LADWP

Concurrent Evaluation

Fiscal Years 20/21 - 22/23

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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 Years 2020/2021 to FY 2022/2023 (FY 20/21 to FY 22/23 or Concurrent Period). This chapter summarizes the impacts from the Concurrent Period and $347,656,585 in spending, achieving over 955 GWh in energy savings.

ES.1 Regulatory Context

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

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

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

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

ES.2 Portfolio Performance Summary

Table ES-1 shows Ex-Ante and Ex-Post MWh savings and the realization rate for each program during the Concurrent Period. The overall MWh realization rate not including Codes, Standards, and Ordinances was 96%. Concurrent Period M&V Sampling strategies resulted in a measure-level precision of <10.0% at the 90% confidence interval.

Table ES-1 Concurrent Period MWh Portfolio Performance Summary

Sector	Program	Ex-Ante MWh	Ex-Post MWh	Realization Rate
Non-Residential	Commercial Direct Install	81,194	85,584	105%
	Commercial Lighting Incentive Program	99,850	87,255	87%
	Custom Performance Program	67,659	72,897	108%
	Food Service Program Point-of-Sale	312	141	45%
	Food Service Program Comprehensive	169	164	97%
	LADWP Facilities	1,493	1,057	71%
	LAUSD Direct Install	16,453	14,585	89%
	Savings by Design	12,225	12,167	100%
	Upstream HVAC	15,428	9,598	62%
	Zero by Design	33	33	100%
Non-Residential Sector Total		294,818	283,481	96%
Residential	Customer Rebate Program	19,466	18,826	97%
	Efficient Product Marketplace	3,915	7,848	200%
	Energy Savings Assistance Program	2,746	1,696	62%
	Home Energy Improvement Program	2,083	2,561	123%
	Refrigerator Exchange	4,332	4,628	107%
	Refrigerator Turn-in and Recycle Program	10,228	3,237	32%
	Residential Lighting Efficiency Program	221	174	79%
Residential Sector Total		42,990	38,970	91%
Cross-Sector	AC Optimization Program	25,712	25,006	97%
	California Advanced Home Program	262	262	100%
	City Plants	20,757	20,757	100%
	Codes, Standards, and Ordinances	582,970	589,997	101%
	Multifamily Whole Building	1,418	1,475	104%
Cross-Sector Total		631,119	637,497	101%
Total		**968,927**	**959,948**	**99%**
Total Excluding Codes, Standards, and Ordinances		**385,957**	**369,951**	**96%**

Figure ES-2 shows Ex-Ante and Ex-Post MWh savings and the realization rate for each program during FY 22/23. The overall MWh realization rate not including Codes, Standards, and Ordinances was 98%.

Table ES-2 FY 22/23 MWh Portfolio Performance Summary

Sector	Program	Ex-Ante MWh	Ex-Post MWh	Realization Rate
Non-Residential	Commercial Direct Install	32,645	37,997	116%
	Commercial Lighting Incentive Program	41,128	31,049	75%
	Custom Performance Program	15,171	14,976	99%
	Food Service Program Comprehensive	37	28	75%
	LADWP Facilities	442	273	62%
	LAUSD Direct Install	4,103	3,368	82%
	Savings by Design	3,922	3,730	95%
	Upstream HVAC	3,591	2,640	74%
	Zero by Design	33	33	100%
Non-Residential Total		101,072	94,094	93%
Residential	Customer Rebate Program	2,623	2,277	87%
	Efficient Product Marketplace	1,302	2,410	185%
	Home Energy Improvement Program	2,083	2,561	123%
	Refrigerator Exchange	1,538	1,681	109%
	Refrigerator Turn-in and Recycle Program	3,910	1,163	30%
	Residential Lighting Efficiency Program	71	49	69%
Residential Total		11,527	10,142	88%
Cross-Sector	AC Optimization Program	12,337	12,295	100%
	California Advanced Home Program	159	159	100%
	City Plants	7,243	7,243	100%
	Codes, Standards, and Ordinances	197,276	199,647	101%
Cross-Sector Total		217,015	219,344	101%
Total		**329,614**	**323,580**	**98%**
Total Excluding Codes, Standards, and Ordinances		**132,338**	**123,933**	**94%**

Figure ES-3 shows Ex-Ante and Ex-Post MW savings and the realization rate for each program during the Concurrent Period. The overall MW realization rate not including Codes, Standards, and Ordinances was 97%.

Table ES-3 Concurrent Period MW Portfolio Performance Summary

Sector	Program	Ex-Ante MW	Ex-Post MW	Realization Rate
Non-Residential	Commercial Direct Install	11.04	11.74	106%
	Commercial Lighting Incentive Program	11.66	10.07	86%
	Custom Performance Program	10.38	11.34	109%
	Food Service Program Point-of-Sale	0.04	0.02	45%
	Food Service Program Comprehensive	0.02	0.02	92%
	LADWP Facilities	0.22	0.15	70%
	LAUSD Direct Install	1.83	1.62	89%
	Savings by Design	2.38	2.35	99%
	Upstream HVAC	3.76	2.30	61%
	Zero by Design	0.01	0.01	100%
Non-Residential Sector Total		41.34	39.62	96%
Residential	Customer Rebate Program	6.42	5.80	90%
	Efficient Product Marketplace	2.42	3.90	162%
	Energy Savings Assistance Program	0.33	0.20	62%
	Home Energy Improvement Program	0.40	0.67	167%
	Refrigerator Exchange	0.81	0.84	103%
	Refrigerator Turn-in and Recycle Program	1.89	0.62	33%
	Residential Lighting Efficiency Program	0.03	0.02	81%
Residential Sector Total		12.29	12.05	98%
Cross-Sector	AC Optimization Program	14.94	14.02	94%
	California Advanced Home Program	0.05	0.05	95%
	City Plants	13.90	13.90	100%
	Codes, Standards, and Ordinances	90.90	91.98	101%
	Multifamily Whole Building	0.23	0.23	104%
Cross-Sector Total		120.01	120.18	100%
Total		**173.64**	**171.85**	**99%**
Total Excluding Codes, Standards, and Ordinances		**82.74**	**79.87**	**97%**

Table ES-4 shows Ex-Ante and Ex-Post MW savings and the realization rate for each program during FY 22/23. The overall MWh realization rate not including Codes, Standards, and Ordinances was 95%.

Table ES-4 FY 22/23 MW Portfolio Performance Summary

Sector	Program	Ex-Ante MW	Ex-Post MW	Realization Rate
Non-Residential	Commercial Direct Install	4.86	5.66	116%
	Commercial Lighting Incentive Program	5.19	3.90	75%
	Custom Performance Program	2.99	3.13	105%
	Food Service Program Comprehensive	0.01	0.00	61%
	LADWP Facilities	0.06	0.04	58%
	LAUSD Direct Install	0.77	0.63	82%
	Savings by Design	1.14	1.08	95%
	Upstream HVAC	0.92	0.65	71%
	Zero by Design	0.01	0.01	100%
Non-Residential Total		15.95	15.10	95%
Residential	Customer Rebate Program	0.70	0.44	62%
	Efficient Product Marketplace	0.55	1.00	183%
	Home Energy Improvement Program	0.40	0.67	167%
	Refrigerator Exchange	0.26	0.26	99%
	Refrigerator Turn-in and Recycle Program	0.67	0.19	28%
	Residential Lighting Efficiency Program	0.01	0.01	76%
Residential Total		2.60	2.57	99%
Cross-Sector	AC Optimization Program	5.43	4.92	91%
	California Advanced Home Program	0.03	0.03	92%
	City Plants	3.24	3.24	100%
	Codes, Standards, and Ordinances	32.50	32.90	101%
Cross-Sector Total		41.20	41.08	100%
Total		**59.74**	**58.75**	**98%**
Total Excluding Codes, Standards, and Ordinances		**27.24**	**25.85**	**95%**

Figure ES-1 shows Ex-Ante and Ex-Post energy savings and the realization rate for each program during the Concurrent Period and Figure ES-2 shows Ex-Ante and Ex-Post energy savings and the realization rate for each program during FY 22/23. Both figures do not include energy and demand impacts from Codes, Standards, and Ordinances.

Figure ES-1 Concurrent Period Energy Impacts Not Including Codes, Standards, and Ordinances

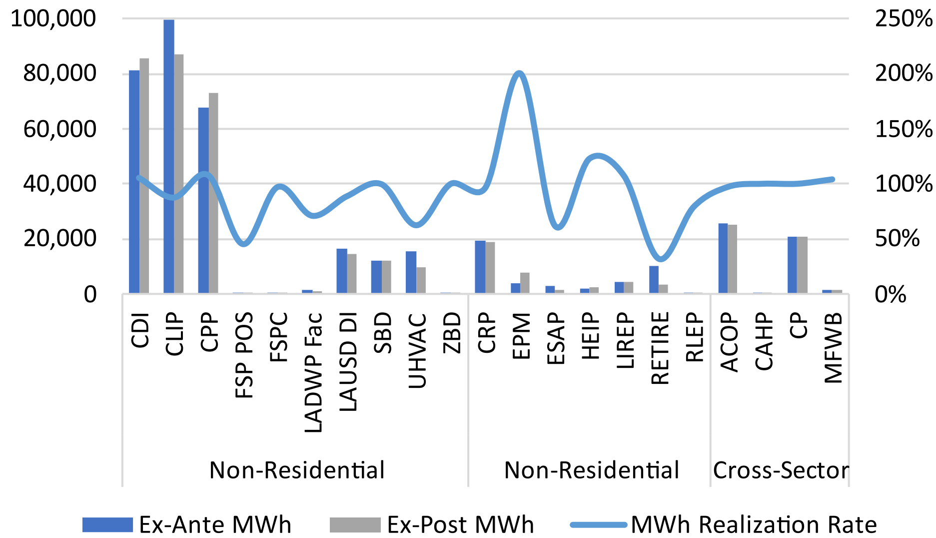


Figure ES-2 FY 22/23 Energy Impacts Not Including Codes, Standards, and Ordinances

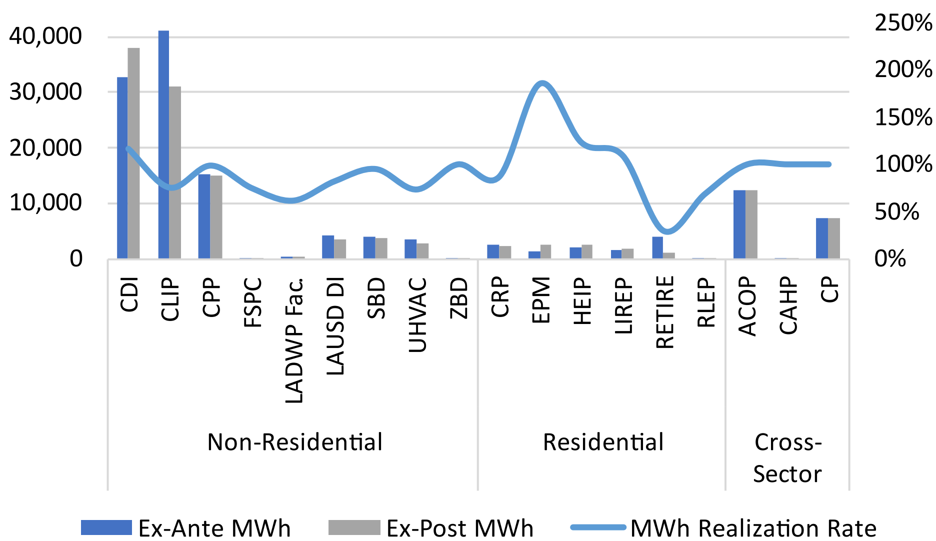


Figure ES-3 shows Ex-Ante and Ex-Post peak demand impacts and the realization rate for each program during the Concurrent Period and Figure ES-4 shows Ex-Ante and Ex-Post peak demand impacts and the realization rate for each program during FY 22/23.

Both figures do not include energy and demand impacts from Codes, Standards, and Ordinances.

Figure ES-3 Concurrent Period Peak Demand Impacts Not Including Codes, Standards, and Ordinances

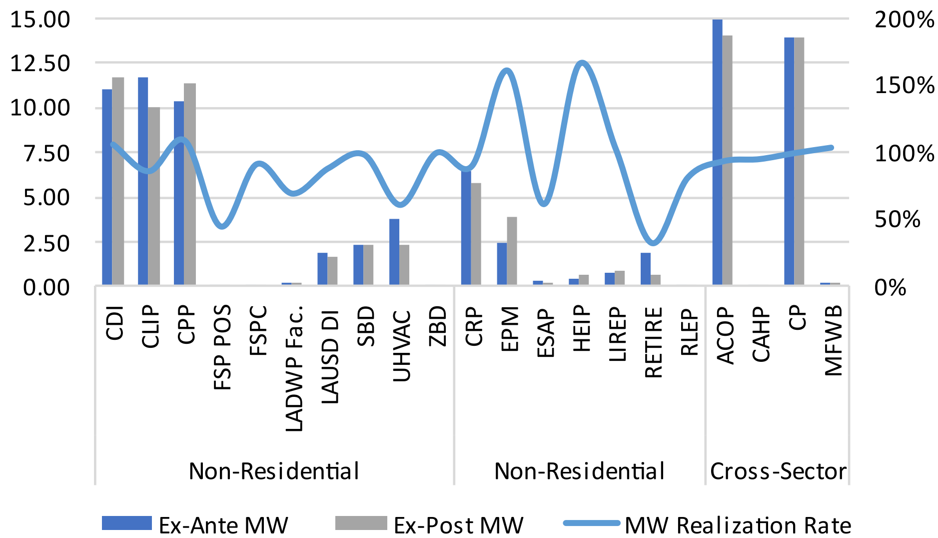


Figure ES-4 FY 22/23 Peak Demand Impacts Not Including Codes, Standards, and Ordinances

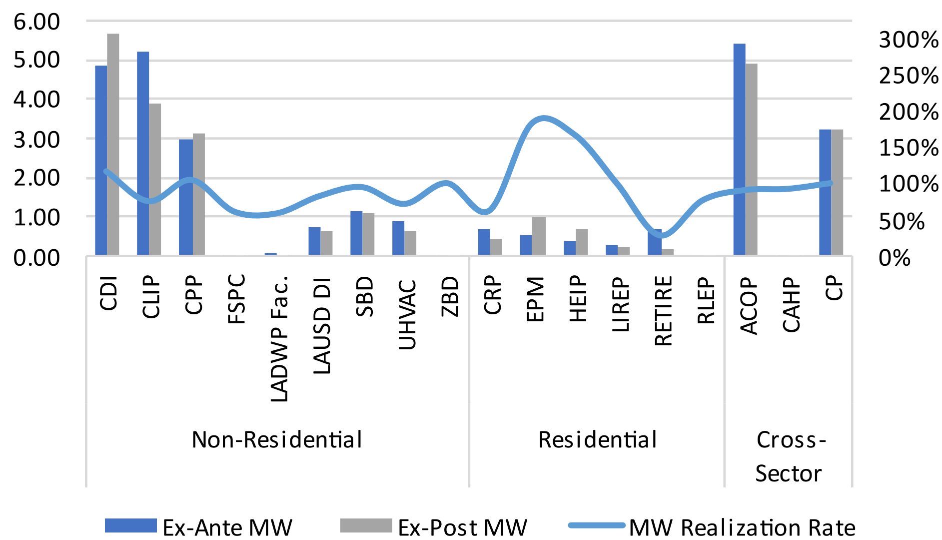


Figure ES-5 through Figure ES-8 show energy and demand impacts from Title 20/24.

Figure ES-5 Concurrent Period Energy Impact of Title 20/24 within Los Angeles

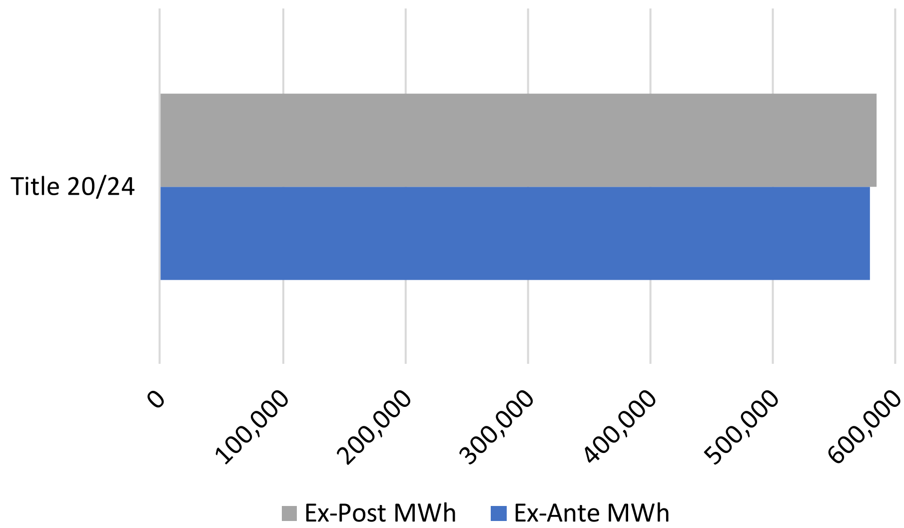


Figure ES-6 FY 22/23 Energy Impact of Title 20/24 within Los Angeles

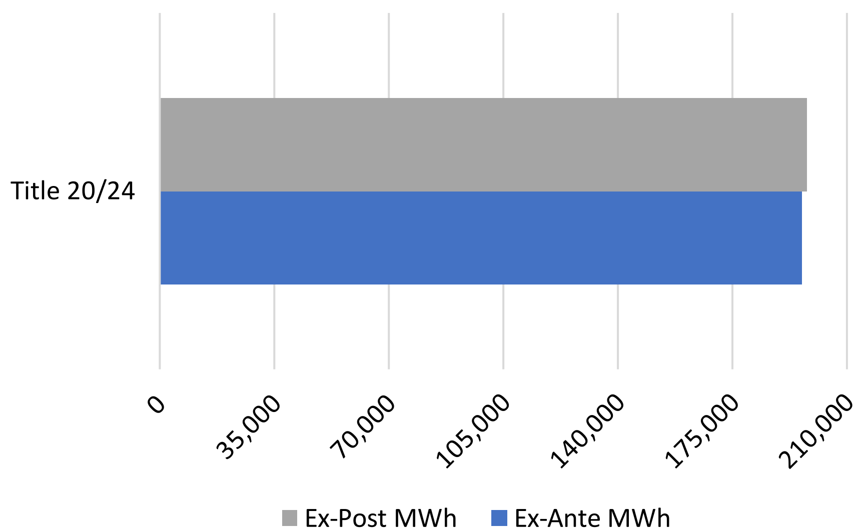


Figure ES-7 Concurrent Period Peak Demand Impact of Title 20/24 within Los Angeles

