to more than six weeks, but most generally fell within four weeks (Table A-194).

Table A-194 How Long to Receive the Requested Tree(s)

Response	Delivered Trees		Street Trees	
	Count	Wtd. Percent	Count	Wtd. Percent
Less than two weeks	21	26%	1	4%
Two to four weeks	30	36%	0	0%
Four to six weeks	11	12%	1	4%
More than six weeks	18	21%	19	76%
I don’t know	4	5%	4	16%

Most respondents (72%) indicated that they were all in somewhat good or very good condition when they arrived, with 7% of respondents indicating that some or all their trees arrived in poor condition (Table A-195).

Table A-195 Condition of the Tree(s) When Delivered

Response	Count	Wtd. Percent
All in very good condition	53	63%
All in at least somewhat good condition	22	26%
At least some in somewhat poor condition	5	7%
At least some in very poor condition	1	1%
All in very poor condition	1	1%
I don’t know	1	1%
Prefer not to answer	1	1%

Twenty-six respondents identified the following problems with their trees upon delivery:

- Ten respondents indicated the trees were thin, too young, or frail.
- Ten respondents said the trees were dry.
- Six respondents commented on the lack of leaves.
- Five respondents identified a range of miscellaneous issues (“poor soil,” “root ball was exposed,” “curled,” “left on driveway when out of town,” “left under the sun”).
- Four respondents did not specify (“almost died,” “did not thrive,” “a little tired,” “badly damaged”).

Planting Experience

A large majority of respondents indicated that all of the trees they received were planted, and about half of the rest said that some were planted (Table A-196).

Table A-196 Proportion of Trees that Were Planted

Response	Count	Wtd. Percent
All the trees were planted	141	91%
Some of the trees were planted	9	5%
None of the trees were planted	5	4%
Don't know	1	0%
Prefer not to answer	0	0%

Of those who reported that they had not yet planted all their trees, 12 gave a range of reasons that fell into three general categories. Six reported that a tree was not in a condition to be planted, four because it had died and two each because the tree was dry or had been chewed up by a puppy. Five identified some circumstance related to timing (they had not yet decided on a location or dug the holes, they were waiting for the tree to grow, or they might need to move and would take the tree with them). One respondent reported there was not enough clearance to plant the tree.

Of 155 respondents who reported how many trees had been planted, 130 reported the number that had been planted on the west side of the property (Table A-197).

Table A-197 Percentage of Trees Planted on West Side Of Property

	Count	Wtd. Percent
None	67	44%
Up to one-third	8	5%
More than one-third, to two-thirds	28	19%
More than two-thirds	3	2%
All	24	17%
Don't know	0	0%
Not answered	20	13%

Of the respondents who reported the number of trees planted, 122 reported how far they had been planted, on average, from the building (residence or business). About two-thirds of those (just over half of all respondents) reported that they planted their trees anywhere more than five and up to 20 feet away from structures.

Table A-198 How Far From Building (In Feet) Trees Were Planted, On Average

Response	Count	Wtd. Percent
Within five	13	9%
More than five, within 10	37	23%
More than 10, within 20	47	32%
More than 20	25	17%
Don’t know	0	0%
Not answered	28	19%

The average distance trees were planted from the building was unrelated to the reported condition of the trees at the time of the survey.

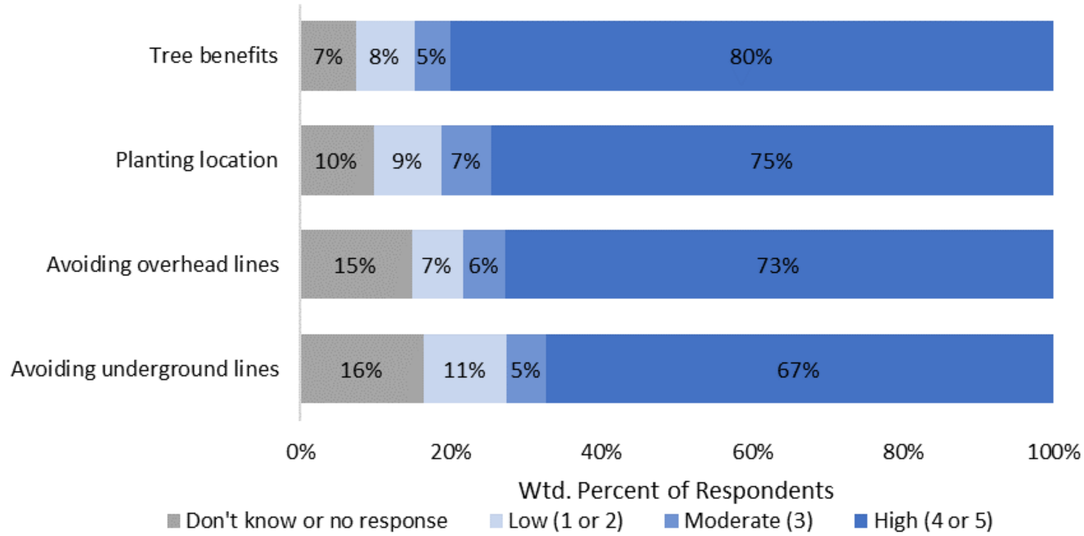
Almost all respondents indicated that they received instructions on how to plant their new trees (Table A-199). Most of those said those instructions were either completely clear or somewhat clear, with only two survey respondents saying the instructions were unclear to some degree.

Table A-199 Receipt of Planting Instructions

Response	Count	Wtd. Percent
Received Instructions on How to Plant Trees		
Yes	126	92%
No	5	3%
Don’t know	6	4%
Prefer not to answer	2	1%
Clarity of Instructions		
Completely clear	99	80%
Somewhat clear	21	16%
Not very clear	1	1%
Not at all clear	1	1%
N/A – Did not need instructions	3	2%
Prefer not to answer	1	1%

Survey respondents indicated that the information they received on planting the trees was mostly helpful (Figure A-46). The information regarding the benefits of planting trees and on planting location was most helpful.

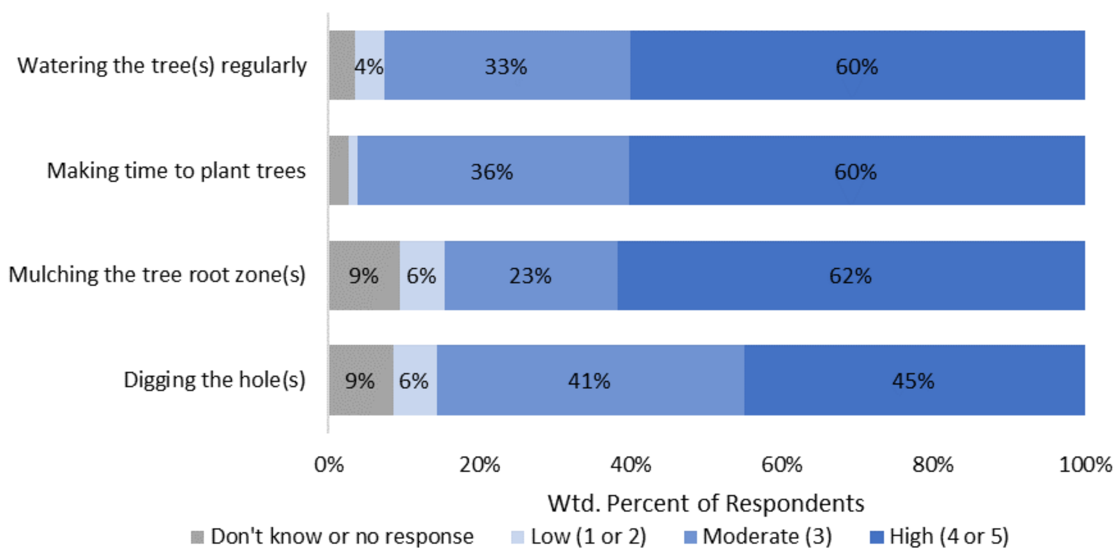
*Figure A-46 Helpfulness of Planting Instructions**



*Responses were on a scale from 1 (not at all helpful) to 5 (extremely helpful). For this graphic, we collapsed responses into low (1 or 2), moderate (3), and high (4 or 5) helpfulness.

Planting trees was, in general, a challenging task for most respondents. Mulching the tree root zone(s), making the time to plant the trees, and watering regularly proved to be the most difficult tasks for program participants (Figure A-47).

Figure A-47 Planting Difficulty



*Responses were on a scale from 1 (very easy to do) to 5 (extremely challenging to do). For this graphic, we collapsed responses into low (1 or 2), moderate (3), and high (4 or 5) challenge.

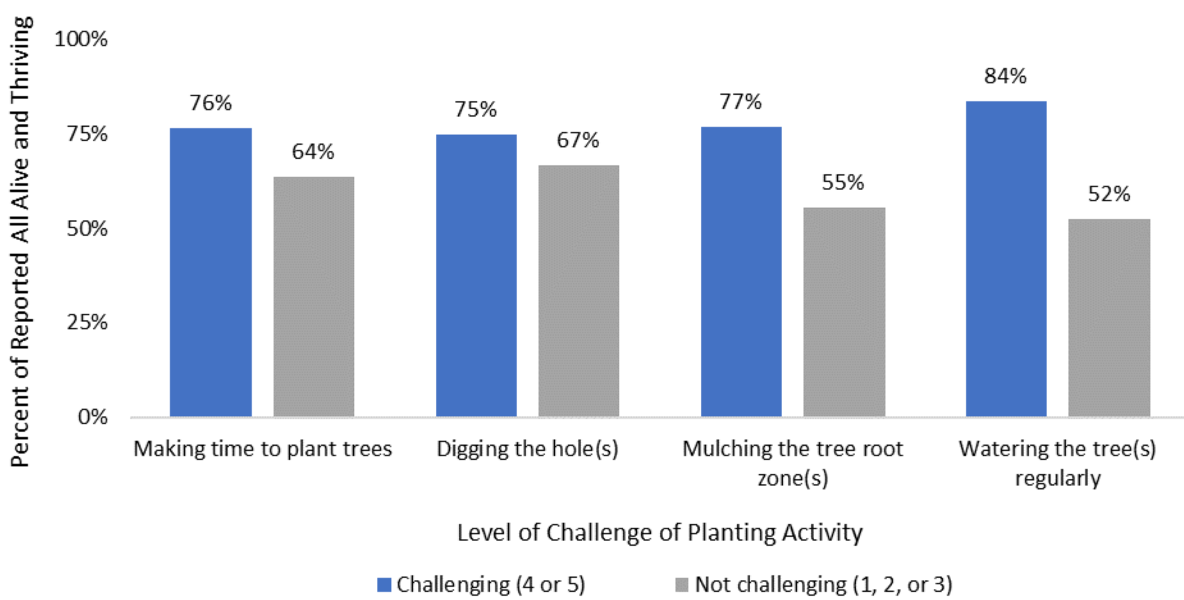
When asked about the current condition of the trees they received through the program, more than two-thirds said all trees are healthy (Table A-200). Most of the rest indicated that some trees were not thriving or were even dead. Five respondents indicated that all their trees had died.