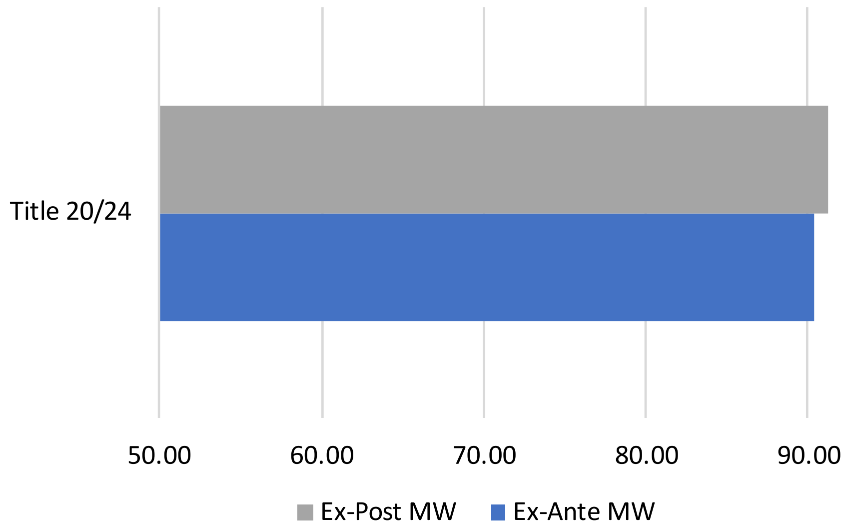
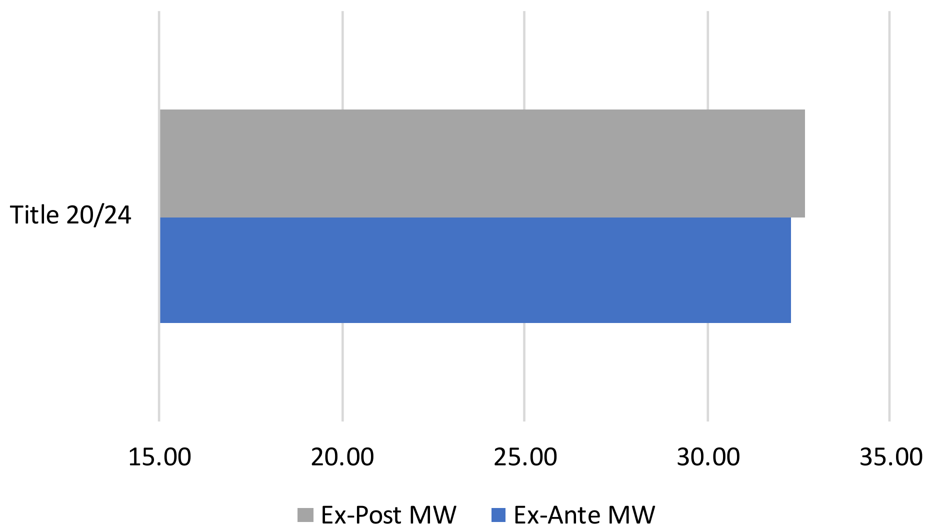


Figure ES-8 FY 22/23 Peak Demand Impact of Title 20/24 within Los Angeles



ES.3 FY 22/23 Water Savings

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

LADWP programs contributed to water savings via the Los Angeles Plumbing Ordinance, as well as through the direct installation of low flow fixtures in residential and small commercial facilities. See Figure ES-9 for a summary of water savings during the Concurrent Period and Figure ES-10 for a summary of water savings during FY 22/23.

Figure ES-9 Concurrent Period Water Savings

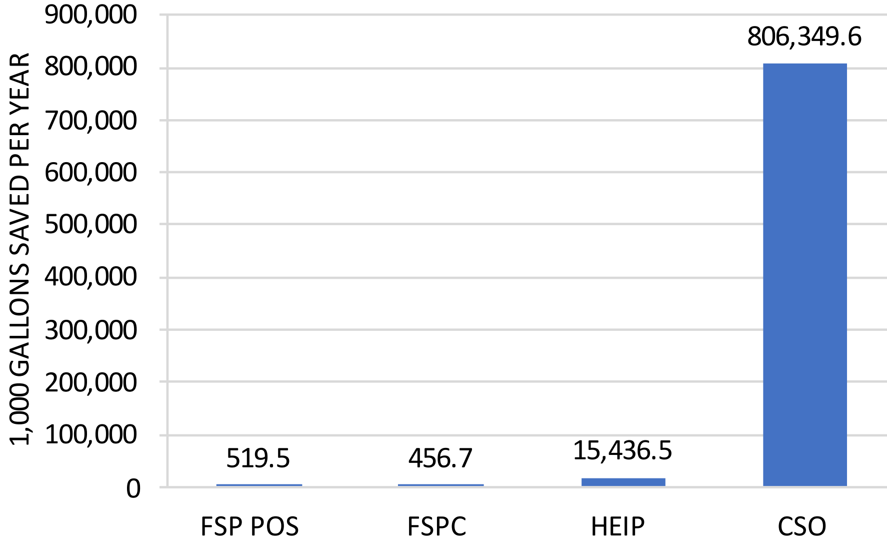


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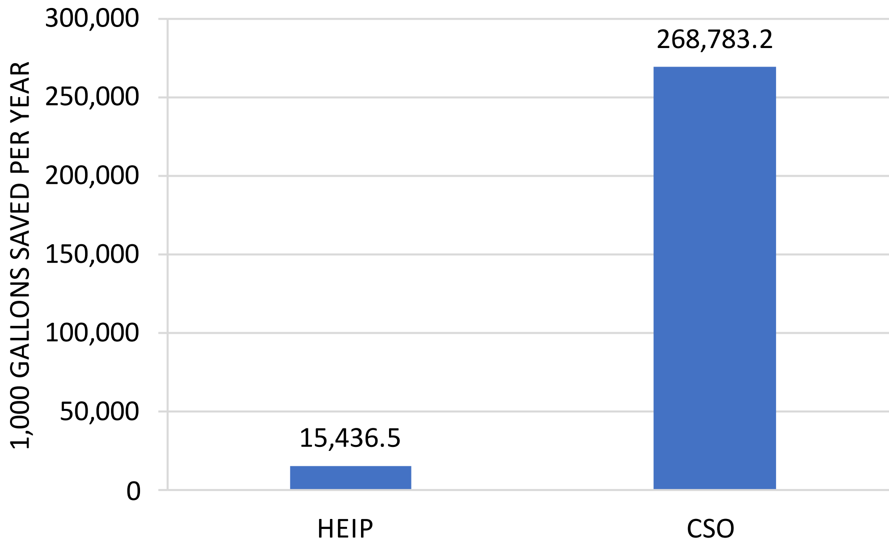
Figure ES-10 FY 22/23 Water Savings



ES.4 Residential Impacts by Technology Type

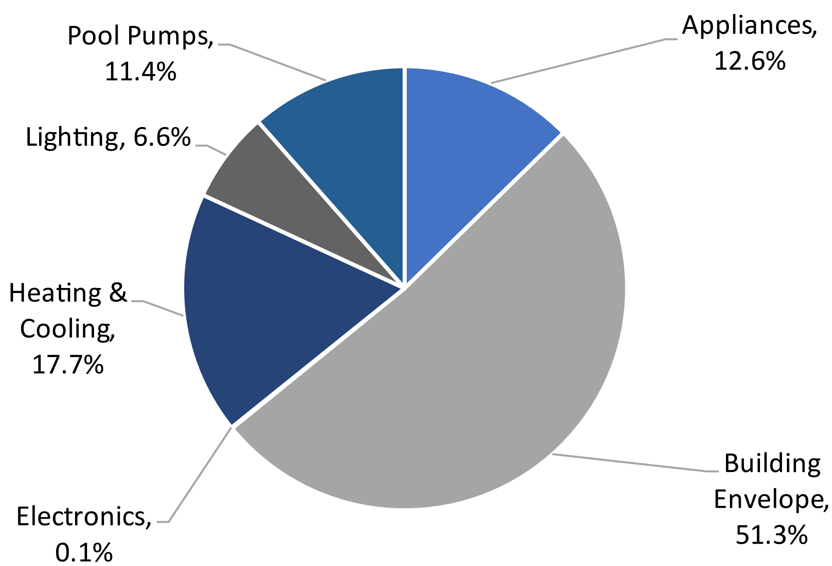
Residential sector savings during the Concurrent Period totaled 64,753,895 kWh (excluding savings from Codes, Standards, & Ordinances and AC Optimization Commercial).

For the Concurrent Period, drivers of savings included:

1. Building Envelope: 51.3% of sector-level kWh savings achieved through the Consumer Rebate Program, Home Energy Improvement Program, and California Advanced Homes Program.

2. Appliances: 16.2% of sector-level impacts achieved through the Efficient Product Marketplace, Consumer Rebate Program, Refrigerator Exchange Program, and RETIRE Program.

Figure ES-11 Concurrent Period Residential Savings by Technology

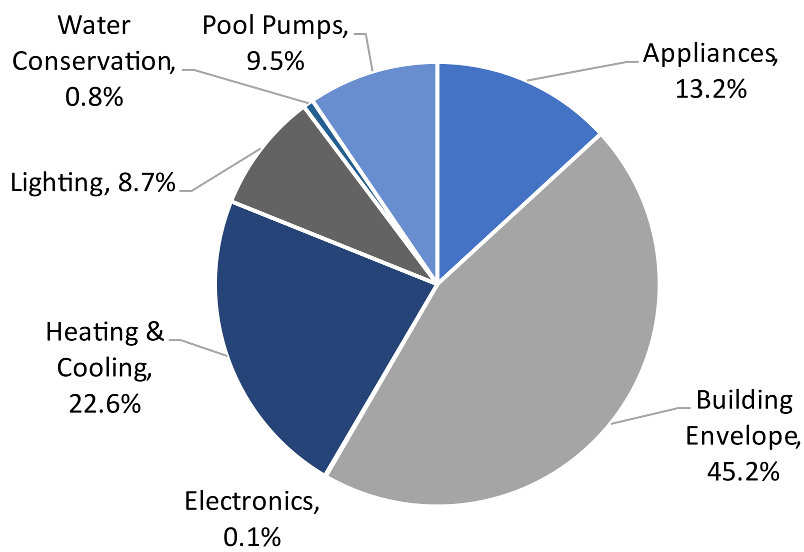


Residential sector savings during FY 22/23 totaled 22,218,412 kWh (excluding savings from Codes, Standards, & Ordinances and AC Optimization Commercial).

For FY 22/23, drivers of savings included:

1. Building Envelope: 45.2.3% of sector-level kWh savings achieved through the Consumer Rebate Program, AC Optimization Program, and California Advanced Homes Program.
2. Appliances: 13.2% of sector-level impacts achieved through the Efficient Product Marketplace, Consumer Rebate Program, Refrigerator Exchange Program, and RETIRE Program.

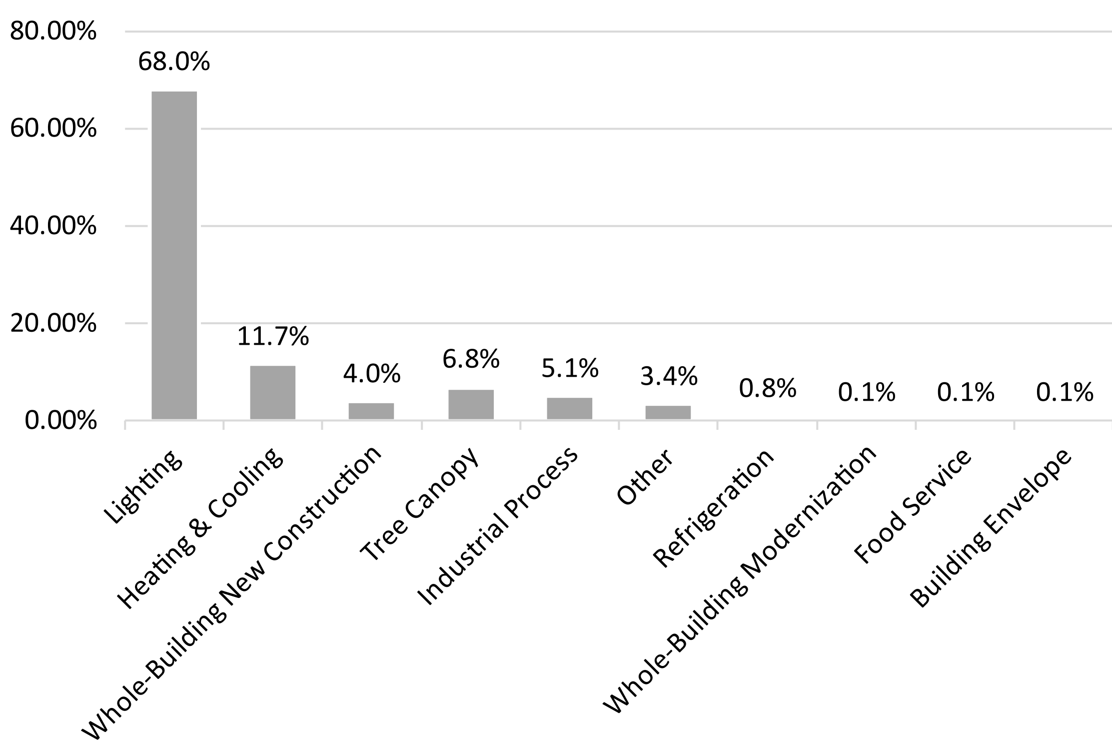
Figure ES-12 FY 22/23 Residential Savings by Technology



ES.5 Non-Residential Impacts by Technology Type

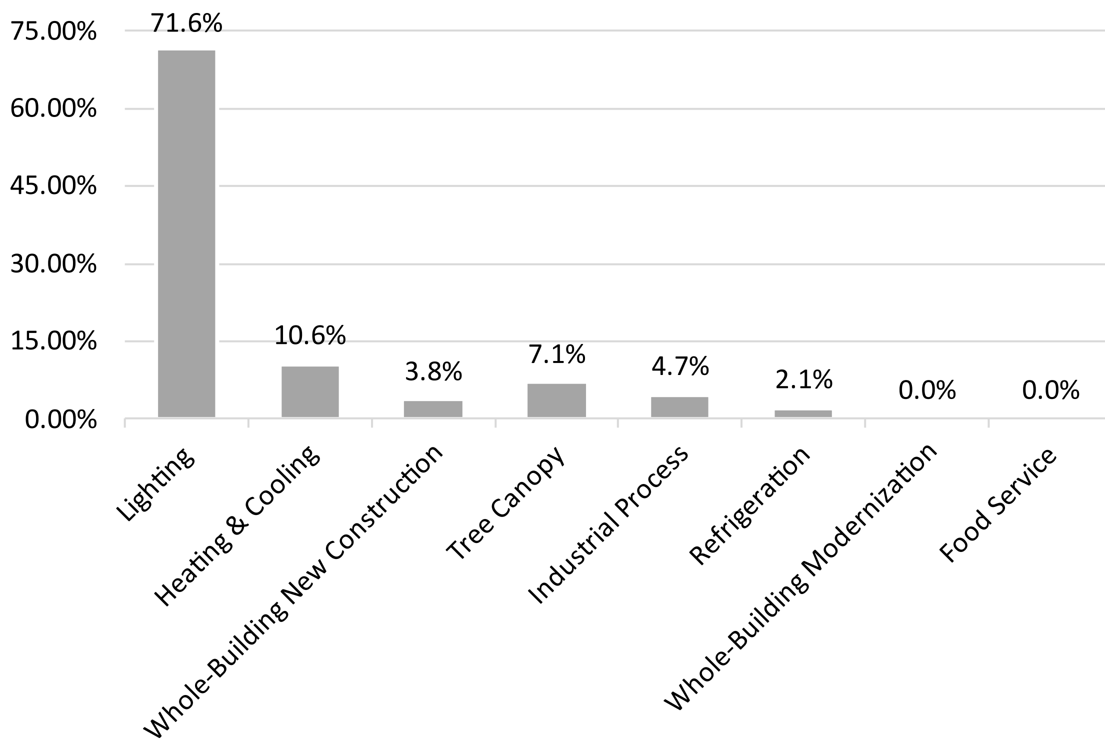
Non-residential sector savings during the Concurrent Period totaled 305,196,999 kWh (excluding savings resulting from Codes, Standards, and Ordinances). Lighting accounted for the largest share of total sector savings (68%).

Figure ES-13 Concurrent Period Non-Residential Savings by Technology



Non-residential sector savings during FY 22/23 totaled 101,714,448 kWh (excluding savings resulting from Codes, Standards, and Ordinances). Lighting accounted for the largest share of total sector savings (72%).

Figure ES-14 FY 22/23 Non-Residential Savings by Technology



ES.6 FY Impact of COVID-19

This evaluation included a review of impacts of the COVID-19 pandemic and Safer-at-Home (SAH) orders. For programs analyzed via billing impacts, statistical models incorporated SAH status as an interaction term. For other programs, savings were re-estimated under COVID-19 and non-COVID-19 conditions based on a review of operating hours with representatives from program participants. Beginning in FY 21/22, the Evaluator determined that all non-residential participants were back to "business as usual" and therefore determined that COVID savings did not differ from typical 1st year savings.

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

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

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

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

Figure ES-15 Concurrent Period Impact of COVID-19 on Program Savings

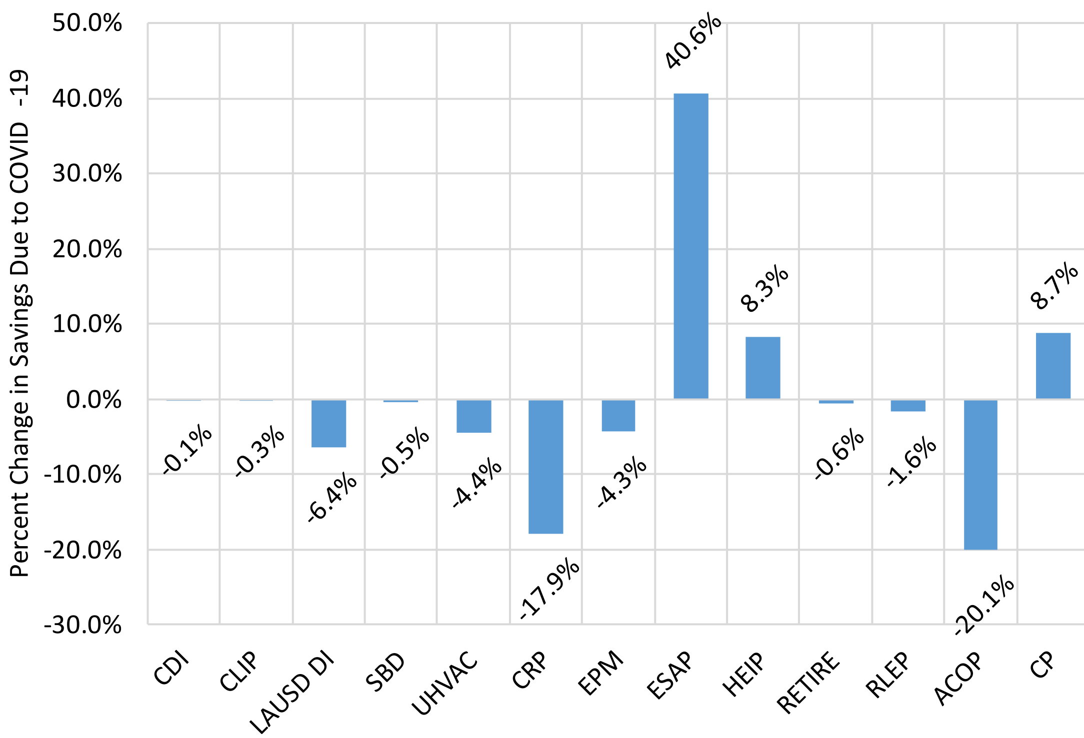
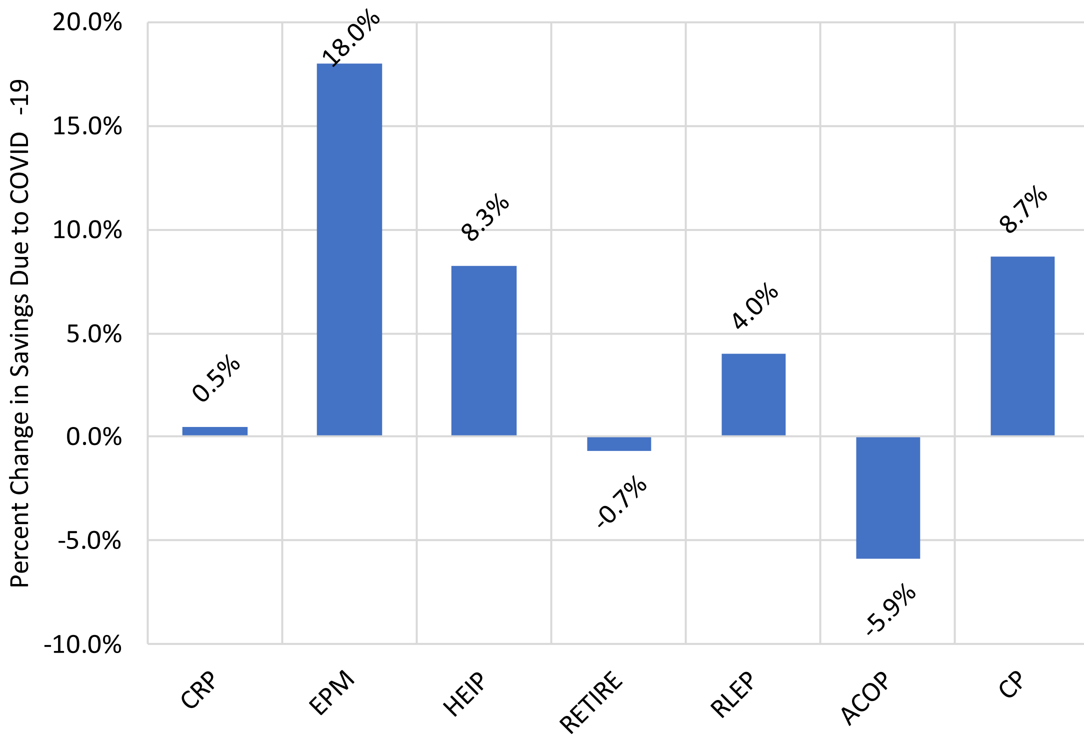


Figure ES-16 FY 22/23 Impact of COVID-19 on Program Savings



ES.6.2 Impact of COVID-19 Key Takeaways

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

- Most residential programs would demonstrate a reduction in savings if the pandemic were not a factor that affected energy use.
- Beginning in FY 21/22, non-residential program participants indicated business is back to normal and therefore no savings impacts were calculated due to the pandemic.
- Codes, Standards, & Ordinances was not included in this re-estimation of savings.

ES.7 Cost Effectiveness Results

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

Table ES-5 lists benefits and costs along with cost effectiveness results for the Concurrent Period by fiscal year. Cost effectiveness results are shown for the Total Resources Cost (TRC) Test, Program Administrator Cost (PAC) Test, the Rate-payer Impact Measure (RIM) Test, Participant Cost Test (PCT), and Modified Total Resources Cost (MTRC) Test.

Table ES-5 Concurrent Period Portfolio-Level Cost Effectiveness Results

Fiscal Year	PAC		TRC		PCT		RIM		MTRC	
	Benefits/ Costs*	Ratio	Benefits/ Costs*	Ratio	Benefits/ Costs*	Ratio	Benefits/ Costs*	Ratio	Benefits/ Costs*	Ratio
20/21	$250,487	2.35	$250,487	2.65	$718,870	15.24	$250,487	0.33	$250,487	2.65
	$106,601		$94,448		$47,178		$766,140		$94,448	
21/22	$323,674	1.79	$323,674	1.70	$880,482	7.79	$323,674	0.34	$323,674	1.70
	$180,997		$190,424		$113,023		$957,884		$190,424	
22/23	$352,837	3.03	$352,837	3.67	$839,975	17.35	$352,837	0.40	$352,837	3.67
	$116,438		$96,020		$48,423		$887,572		$96,020	
Grand Total	$926,998	2.29	$926,998	2.43	$2,439,327	11.69	$926,998	0.35	$926,998	2.43
	$404,035		$380,893		$208,624		$2,611,596		$380,893	

*Dollar amounts in thousands of dollars

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 the Concurrent Period. 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

The Evaluator 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 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 the Concurrent Period.

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 and water. This program is designed to integrate electric and water 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 efficiency measures (EEMs) 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 are not included in other LADWP non-residential energy efficiency programs. Incentives for each project are paid per kilowatt-hour (kWh) based on energy savings calculated or accepted by LADWP. In addition, two previously self-standing LADWP efficiency programs, Retro-commissioning (RCx) and the Energy Efficiency Technical Assistance Program (EETAP), were rolled into the CPP in 2017.

1.2.1.4 Food Service Program (FSP)

The Food Service Program (FSP), Comprehensive and Point-of-Sale, 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.

1.2.1.9 Zero by Design

The Zero By Design program is a component of the City of Los Angeles' "Green New Deal 2019 Sustainable City pLAn." This initiative aims to achieve zero carbon emissions from all new buildings by 2030 and to ensure that all existing buildings in the city are net zero carbon by 2050. Zero By Design offers incentives and technical assistance to commercial and multifamily developers in the region to promote the adoption of sustainable building practices.

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.

The last year of implementation for the program was FY 20/21. There were no savings during FY 21/22 and FY 22/23.

1.2.2.4 Home Energy Improvement Program (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.

1.2.2.7 Residential Lighting Efficiency Program (RLEP)

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

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 Evaluation Methodology

Evaluation methods used for FY 22/23 applied industry best practices, including:

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

Impact analysis methods included:

- Billing Data Analysis
    - Measuring impacts of projects on customer bills
    - Pre- and post- analysis, and analysis of post bills with usage adjusted to align with minimum code
- Project M&V
    - Audits of commercial & industrial projects
    - Apply International Performance Measurement and Verification Protocols

- Survey-Based Verification
  - Survey efforts with residential and nonresidential customers to address measure installation and persistence
- Virtual Verification
  - Virtual facility walkthroughs - customers show their project to evaluation staff through a user-friendly mobile app

1.3.1 Primary Data Collection

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

1.3.1.1 Program and Project Data Collection

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

Table 1-1 Non-Residential Program Data Collection

Data	Source
Program tracking data	Data requested from LADWP including all data tracking program participation
Desk review	Reviews of project documentation (Proposed Activity Report, Post Installation Report, energy models) of a sample of customers who have participated in the program
On site verification	Virtual or in-person site visits of a sample of customers to collect data used for savings calculations, to verify installation, and determine operating parameters

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

Table 1-2 Residential Program Data Collection

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

1.3.1.2 Program Staff Interviews

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

Table 1-3 Summary of Staff Interviews Completed

Program	Number of Interviews
CDI	1
CLIP	1
CPP	1
FSP	1
SBD/LADWP ZBD	2
Upstream HVAC	1
CRP	1
EPM	1
LI REP	1
RETIRE	1
ACOP	1
CP	1
CSO	1
ETP	1
MEO	1
PADP	1
PCOP	1
CAMR	1

1.3.1.3 Participant Surveys

The Evaluator administered surveys to customers who participated in the following programs during FY 22/23:

- Consumer Rebate Program (CRP);
- Efficient Product Marketplace (EPM);
- Low Income Refrigerator Exchange Program (LI REP);
- Refrigerator Turn-In and Recycle Program (RETIRE);
- Home Energy Improvement Program (HEIP).

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 within the groups.

Sample frames were developed from program participation records of FY 22/23 participants.

Table 1-4 Participant Survey Samples

Program	Number of Participants Contacted	Achieved Sample Size	Sample Type	Mode of Administration
CRP	215	18	Census Attempt	Online
EPM	2,166	215	Census Attempt /Simple Random Sample[1]	Online
RETIRE	796	96	Census Attempt	Online
REP - Residential	482	50	Simple Random Sample	Telephone
REP - Institutional	14	4	Census Attempt	Telephone
HEIP	906	155	Census Attempt	Online

1. The Evaluator attempted a census of participants implementing lower volume measures and used a simple random sample of contacts for higher volume measures

1.3.1.4 Interviews and Other Research with Program Partners and Market Actors

The Evaluator completed interviews with market actor participants in the SBD/LADWP ZBD.

Table 1-5 Summary of Interviews Completed

Program	Group	Number of Interviews Completed
SBD/ZBD	Market actors	5 owner/developer interviews 3 design team members

1.3.2 Overview of Process Evaluation Approach

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

Table 1-6 Process Evaluation Types and Research Objectives

Process Evaluation Type	Process Evaluation Objective
Technical	Evaluate energy-saving algorithms and criteria used in 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. 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 completed a full-process evaluation once during the Concurrent Period for each program offering. Full process evaluations were completed in FY 22/23 for the following programs:

- Savings by Design / LADWP Zero by Design Program (SBD/LADWP ZBD)
- Home Energy Improvement Program (HEIP)

Brief summary process evaluations were completed in FY 22/23 for the following programs.

- Consumer Rebate Program (CRP)
- Efficient Product Marketplace (EPM)
- Commercial Lighting Incentive Program (CLIP)
- Custom Performance Program (CPP) (Included contractor interview findings)
- Food Service Program (FSPC)
- Upstream HVAC Program (UHVAC)
- Codes, Standards, and Ordinances Program (CSO)
- Marketing, Education, and Outreach Program (MEO)
- Emerging Technologies Program (ETP)
- Marketing, Education, and Outreach Program (MEO)
- Program Analysis & Development Program (PADP)

- Program Outreach & Community Partnerships (POCP)
- Comprehensive Affordable Multifamily Retrofits Program (CAMR)

1.4 Overview of Report

The report is organized as follows:

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

- The ACOP evaluation is presented in Chapter 18 with technical details presented in Appendix A Section A.17.
- The CAHP evaluation is presented in Chapter 19.
- The CP evaluation is presented in Chapter 20 with technical details presented in Appendix A Section A.18.
- The POCP Program evaluation is presented in Chapter 21 with technical details presented in Appendix A Section A.19.
- The CSO Program evaluation is presented in Chapter 22 with technical details presented in Appendix A Section A.20.
- The ETP evaluation is presented in Chapter 23 with technical details presented in Appendix A Section □.
- The MEO Program evaluation is presented in Chapter 24 with technical details presented in Appendix A Section A.22.
- The PADP evaluation is presented in Chapter 25 with technical details presented in Appendix A Section A.23.
- The MFWB evaluation is presented in Section 4.5.2.
- The Cost Effectiveness evaluation is presented in Chapter 26 with measure level results presented in Appendix B.
- The survey instruments and interview guides used to perform process evaluations are included in Appendix C (Due to confidential and privacy considerations, Appendix C was not published with the public version of the report).
- The site-level non-residential sector reports are presented in Appendix D (Due to confidential and privacy considerations, Appendix D was not published with the public version of the report).

2 Commercial Direct Install Program

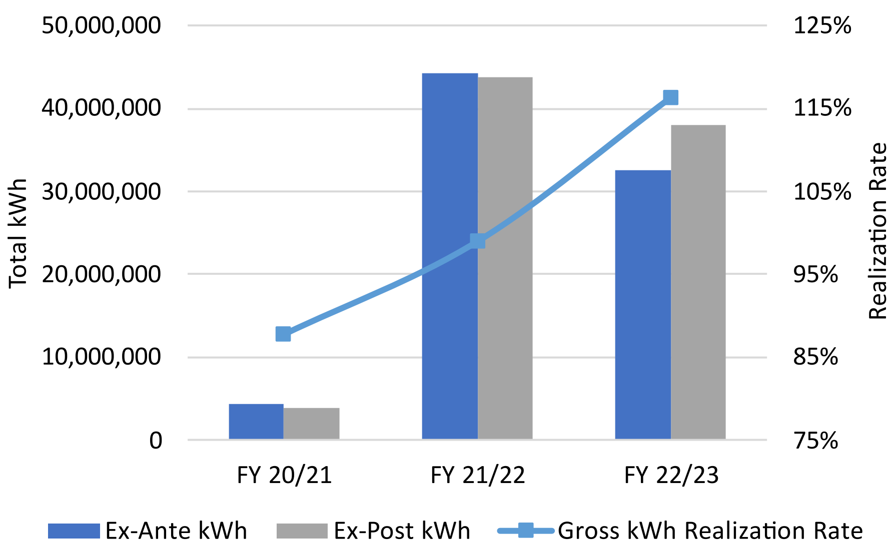
This chapter summarizes the impact and process evaluation of the Commercial Direct Install Program (CDI) that LADWP offered customers during Fiscal Years 20/21 to 22/23 (Concurrent Period).

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

2.1 Program Performance Summary

CDI is a program that provides direct installation of lighting efficiency measures to small and medium commercial customers (with monthly demand no greater than 250 kW). The program is supported and marketed by the LADWP Power Construction Maintenance Group and community-based organizations (CBOs). Figure 2-1 compares Ex-Ante and Ex-Post energy savings across the Concurrent Period.

Figure 2-1 CDI Program Performance Summary



2.1.1 Key Evaluation Takeaways

- The program design and operations remained largely unchanged in FY 22/23. Refrigeration measures are in the process of being added to the program.
- The overall kWh program realization rate was 116% during FY 22/23 and 105% during the Concurrent Period.
- For future program years, the CDI Program may offer refrigeration measures including case lighting, EC fan motors for walk-in coolers and freezers, and auto door closers for coolers and freezers.

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 (Wildan Energy Solutions). The program targets small to large business customers in the LADWP service territory, offering upgrades to targeted systems, including lights and water. 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	Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	174	4,345,377	300.56
FY 21/22	4,750	44,233,732	5,875.57
FY 22/23	3,101	32,644,666	4,861.34
Total	**8,025**	**81,223,775**	**11,037.46**

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 3,101 CDI projects completed for FY 22/23, 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 CY3 Program Data Ex-Ante Savings by Measure

Measures	Ex-Ante kWh Savings
Exterior Lighting	7,041,543
Interior Lighting	22,188,263
Lighting With Sensors	3,414,861
Total	**32,644,666**

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 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 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 CY3 program data. The resulting CY3 sample of 326 measures consisted of 9 categories, or strata. The sample precision based on Ex-Post annual energy savings (kWh) is ±10.0%
- 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 from the data collected from installation of lighting loggers.
- 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: Generally, the verified lighting hours of use for interior fixtures, interior fixtures with controls, and 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 3, the program level Ex-Post energy savings realization rate was 116% when comparing to tracking data Ex-Ante savings.

Table 2-4 CDI CY3 Evaluation Results 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
Lighting W/Controls 3	1,955,734	1,614,619	83%	417.02	438.96	105%
Lighting W/Controls 2	1,409,157	1,636,784	116%	280.23	296.63	106%
Lighting W/Controls 1	49,970	59,926	120%	11.03	11.61	105%
Interior Lighting 3	5,985,689	7,034,942	118%	1,045.77	654.95	63%
Interior Lighting 2	12,791,864	16,848,276	132%	2,599.45	3,356.41	129%

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
Interior Lighting 1	3,410,710	3,456,535	101%	781.24	733.54	94%
Exterior Lighting 3	4,369,460	4,550,541	104%	0.00	0.00	-
Exterior Lighting 2	2,508,268	2,568,583	102%	0.00	0.48	-
Exterior Lighting 1	163,815	226,445	138%	0.00	0.29	-
Total	**32,644,666**	**37,996,651**	**116%**	**5134.73**	**5492.86**	**107%**

The sampled measures had a realization of 109% as seen below in Table 2-5, this was driven by Ex-Post hours and interactive effects. The sample realization rate was greater than 100% because the Evaluator found that generally the lighting hours of operations were greater than those used in the Ex-Ante estimation. The hours the Evaluator used in the Ex-Post savings were sourced from information collected during site visits or from light loggers the Evaluator installed. Table 2-6 presents the CY3 savings by measure type.