Table A-200 Current Condition of Planted Trees

Response	Count	Wtd. Percent
All alive and thriving	88	67%
All alive but some are not thriving	17	12%
Some died but the rest are thriving	13	11%
Some died and some are not thriving	1	1%
All have died	5	4%
Don't know	5	4%
Prefer not to answer	1	1%

We examined whether the perceived level of challenge associated with tree planting was related to the reported condition of trees at the time of the survey. As Figure A-48 shows, respondents were more likely to report that all trees were alive and thriving if they reported tree planting challenges. For example, 76% of respondents who reported that making time to plant trees was challenging said that all trees were alive and thriving, compared to 64% of those who reported it was not challenging. The differences were statistically significant by two-sample z-test for proportions for mulching the tree root zone ($z = 2.33$, $p = .02$) and watering the tree regularly ($z = 3.71$, $p < .001$), but not for the other two items.

Figure A-48 Current Status of Trees, by Level of Planting Challenge

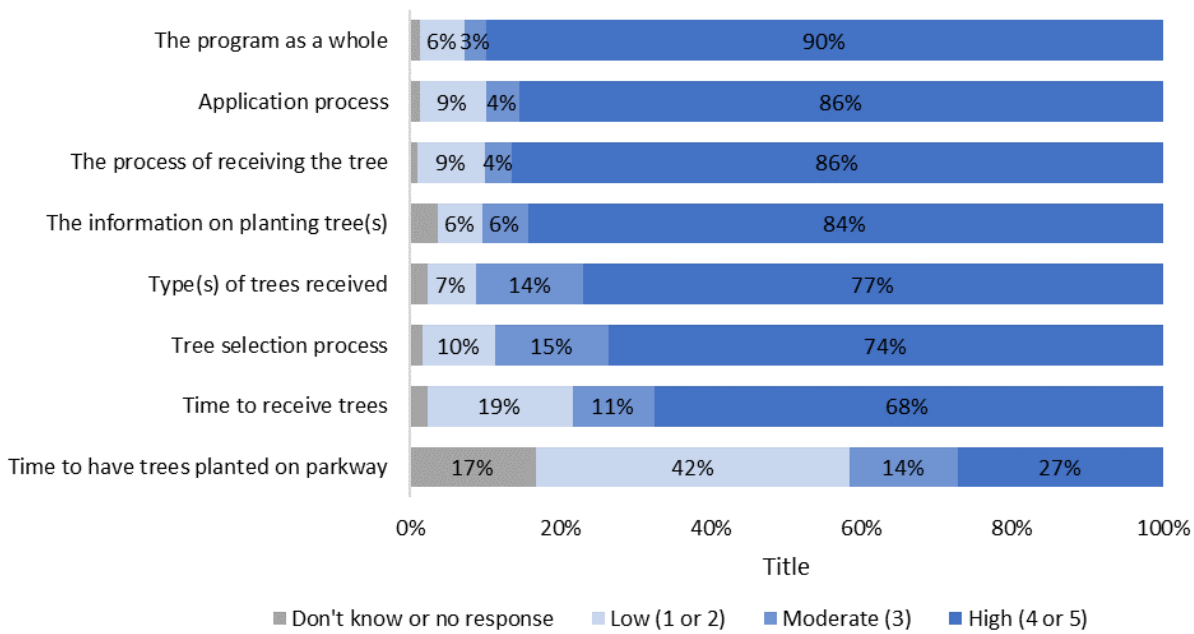


Possibly, reporting a greater level of challenge associated with mulching and watering reflects greater efforts made in these areas, which might explain the higher success rate associated with those responses. If so, these findings would reinforce the value of providing clear instructions on tree planting.

Program Satisfaction

Participants generally reported satisfaction with their program experience (Figure A-49), particularly with the program, the application process, and the types of trees participants received. However, satisfaction was low with the time it took to plant trees on parkways.

Figure A-49 Program Satisfaction



Just over half (54%) of respondents reported a favorable attitude toward LADWP, and about the same proportion indicated that participating in the City Plants Program had improved their attitude toward LADWP (Table A-201).

Table A-201 Attitude Toward LADWP

Response	Count	Wtd. Percent
Overall Opinion Toward LADWP		
1-Not at all favorable	5	4%
2	11	6%
3	43	31%
4	45	31%
5-Extremely favorable	34	23%

Response	Count	Wtd. Percent
I don't know	4	3%
Prefer not to answer	2	2%
Impact of Participation on Attitude Toward LADWP		
Improved attitude	85	55%
No impact	54	38%
Worsened attitude	3	2%

Respondents were given opportunities to offer additional comments – positive, neutral, or negative – about the program or LADWP in general. Table A-202 summarizes the responses. About one-quarter of respondents offered some type of complaint or criticism. The most common of these was some comment about poor communication – specifically, in order of frequency, communication about the delivery time, about types of trees, general inability to reach program staff (i.e., no response to voice mail or email, better planting guidance), and general lack of communication after the application was submitted. The second most common criticism was about the time it took to receive trees (reflecting Figure A-49). Other delivery issues reflected those identified in Section 1.3.4, such as trees being delivered without adequate notice, but also included comments about not receiving requested trees and receiving the wrong trees.

Table A-202 Respondent Open-Ended Comments

Response	Raw Count	Wtd. Percent
Complaints/Criticisms		
Any complaint or criticism	45	27%
Communication issues	22	13%
Long delay to receive	16	8%
Delivery issues	11	6%
Tree availability/selection	10	6%
Trees not thriving	3	3%
Other/Not spec	4	3%
Pick-up process	2	2%
Website issues	2	1%
Positive Comments		
General approval of City Plants program	28	22%
Neutral Comments About City Plants		
Wants more trees	4	3%
Miscellaneous City Plants comment	3	2%

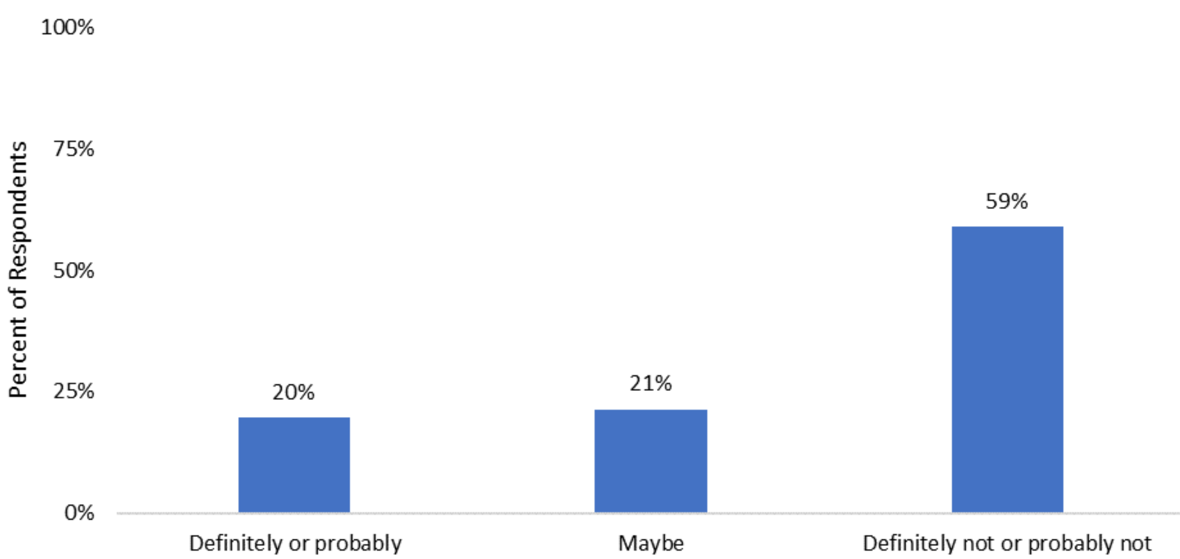
Response	Raw Count	Wtd. Percent
Non-City Plants-Related Comments		
High bills from LADWP	5	3%
Additional services desired	5	3%
Other/nonspecific	3	2%

About one-fifth of respondents offered comments reflecting general approval of the program (e.g., “Love this program,” “Please keep the tree program going”). A handful of respondents left comments that were neither complaints nor commendations about City Plants. Finally, a few respondents offered comments that were not related to City Plants, such as complaints about high energy or water bills from LADWP, suggestions for additional services that would be desirable, and other miscellaneous comments.

Interest in Planting Additional Trees

To provide information on whether LADWP and City Plants should increase the cap on the number of trees provided through the program, we asked respondents whether they would plant more trees if they could. A clear majority said they definitely or probably would not, while one in five said they definitely or probably would (Figure A-50).

Figure A-50 Likelihood Would Plant More Trees if Allowed

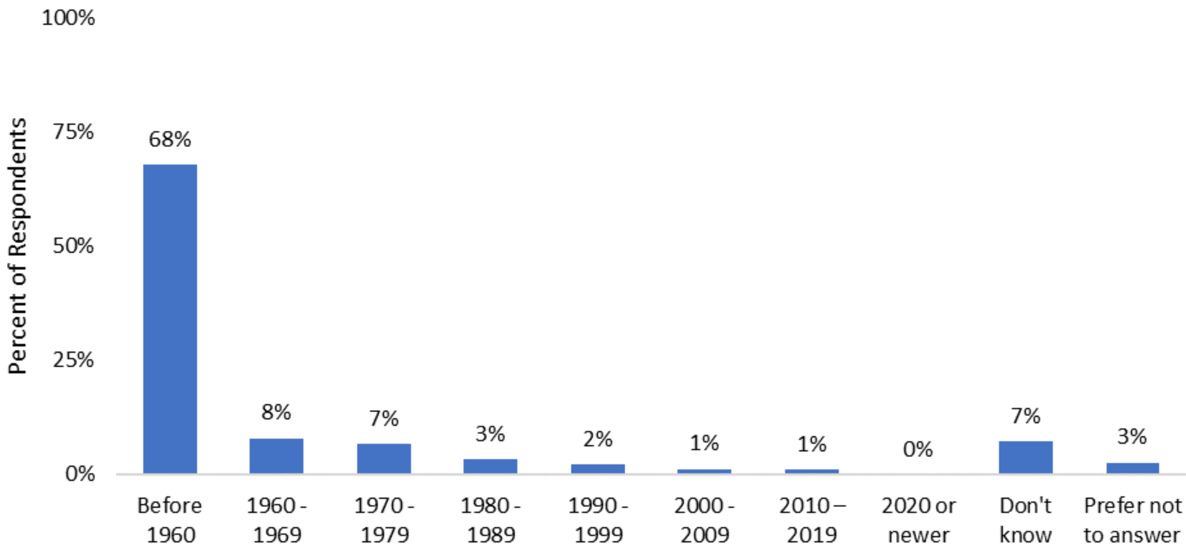


Description of Respondents

Most of the survey respondents indicated that they own their home (80%) and live in a single-family, detached residence (82%), while nine respondents indicated that they live in a single-family, attached residence. Six respondents indicated that they live in an apartment or condo, and of that most (41%) live in a complex with 11 to 25 units. Only one respondent indicated that they live in a complex with over 50 units, and one reported living in a complex with fewer than five units.

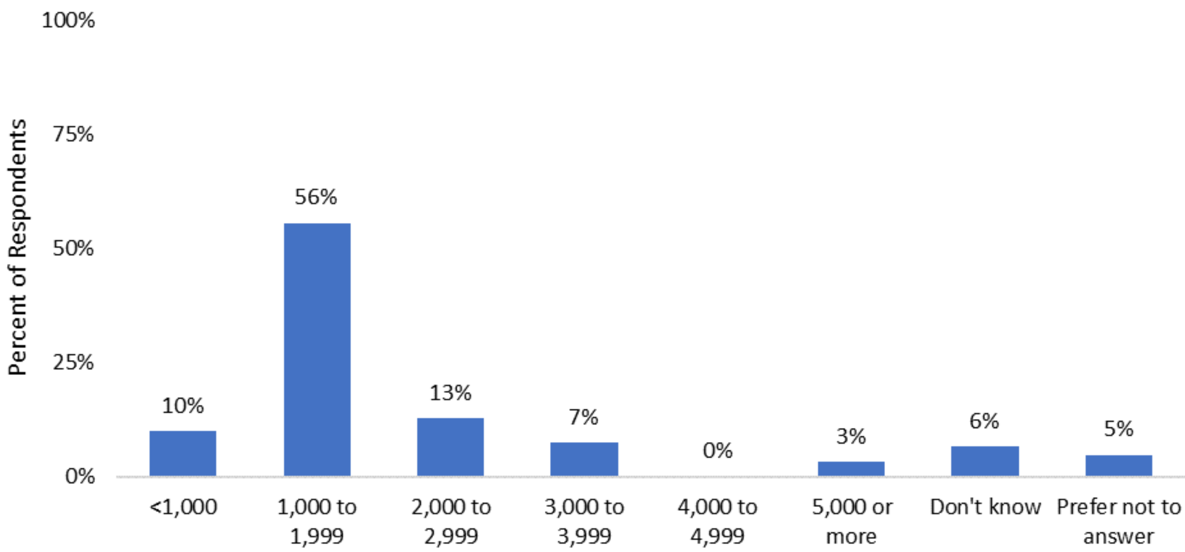
Two-thirds of survey respondents reported their residence was built before 1960 (Figure A-51).

Figure A-51 Year Residence Was Built



A little more than half of the survey participants indicated their residence was somewhere from 1,000 to 1,999 square feet.

Figure A-52 Size of Residence (SF)



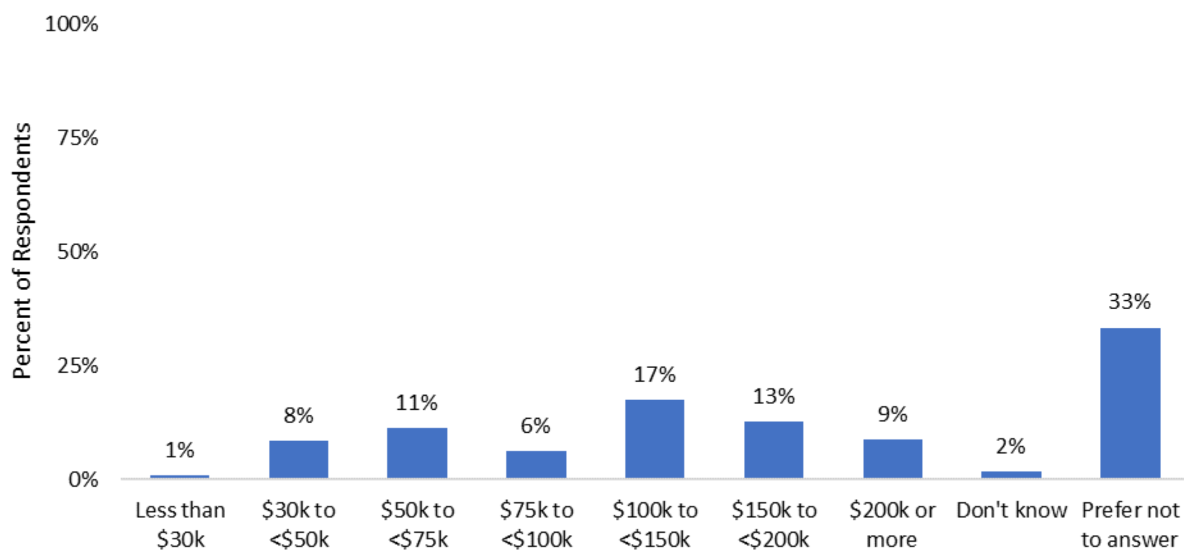
About two-thirds of survey participants indicated that their residence's primary heating fuel is natural gas, with most of the rest reporting electricity. Eleven respondents indicated that they either did not know or preferred not to answer (Figure A-51).

Table A-203 Primary Heating Fuel

Response	Count	Percent
Natural Gas	89	64%
Electricity	36	25%
I don't know	7	6%
Propane	0	0%
Other	1	1%
Prefer not to answer	6	4%

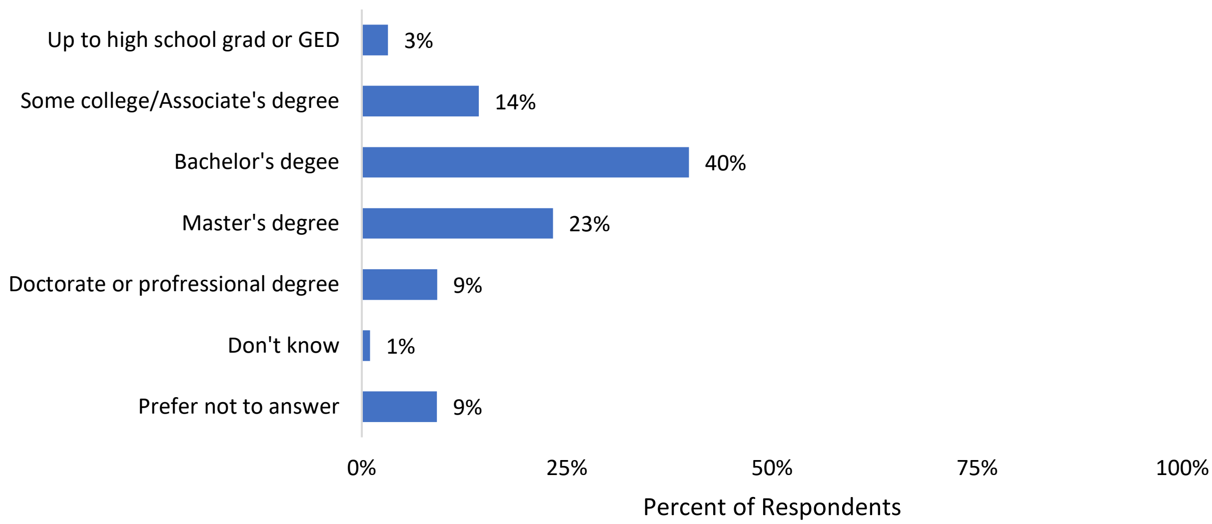
The two-thirds of respondents who chose to disclose their household income reported incomes that spanned the range, with a relatively normal distribution (Figure A-53).

Figure A-53 Household Income in 2022



Respondents reported a range of education levels, most commonly reporting a bachelor's degree (Figure A-54).

Figure A-54 Education Level



A.18.3.2.3 Recommendations

- **LADWP and City Plants should consider overhauling the application and data tracking systems to coordinate requests through different channels and at different times.** At a minimum, this should include the use of a single unique customer identifier to be recorded with each request. In addition, the application should specify whether the request is for a residence occupied by the customer, a residence owned by the customer but occupied by someone else (e.g., renters), or a business. Such revisions will facilitate program management as well as evaluation.
- **Program marketing and outreach should emphasize personal benefits and ease of participation over environmental benefits.** The research indicates that the appeal of personal benefits influences customers more than environmental benefits.
- **LADWP should continue cross marketing the program through the Home Energy Improvement Program and the Turf Replacement Program, but LADWP also should continue to support and fund City Plant's promotion and marketing efforts.**
- **City Plants should consider approaches to increase recipient awareness of and compliance with the recommended planting zone.** This may include revising applications to ask customers to commit to planting trees within the 5-to-20-foot zone. Research has demonstrated that asking for specific commitments can promote adoption of targeted behaviors.

- **City Plants should continue to try to improve the tree delivery time but, at a minimum, should work at improving communication about the expected time.** As part of this communication, City Plants should provide advance notices to participants about the delivery schedule when it is known.
- **City Plants should leave the current cap in place as it provides as many trees as most customers want, discourages ordering more trees than customers will plant, and allows the program to distribute resources and trees to a larger number of customers.** Most customers stated they would not plant more trees if the cap was increased.

A.19 Program Outreach & Community Partnerships (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[24] and water conservation programs through the activities of community organizations. This program offers grants to local nonprofit 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.19.1 Process Evaluation Approach and Methodology

The Evaluator conducted a Limited Process Evaluation in FY2020/21 and completed the full process evaluation in FY2021/22. In July 2021, LADWP and the Evaluator revised the primary focus and associated activities of this evaluation to assess potential equity metrics to support LADWP's intention to categorize the program into the Equity segment of their Energy Efficiency Program Portfolio[25]. In addition to reporting high-level insights

[24] LADWP partners with the Southern California Gas Company to deliver natural gas efficiency programs.

[25] 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.

on grantee experiences, this evaluation explores the potential of POCP to measure equity-based impacts.

A.19.1.1 Research Questions

Table A-204 below summarizes the research questions and topics to be addressed through the process evaluation, as well as data sources to address them.

Table A-204 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 nonprofit 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 nonprofits 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

A.19.2 Methodology

The information within this chapter is based on three activities: 1) staff interviews, 2) program data tracking and materials review, and 3) 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[26]. 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 an 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.

[26] The Evaluator will review and assess grantee educational materials, including those on the program website as part of the full evaluation.

A.19.3 Results and Findings

A.19.3.1 Administrative and Customer Process Evaluation Findings

This section summarizes key findings from CY1 Process Evaluation activities.

A.19.3.2 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[27].

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 nonprofit staff about energy and water conservation (i.e., understanding energy efficiency, efficient equipment, ways to reduce utility bills).

A.19.3.3 Implementation

A.19.3.3.1 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

[27] Source: Discussion with the program manager, December 2020.

range from 12-18 months. The program allocates one grant to a Peer Facilitator and all other grants go to nonprofit 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 nonprofit 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
  - 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.

Nonprofit 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[28], 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.

[28] 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.

- 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.

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[29]:

- Changed the grant cycle nomenclature to describe the current grant year more clearly 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.19.3.3.2 Program Awareness and Grantee Engagement

LADWP raises awareness among nonprofit 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:

[29] Source: Community Partnership Outreach Grants for Non-Profit Organizations – 2022 Round Pre-Application Webinar. https://vimeo.com/676419542. Retrieved March 25, 2022.

- 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 complement to 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
        - 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.19.3.3.3 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 nonprofit organizations in each of the Los Angeles Council Districts. During 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.19.3.3.4 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.19.3.4 Grantee Feedback

The Evaluator’s key findings from the grantee interviews are summarized in this section.