Table 2-5 CDI CY3 Sampled and Non-Sampled Measure Savings

Measures	Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
Sampled Measures	1,042,943	1,131,781	109%
Non-sampled Projects	31,601,723	36,864,870	117%
Total	**32,644,666**	**37,996,651**	**116%**

Table 2-6 CDI CY3 Measure Savings

Measures	Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
Exterior Lighting	7,041,543	7,345,569	104%
Interior Lighting	22,188,263	27,339,753	123%
Lighting With Sensors	3,414,861	3,311,329	97%
Total	**32,644,666**	**37,996,651**	**116%**

Table 2-7 presents program Ex-Post energy savings and peak demand reduction compared to Ex-Ante.

Table 2-7 CDI Evaluation Results

Fiscal Year	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
FY 20/21	4,345,377	3,789,168	87%	300.56	263.90	88%
FY 21/22	44,233,732	43,797,900	99%	5,875.57	5,818.83	99%
FY 22/23	32,644,666	37,996,651	116%	4,861.34	5,658.34	116%
Total	**81,223,775**	**85,583,719**	**105%**	**11,037.46**	**11,741.07**	**106**

2.5.1 COVID-19 Impacts on Energy Use

Based on the information the Evaluator collected about COVID-19 impacts on the facility or equipment operation, no significant impact was found. Therefore, COVID-19 impacts did not differ from typical 1st year energy savings.

2.6 Process Evaluation

The Evaluators completed a summary process evaluation that was limited in scope for FY 22/23. The evaluation 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 program performance
- Barriers and opportunities going forward
- Other topics as relevant

The Evaluators performed a full process evaluation of CDI in FY 21/22. The key findings from that process evaluation are summarized below:

- The program operated as intended from the perspectives of customers, energy service representatives and program staff.
- The primary form of outreach is door-to-door canvassing by energy service representatives.
- Customers were motivated by the prospect of saving money on their energy bills and getting free lighting upgrades.
- Surveyed customers were highly satisfied with all aspects of the program.

Section A.1.3 presents additional findings from the staff interview.

Key findings of the FY 22/23 evaluation were:

- **The CDI Program remained largely unchanged in design and operations, but some measures were added, pending review by SCPPA's legal team.**

Specifically, the measures to be added are refrigeration measures including: case lighting, EC fan motors for walk-in coolers and freezers, and auto door closers for coolers and freezers.

- **Two internal changes were made to the program.** The changes were a modification of the invoice review and check-off process to improve accountability and help with documentation for audits, and an organizational change at LADWP where the program moved from the Customer Service division to the Efficiency Solutions division, and then subsequently to the Power System division.

2.7 Cost Effectiveness Results

Table 2-8 presents benefits, costs, and the results of cost-effectiveness testing for the CDI Program. Overall, the Total Resource Cost (TRC) test indicates the program is cost effective.

Table 2-8 FY 22/23 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	$15,812,498	$15,812,498	$71,170,074	$15,812,498	$15,812,498
Total Costs	$31,227,135	$8,668,127	$248,498	$79,589,703	$8,668,127
Benefit/Cost Ratio	0.51	1.82	286.40	0.20	1.82

2.8 Program Key Findings and Recommendations

- **Evaluation results indicate 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).

3 Commercial Lighting Incentive Program

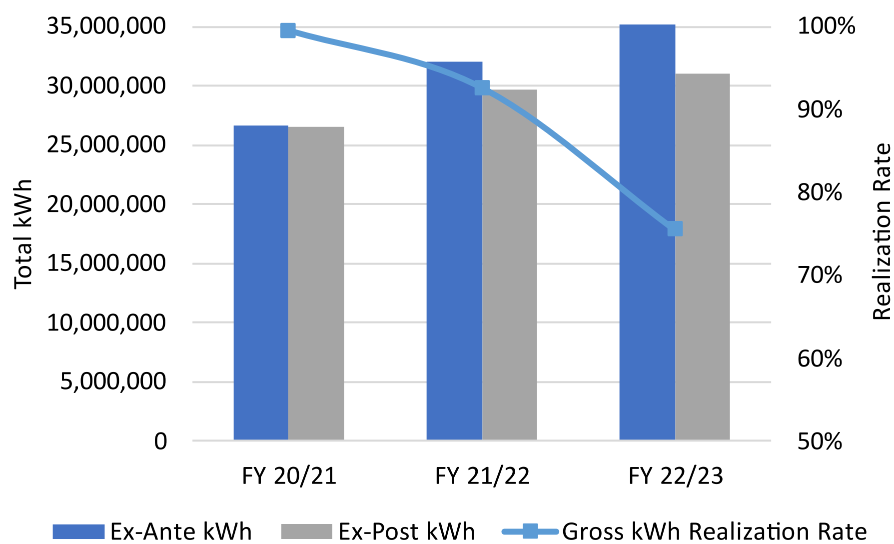
This chapter summarizes the impact and process evaluation of the Commercial Lighting Incentive Program (CLIP) that LADWP offered customers during Fiscal Years 20/21 to 22/23 (Concurrent Period).

The primary objective of this evaluation was to calculate energy savings and peak demand reductions attributable to CLIP, as well as to perform a summary process evaluation.

3.1 Program Performance Summary

CLIP provides incentives for standard fixture replacements and installation of lighting controls. Participation is mostly contractor-driven, though customers may submit applications on their own behalf in lieu of using a contractor to do so. Figure 3-1 compares Ex-Ante and Ex-Post energy savings across the Concurrent Period.

Figure 3-1 CLIP Performance Summary



3.1.1 Key Evaluation Takeaways

- During FY 22/23, CLIP continued a trend of year-to-year increases in program activity and energy savings compared to FY 21/22.
- The overall kWh program realization rate was 76% during FY 22/23 and 87% during the Concurrent Period.
- Program staff noted that CLIP internal operations are going smoothly and some modifications were made to the program. The program modifications include updated terms and conditions, a focus on lighting controls with an assessment of the potential to increase lighting control incentives, and development of a revised

Recognized Vendor Program (now referred to as the Recognized Contractor Program).

3.2 Program Description

CLIP is designed to offer incentives to non-residential customers for replacing standard lighting fixtures with high efficiency fixtures, lamps, and/or controls. Any high efficiency lighting product that meets program requirements is eligible for incentives through CLIP. Participation in CLIP is mostly contractor driven, although there are multiple paths to participation. Table 3-1 summarizes the program's Ex-Ante energy savings and peak demand reduction for FY 22/23.

Table 3-1 CLIP Ex-Ante Savings Summary

Fiscal Year	Number of Projects	Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	125	26,798,030	2,921.98
FY 21/22	138	32,058,688	3,542.55
FY 22/23	177	41,127,932	5,192.92
Total	**440**	**99,984,650**	**11,657.46**

3.3 Methodology

The Evaluator performed a review of program tracking data for projects completed during FY 22/23. 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.

3.4 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 FY 22/23, for which results were aggregated to determine a strata level realization rate for extrapolation to the population. A detailed impact evaluation can be found in Appendix A, Section A.2.2.

3.5 Ex-Post Gross Savings

A sample of ten projects from FY 22/23 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	Ex-Ante kWh Savings	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	25,578	25,050	98%	6.46	2.58	40%
2	145,734	101,918	70%	24.29	17.57	72%
3	127,034	52,922	42%	14.50	12.56	87%
4	561,949	578,541	103%	67.79	78.71	116%
5	1,218,545	720,769	59%	205.92	84.79	41%
Total	**2,078,839**	**1,479,200**	**71%**	**318.96**	**196.22**	**62%**

Sampled projects resulted in a realization rate of 71% 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 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	2,078,839	1,479,200	71%
Non-sampled Projects	39,049,093	29,570,048	76%
Total	**41,127,932**	**31,049,248**	**75%**

Table 3-4 CLIP Evaluation Results

Fiscal Year	Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
FY 20/21	26,663,687	26,524,720	99%	2,921.98	2,906.75	99%
FY 21/22	32,058,688	29,681,208	93%	3,542.55	3,262.16	92%
FY 22/23	41,127,932	31,049,248	75%	5,192.92	3,900.46	75%
Total	**99,850,307**	**87,255,176**	**87%**	**11,657.46**	**10,069.37**	**86%**

3.5.1 COVID-19 Impacts on Energy Use

Based on the information the Evaluator collected about COVID-19 impacts on the facility or equipment operation, no significant impact was found. Therefore, COVID-19 impacts did not differ from typical 1st year energy savings.

3.6 Process Evaluation

For FY 22/23, 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 FY 20/21, and a summary process evaluation in FY 21/22.

The key findings from the FY 20/21 full process evaluation are:

- **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.

The key findings from the FY 21/22 summary process evaluation are:

- Staff believe customers and vendors are generally happy with the program and incentive rates.
- Staff felt internal operations, including application processing, was going smoothly.

- Staff made progress toward their hiring and onboarding goals by standardizing their procedures and training for hiring new personnel and adding six staff members.

Section A.2.3 presents additional findings from the staff interview. Key findings of the FY 22/23 process evaluation are:

- The program design and processes remained unchanged in FY 22/23, but staff are looking towards future modifications. These future modifications include:
  - Updated program requirements, terms and conditions, and possibly higher incentives.
  - An increased focus on lighting controls, including an assessment of the potential for increasing incentives.
  - Launch of a revised Recognized Vendor Program renamed the Recognized Contractor Program. The updated program will include a contractor liaison who will act as the primary contact for contractors with the program and will be their go-to person if they have issues with a project. This should allow for quicker responses to contractor inquiries, which can shorten project timelines.
  - Planned program updates to encourage participation. The staff hope to make some program changes in 2024 to encourage greater participation. These may include program requirements, terms and conditions, or increased incentive levels.

3.7 Cost Effectiveness Results

Table 3-5 presents benefits, costs, and the results of cost-effectiveness testing for the CLIP. Overall, the program was cost effective.

Table 3-5 FY 22/23 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	$13,542,135	$13,542,135	$52,571,156	$13,542,135	$13,542,135
Total Costs	$15,572,013	$8,843,401	$2,401,674	$59,012,884	$8,843,401
Benefit/Cost Ratio	0.87	1.53	21.89	0.23	1.53

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.

4 Custom Performance Program

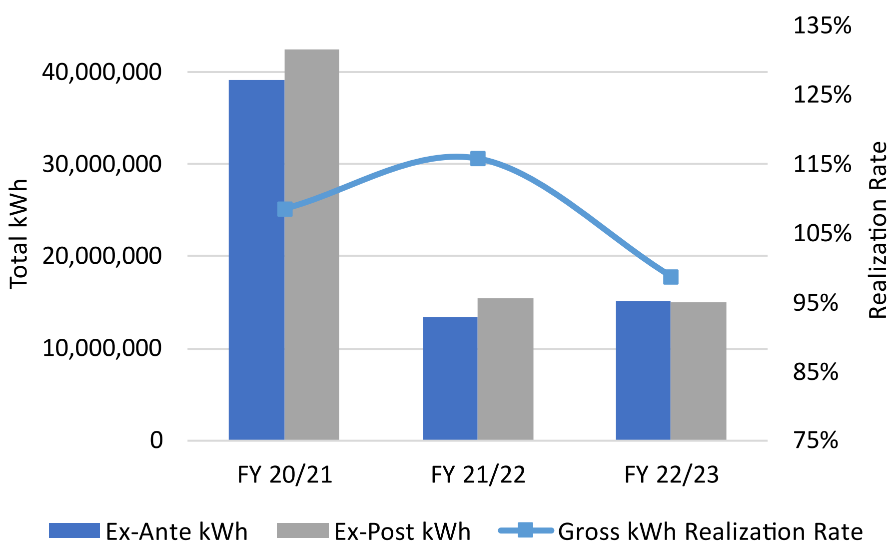
This chapter summarizes the impact and process evaluation of the Custom Performance Program (CPP) that LADWP offered customers during Fiscal Years 20/21 to 22/23 (Concurrent Period).

The primary objective of this evaluation was to calculate energy savings and peak demand reductions attributable to CPP, as well as to perform a summary process evaluation.

4.1 Program Performance Summary

CPP provides customized incentives for a range of equipment retrofits for the commercial and industrial sectors, including equipment controls, process improvements, heating and cooling retrofits, retro-commissioning, and any other improvement that cannot be readily captured by other LADWP non-residential programs. Figure 4-1 compares Ex-Ante and Ex-Post energy savings across the Concurrent Period.

Figure 4-1 CPP Performance Summary



4.1.1 Key Evaluation Takeaways

- CPP activity for FY 22/23 was very similar to FY 21/22 but significantly lower than FY 20/21; this is not unusual given the unique nature of projects processed through the program.
- The overall kWh program realization rate was 99% during FY 22/23 and 108% during the Concurrent Period.
- The program design and process remained largely the same.

- Staff noted concerns about low participation and are focusing on engaging with different industries and leveraging LADWP's Key Accounts Section to increase participation.

4.2 Program Description

CPP offers cash incentives for energy saving measures not covered by other LADWP non-residential energy efficiency programs. This includes equipment controls, industrial processes, retro-commissioning, chiller efficiency, and innovative energy-saving strategies meeting or exceeding Title 24 or Industry Standards. Table 4-1 summarizes the program's ex-Ante energy savings summary for FY 20/21, 21/22 and 22/23.

Table 4-1 CPP Ex-Ante Savings Summary

Fiscal Year	Number of Projects	Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	127	39,161,241	5,634.99
FY 21/22	134	13,327,718	1,756.35
FY 22/23	141	15,170,555	2,993.13
Total	**402**	**67,659,514**	**10,384.47**

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.

4.3 Methodology

This section presents the methodology used to evaluate the CPP.

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

- Review of program tracking data for completeness and sampling;
- Project documentation review;
- Site-specific Measurement and Verification Plan (M&V 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.

4.4 Impact Evaluation

This section presents findings from the evaluation verification of a sample of projects to determine Ex-post gross annual energy savings, lifetimes energy savings, and peak demand reduction through 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.3.1.9.

4.5 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 16 projects and an evaluation was completed for all sampled projects. Verified results from the FY 20/23 (CY3) evaluation sample resulted in a statistical precision of 28.3% at the 90% confidence interval for annual energy savings. However, the overall precision for the combined CY1, CY2 and CY3 is 9.4%. Program level results are shown in Table 4-2.

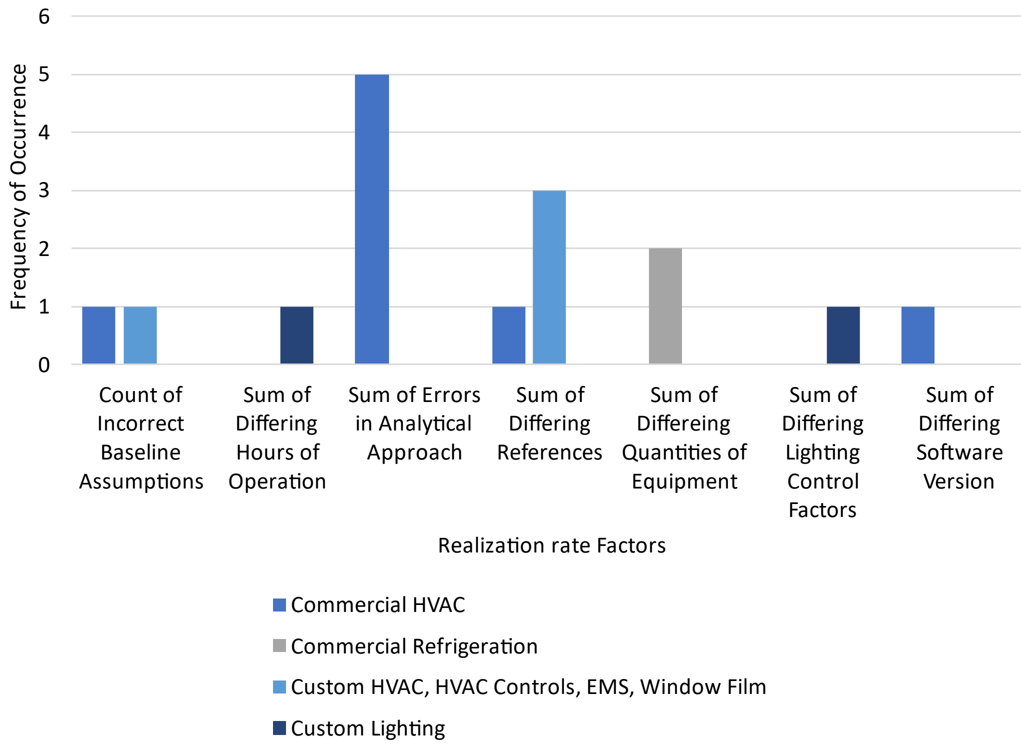
Table 4-2 CPP Concurrent Period Evaluation Results by Measure

Fiscal Year	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
20/21	Building Envelope	387,888	445,777	115%	8	7	90%
	Controls	4,369,023	4,295,280	98%	615	603	98%
	HVAC	8,182,984	10,582,816	129%	1,625	1,346	83%
	Lighting	13,934,171	15,440,925	111%	5,636	5,961	106%
	Other	10,627,597	10,036,147	94%	1,374	772	56%
	Process	251,792	300,699	119%	42	47	113%
	VFD	1,407,785	1,385,966	98%	236	229	97%
	Total	**39,161,240**	**42,487,610**	**108%**	**9,537.25**	**8,965.57**	**94%**
21/22	Building Envelope	0	0	0%	0	0	0%
	Custom HVAC, HVAC Controls, EMS, Window Film	3,915,977	4,085,596	104%	264	270	102%
	Commercial HVAC	5,784,897	7,371,123	127%	1,930	2,427	126%
	Custom Lighting	2,984,464	3,362,500	113%	1,314	1,875	143%

Fiscal Year	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	422,440	94%	61	61	99%
	Commercial Refrigeration	192,099	191,839	100%	9	0	0%
	VFD	0	0	0%	0	0	0%
	Total	**13,327,718**	**15,433,498**	**116%**	**3,577.53**	**4,631.48**	**129%**
22/23	Building Envelope	0	0	0%	0	0	0%
	Controls	0	0	0%	0	0	0%
	HVAC	9,521,650	9,640,086	101%	999	881	88%
	Lighting	290,214	180,882	62%	235	0	0%
	Process	2,951,350	3,013,017	102%	637	762	120%
	Refrigeration	2,378,911	2,113,411	89%	158	114	72%
	Food Service	28,432	28,626	101%	5	5	101%
	VFD	0	0	0%	0	0	0%
	Total	**15,170,555**	**14,976,022**	**99%**	**2,034.14**	**1,761.43**	**87%**
Grand Total		**67,659,513**	**72,897,130**	**108%**	**15,148.92**	**15,358.48**	**101%**

Realization rate factors were found to have minimal influence on the overall population. Evaluation has the advantage of verifying energy savings after the 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 or differing load profiles. Most differences were found due to incorrect baseline assumptions or errors in the analytical approach and differing references. The impact of realization rate factors by measure category is shown in Figure 4-2.