A.19.3.4.1 Experience with Program Processes

All grantee organizations we interviewed had very 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 very 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 the 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.19.3.4.2 Satisfaction

Overall, grantees indicated that they were very satisfied with LADWP and the program. 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.19.3.4.3 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's 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.19.3.4.4 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. Grantees described how limited English communication abilities can be a barrier for both non-native native English speakers and native English speakers. To address this challenge, grantees used bilingual staff, offered services in Spanish, and adapted program materials with simplified language, fewer words, and incorporated images that help explain concepts.

A.19.3.5 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.19.3.5.1 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)[30]. 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 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-55 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.

[30] 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.

Figure A-55 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[31]
- Ability to speak English
- Number of years living in the United States
- Tribal affiliation status

Due to grantees' varied outreach approaches[32] 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[33].

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:

[31] Grantees have provided outreach in multiple languages including English, Spanish, Armenian, Korean, Russian, Farsi, Chinese, and others.

[32] 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.

[33] 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.19.3.5.2 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 A-205 on the following page 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 (see Table A-205).

Table A-205 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.		

Outcomes	Activities	Outputs	Metric(s)
Potential measurement solutions	Consider developing proxy measures for customer engagement with and awareness of LADWP programs. Refer to recommendations in the Recommendations section (A.17.2). 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 ▪ PROPOSED! LADWP identifies and prioritizes targeted communities, and documents key sources used to make this determination	▪ 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 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.)	▪ 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 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.		

Outcomes	Activities	Outputs	Metric(s)
***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. 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	▪ Number of grantees that aim to provide behavior change services ▪ Number of water conservations pledges (i.e., shorter showers)	▪ Percentage of grantees that provide behavior change services

Outcomes	Activities	Outputs	Metric(s)
	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 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	▪ 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	▪ 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	▪ Rates of grantee satisfaction ▪ Rate of grantee knowledge/skill attainment

Outcomes	Activities	Outputs	Metric(s)
	awareness of LADWP program offerings	energy and water conservation Feedback from grantees about their post-participation knowledge gain and skill development	
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.19.4 Recommendations

The Evaluator identified and prioritized recommendations for the program. This section lists recommendations for three key program areas.

A.19.4.1 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.19.4.2 Awareness and Engagement with LADWP programs

In the baseline program theory logic model shown in Table A-205 , 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'. 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 nonparticipant 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, that 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.

A.19.4.3 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 three 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-205).

- 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-205).

- Rate of targeted customers reached

- Rate of targeted customer application to LADWP programs
- Rate of targeted customer program enrollment
- Rate of targeted customers program completion

A.20 Codes, Standards & Ordinances (CSO)

The CSO Program provides advocacy and support activities to improve the energy and water efficiency of buildings and appliances across Los Angeles. Energy and water efficiency are promoted through focusing on the development of codes, standards, and ordinances that increase the baseline of energy and water measures for all customers.

CSO staff monitor code and ordinance changes at the local, state, and federal level. At the local level, staff work closely with the mayor's office to review proposed changes to local ordinances and provide support. At the state level, staff participate in the Statewide Codes and Standards Enhancement (CASE) Team, which also includes investor-owned utilities. This group collaborates with the California Energy Commission to sponsor studies that are used to evaluate proposed changes to future editions of the California Energy Code. Members of the statewide team, including LADWP, claim the savings associated with these codes based on energy savings delivered. Staff also monitor changes in code or standards at the federal level and advocate for changes through national partners like ACEEE.

In addition to monitoring and investigating upcoming code changes, staff also provide training and support to staff on new codes, standards, and ordinances.

A.20.1 Process Evaluation Approach and Methodology

For FY21/22, the Evaluator performed a summary process evaluation of the CSO program. This included an in-depth interview with LADWP program staff to understand and explore the following:

- Changes to the program's objective, goals, or approach
- Updates to program operations or processes
- Program successes
- Current focus areas, challenges, and opportunities going forward
- Other topics as relevant

The Evaluators performed a full process evaluation of the CSO program in FY20/21.

A.20.2 Process Evaluation Findings

The following sections include a summary of findings informed by the LADWP program staff interview.

A.20.2.1 Program Operations and Approach

Program staff note that the program's objectives and approach are the same as previous years and are largely driven by the statewide CASE program. However, staff are currently in the process of reviewing CSO tasks and exploring how to take a more proactive approach to codes, standards, and ordinance development going forward, especially at the local level. As a part of this, the program plans to add staff to support these efforts once future program tasks are better established.

A.20.2.2 Current Focus Area

Program staff highlighted the following focus areas currently being explored:

- **Development of customer guidance documents.** Program staff highlighted the recent production of a facility standards guidance document. The customer is the primary audience for this guidance document, and it will contain standard design information to inform the implementation of not only code-related items, but also other items to consider that streamlines the customer journey. The program intends to produce a similar guidance document for heat pump water heaters, as well as most new measures as they are added to the portfolio.
- **Create a stronger link between CSO and resource program measures that are ready to become a code, standard, or ordinance.** Program staff indicated that in the future they would like to take a closer look at program measures that are very cost-effective or have high free-ridership rates, and determine their readiness to transition into a code, standard, or ordinance. The program acknowledges that while the CASE program addresses measures at a state level, it does not fully meet the needs on a local level, so this stronger linkage will assist in providing more local benefits.

A.20.2.3 Previous Evaluation Recommendations

Table A-206 below includes a summary of previous recommendations and the program's response to date.

Table A-206 Previous CSO Recommendations & Program Response

Summary of Past Recommendations	Program Response
More frequent trainings with LADWP staff and involve staff in program design/redesign	CSO engineering staff have provided more subject-related updates to resource program staff where code changes are being made. For example, they recently gave a presentation on changing federal standards.

Summary of Past Recommendations	Program Response
Develop and maintain additional program documentation, detailing CSO program processes and program roles	Staff are currently in the process of reviewing CSO tasks and roles going forward.
Track program outputs	Program outputs will be explored once future program tasks and roles are established.
Monitor compliance with codes and ordinances	Compliance is in the realm of Building and Safety. Their role is typically to facilitate training on new energy codes. In the new year, they will offer a mini training to Building and Safety code officials.
Consider supporting permit review for Department of Building and Safety	This recommendation is not attainable, as it would overlap too much with Building and Safety responsibilities. The more likely route of support is to provide training to code officials and performing inspections via the resource programs. More recently, they have also begun asking customers to provide building permit numbers to qualify for incentives.

A.20.2.4 Recommendations

The Evaluators do not have any recommendations for CSO at this time.

A.21 Emerging Technology Program (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.

The program recently established a formalized workflow with National Renewable Energy Laboratory (NREL), designed to intake new technologies and ideas and evaluate them against program goals and enhanced technology screening.

A.21.1 Process Evaluation Approach and Methodology

For FY21/22, the Evaluator performed a summary process evaluation of ETP. This included an in-depth interview with LADWP program staff to understand and explore the following:

- Changes to the program’s objective, goals, or approach
- Updates to program operations or processes
- Program successes

- Current focus areas, challenges, and opportunities going forward
- Other topics as relevant

The Evaluators performed a full process evaluation of ETP in FY20/21.

A.21.2 Process Evaluation Findings

The following sections include a summary of findings informed by the LADWP program staff interview.

A.21.2.1 Program Operations and Approach

Program staff report that since the last program year, they have continued to test and refine the project intake and evaluation workflow process that was developed with NREL. Staff note that having a defined workflow in place has allowed for a more objective process, benefiting both the program and the market by measuring new ideas against the same criteria and goals. Staff state that the objectives of ETP largely remain the same, and they continue to focus on technologies that are market ready and cost-effective.

The program has also continued to partner with the Los Angeles Clean Tech Incubator (LACI), and more recently held a workshop with LACI staff to share and discuss each other's processes and to identify areas to collaborate going forward. LADWP program staff also continue to informally provide idea and technology referrals to ET staff.

A.21.2.2 Current Focus Areas

Program staff highlighted the following focus areas currently being explored:

- **Decarbonization, equity, and extreme heat. Decarbonization continues to be a priority area for the program.** To date, heat pumps have been a program focus. ETP is exploring how decarbonization and equity intersect, specifically related to extreme heat. For example, the program is exploring technologies from Europe that may not be emerging but have potential to address extreme heat in disadvantaged communities that do not have ready access to air conditioning.
- **Flexible loads.** The program continues to explore opportunities to shape and shift electrical loads to coordinate energy use and support the electric grid.
- **Addressing data access for developers.** Emerging technology developers require access to data to understand a technology's effect on energy consumption. LADWP currently does not support Green Button and obtaining approval to provide data often requires layers of review. As an alternative solution, the program is considering the creation of dashboards to meet this need.

Program staff also note that at this time, no formal program metrics have been established to measure the program's progress. However, as the program more fully launches and emerging technology projects kick off, they will explore metrics to track over time.

A.21.2.3 Previous Evaluation Recommendations

Table A-207 below includes a summary of previous recommendations and the program's response to date.

Table A-207 Previous ETP Recommendations & Program Response

Summary of Past Recommendations	Program Response
Establish specific program goals, and create and track specific, measurable program metrics which map directly to them.	Overall program metrics will be established once program processes are more fully launched, and projects are in place.
Increase pipeline and programmatic fit of submitted ideas by creating targeted solicitations	This may be considered after the program more fully launches and is ready to increase its pipeline of ideas.
Improve submitted idea quality by making research priorities and selection criteria clear and publicly available	This may be considered after the program more fully launches and is ready to increase its pipeline of ideas.
Create regimented time periods for key program processes, specifically idea solicitation and selection	Not being considered at this time. Instituting a regimented cycle can also introduce challenges, as start-ups do not necessarily begin on a set schedule.

A.21.3 Recommendations

The Evaluators do not have any recommendations for ETP at this time.

A.22 Marketing, Education and Outreach (MEO)

LADWP marketing efforts aim to increase customer awareness of energy efficiency, in general, 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.22.1 Process Evaluation Approach and Methodology

In March 2022, the Evaluator delivered a full process evaluation of the MEO program to LADWP. Evaluation tasks included performing program staff interviews, conducting a review of marketing materials, creating a visualization of the program marketing process, identifying potential pain points and opportunities, and analyzing MEO-related questions included in residential and business program participant surveys that fielded during the previous year.

The purpose of this section is to provide a summary of MEO-focused findings from the recently fielded general population survey and to identify considerations for the MEO program going forward. The survey was administered via email invitation in the summer and fall of 2022, resulting in 1,000 usable responses. The Evaluator also fielded several residential program surveys in CY2, including for the Refrigerator Exchange Program (REP), the Refrigerator Turn-in and Recycle Program (RETIRE), the Air Conditioning Optimization Program (ACOP), and the City Trees Program. Where relevant, comparisons and insights are also drawn from the results of these surveys.

A.22.1.1 Research Objectives and Survey Questions

The general population survey included a series of questions to inform MEO efforts on awareness and outreach. In the table below, we categorize these questions into four key research objective areas: (1) program awareness, (2) program communications, (3) customer interest, and (4) customer perceptions of LADWP.

Table A-208 …

Research Objective Areas	Related General Population Survey Questions	Included in Participant Surveys?
Program awareness	Did you know that LADWP offers programs to customers like you to help them save energy, water, and money on their bill? (Y/N) What programs are you aware of? Please select all that apply.	Yes
Program communications	How did you learn about the program(s) you mentioned? Please select all that apply. In your opinion, what is the best way for LADWP to keep customers like you informed about opportunities to save energy?	Yes
Customer interest	Would you be interested in learning more about the programs that LADWP offers to help customers save energy, water, and money on their bill?	No

Research Objective Areas	Related General Population Survey Questions	Included in Participant Surveys?
	Which of the following programs would you be interested in finding more information about? Please select all that apply.	
Customer perceptions of LADWP	How would you describe your overall opinion of LADWP? Where is LADWP doing well? Select up to three strengths. Select up to three areas where LADWP could improve.	Yes

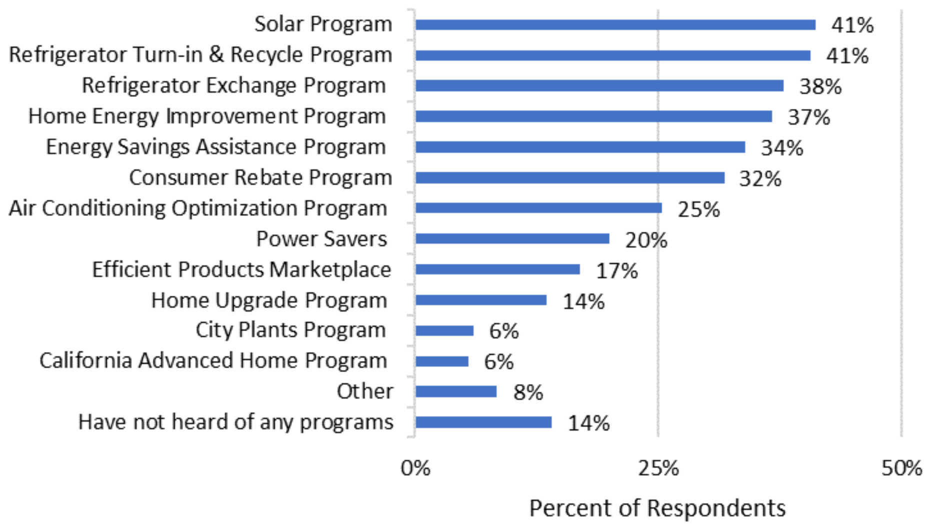
A.22.2 MEO-Related Findings

The following memo sections provide an overview of the Evaluator's general population survey findings in each of the research areas noted above. Related insights from program participant surveys fielded in CY2 are also included.

A.22.2.1 Program Awareness

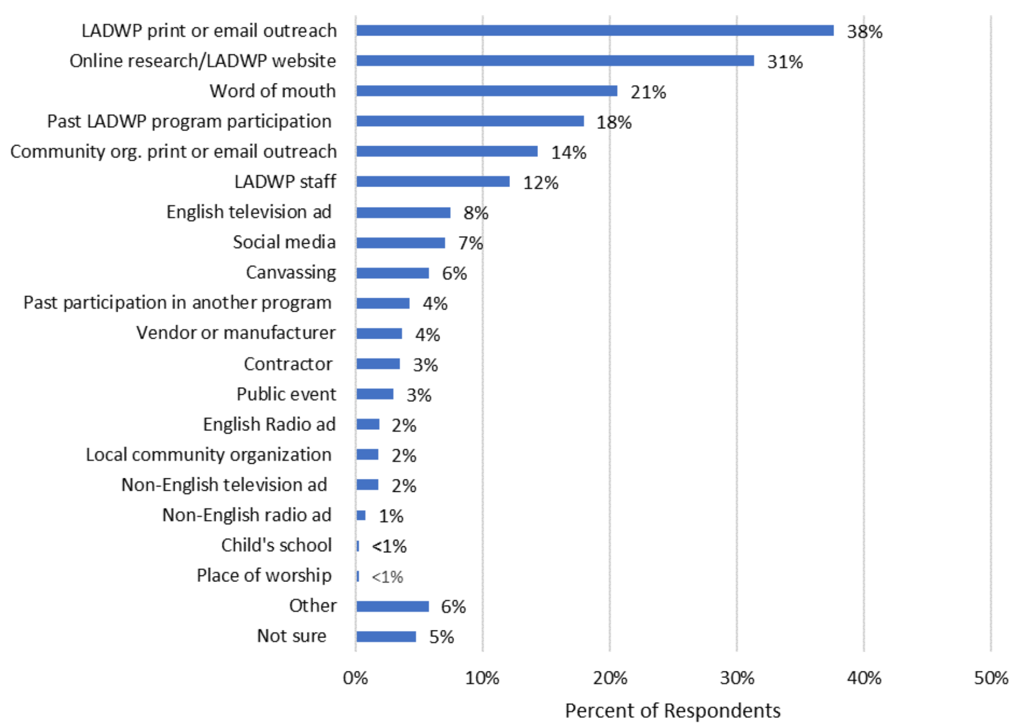
The Evaluator found that about two-thirds of all 570 general population survey respondents – or 64% - were aware of LADWP energy efficiency programs. As shown in Figure A-56, the most familiar programs were the Solar Program (41%), the Refrigerator Turn-in and Recycle Program (41%), the Refrigerator Exchange Program (38%), and the Home Energy Improvement (37%). Notably, 19% of respondents who initially said they were aware of LADWP programs could not identify a specific program offering that they were aware of.

Figure A-56 Program Awareness (n = 376)



The most frequent way to learn about programs was LADWP printed or emailed outreach materials (38%), followed by online research or the LADWP website (31%), and word-of-mouth (21%).

Figure A-57 Program Awareness Source (n=337)



LADWP's POCP is offering awards grants to local community organizations to conduct outreach to its constituents about program offerings and ways to save energy. Approximately 14% (n=39) of survey respondents noted that they learned about programs through printed or emailed outreach from a community organization. LADWP should consider tracking this source in future general population survey efforts to understand the extent of community organizations' reach over time.

Cross-Program Participant Awareness

How participants learn about an offering varies by program, though the ways in which they become aware generally align with top three results from the general population survey (receiving printed or email outreach materials, conducting online research or looking at the LADWP website, and word of mouth). Word of mouth was most prevalent (35%, n=55) for the REP, followed by printed or emailed materials from the program (33%, n=52). For the RETIRE program, conducting internet research or looking at the program website was by far the most common way to learn about the program (54%, n=114). The next closest options were the LADWP customer service center (11%, n=24) and word-of-mouth (11%, n=24). Conducting internet research or looking at the program website was also the most prevalent way participants found out about ACOP (25%, n=67), followed closely by printed or emailed materials from the program (18%, n=50) and past LADWP program participation (18%, n=48). City Trees participants heard about the offering primarily from the program itself (31%, n=62), followed by word of mouth (18%, n=33).

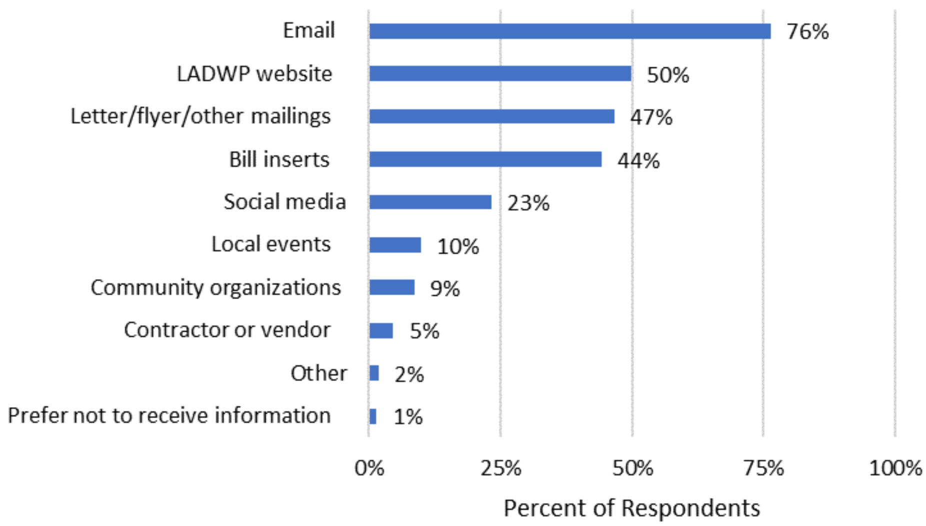
Program participants were also asked if they were aware of other program offerings. Results were mixed, with only 31% (n=48) of REP participants aware of other programs, and 68% (n=142) of RETIRE participants aware of other programs[38]. REP participants were most frequently aware of the Energy Savings Assistance Program (48%, n=23), followed by the Home Energy Improvement Program (40%, n=19). RETIRE participants most frequently identified being aware of the REP (68%, n=94), followed by the Customer Rebate Program (42%, n=59). For ACOP, the Customer Rebate Program was the most frequently mentioned, followed by Home Energy Improvement and RETIRE.

A.22.2.2 Program Communications

A large majority of general population survey respondents (76%) said that email is the best way to keep them informed about opportunities to save energy. This was followed by the LADWP website (50%) and letters, flyers, or other mailings (47%), as shown in Figure A-58.

[38] ACOP and City Trees participants were not asked if they were generally aware of other LADWP programs.

Figure A-58 Preferred Form of Communication (n=570)



While email, the LADWP website, and mailings are identified by the most respondents as the best ways to hear about opportunities, MEO should consider how communications may need to differ depending on the barriers that certain customer groups face. As LADWP pursues its goals of decarbonization and equity, expanding awareness and participation by reaching non-participants and underserved or distressed communities becomes increasingly important. In 2020, ILLUME conducted a study in Massachusetts[39] that characterized nonparticipants, investigated barriers to participation, and identified engagement opportunities. This research found that non-participants often expressed a lack of trust in government or institutions, needed more information or understanding of utility offerings, participation processes, and benefits, and often perceived energy efficiency as irrelevant or not applicable to them. LADWP should consider who is served by each of its communication strategies and identify gaps, along with ways to address them.

It is also noteworthy—but perhaps not surprising—that only 5% of respondents believe that contractors or vendors are the best way to keep them informed. While in general, customers may prefer not to hear about opportunities through a contractor first, this may be the case in practice when an appliance or piece of equipment needs to be replaced on failure or quickly repaired. In these cases, the contractor plays a key role in educating the customer on energy savings opportunities and potential rebates. LADWP should also ensure that contractors and vendors are thoroughly considered in its communication strategies to increase customer awareness.

[39] Massachusetts Residential Non-Participant Market Characterization and Barriers Study (accessed on January 27, 2023). https://ma-eeac.org/wp-content/uploads/MA19R04-A-NP-Nonpart-MarketBarriersStudy_Final.pdf .