Figure 4-2 The Impact of Realization Rate Factors 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	ESP Data Ex-Ante kW Savings	ESP Data Ex-Post kW Savings	Gross kW Realization Rate
FY 20/21	39,161,241	42,487,610	108%	5,634.99	6,160.19	109%
FY 21/22	13,327,718	15,433,498	116%	1,756.35	2,048.69	117%
FY 22/23	15,170,555	14,976,022	99%	2,993.13	3,129.22	105%
Total	**67,659,514**	**72,897,130**	**108%**	**10,384.47**	**11,338.11**	**109%**

4.5.1 COVID-19 Impacts on Energy Use

Based on the information the Evaluator collected about COVID-19 impact on the facility or equipment operation, no significant impact was found. Therefore, COVID-19 impacts did not differ from typical 1st year energy savings.

4.5.2 Evaluation of Multifamily Whole Building Program

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

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

The Evaluator performed a desk review of available MFWB program data and applied average Ex-Post realization rates from the CPP analysis in order to calculate Ex-Post savings for the MFWB. Below are the results of that analysis for FY 20/21. The MFWB program did not have additional participation or energy savings in FY 21/22 and FY 22/23.

Table 4-4 MFWB FY 20/21 Evaluation Results

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

Table 4-5 presents benefits, costs, and the results of cost-effectiveness testing for the MFWB. Overall, the program was cost effective.

Table 4-5 MFWB 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	$1,305,271	$1,305,271	$3,824,705	$1,305,271	$1,305,271
Total Costs	$1,031,059	$870,082	$304,926	$4,389,862	$870,082
Benefit/Cost Ratio	1.27	1.50	12.54	0.30	1.50

4.6 Process Evaluation

For FY 22/23, 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 Evaluators performed a full process evaluation of CPP in FY 20/21, and a summary process evaluation in FY 21/22. The key findings from the full process evaluation were:

- The LADWP project evaluation and quality control process is rigorous and thorough. The key features are:
  - Pre-inspection for most express track projects and all custom calculated projects.
  - Structured protocols for guiding savings estimation and project documentation for the custom calculated tracks including, development of a pre-inspection checklist to systemize data collection, documentation of an M&V plan, documentation of final project evaluation in a report.
  - A well-structured process for quality control review of the savings estimation and project documentation provided by the Energy Service Providers (ESPs) that evaluate the projects.
  - A process for reviewing completed express track projects.
- The division of the project into express and custom calculated tracks has improved the efficiency of the program. The addition of the express track for prescriptive measures with deemed savings has simplified the program process and allowed staff to reallocate efforts to larger, customized projects that are more impactful on overall program results.
- The quality control process for reviews of custom calculated projects is rigorous . The process for reviewing ESPs project evaluations is designed to ensure the program procedures are being followed by the service providers and provide feedback to them. The reviews do not alter project savings. This process is time-consuming and labor-intensive for LADWP staff, and staffing resources are oftentimes unavailable to complete the reviews in a timely manner.
- COVID-19 has restricted large business energy efficiency budgets, which has limited participation in the program.
- Based on limited survey responses, participants are primarily learning of the program from prior experience with it, from LADWP staff, and through internet research. Relatively few respondents reported learning of the program from contractors or vendors.

- Most participants were satisfied with the program overall. Dissatisfaction was highest with the effort to complete the application.
- Analyses of tracking data suggests that rebate processing times have decreased in recent months, suggesting that program processes are improving as intended by recent program changes -the addition of the "Express" program track that offers an expedited application process for prescriptive measures and the use of third-party engineering service contracts for custom calculated projects.

The summarized key findings from the FY 21/22 summary process evaluation include:

- The CPP design and delivery are largely unchanged from the previous fiscal year.
- The application process was smooth for participants.
- Program staff were able to resume in-person site visits as COVID receded.
- The program hired three additional team members to assist with operations.
- Staff noted challenges in calculating building energy use baselines due to pandemic-induced building vacancies.
- Extended shipping times and higher equipment prices affected the scale and number of projects.

Section A.3.2 presents additional findings from the staff interview. The key findings from the FY 22/23 summary process evaluation are:

- **The CPP design is largely the same as the previous fiscal year.**
- **The program was short-staffed by two project managers at the time of the interview.** Despite this limitation, the program has remained focused on proactively reaching out to customers and contractors to ensure any issues they face with the program are addressed.
- **Low participation in the program has been a concern.** Program staff has reached out to different industries and focused on leveraging the Key Accounts Section to increase participation.

4.7 Cost Effectiveness Results

Table 4-6 presents benefits, costs, and the results of cost-effectiveness testing for the CPP. Overall, the Total Resource Cost (TRC) test indicates there could be areas for improvement to make the program cost effective.

Table 4-6 FY 22/23 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	$19,982,901	$19,982,901	$40,001,831	$19,982,901	$19,982,901

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Costs	$6,478,534	$41,392,293	$38,055,827	$43,338,297	$41,392,293
Benefit/Cost Ratio	3.08	0.48	1.05	0.46	0.48

4.8 Program Key Findings and Recommendations

Evaluation efforts determined the following key findings:

- Verified annual energy savings confirmed Ex-Ante estimates at the program level. In general, higher savings were determined for HVAC, Process and Food Service related measures, while energy savings were lower for the Lighting and Refrigeration projects than Ex-Ante savings.
- Realization rate factors included errors in analytical approach, differing hours of operation, differing equipment quantities, incorrect baseline assumptions, and differing references. Clerical errors 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.

The Evaluator offers the following recommendations for the CPP Program:

- **LADWP should consider a more focused market assessment to identify root factors affecting current participation levels and opportunities to increase participation.** Better information on contractor awareness of CPP, understanding of offered services, relevant market segments, and barriers and opportunities due to program requirements would help inform strategies to boost participation.

5 Food Service Program – Comprehensive

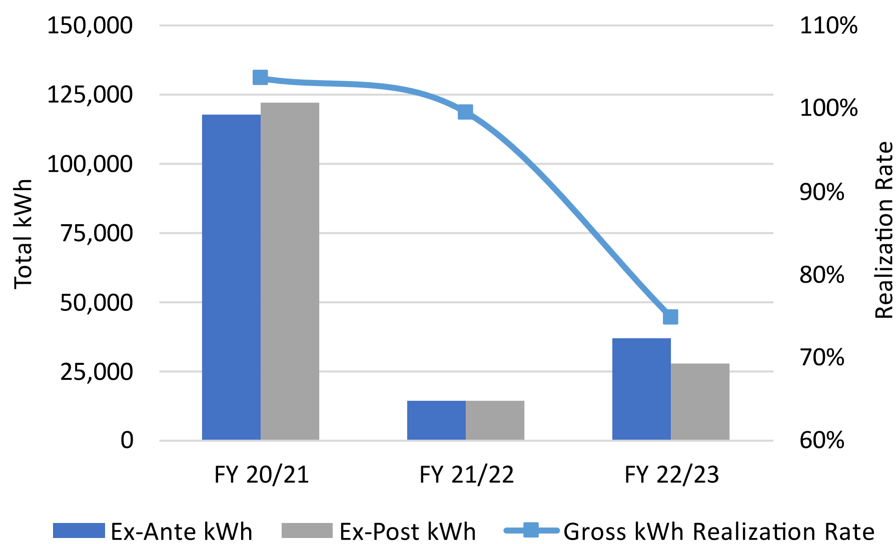
This chapter summarizes the impact and process evaluation of the Food Service Program - Comprehensive (FSPC) that LADWP offered customers during Fiscal Years 20/21 to 22/23 (Concurrent Period).

The primary objective of this evaluation was to calculate energy savings and peak demand reductions attributable to FSPC, as well as to perform a summary process evaluation.

5.1 Program Performance Summary

FSPC provides rebates for efficient food service equipment, including cooking equipment, refrigerated and frozen food storage, and kitchen ventilation. Marketing efforts from the FSPC are intended to drive distributors and vendors to then encourage their customers to purchase high efficiency options. Figure 5-1 compares Ex-Ante and Ex-Post energy savings across the Concurrent Period.

Figure 5-1 FSPC Performance Summary



5.1.1 Key Evaluation Takeaways

- FSPC program activity increased modestly in FY 22/23 compared FY 21/22, during which there were equipment shortages as well as high food costs which limited customers' ability to upgrade existing equipment;
- LADWP staff indicated that customers have been opting to purchase used foodservice equipment due to the high cost of new equipment.
- The overall kWh program realization rate was 75% during FY 22/23 and 97% during the Concurrent Period.

- Participation decreased in FY 21/22 and onward, likely because of decreased marketing and because bonus incentives were not offered; it is possible that the pandemic-related closures in FY 20/21 have continued to impact business closures and limited the business hours of foodservice establishments.

5.2 Program Description

The FSPC is a program designed to assist grocery stores (small to large), liquor stores, convenience stores, restaurants, and other commercial customers with refrigeration and food service equipment. This program offers rebates for ice machines, glass, and solid door freezers/refrigerators, commercial ovens, etc. The FSPC is designed to be utilized by major vendors and manufacturers to promote the highest efficiency refrigeration and food service equipment for retrofit projects. Table 5-1 presents the FY 20/21, FY 21/22 and FY 22/23, Ex-Ante energy savings summary.

Table 5-1 FSPC Ex-Ante Savings Summary

Fiscal Year	Number of Projects	ESP Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	18	117,921	15.50
FY 21/22	31	14,268	1.83
FY 22/23	14	36,966	6.58
Total	**63**	**169,155**	**23.91**

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	Ex-Ante kWh Savings	Proportion of Ex-Ante kWh Savings
Auto Closer - Cooler Doors	1,612	1%
Combination Oven	57,485	34%
Convection Oven	6,837	4%
Electric Deck Oven	22,557	13%
Hot Food Holding Cabinet	6,077	4%
Ice Machine	6,758	4%
Kitchen Hood DVC	37,773	22%

Measures	Ex-Ante kWh Savings	Proportion of Ex-Ante kWh Savings
Refrigerator/Freezer	30,056	18%
Total	**169,155**	**100%**

5.3 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 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 29 projects consisted of 7 categories, or strata. The sample precision based on Ex-Post annual energy savings (kWh) is ±7%
- 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.

5.4 Impact Evaluation

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

- Engineering review procedures
    - Available documentation was reviewed for a sample of projects, with attention given to model numbers, California Energy Wise[1] eligibility, 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.
- Two 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 97%. 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.
    - **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." The Evaluator 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 remains high, however the Evaluator cannot verify this is the source of the discrepancy.

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

[1] https://caenergywise.com/business-rebates/

5.5 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 22/23, the program level Ex-Post energy savings realization rate was 75% when comparing to tracking data Ex-Ante savings.

Table 5-4 FSPC FY 22/23 Evaluation Results by Strata

Stratum	Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Ex-Ante Peak kW Savings	ESP Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
Ice Machine	2,789	7,099	255%	0.51	0.97	189%
Refrigerator/Freezer	7,195	7,797	108%	1.25	0.97	77%
Hot Food Cabinet	1,068	347	32%	0.20	0.06	33%
Oven	3,357	5,600	167%	0.45	0.75	167%
Oven 2	22,557	6820	30%	4.16	1.26	30%
Total	**36,966**	**27,664**	**75%**	**6.58**	**4.01**	**61%**

The program level realization rate for all three concurrent years combined of 97% was driven by key projects from each concurrent year. In CY1, the realization rate was driven by Project 2 and Project 5 as seen below in Table 5-5. Project 2 was a combination oven installation where the Evaluator used the purchased units' efficient parameters in lieu of the default DEER workpaper values used in the Ex-Ante estimate. Project 5 was a kitchen hood DCV site where the Ex-Post savings sourced from the DEER workpapers were greater than the Ex-Ante savings; the source of the Ex-Ante values was unknown.

In CY2 the realization rate 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 "averaging" method of calculation.

In CY3 the realization rate was driven by Project 6 as seen below in Table 5-5. This project involved the installation of a deck oven. The source of the discrepancies was mainly due to the Ex-Ante assumption of the installation of three triple deck ovens, the actual implementation featured only a singular triple deck oven. This discrepancy was also a result of the use of different equipment parameters between the Ex-Ante and Ex-Post calculations. Ex-Ante calculations utilized all default values as dictated by the DEER workpapers whereas the Ex-Post calculations drew values from product specification sheets.

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

Project	Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
CY1 Project 1	25,822	22,737	88%
CY1 Project 2	11,497	20,218	176%
CY1 Project 3	808	685	85%
CY1 Project 4	22,994	6,640	29%
CY1 Project 5	8,916	14,730	165%
CY1 Project 6	1,067	82	8%
CY1 Project 7	3,665	4,235	116%
CY2 Project 1	427	353	83%
CY2 Project 2	1,810	1,809	100%
CY2 Project 3	2,064	2,093	101%
CY3 Project 1	3,357	5,600	167%
CY3 Project 2	446	506	113%
CY3 Project 3	1,152	1,113	97%
CY3 Project 4	1,118	1,498	138%
CY3 Project 5	854	790	93%
CY3 Project 6	22,557	6,820	30%
CY3 Project 7	2,366	7,108	300%
CY3 Project 8	2,236	1,076	48%
CY3 Project 9	446	475	107%
CY3 Project 10	446	491	110%
CY1 Non-Sampled Projects	44,220	52,980	120%
CY2 Non-sampled Projects	9,968	9,955	100%
CY3 Non-sampled Projects	1,986	2,187	110%
Total	**170,223**	**164,181**	**96%**

Table 5-6 shows Ex-Post kWh savings compared to tracking data Ex-Ante kWh. The program realization rate is 96%.

Table 5-6 FSPC Evaluation Results

Fiscal Year	ESP Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
FY 20/21	117,921	122,307	103%	15.50	16.08	104%
FY 21/22	14,268	14,210	100%	1.83	1.82	100%
FY 22/23	36,966	27,664	75%	6.58	4.01	61%
Total	**169,155**	**164,181**	**97%**	**23.91**	**21.91**	**92%**

5.5.1 COVID-19 Impacts on Energy Use

Based on the information the Evaluator collected about COVID-19 impacts on the facility or equipment operation, no significant impact was found. Therefore, COVID-19 impacts did not differ from typical 1st year energy savings.

5.6 Process Evaluation

For FY 22/23, 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 summary process evaluation of FSP in FY 21/22 and a full process evaluation in FY 20/21.

Key findings of the full process evaluation were:

- The pandemic exacerbated challenges reaching the food service market in FY 20/21.
- Dealers generally found the equipment rebates to be helpful in selling efficient equipment, although some would like electric equipment rebate amounts to be higher. Overall, dealers were happy with both the Comprehensive and POS programs. Likewise, dealers offered positive feedback on other aspects of the program, including the enrollment process and the sales and administrative trainings.
- All dealers highlighted program paperwork as a key pain point in the overall participation process. In particular, dealers struggled to collect customer signatures, which is required to complete different application forms for both the POS and

comprehensive programs. Securing a customer signature can be challenging for dealers, particularly when not interacting with customers in-person.

Summarized key findings from the FY 20/21 summary process evaluation include:

- Comprehensive program design and delivery was largely the same as the previous year.
- The program offered a 50% bonus incentive at the beginning of 2022 which was well received.
- Although the Point-of-Sale program ended on April 2023, dealers who had been participants agreed to help promote the comprehensive program with information on their invoices.
- Chip and semi-conductor shortages caused delays in shipment of and increased prices for equipment.
- Inflation reduced available budgets for food service industry businesses.
- The program continued to face challenges with eligibility confirmation, increasing demands on staff time.

Section A.4.3 presents additional findings from the staff interview. The key findings from the FY 22/23 summary process evaluation are:

- **Program staff note that the Comprehensive program design and delivery is mostly unchanged from the previous fiscal year, with the primary difference being equipment must now be electric.** Other than that, the incentives offered, and incentive structure are unchanged.
- **Staff reported participation decreased this year, likely a result of decreased marketing and not offering the bonus.** Staff said that they did not market the program this fiscal year because of the lingering pandemic impact on the industry; restrictions were just lifted in January 2023. Additional marketing and participation in community events are planned for the coming fiscal year.

5.7 Cost Effectiveness Results

Table 5-7 presents benefits, costs, and the results of cost-effectiveness testing for the FSPC. Overall, the Total Resource Cost (TRC) test indicates there could be areas for improvement to make the program cost effective.

Table 5-7 FY 22/23 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	$22,062	$22,062	$72,688	$22,062	$22,062
Total Costs	$68,572	$78,989	$20,552	$131,125	$78,989

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Benefit/Cost Ratio	0.32	0.28	3.54	0.17	0.28

5.8 Program Key Findings and Recommendations

The Evaluator does not have new recommendations for FSPC, but previous recommendations are provided below.

Table 5-8 Previous FSP Recommendations and Program Response

Summary of Past Recommendations (Comprehensive only)	Program Response
Consider targeted marketing to boost participation to achieve program goals	Program marketing has been on hold this fiscal year. COVID-19 restrictions were just fully lifted in early 2023, and supply chain issues are still prevalent. They expect to greatly expand marketing and outreach efforts in the coming fiscal year. They advertised in a small business newsletter to a very targeted group but saw little if any increase in program activity.
Create materials to educate customers about why LADWP promotes energy efficiency	No action on this. Staff noted that the program is listed on the state program website which includes tips and tricks for industries.
Create follow-up materials on the importance of maintenance for continued efficient operation of equipment	They do not have any LADWP-specific material.