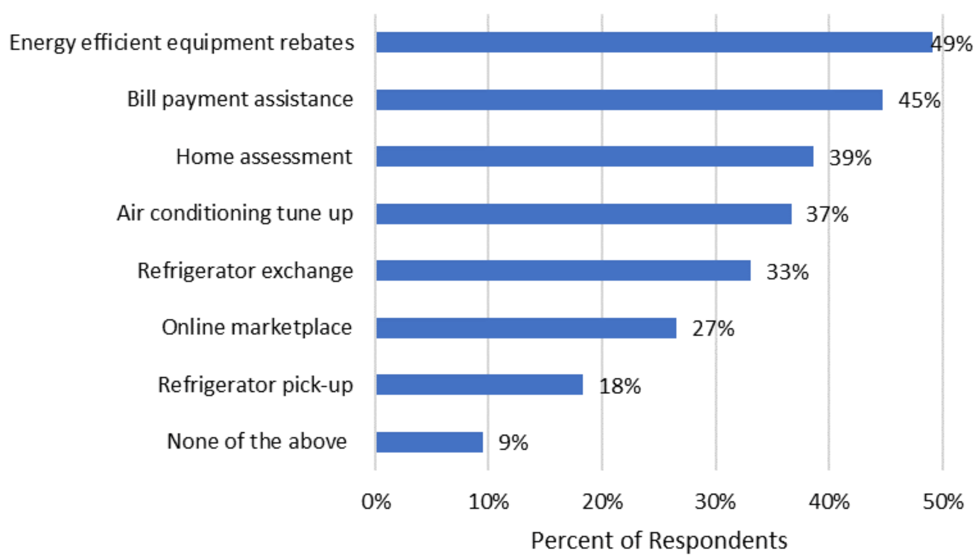
Cross-Program Participant Communications

Program participant preferences for how to best communicate energy savings opportunities were also generally aligned with results from the general population survey. RETIRE participants noted that email (63%, n=133) was the best way to keep them informed, with the LADWP website coming in second (57%, n=118). Similarly, ACOP participants chose email as the best approach (35%, n=181), and then the LADWP website (21%, n=110). In contrast, REP participants said that letters, flyers, or other mailings (53%, n=83) were the best way to keep them informed on opportunities to save energy, followed by email (40%, n=63).

A.22.2.3 Customer Interest

Customers are overwhelmingly interested in finding out more about LADWP programs, with 90% (n=511) of general population survey respondents saying would like to know more. This level of interest suggests that there is still ample room to increase customer awareness of and participation in LADWP programs. Respondents are most interested in finding out about energy efficiency equipment rebates (49%), followed by bill payment assistance (45%), as shown in Figure A-59. Respondents are least interested in learning more about refrigerator pick-up (18%).

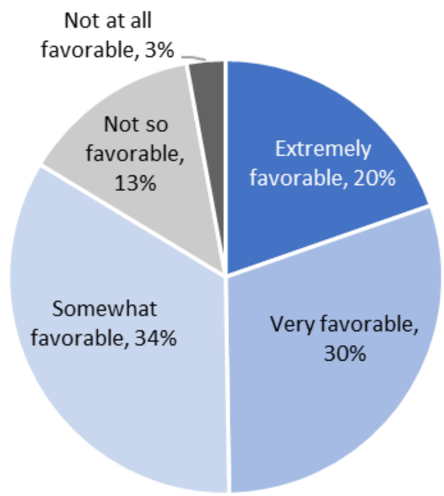
Figure A-59 Programs of Interest (n=511)



A.22.2.4 Customer Perceptions of LADWP

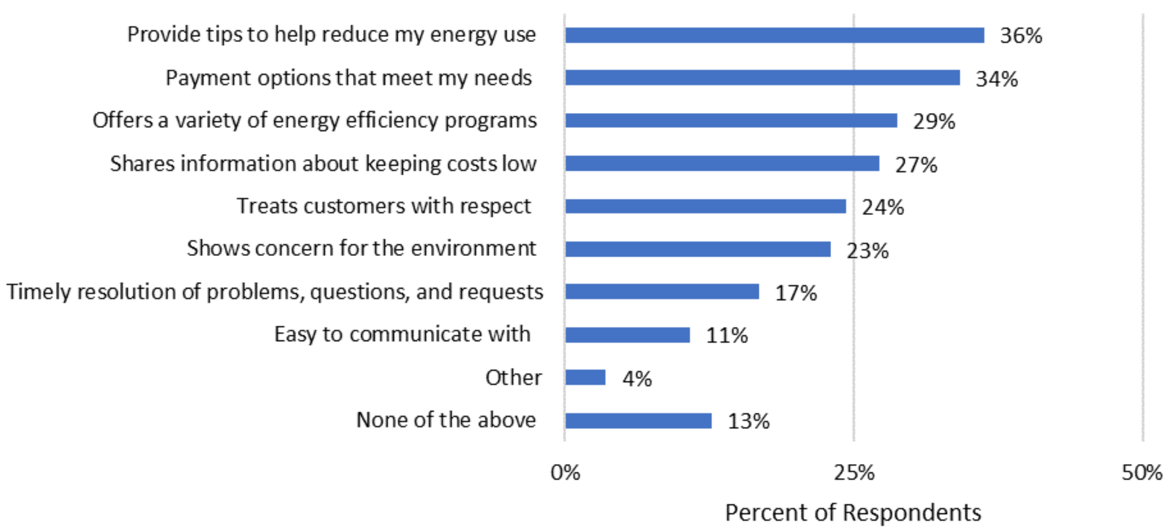
Fifty percent of general population survey respondents have either extremely favorable or very favorable opinions of LADWP. A total of 16% of respondents are either not so favorable or not at all favorable, as shown in Figure A-60.

Figure A-60 Opinion of LADWP (n=570)



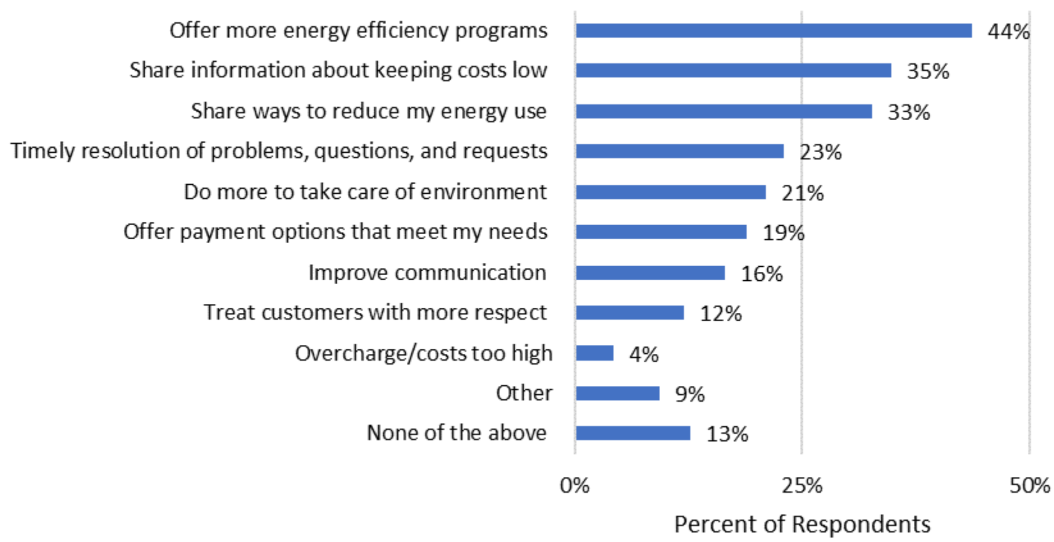
Respondents also identified the top areas where LADWP is doing well, which included providing tips to help reduce my energy usage (36%), offering payment options that meet my needs (34%), and offering a variety of energy efficiency programs (29%).

Figure A-61 Areas Where LADWP is Doing Well (n=570)



Conversely, respondents also identified three areas where LADWP could improve. The top-ranking area was offering more energy efficiency programs (44%), followed by sharing information about keeping costs low (35%), and sharing ways to reduce my energy use (33%).

Figure A-62 Areas Where LADWP Could Improve (n=570)



Cross-Program Participant Perceptions

Program participants were also asked to describe their overall opinion of LADWP. Generally, program participants show more favorable opinions of LADWP than the general population. Eighty-three percent (n=130) of REP participants, 75% (n=155) of ACOP participants, 71% (n=147) of RETIRE participants, and 54% (n=79) of City Trees participants were either extremely favorable or very favorable of LADWP.

As a related follow-up, program participants were also asked what impact program participation had on their attitude towards LADWP. Program participation largely improved people's attitudes towards the utility, with 83% (n=128) of REP participants, 73% (n=151) of ACOP participants, 67% (n=135) of RETIRE participants, and 56% (n=84) of City Trees participants noting an improvement.

A.22.3 Summary of Findings and Recommendations

- **With just 64% of the general population aware of LADWP programs—and 90% interested in learning more—there is still room to increase awareness with program opportunities and convert this awareness into participation.** Additionally, while 76% of customers prefer to receive information on program offerings via email, LADWP should also carefully consider how its communication strategies serve different types of customers with varying needs and barriers. As LADWP continues to pursue increasing goals of decarbonization and equity, expanding awareness and familiarity with programs—and the strategies used to communicate this information—will be increasingly critical.

- **Recommendation:** LADWP should consider more clearly charting out the customer journey within and across programs opportunities to increase awareness and familiarity. The Evaluator's full process evaluation for MEO identified some initial considerations to improve the customer journey, and opportunities for MEO support. Beyond this, LADWP may wish to also consider how customers interact with different LADWP programs as they move along in their energy efficiency journey overtime. For example, if a customer first participates in the RETIRE program, how can LADWP help them to identify and take part in the next opportunity? Completing a portfolio journey mapping exercise would help to streamline the path for customers and create "handshakes" between programs.
- **Recommendation:** Identify opportunities to educate contractors and vendors about the full suite of LADWP programs. Contractors and vendors play an important role in educating customers about energy efficiency opportunities, especially when an appliance fails or when other renovations or repairs are being made in the home. Contractors are also actively in the field responding to customer needs on a day-to-day basis, making them ideal partners for LADWP programs. Arming them with information about additional program opportunities can support the customer in their energy savings journey, and boost program awareness and participation.
- **Recommendation:** LADWP should consider conducting a study to understand non-participant barriers and opportunities more deeply. Increasing goals of decarbonization and equity are prompting utilities across the nation to look more closely at how to best serve populations that they have not historically reached. If pursued, study research areas could include characterizing nonparticipants, investigating barriers to participation, and identifying engagement opportunities.

- **A small but notable proportion of customers learn about programs through community organization outreach.** Of those customers aware of an LADWP program, about 14% said that they learned about it through community organization materials or email outreach. Nine percent of customers also say that they would prefer to learn about energy savings opportunities from community organizations.
  - **Recommendation:** To support POCP metrics and impact assessment, consider tracking the incidence of customers learning about and participating in programs through local community organizations with more frequency and earlier in the participation process. This could be

achieved by including a question on program applications asking how a customer heard about the program, and including an option to select local community organizations outreach or materials. Results could be supplied to POCP on a quarterly basis (or more frequently depending on ability) to better understand the effect of grantee activities overall on participation.

- **Program participation appears to have a positive effect on customer attitudes towards LADWP.** This is good news as LADWP pursues goals like decarbonization and equity that require it to expand its reach and implement new approaches and strategies.
  - **Recommendation:** LADWP should consider additional ways to increase access to program participation opportunities for its customers. MEO should also consider ways to offer support and coordination across resource programs to ensure efforts are aligned. Drawing from the full process evaluation recommendations delivered in March 2022, MEO could create an annual calendar of marketing promotions to consolidate and coordinate marketing efforts across the company, as well as develop a program theory and logic model to refine inputs, activities, and overall outcomes.

A.23 Program Analysis and Development (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[40]. 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 the collection and monitoring of program metrics and regulatory reporting, coordinating collaborations with academic and government agencies, technical groups to advance energy efficiency analysis, and supporting other LADWP groups, including Power Systems and Communications, with analysis and reporting.

[40] LADWP staff have also used other names to refer to the program, including the PA&D program and the Program Development program.

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[41].

A.23.1 Process Evaluation Approach and Methodology

This section reports the approach, research questions, and study methods of this evaluation.

A.23.1.1 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.23.1.2 Research Questions

The PADP process evaluation is designed to answer the research questions included in the Table A-209 below.

Table A-209 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

[41] 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.

Research Question or Objective	Data Sources
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.23.1.3 Methods

The Evaluator conducted the following activities to answer the research questions.

A.23.1.3.1 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.23.1.3.2 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 training. 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 training courses, 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, 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[42]. The Evaluator then used the process flow chart to identify any bottlenecks or other issues and made recommendations to address these.

A.23.1.3.3 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 PADP support and services useful, their satisfaction with PADP outputs, and any suggested improvements.

A.23.2 Results and Findings

This section presents findings and insights from the evaluation research.

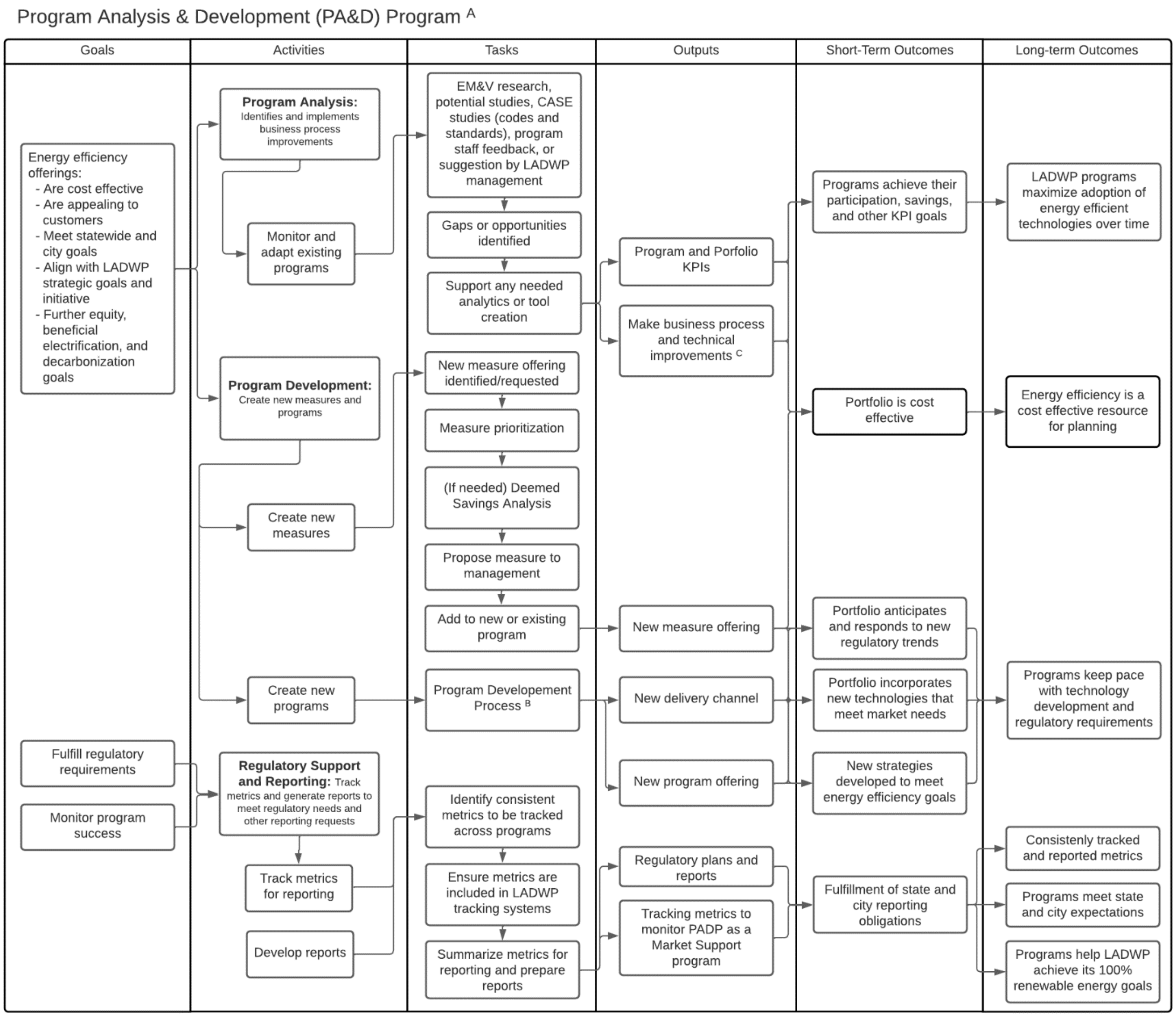
A.23.2.1 Baseline Logic Model

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-63 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.

[42] 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.

Figure A-63 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.23.2.1.1 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.23.2.1.2 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 support 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.23.2.1.3 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.23.2.1.4 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 were 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 were 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.23.2.1.5 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 segments 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-210 below:

Table A-210 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[43] ▪ 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).

[43] Please reference Appendix A 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

As shown Table A-210 above, while some of the Innovation and Accessibility metrics may be well suited to the PADP program, others may be more appropriately measured through Codes and Standards (CSO), Emerging Technology (ET), or Marketing, Education and Outreach (MEO). Table A-211 below shows the Evaluators proposed breakdown of how these metrics could be captured across LADWP's non-resource programs.

Table A-211 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 be collected now (program outputs for relevant programs)	▪ Number 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	▪ Number of new, validated technologies recommended to CalTF	▪ None	▪ None

Metric Type:	PADP	ET	CSO	MEO
	support programs relative to cost effectiveness of a technology after intervention by the market support programs (% change in cost effectiveness)			
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

Similarly, some Access to Capital metrics may be well suited to the PADP program, while other may make more sense to measure through Marketing, Education and Outreach. Table A-212 below shows the Evaluators proposed breakdown of how these metrics could be captured across LADWP's non-resource programs.

Table A-212 Proposed alignment of LADWP Non-Resource Programs with Innovation and Accessibility 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

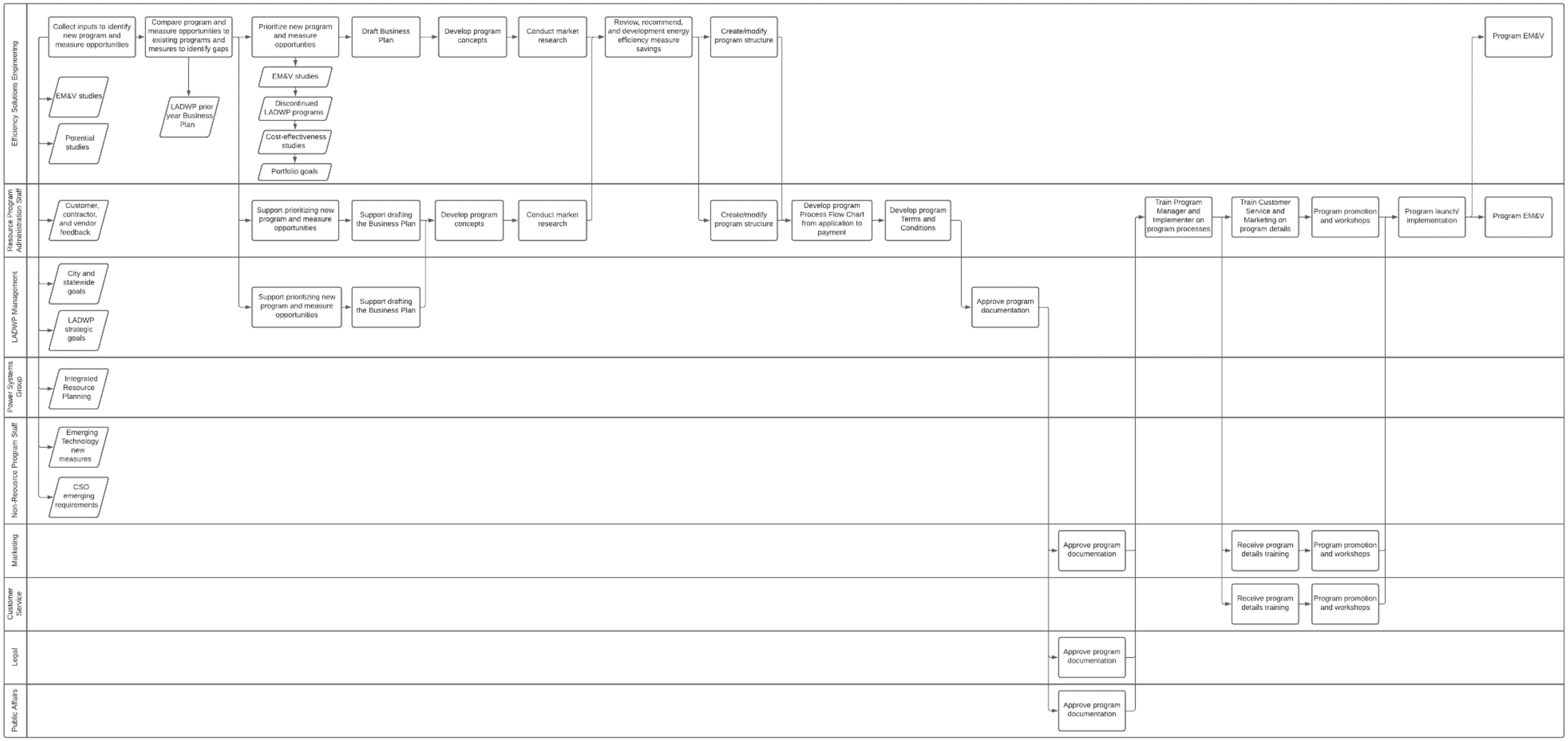
Metric Type:	PADP	MEO
		energy efficient projects, products, or services (behavior)

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.

A.23.2.2 Process Flow Chart: New Program Development

In this section, we focus specifically on the process for new-program development. Figure A-64 shows the new program development process, including the internal groups within LADWP who are involved and their responsibilities.

Figure A-64 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. Additional information is provided in Section A.23.2.3.

As shown in the intended process, the 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. Also, ESE is solely responsible for reviewing, recommending, and developing savings for the energy efficient measures. Throughout the initial program, the 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, approved by LADWP management and 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 the program EM&V and make ongoing improvements.