6 Food Service Program – Point-of-Sale

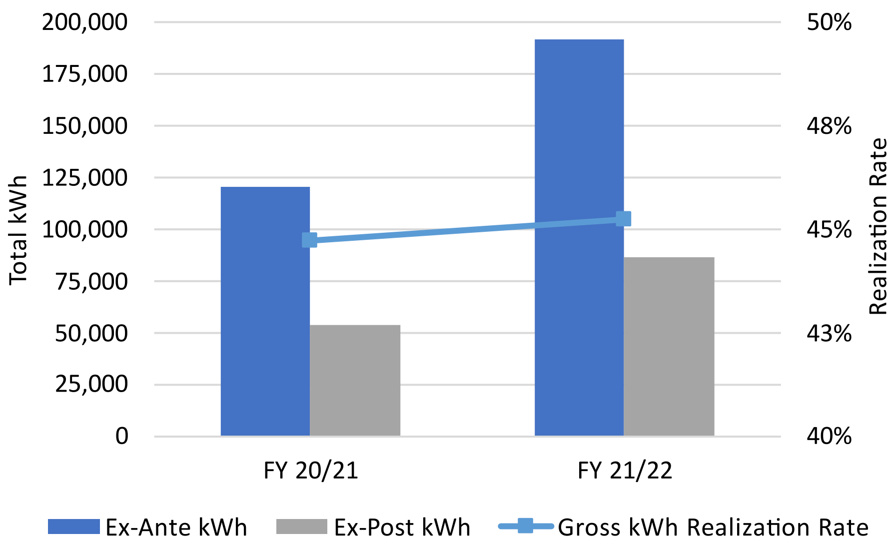
This chapter summarizes the impact evaluation of the Food Service Program Point of Sale (FSP POS) that LADWP offered customers during Fiscal Year 20/21 and 21/22 (FY 20/21 or Concurrent Year 1 and FY 21/22 or Concurrent Year 2).

The primary objective of this evaluation was to calculate energy savings and peak demand reduction impacts attributable to the FSP POS.

6.1 Program Performance Summary

FSP POS is a new initiative from LADWP that transitions the food service rebates to an instant rebate from the participating retailer or distributor. This removes the need for a project rebate application from the purchaser. The program launched in August of 2019, and the results presented in this report summarize 2 years of participation. Figure 6-1 compares Ex-Ante and Ex-Post energy savings across the Concurrent Period.

Figure 6-1 FSP POS Performance Summary



6.1.1 Key Evaluation Takeaways

- FY 21/22 was the last year FSP POS was operational; program staff indicated the program was not cost effective; the program did not operate in Concurrent Year 3.
- The overall kWh program realization rate for FY 20/21 to FY 21/22 was 45%.
- FSP POS faced many challenges, including high administrative fees, and the negative effect the pandemic had on the amount of new equipment purchased by customers; the program has been discontinued.

6.2 Program Description

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. 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	Ex-Ante ESP kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	92	120,591	15.85
FY 21/22	66	191,761	24.62
FY 22/23	N/A	-	-
Total	**158**	**312,352**	**40.47**

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

Table 6-2 FSP POS FY 20/21 & FY 21/22 Combined ESP Data Ex-Ante Savings by Measure

Measures	Ex-Ante ESP kWh Savings	ESP Data Ex-Ante Peak kW Savings
Ovens	149,417	19.22
Hot Food Holding Cabinet	34,410	4.48
Ice Machines	7,759	1.01
Refrigerator/Freezer	64,600	8.43
Steamers	56,165	7.33
Total	**312,352**	**40.47**

6.3 Methodology

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

Table 6-3 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 23 projects consisted of 7 categories, or strata. The sample precision based on Ex-Post annual energy savings (kWh) was ± 21%. Due to the premature conclusion of this program, the sample encapsulates only two years of data instead of the projected three. Consequently, the precision of our results did not attain the targeted 10% at a 90% confidence interval.
- 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.

6.4 Impact Evaluation

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

- Engineering review procedures
  - Available documentation was reviewed for a sample of projects, with attention given to model numbers, California Energy Wise[2] eligibility, 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.

6.5 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	Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
CY1-1	29,210	26,234	90%

[2] https://caenergywise.com/business-rebates/

Stratum	Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
CY1-2	23,418	10,521	45%
CY1-3	43,177	17,196	40%
CY2-FF1 (Fridge/Freezers 1)	8,027	5,239	65%
CY2-FF2 (Fridge/Freezers 2)	6,678	7,245	108%
CY2-FF3 (Fridge/Freezers 3)	4,602	4,804	104%
CY2-HFC (Hot Food Cabinets)	13,058	8,967	69%
CY2-ICE (Ice Machines)	3,007	1,372	46%
CY2-Oven1 (Ovens 1)	8,393	1,563	19%
CY2-Oven2(Ovens 2)	147,996	57,583	39%
Total	**287,566**	**140,725**	**49%**

The program level realization rate of 45% was driven by Projects 2, 4 and 4 from CY1 and Projects 2, 6, 7, and 8 from CY2 as seen below in Table 6-5.

CY1 projects 2 and 7, and CY2 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 CY1 Project 4 resulted in an energy savings realization rate of 4% and a discrepancy of 17,956 kWh in savings. This project was an electric steamer site where the Evaluator found the size of the efficient equipment to only be 6 pans. The Ex-Post calculations use the as-found parameters and they are as follows: pre-heat energy of 1.66 kWh, an idle energy rate of .29 kW, steam cooking efficiency of 79%, a production capacity of 132 lbs./day, an idle energy rate of .29 kW, the time in constant steam mode of 0%, and a water consumption rate of .9 gal/hour and .5 preheats per day. The verification site visit found the equipment to be operational .57 hours per day and 363 days per year.

The Ex-Ante calculations use all default DEER workpaper values. In this case, this means Ex-ante calculations use the following: 6.43 pans, a pre-heat energy of 1.776 kWh, an idle energy rate of .286 kW, a steam cooking efficiency of 70.39%, a production capacity of 122.07 lbs./day, an idle energy rate of .286 kW, the time in constant steam mode of 0%, a water consumption rate of 2.91 gal/hour and 1 preheat per day. The deemed values of 9.25 hours per day and 310.58 days per year were used.

Analysis of CY2 Project 8 resulted in an energy savings realization rate of 49% and a discrepancy of 15,385 kWh in savings. This project was a combination 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 verification 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	Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
CY1 Project 1	9,361	10,689	114%
CY1 Project 2	2,135	-	0%
CY1 Project 3	3,203	2,342	73%
CY1 Project 4	18,722	766	4%
CY1 Project 5	259	213	82%
CY1 Project 6	1,068	1,439	135%
CY1 Project 7	3,357	-	0%
CY1 Project 8	931	856	92%
CY2 Project 1	3,357	625	19%
CY2 Project 2	15,038	4,715	31%
CY2 Project 3	4,602	4,804	104%
CY2 Project 4	666	377	57%
CY2 Project 5	666	231	35%
CY2 Project 6	11,501	-	0%
CY2 Project 7	11,501	-	0%
CY2 Project 8	30,190	14,806	49%
CY2 Project 9	558	576	103%
CY2 Project 10	11,501	11,501	100%
CY2 Project 11	558	574	103%
CY2 Project 12	486	551	113%

Project	Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
CY2 Project 13	423	276	65%
CY2 Project 14	575	600	104%
CY2 Project 15	558	-	0%
CY1 Non-sampled Projects	56,769	37,647	66%
CY2 Non-sampled Projects	99,578	47,137	47%
Total	**287,566**	**140,725**	49%

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	Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
FY 20/21	120,591	53,952	45%	15.85	7.09	45%
FY 21/22	191,761	86,773	45%	24.62	11.14	45%
Total	**312,352**	**140,725**	**45%**	**40.47**	**18.23**	**45%**

6.5.1 COVID-19 Impacts on Energy Use

Based on the information the Evaluator collected about COVID-19 impacts on the facility or equipment operation, no significant impact was found. Therefore, COVID-19 impacts did not differ from typical 1st year energy savings.

6.6 Process Evaluation

The process evaluation for the FSPC and FSP-POS are combined and reported in Section 5.6.

6.7 Cost-Effectiveness Results

Table 6-7 presents benefits, costs, and the results of cost-effectiveness testing for the FSP POS. Overall, the Total Resource Cost (TRC) test indicates there could be areas for improvement to make the program cost effective.

Table 6-7 FY 21/22 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	$59,327	$59,327	$225,192	$59,327	$59,327
Total Costs	$272,439	$326,803	$90,509	$461,486	$326,803
Benefit/Cost Ratio	0.22	0.18	2.49	0.13	0.18

6.8 Program Key Findings and Recommendations

The Evaluator does not have any recommendations for FSP POS since the program has ended operations.

7 LADWP Facilities and Upgrade Program

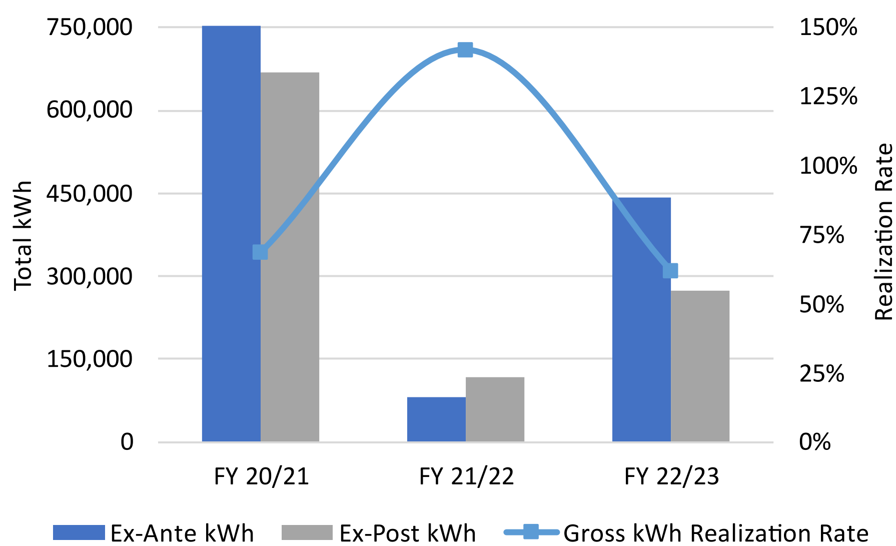
This chapter summarizes the impact evaluation of the LADWP Facilities and Upgrade Program that LADWP offered customers from Fiscal Years 20/21 to 22/23 (Concurrent Period).

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

7.1 Program Performance Summary

The LADWP Facilities Program was established in 2009 in response to the City of Los Angeles Green LA Directive. The program provides funding for direct install improvements for LADWP facilities, from which operational cost reductions then become ratepayer benefits. Figure 7-1 compares Ex-Ante and Ex-Post energy savings across the Concurrent Period.

Figure 7-1 LADWP Facilities Program Performance Summary



7.1.1 Key Evaluation Takeaways

- The overall kWh program realization rate was 62% during FY 22/23 and 71% during the Concurrent Period.
- The FY 22/23 annual energy savings realization rate was impacted by lower lighting hours of use determined through monitoring light output.
- FY 22/23 made up 30% of estimated Ex-Ante annual energy savings across the past 3 program years.
- There continue to be opportunities for lighting upgrades and integration of building controls.

7.2 Program Description

The LADWP Facilities and Upgrade Program upgrades lighting technology to reduce energy consumption within LADWP facilities. The program is designed to achieve the City's Energy Efficiency goals and provides a functional and safe workspace for employees. Engineering staff provide expertise in retrofitting facilities with detailed design, energy savings calculations, and project management. Table 7-1 summarizes the program's Ex-Ante energy savings and peak demand reduction during FY 22/23.

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
FY 20/21	3	969,545	152.63
FY 21/22	2	81,874	3.72
FY 22/23	4	441,771	64.43
Total	**9**	**1,493,190**	**220.78**

7.3 Methodology

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

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 tracking data review to ensure that the data provided sufficient information to calculate energy and peak demand impacts.

- M&V sample design
  - The FY 22/23 LADWP Facilities program included four projects. One of the projects was a street lighting project that was not included in the evaluation sample. The other three projects were selected for evaluation.
- Algorithms and references
  - For projects involving lighting measures, savings were determined utilizing DEER workpaper algorithms and interactive effects. Lighting hours of use was determined through monitoring of light output.
- 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.

7.4 Impact Evaluation

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

- Engineering review procedures
  - Analysis of lighting savings was accomplished using the Evaluator's custom-designed lighting evaluation model with system parameters (fixture wattage, operating characteristics, etc.) based on information either collected in person, referenced in project documentation or DEER workpapers and, if appropriate, referencing industry standards.
- Description of factors affecting gross realized savings
  - Differing Baseline Assumptions
  - Differing Hours of Operations
  - Differing Analytical Approach
  - Differing Algorithm Input Selection

Details on the impact evaluation can be found in Appendix A, A.6.2.

7.5 Ex-Post Gross Savings

This section presents Ex-Post gross savings for the CY3 LADWP Facilities Program. Table 7-3 compares Ex-Post energy impacts to Ex-Ante claimed savings from the tracking data for projects in CY3. Project 1 was not included in the evaluation sample. Ex-Post results are based on extrapolation from previous similar projects (street lighting). The program level Ex-Post energy savings realization rate was 68% when comparing to tracking data Ex-Ante savings.

Table 7-3 LADWP CY3 Facilities Census Project Savings

Project	Ex -Ante kWh Savings	Ex- Post kWh Savings	Gross kWh Realization Rate
Lighting Project 1	57,314	58,809	103%
Lighting Project 2	36,400	38,651	106%
Lighting Project 3	324,545	139,376	43%
Street Lighting Project 4	3,491	5,357	153%
Street Lighting Project 5	20,021	30,720	153%
Total	**441,771**	**272,913**	**62%**

Table 7-4 compares Ex-Post energy impacts to Ex-Ante claimed savings from the tracking data for FY 22/23. Across the past 3 program years, only the two street lighting projects in FY 22/23 were not included in the evaluation sample. With all other projects evaluated, the 3-year annual energy savings precision for Ex-Post results is 3.41% at the 90% confidence interval.

Table 7-4 LADWP Facilities Evaluation Results

Fiscal Year	ESP Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
FY 20/21	969,545	668,209	69%	152.63	105.19	69%
FY 21/22	81,874	116,240	142%	3.72	10.94	294%
FY 22/23	441,771	272,913	62%	64.43	37.58	58%
Total	**1,493,190**	**1,057,362**	**71%**	**220.78**	**153.71**	**70%**

7.5.1 COVID-19 Impacts on Energy Use

Based on the information the Evaluator collected about COVID-19 impacts on the facility or equipment operation, no significant impact was found. Therefore, COVID-19 impacts did not differ from typical 1st year energy savings.

7.6 Process Evaluation

The Evaluator completed a process evaluation of the LADWP Facilities Program during FY 20/21 and did not complete a process evaluation for FY 22/23. The key findings from the full process evaluation were:

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

7.7 Cost Effectiveness Results

Table 7-5 presents benefits, costs, and the results of cost-effectiveness testing for the LADWP Facilities Program. Overall, the program was cost effective.

Table 7-5 FY 22/23 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	$248,801	$248,801	$2,897,283	$248,801	$248,801
Total Costs	$2,207,317	$21,157	$21,110	$2,897,330	$21,157
Benefit/Cost Ratio	0.11	11.76	137.25	0.09	11.76

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:

- Monitoring for lighting hours of use indicated lower hours for some locations compared to deemed values applied to savings estimates. The Evaluator recommends continued monitoring during evaluations to capture accurate energy savings.

- 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 Program

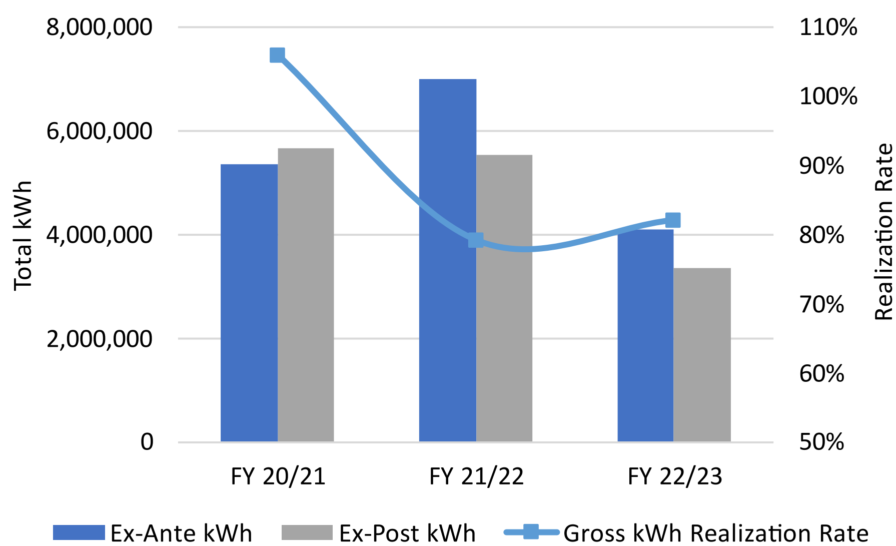
This chapter summarizes the impact evaluation of the LAUSD Direct Install (LAUSD DI) Program that LADWP offered customers from Fiscal Year 20/21 to 22/23 (Concurrent Period).

The primary objective of this evaluation was to estimate energy savings impact attributable to the LAUSD DI Program.

8.1 Program Performance Summary

LAUSD-DI targets facilities within the Los Angeles Unified School District with electric, water, and gas saving measures. LAUSD-DI was launched in 2012 in response to budget challenges faced by LAUSD, and the program also provided technical and project management assistance to facilitate project completion. Figure 8-1 compares Ex-Ante and Ex-Post energy savings across the Concurrent Period.

Figure 8-1 LAUSD DI Program Performance Summary



8.1.1 Key Evaluation Takeaways

- LAUSD DI Program activity was lower in FY 22/23 compared to FY 21/22.
- The realization kWh rate was 82% during FY 22/23 and 89% during the Concurrent Period.
- The program continues to operate efficiently under the collaboration of LAUSD Staff, LADWP program managers, and Wildan (the implementation contractor).

8.2 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 22/23.

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 20/21	37	5,348,832	560.17
FY 21/22	16	7,001,196	504.10
FY 22/23	12	4,103,398	765.53
Total	**65**	**16,453,426**	**1,829.79**

8.3 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
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 4 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.