A.23.2.3 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 early 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.23.2.3.1 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.23.2.3.2 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.23.2.3.3 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 suggestions 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 various 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[44]
    - Improving data collection methodologies and data accuracy[44]
    - 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[44]
    - Regularly reviewing program savings and incentives amounts to ensure calculation methodologies and assumptions are appropriately documented and up to date[44]

A.23.2.3.4 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

[44] Starred efforts were identified as in-progress by interviewees.

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.23.3 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 ever-changing 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.24 CAMR

LADWP rolled out CAMR in July 2022 as a new program that arose from the previous collaboration with SoCalGas. It is now run exclusively by LADWP, their contractor the Association for Energy Affordability (AEA), and AEA subcontractor California Housing Partnership, (CHP). The program runs during a fiscal year (a fiscal year, FY, is July 1 to June 30). The program's goals are to save energy, reduce greenhouse gas emissions, and support jobs.

The program targets buildings with a high percent of low-income tenants or buildings located in LADWP equity areas, defined as being located in a Disadvantaged Communities (DACs). CAMR provides multi-family property owners free property assessments to identify efficiency opportunities to help owners and their residents save energy and reduce costs. In addition, qualified property owners receive aid with work scope development and the contractor procurement process.

The program also offers property owners financial incentives for reducing energy use (and therefore energy costs) in both common areas and inside tenants' units. The incentives are based on reduction in greenhouse gas emissions estimated on the reduced energy use. The incentives are higher for sites with 65 or more units and for measures that reduce tenant-paid energy costs (Table A-213).

Table A-213 CAMR Incentives

Number of Units	For Energy Efficiency Measures that Reduce Owner-Paid Energy Costs	For Energy Efficiency Measures that Reduce Tenant-Paid Energy Costs
5-64	$5,400/MTCO2e	$6,750/MTCO2e
65+	$6,200/MTCO2e	$7,750/MTCO2e

**MTCO2e = Metric Ton of Carbon Dioxide*

A.24.1 Process Evaluation Approach and Methodology

This is a concurrent summary process evaluation of FY21/22 that included review of documents, staff interviews, and creation of a program logic model.

A.24.1.1 Document Review

The Evaluator reviewed the CAMR fact sheet, program terms and conditions, 2021 Portfolio Business Plan, a PPT presented in June 2022 to the Evaluator by CAMR, and information on the LADWP website.

A.24.1.2 Staff Interviews

Over a one-hour period in July 2022, the evaluation team interviewed three (3) CAMR staff. Additionally, the Evaluator spent an hour with the CAMR team in September 2022 discussing the draft program logic model. A logic model shows high level activities and the outcomes expected from those activities. Additionally, a logic model can indicate where to collect data to track program activities and show success.

A.24.1.3 Process Evaluation Findings

The Evaluator's analysis of CAMR focused on information collected from speaking with the LADWP project managers about the program. In addition to describing the CAMR program based on document review, the Evaluator created a logic model. The logic model was reviewed and updated by the CAMR team before finalizing (final model shown in Figure A-65).

A.24.1.3.1 Program Requirements and Goals

Participating properties must:

- Consist of five (5) or more units.
- Meet affordability requirement of at least 66% of households at or below 80% of Area Median Income.
- Be located in a Disadvantaged Community (DAC) or if outside of a DAC, the property can participate with proof of rent regulatory agreement or provision of public assistance program documentation.
- Install energy improvements that equate to at least 5% in electrical energy savings.

Property owners who are able to achieve more than 5% in electrical energy savings may also be eligible to receive incentives for the installation of solar photovoltaic systems.

In addition, contractors hired by LADWP customers must meet prevailing wage, skilled and trained workforce, and licensing requirements, as applicable.

There are internal goals related to equity (e.g., number of properties in DACs, lowering utility bills), environment (e.g., kWh savings, GHG reductions), and employment (determined by labor hours for AEA technical support staff).

A.24.1.3.2 Marketing and Outreach

CAMR uses email blasts, webinars, and booths at events to market the program. While AEA and CHP are doing most of the outreach, it is done in collaboration with LADWP. LADWP plans to hold monthly or bi-monthly webinar meetings to educate and answer questions. Additionally, CAMR is collaborating with the LA Housing department to get CAMR information included in letters that LA Housing sends out to property owners.

Program staff indicated that the incentives based on GHG reductions often take a little more time to describe during the webinars as potential customers are finding it confusing. However, the program is working to clarify how the incentive works.

A.24.1.3.3 Collaboration

CAMR expects to collaborate often with the Home Energy Improvement Program (HEIP). In fact, CAMR sees HEIP as a way to provide no-cost measures to the CAMR participants that then frees up the CAMR participants capital for other investments.

A.24.1.3.4 Measures

CAMR participants can earn GHG incentives based on a full suite of energy savings measures as shown in Table A-214.

*Table A-214 CAMR Measures**

Water Measures	HVAC Measures	Appliance Measures	Weatherization Measures
Low-flow faucet aerators – kitchen and bath	(leveraged through other LADWP programs)	Clothes washers (common areas)	Wall and ceiling, crawl space insulation
Low-flow showerhead	Full HVAC system	Clothes dryers (common areas)	T24 window
Shower diverter valve	Electrification (Heat Pump)	Dishwashers (tenant)	Air conditioner cover
Showerhead adapter	Window/Room AC	Refrigerators (tenant)	Appliance closet weather-stripping and door latch
		Heat pump water heaters	Attic access cover
		Tankless electric / storage electric water heaters	Caulking up to 100’
			Doors – solid core
			Door hardware – locks, handles, hinges

Water Measures	HVAC Measures	Appliance Measures	Weatherization Measures
			Door casing sweep and threshold
			Window casing
			Evaporative cooler register cover
			Glass replacement and caulking
			Switch and outlet gaskets & covers
			Wall repairs
			Water heater blanket and pipe insulation
			Weather stripping

*CAMR was finalizing the list of measures at the time of our discussion in July 2022. As such, this list may be updated.

A.24.1.3.5 Participation and Logic Model

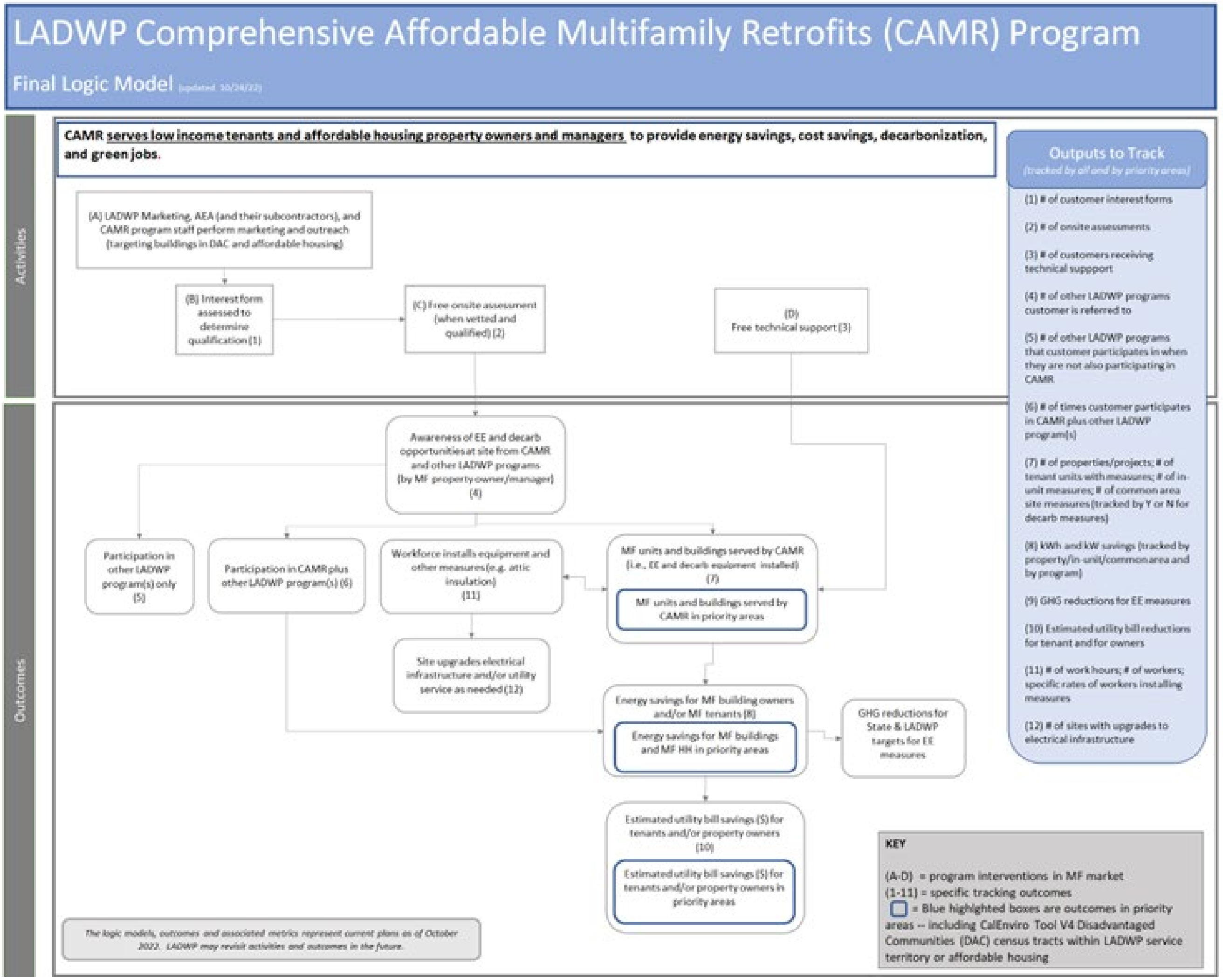
A customer begins the participation process by filling out an interest form found on the LADWP website (https://ladwpcamr.com/). Once LADWP vets the customer and determines them to be qualified, they receive a free onsite assessment to help understand energy efficiency and decarbonization opportunities. After the assessment and a full understanding of opportunities specific to the site, the CAMR technical support may refer the customers to a different LADWP program, provide information on participating in both a different LADWP program and CAMR, or serve the program solely through CAMR.

Building owners/property managers procure their own contractor to perform any work associated with the energy opportunities. Additionally, if electrical infrastructure upgrades are required at the site prior to installing energy efficiency or decarbonization measures, the building owner is responsible for finding a suitable contractor for that work too. However, free technical support is provided throughout the participation process and can include work scope development and helping the owner procure contractors.

The logic model is shown in Figure A-65. Besides documenting the main program activities, it also shows the outcomes from program activities and outputs for the program to track to demonstrate success.

One of the outcomes of the programs is estimated tenant and building owner bill savings. These bill savings are from an Excel based model (created by the LADWP engineering team) that uses estimated billing rates for five years.

Figure A-65 CAMR Program Logic Model



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	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
Lighting	0.22	0.38	362.42	0.11	0.38

Table B-2 CLIP Measure Level Cost Effectiveness Results

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
Lighting	0.63	0.87	17.10	0.19	0.87

Table B-3 CP Measure Level Cost Effectiveness Results

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
Shade Trees	4.84	4.84	13.41	0.98	4.84

Table B-4 CPP Measure Level Cost Effectiveness Results

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	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	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	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
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

Measure	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
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 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-19 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