8.4 Impact Evaluation

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

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

A detailed impact evaluation can be found in Appendix A, Section A.7.3.

8.5 Ex-Post Gross Savings

This section presents Ex-Post gross savings for the LAUSD DI program. Table 8-3 compares CY3 Ex-Post energy impacts to Ex-Ante claimed savings from the program data for sampled sites only. For FY 22/23, the program level Ex-Post energy savings realization rate was 78% when comparing to program data Ex-Ante savings.

Table 8-3 LAUSD CY3 DI Evaluation Results by Strata

Stratum	Ex-Ante kWh Savings	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	421,606	412,422	98%	24.55	18.62	76%
Retrofit Interior	2,025,875	1,563,391	77%	357.58	156.82	44%
Sensor Exterior	575,950	600,220	104%	114.03	86.48	76%
Sensor Interior	1,079,966	792,193	73%	221.53	94.42	43%
Total	**4,103,398**	**3,368,226**	**82%**	**717.69**	**356.33**	**50%**

Table 8-4 compares Ex-Post energy impacts to Ex-Ante claimed savings from the CY3 program year data by sampled project, and for the program overall. The evaluation effort included verification of 151 lighting measures across four schools. For FY 22/23, the program level Ex-Post energy savings realization rate was 82% when comparing to program data Ex-Ante savings.

Table 8-4 LAUSD CY3 DI Sampled and Non-Sampled Project Savings

Project	Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
Project 1	221,975	198,092	89%
Project 2	566,114	470,724	83%
Project 3	437,605	361,515	83%
Project 4	296,029	203,585	69%
Non-sampled Projects	2,581,674	2,134,310	83%
Total	**4,103,398**	**3,368,226**	**82%**

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 2.65% precision at the 90% confidence interval.

Table 8-5 LAUSD DI Evaluation Results

Fiscal Year	ESP Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
FY 20/21	5,348,832	5,671,907	106%	560.17	594.00	106%
FY 21/22	7,001,196	5,545,135	79%	504.10	399.71	79%
FY 22/23	4,103,398	3,368,226	82%	765.53	628.38	82%
Total	**16,453,426**	**14,585,268**	**89%**	**1,829.79**	**1,622.09**	**89%**

8.5.1 COVID-19 Impacts on Energy Use

Based on the information the Evaluator collected about COVID-19 impacts on the facility or equipment operation, no significant impact was found. Therefore, COVID-19 impacts did not differ from typical 1st year energy savings.

8.6 Process Evaluation

The Evaluator completed a process evaluation of the LAUSD DI Program during FY 20/21 and did not complete a process evaluation for FY 22/23.

The key findings from that evaluation were as follows:

- **The program funds retrofits in approximately 12 schools per year.** The schools consist of a mix of high schools, middle schools, and elementary schools.
- **Projects are initiated with an audit that leads to a proposed retrofit with estimated energy savings and costs**. The program supervisor reviews the cost and cost effectiveness and approves anything that costs $3/kWh or less.
- **All sites receive a walk-through inspection to verify that the measures are installed and working.**
- **LAUSD is very pleased with the program and does not believe they could implement these retrofits without the assistance of the program.**
- **COVID-19 has increased installation costs because installations must be performed at night and contractors must sanitize the classrooms before they enter and leave a classroom.**

8.7 Cost Effectiveness Results

Table 8-6 presents benefits, costs, and the results of cost-effectiveness testing for the LAUSD DI Program. Overall, the program was cost effective.

Table 8-6 FY 22/23 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	$3,370,020	$3,370,020	$16,579,822	$3,370,020	$3,370,020
Total Costs	$11,682,386	$3,867,919	$230,341	$20,217,400	$3,867,919
Benefit/Cost Ratio	0.29	0.87	71.98	0.17	0.87

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.

The Evaluator 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

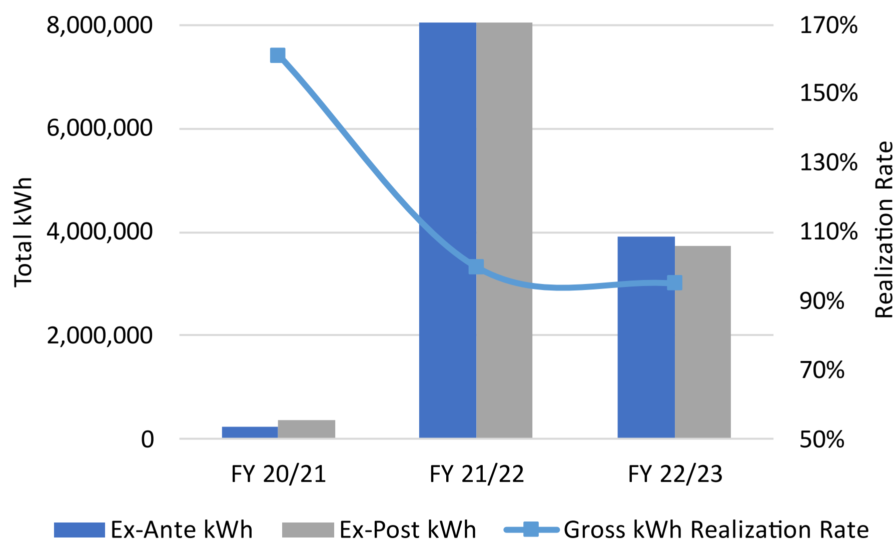
This chapter presents an impact evaluation of the Savings by Design (SBD) that LADWP offered to customers in Fiscal Years 20/21 to 22/23 (Concurrent Period), and LADWP Zero by Design (LADWP ZBD) that LADWP offered to customers in Fiscal Year 22/23 (FY 22/23 or Concurrent Year 3). LADWP ZBD will replace SBD in future program years.

The primary objective of this evaluation was to estimate energy and peak demand impacts attributable to the SBD/ LADWP ZBD program, as well as perform a process evaluation for LADWP ZBD.

9.1 Program Performance Summary

SBD/ LADWP ZBD is a statewide program model that provides incentives for new construction and modernization ("gut rehab") projects that exceed Title 24 energy code requirements. SBD has been discontinued by LADWP and is now replaced with a new program design that is unique to LADWP. Figure 9-1 compares Ex-Ante and Ex-Post energy savings across the Concurrent Period.

Figure 9-1 SBD Program Performance Summary



9.1.1 Key Evaluation Takeaways

- SBD has reached its sunset, but the program continued to complete any project applications during CY3 that were submitted before the program ended.
- The overall kWh SBD program realization rate was 95% during FY 22/23 and 100% during the Concurrent Period.

- LADWP ZBD is currently ramping up and the electrification incentives are in development; during CY3, two projects were completed under LADWP ZBD. The overall program realization rate was 100%.
- LADWP staff had concerns about the market receptivity to LADWP ZBD, but interviews with market actors found that this program was more streamlined and had a quicker process than the SBD program it replaced.

9.2 Program Description

The non-residential SBD/ LADWP ZBD Program provides incentives for New Construction or Modernization projects that exceed Title 24 energy standards. This evaluation represents projects completed in Fiscal Year 2020-2023.

Table 9-1 and Table 9-2 summarize the program's Ex-Ante energy savings and peak demand reduction for the SBD/ LADWP ZBD program for FY 20/21 to FY 22/23. A total of 28 LADWP SBD and two LADWP ZBD projects were completed during CY3.

Table 9-1 SBD Program Ex-Ante Savings Summary

Fiscal Year	Project Type	Number of Projects	Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	New Construction	2	201,008	44.1
	Modernization	1	32,002	7.0
	Total	3	233010	51.1
FY 21/22	New Construction	29	7,939,323	1,981
	Modernization	1	130,226	
	Total	30	8,069,549	1981.0
FY 22/23	New Construction	27	3,887,031	
	Modernization	1	35,102	1,186
	Total	28	3,922,133	1186.2
Grand Total		**61**	**12,224,692**	**3,218.3**

Table 9-2 LADWP ZBD Program Ex-Ante Savings Summary

Fiscal Year	Number of Projects	Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 22/23	2	33,096	7.22
Total	**2**	**33,096**	**7.22**

9.3 Methodology

This section presents a summary of the methodology used to evaluate the SBD/ LADWP ZBD program. Ex-Post annual energy savings, lifetime energy savings, and peak demand reduction were determined using the methodologies described here. 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 (M&V 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

The sample size for ZBD program was small; therefore, the sample selection was “census” in this case. A detailed evaluation methodology can be found in Appendix A, Section A.8.1.

9.4 Impact Evaluation

This section presents findings from the determination of Ex-Post gross annual energy savings, lifetimes energy savings, and peak demand reduction through 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.

9.5 Ex-Post Gross Savings

Program level gross energy savings are the aggregation of the evaluated projects. Energy impacts under SBD were disaggregated by project type: new construction and modernization. Ex-Post Savings results are shown in Table 9-3. Table 9-4 presents evaluation results for the ZBD program.

Table 9-3 SBD Concurrent Period Evaluation Results

Fiscal Year	Project Type	Ex-Ante kWh Savings	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
20/21	New Construction	201,008	343,291	171%	44.08	75.28	171%
	Modernization	32,002	32,100	100%	7.02	7.04	100%
	Total	233,010	375,391	161%	51.10	82.32	106%
21/22	New Construction	7,939,323	7,918,154	100%	1,164.60	1,163.42	100%
	Modernization	130,226	143,224	110%	21.61	21.59	100%
	Total	8,069,549	8,061,378	100%	1,186.21	1,185.01	79%
22/23	New Construction	3,887,031	3,707,610	95%	1,142.48	1,080.75	95%
	Modernization	35,102	22,755	65%	0.50	0.58	116%
	Total	3,922,133	3,730,365	95%	1,142.98	1,081.33	95%
Grand Total		**12,224,692**	**12,167,134**	**100%**	**2,380.29**	**2,348.66**	**99%**

Table 9-4 ZBD Evaluation Results

Project Type	Ex-Ante kWh Savings	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
New Construction	33,096	33,097	100%	7.22	7.50	100%
Total	**33,096**	**33,097**	**100%**	**7.22**	**7.50**	**100%**

9.5.1 COVID-19 Impact on Energy Use

All of the facilities evaluated reported “business as usual” during CY3 period. Therefore, COVID-19 impact on energy use did not apply. The Evaluator has concluded that the typical year energy savings presented in Table 9-3 represent current and future operating conditions.

9.6 Process Evaluation

The Evaluator completed a full process evaluation for the LADWP ZBD FY 22/23 Program that included the following activities:

- A review of program documents
- An interview with program staff
- An interview with Okapi Architecture which assists LADWP with the implementation of the program.
- Interviews with 5 owners/developers and 3 design team members.
- Estimation of the rate of free ridership in the program based on responses from interviews with owners/developers.

Key findings of the process evaluation are as follows:

- **The program is still ramping up and electrification incentives are in development.** Program staff indicated that the new program is still ramping up but that they believe it is a big improvement and that the process for handling applications is more streamlined. A key challenge in addressing electrification is how to count those impacts in savings reports when program measures may increase electricity usage.
- **Market actor views of the program may be more positive than the program staff believe.** LADWP staff raised concerns about how well word about the program is getting out and the implementation contractor stated that there is a lot of interest in the program that is not leading to application submissions. However, none of the interviewed market actors expressed concerns about participating and they generally believed the program is more streamlined and quicker than SBD. Participants also praised Okapi's responsiveness.
- **Market actors identified some opportunities for improvement.** Several market actors expressed concern about what happens during the review of applications. One owner noted that he thought he received more information on savings and how incentives work under SBD. Another suggested area for improvement was to design the application to use information in the Title 24 report or an energy model so it was less time consuming to complete the application. Other suggested improvements related to Title 24 compliance are discussed in the detailed findings.
- **Rebates and sustainability goals influence the efficiency of new buildings**. Participants reported that both factors are influencing decisions about building efficiency. Interview responses suggest that some participants are greatly influenced by the program, some not at all, and others somewhere in between.

9.7 Cost Effectiveness Results

Table 9-5 presents benefits, costs, and the results of cost-effectiveness testing for the SBD and LADWP ZBD Programs. Overall, SBD was cost effective, but LADWP ZBD could see some improvements in cost effectiveness.

Table 9-5 FY 22/23 SBD Cost/ Benefit Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$6,642,341	$6,642,341	$12,006,624	$6,642,341	$6,642,341
Total Costs	$1,642,449	$828,197	$815,335	$12,019,486	$828,197
Benefit/Cost Ratio	4.04	8.02	14.73	0.55	8.02

Table 9-6 FY 22/23 LADWP ZBD Cost/ Benefit Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$58,002	$58,002	$106,278	$58,002	$58,002
Total Costs	$498,422	$491,395	$7,182	$590,492	$491,395
Benefit/Cost Ratio	0.12	0.12	14.80	0.10	0.12

9.8 Program Key Findings and Recommendations

The Evaluator offers the following key findings and recommendations for the SBD/ LADWP ZBD 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.
- The program participants should be encouraged to show cooperation for participating in the evaluation activities, when needed. In some cases, program participants did not seem cooperative while site visits were requested for data collection.

The Evaluator offers the following key findings and recommendations for LADWP ZBD:

- **Study experiences of non-participants, especially those who expressed interest but then did not submit an application.** Better knowledge of impediments to program participation will enable effective action to overcome them. For example, if completing and submitting an application is the stopping point for potential participants (i.e., program staff and implementer agree that a major challenge is getting applications in the door, and the implementer noted that something is getting in the way of interested candidates ultimately submitting applications), LADWP could explore options for providing more extensive application development assistance.

- **Seek opportunities for more coordination between implementer engineers and the team at the utility, especially around electrification options.** The goal is to need fewer hand-offs between the two groups which could lead to more participation.
- **Look for options to increase public recognition for market actors who participate in the program and are therefore going above and beyond Title 24 compliance.** Program verification and recognition of their sustainability efforts can be as important to participants as the offered incentives.
- **Find ways to provide more transparency within LADWP ZBD on application progress and more certainty on expected savings and incentives, especially for larger institutional participants.** This will help sustainability professionals in their reporting to decision makers on impact quantification, costs, incentives, and payback periods.
- **Adapt application materials to be more in line with what is already required for Title 24 compliance, thus reducing the information burden on participants.**
- **Seek innovative solutions that could support customers in adopting technologies and options that add value to electrification such as a combination of electric vehicle/fleet off-peak charging, on-site PV generation and storage, and interconnection agreements enabling grid sales and emergency backup power.** All-electric options tend to be costly, and enabling additional functionality or services can improve the value of the investments. Also, exploring options for incentivizing reductions in fossil fuel use (natural gas, vehicle fuels) could further elevate electric options.
- **Help customers with tools and/or assistance for organizing economic incentives beyond LADWP ZBD to maximize the financial benefits of energy efficiency, distributed energy resources, and energy optimizing technology investments.** There are many options for reducing costs that most market actors do not have time to sort out.

10 Upstream HVAC Program

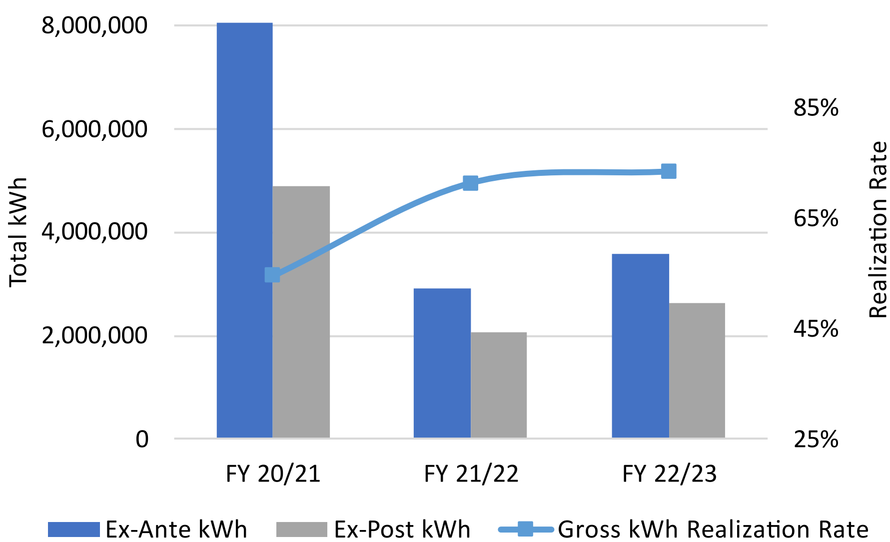
This chapter summarizes the impact evaluation of the Upstream Heating Ventilation, and Air Conditioning (UHVAC) Program that LADWP offered customers from Fiscal Years 20/21 to 22/23 (Concurrent Period).

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 summary process evaluation.

10.1 Program Performance Summary

UHVAC partners with distributors and manufacturers to provide incentives to encourage the sale of high efficiency HVAC equipment. The goal of this effort is to increase the availability of and marketing for high efficiency options, so that this will facilitate equipment selection by contractors and end-use customers. Figure 10-1 compares Ex-Ante and Ex-Post energy savings across the Concurrent Period.

Figure 10-1 Upstream HVAC Program Performance Summary



10.1.1 Key Evaluation Takeaways

- Lingering effects of the pandemic and higher equipment costs due to inflation have reduced the capacity of the program, evidenced by the large decline in savings from FY 20/21 to FY 21/22; UHVAC energy savings rebounded slightly in FY 22/23.
- The overall kWh realization rate was 74% during FY 22/23 and 62% during the Concurrent Period.
- Data collection and reporting play a key role in the accurate selection of kWh/ton and kW/ton savings rates.

- Realization rates may be influenced by baseline equipment assumptions; the Evaluator advises that LADWP assume a baseline case that meets code rather than assuming savings beyond code.
- The UHVAC program design and delivery remains largely unchanged including the measures and incentive levels. Staff noted that measure tiers will be updated to reflect federal code changes for HVAC equipment.

10.2 Program Description

Through an agreement with participating distributors and manufacturers, UHVAC provides incentives to participants to stock and upsell high efficiency HVAC equipment. Contractors and HVAC customers can then immediately access premium replacement technology that might not have been readily available to them without the program. The upstream approach allows LADWP to capture energy savings at the point of sale which would not have been applied for in LADWP's downstream programs. Table 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 20/21	1,293	8,927,912	2,364.23
FY 21/22	708	2,909,500	477.84
FY 22/23	584	3,591,027	916.04
Total	**2,585**	**15,428,439**	**3,758.11**

In all project years, the program included various types and sizes of heat pumps, unitary AC units, packaged AC units, air-cooled chillers, and variable refrigerant flow (VRF) systems. Using the provided program data, the FY 22/23 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 FY 22/23

Model Type	Quantity of Measures	ESP Ex-Ante kWh Savings	Proportion of kWh Savings	ESP Ex-Ante kW Savings
VRF <20	155	1,796,959	50.1%	422.68
MSHP	175	497,287	13.8%	129.97
AC 11.3-20.0	29	267,967	7.5%	78.09
AC < 5.4	98	244,019	6.8%	65.12
AC 5.4-11.3	51	214,654	6.0%	66.51
ACC	3	166,351	4.6%	38.81

Model Type	Quantity of Measures	ESP Ex-Ante kWh Savings	Proportion of kWh Savings	ESP Ex-Ante kW Savings
VRF	13	155,152	4.3%	41.67
AC 20-63.3	11	96,826	2.7%	38.01
HP < 5.4	29	52,618	1.4%	13.85
AC > 63.3	8	51,410	1.4%	10.28
WSHP	10	34,907	1.0%	7.40
VRF <80	2	12,877	0.4%	3.66
Total	**584**	**3,591,027**	**100.0%**	**916.04**

Table 10-3 UHVAC Ex-Ante ESP Savings by Equipment Type for FY 22/23

Equipment Type	Count of Equipment Type	Ex-Ante kWh ESP	Ex-Ante kW ESP
VRF	67	1,964,988	468.01
AC	118	874,876	258.00
HP	74	584,812	151.22
Chiller	2	166,351	38.81
Total	**261**	**3,591,027**	**916.04**

10.3 Methodology

The concurrent impact evaluation consisted of a prescriptive savings approach with a thorough review of all available project documentation and customer data, followed by an analysis of energy savings methodologies. The prescriptive approach utilized applicable energy savings rates found in the Database for Energy Efficiency Resources (DEER) workpapers. In the event a DEER workpaper is not available or not relevant then an industry standard algorithm is applied. 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;
- 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.

10.4 Impact Evaluation

The Evaluator conducted an impact evaluation to determine Ex-Post annual energy savings, peak demand reduction, and lifetime energy savings for FY 22/23. 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 determined from 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 10-4. The FY 22/23 extrapolated results are presented with a +/- 21.50% precision at a 90% confidence interval. All three fiscal years' savings were combined and presented with a +/- 9.48% precision at a 90% confidence interval.

Table 10-4 UHVAC Detailed Ex-Post Gross Results by Model for FY 22/23

Model Type	ESP Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Ex-Ante kW Savings	Ex-Post kW Savings	Gross kW Realization Rate
VRF <20	1,796,959	1,620,476	90%	422.68	183.64	43%
MSHP	497,287	335,732	68%	129.97	99.48	77%
AC 11.3-20.0	267,967	51,676	19%	78.09	25.57	33%
AC < 5.4	244,019	98,714	40%	65.12	53.53	82%
AC 5.4-11.3	214,654	61,717	29%	66.51	26.23	39%
ACC	166,351	166,351	100%	38.81	23.38	60%
VRF	155,152	131,663	85%	41.67	8.59	21%
AC 20-63.3	96,826	30,807	32%	38.01	15.86	42%
HP < 5.4	52,618	34,720	66%	13.85	16.92	122%
AC > 63.3	51,410	74,779	145%	10.28	39.25	382%
WSHP	34,907	23,557	67%	7.40	8.33	113%
VRF <80	12,877	11,540	90%	3.66	2.12	58%
Total	**3,591,027**	**2,641,732**	**74%**	**916.04**	**502.91**	**55%**

Table 10-5 shows a simplification of these result into four general equipment categories.

Table 10-5 UHVAC FY 22/23 Evaluation Results

Equipment Category	ESP Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Ex-Ante Peak kW Savings	ESP Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
VRF	1,964,988	1,763,679	90%	468.01	397.79	85%
AC	874,876	317,693	36%	258.00	117.18	45%
HP	584,812	392,302	67%	151.22	108.90	72%
Chiller	166,351	166,351	100%	38.81	30.13	78%
Total	**3,591,027**	**2,640,025**	**74%**	**916.04**	**654.00**	**71%**

10.4.1 Billing Regression

In FY 22/23, there were 37 sites selected as candidates for a billing regression. The Evaluator used LADWP's MV database to perform an assessment of the metering data. Upon review, it was found that most of these sites had insufficient billing data to perform an analysis. There were many instances where data was not available at all. In cases where data was available for download, it was found that there were substantial gaps during the installation period, making it impossible to derive any conclusions about the baseline versus post-installation energy consumption.

10.4.2 Realization Rate Factors

The Evaluator was able to attribute the differences in savings to three factors: a difference in capacity, a difference in calculation methodology for VRFs, and DEER workpaper savings rate selection.

The difference in capacity was a simple comparison between the sample's capacity as reported through the program data and the sample's capacity as reported by the Evaluator. This parameter had marginal influence on the savings differences. The factor for difference in methodology stems from the discontinuation of the DEER workpaper for VRFs. The final category is the most nebulous; differences in DEER workpaper savings rates could be a result of one or more characteristics, including:

- Baseline Equipment Assumptions
- Building Type
- Building Vintage
- Climate Zone
- Equipment Type
- Equipment Specifications
- Workpaper Limitations

Because some of the above factors were not listed in program data, it was infeasible to trace the origin of LADWP's savings rates. Moreover, the savings rates that rely on the above options must also sometimes be interpolated or extrapolated, which made successfully tracing the primary driver even less likely.

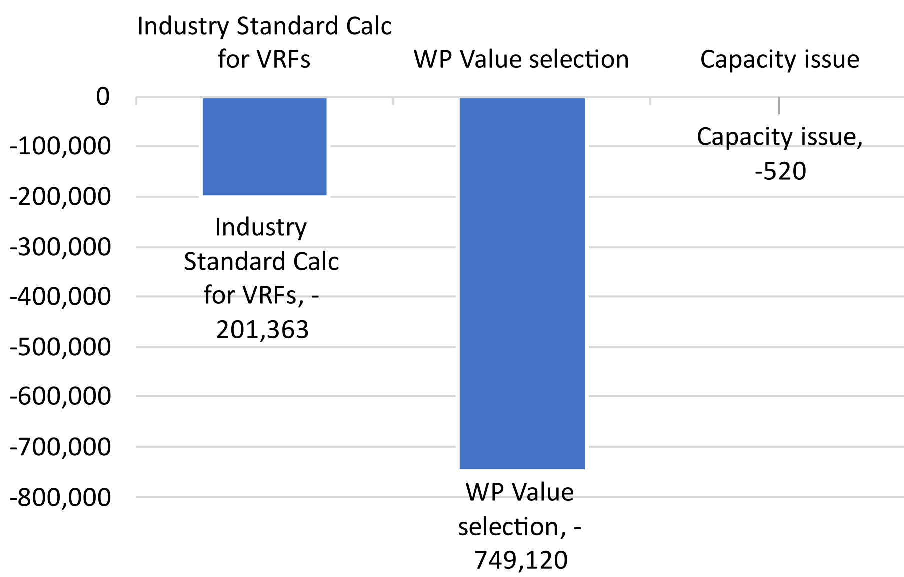
The Evaluator was able to investigate some of the listed characteristics, including capacity of sampled items, climate zone of the population, and building type for the population. The latter two are explored in more detail in section 10.4.3. However, because of the potential for multiple factors to be wrong plus the lack of traceability, it was impossible to meaningfully ascribe factors at the above granularity.

The Evaluator noted that some of the savings rates extracted from the program data were higher than expected for the matching equipment type. This rate difference may plausibly be the result of an assumption that the baseline equipment had savings below-code. However, in instances where data is limited, it is assumed that the baseline equipment meets code. This conservative approach is standard for midstream programs where baseline data is not as easily collected.

10.4.2.1 kWh Realization Rate Factors

The most impactful factor in the kWh realization rate was the DEER workpaper savings rate, as seen in Figure 10-2, accounting for approximately 79% of the kWh difference. The second dominant factor was the Evaluator's use of an industry standard calculation for VRFs in lieu of the discontinued workpaper, resulting in most of the remaining difference at approximately 21% of the kWh difference. Lastly, <.1% of the difference stemmed from a difference in equipment capacity.

Figure 10-2 UHVAC Factors Influencing kWh Realization Rate FY 22/23



10.4.2.2 kW Realization Rate Factors

Program data was compared to Ex-Post kW calculations. The most impactful factor for the difference in demand savings was the use of an industry standard calculation for

VRFs. Close to half of the difference stemmed from this factor, while most of the remainder came from a difference in selection of DEER savings rates. Like the kWh factors, the equipment capacity amounted to <.1% of the difference in savings.

10.4.3 Building Type & Climate Zone Review

As previously mentioned, two of the selection criteria for DEER savings rates are the site's climate zone and building type. The Evaluator confirmed that the climate zones reported through the program data were selected correctly. The building types were less consistent, however. Some of these buildings were misclassified in the program data. The clearest illustration of this misclassification is for a synagogue containing the word "University" in its name; this was classified as a university in the program data but should have been listed as an assembly building. However, since this site installed a VRF and the Evaluator used an industry-standard approach independent of DEER building type, this scenario does not appear in Table 10-6. The discontinued workpaper also limited the selectable building types to Office – Small and Office – Large for VRFs, making the classification further irrelevant for this measure type.

Table 10-6 UHVAC Program Data Building Types compared to the Evaluator's Building Types for Sampled, Non-VRF sites.

Program Data Building Type	ADM Selected Building Type (With Workpaper Limitations)
3x Health/Medical - Clinics	3x Commercial (Misc.)
2x Education - Primary School	2x Education - Secondary School
6x Education - Secondary School	5x Education - Secondary School 1x Education - Primary School
2x Health/Medical - Hospital	1x Health/Medical - Hospital 1x Retail - Single-Story Large
2x Lodging - Hotel	2x Lodging - Hotel
3x Office - Large	1x Office - Large 1x Office - Small 1x - Commercial (Misc.)
1x Office - Small	1x Office - Small
1x Restaurant - Fast-Food	1x Restaurant - Fast-Food
5x Retail - Single-Story Large	5x Retail - Single-Story Large
5x Retail - Small	1x Retail - Small 4x Retail - Single-Story Large
1x Storage - Conditioned	1x Storage - Conditioned
14x Commercial (Misc.)	10x Commercial (Misc.) 1x Retail - Single-Story Large 3x Retail - Small
45x Sampled Non-VRF Sites in FY 22/23	

A complete breakdown of building types for the whole population, regardless of workpaper limitations or measure type can be found in Section 26.2A.9.2.5.

10.4.4 Concurrent Period Savings

Application of the realization rate factors from section 10.4.2 resulted in lower-than-expected Ex-Post annual energy savings. Ex-Post peak demand reduction (kW) is calculated in ESP using load shapes based off the Ex-Post annual energy savings. The anticipated and verified savings by fiscal year can be seen below in Table 10-7.

Table 10-7 UHVAC Concurrent Savings by Fiscal Year.

Fiscal Year	ESP Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post kW Savings	Gross Peak kW Realization Rate
FY 20/21	8,927,912	4,879,518	55%	2,364.23	1,303.44	55%
FY 21/22	2,909,500	2,078,144	71%	477.84	341.30	71%
FY 22/23	3,591,027	2,640,025	74%	916.04	654.00	71%
Total	**15,428,439**	**9,597,687**	**62%**	**3,758.11**	**2,298.75**	**61%**

10.5 Process Evaluation

For FY 22/23, the Evaluator performed a summary process evaluation of UHVAC. 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 summary process evaluation of the program in FY 21/22 and a full process evaluation in FY 20/21.

Key findings from the FY 20/21 full process evaluation were:

- **Overall, the UHVAC participation and application process is streamlined.** The program leverages an online tool and requires relatively few inputs. The inputs needed are essential from the perspective of estimating savings and ensuring that the sale is made to an LADWP customer and include equipment specification and quantities, as well as building location. The program does not require an account or a customer signature (as is required by the LADWP point-of-sale food services program).
- **Verification of the measures is based upon review of measure documentation (e.g., unity type and model information) and information on the reported installation address of the equipment.** Program staff considered making equipment installation verification a requirement for the program but noted that this

has been difficult because the customer may not be aware that they have participated in an LADWP sponsored program.

- **The COVID-19 pandemic impacted program participation and the commercial HVAC market in general.** Participating distributors and manufacturers consistently noted that the COVID-19 pandemic impacted their participation in the program in 2020, primarily because they noted slow-downs in large construction projects and subsequent demand for commercial HVAC equipment. Several market actors noted that 2021 had been a substantially better year for their business, but that prices were higher due to a steel shortage, and that wait times were longer. Distributors and manufacturers noted that their customer’s budgets were often tighter as customers were managing with shortfalls and lockdown combined with the increased cost (due to steel shortages and other supply chain issues). As a result, they were seeing less interest in higher-priced efficient equipment and a preference for equipment with a lower first cost.
- **Participating distributors who were more active in the program also tended to be more satisfied with the program than the less active distributors.** Those market actors who were more active in the program expressed high satisfaction as well as receiving the support they received from the implementation team, comparing them favorably to other utility program implementers. Conversely, distributors and manufacturers who participated less frequently were less satisfied with the program, including support provided by the implementation team, and specifically noted an absence in communication. However, it is difficult to determine whether lower satisfaction affected level of participation, or if those less active market actors are not as visible and do not receive the same level of support as those more active.
- **Distributors believe that the program works best for plan and spec projects.** In these situations, the distributor/manufacturer has the time to confirm the address and establish site eligibility as well as confirming equipment eligibility and incentive amount. Situations where there was an emergency replacement were more challenging as the distributor might not have the address of the installation site or might not have a viable unit in stock or have the time to upsell a more efficient unit.
- **The LADWP incentives are higher than the statewide incentives but do not affect stocking decisions, which are more likely to be based on the statewide program equipment list.** The LADWP program is one of several similar upstream programs in the region, and market actors compare these programs. The higher incentive amounts and additional eligible measures in LADWP’s program ensure that where possible, distributors/manufacturers will apply for a rebate through that program. However, when making stocking decisions, they may not use the LADWP product list as a basis for their decisions, instead using the statewide programs measure list to make stocking decisions.
- **The LADWP incentives support VRF installations in the region, which are not covered under the statewide program.** Participating distributors and manufacturers expressed appreciation that the LADWP program continues to

provide incentives for VRF systems, which are often a good option for commercial properties and are no longer eligible in the statewide program.

- **The participating market actors reported an interest in increased communication and program support.** Participating market actors also reported varying levels of support from the Energy Solutions team. For example, one dealer noted that the ES team would provide them a clear list of what products were eligible for the rebates, while another distributor noted that they had to put it in the systems and check manually to see if a particular product was eligible.
- **Procedures are in place to ensure that UHVAC project savings are not counted in a downstream program and that the installation location receives service from LADWP.** As part of the UHVAC incentive payment review process, the program verifies that a downstream incentive has not been submitted for the project and staff use the installation address to confirm that the site receives service from LADWP.

Key findings from the FY 21/22 summary evaluation included:

- **The program's design and delivery were largely unchanged from the previous year and operations are running smoothly.** 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 but began 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 noted customers experienced long delays in equipment delivery times and higher prices due to supply chain issues and inflation, the latter of which reduced the effectiveness of current incentives levels.** With the delays, a project can take nine to 12 months to complete, and the costs of equipment have increased by 20 to 30 percent.
- **Issues with slow permitting approvals delayed new construction projects.** 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.

Section A.9.3 presents additional findings from the staff interview. The key findings from the FY 22/23 summary process evaluation are:

- **LADWP staff noted that the UHVAC program's design and delivery is largely the same as the previous fiscal year, including the same measures and incentive levels.** However, the program did reassess the distributor outreach process. Specifically, the program implementer, Energy Solutions (ES), began going to more conventions to meet sales point level distributors rather than working through the executive level. Additionally, to avoid overlap with other programs such as LADWP Zero by Design and the Custom Program Performance Program, the application deadline for distributors was changed to 90 days from the sale date from the end of the fiscal year.

- **Staff noted concerns about the impact of lowering incentives.** UHVAC has higher incentives than that offered by other programs and are concerned if incentives are lowered to improve cost effectiveness, it will lower participation and savings.
- **Federal code changes will prompt program changes.** Measure tiers are likely to be updated to reflect federal codes changes for commercial HVAC equipment that affect minimum efficiency standards.

10.6 Cost-Effectiveness Results

Table 10-8 presents benefits, costs, and the results of cost-effectiveness testing for the UHVAC Program. Overall, the program was cost effective.

Table 10-8 FY 22/23 UHVAC Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$5,071,899	$5,071,899	$8,485,513	$5,071,899	$5,071,899
Total Costs	$953,157	$952,956	$950,284	$8,488,184	$952,956
Benefit/Cost Ratio	5.32	5.32	8.93	0.60	5.32

10.7 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.

There are multiple steps the program can take to improve the Ex-Ante savings estimates. The Evaluator recommends updating HVAC units' energy savings calculations to reflect from code to efficient condition, using recent DEER workpapers, ensuring consistency in workpaper selection during concurrent evaluation periods, and maintaining contractor expertise to support the complexity of better-than-code systems in response to evolving baseline conditions.

- 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.

Interviews with program staff on the program process suggest that overall, the UHVAC Program is operating well. In the interest of continual improvement, the Evaluator offers the following recommendations for consideration.

- Look for options to tag HVAC equipment to prevent denying rebates for UHVAC discounted equipment. Identify equipment in production, at the wholesaler or retailer once a rebate claim is made against it through the UHVAC or other LADWP program so that contractors or customers are not surprised later on that it is ineligible because it was already rebated. Working with distributors to identify equipment as rebated, may prevent some of the issues noted by program staff about the challenge of distributors selling a product and the customer also claiming a rebate for it without realizing it had already been rebated.
- Consider secondary effects of reducing program incentives. When assessing if incentives should be decreased to improve cost-effectiveness, consider secondary effects such as reduction in local equipment availability, the economic backdrop of inflation, and reduced program participation and progress toward savings goals.

11 Consumer Rebate Program

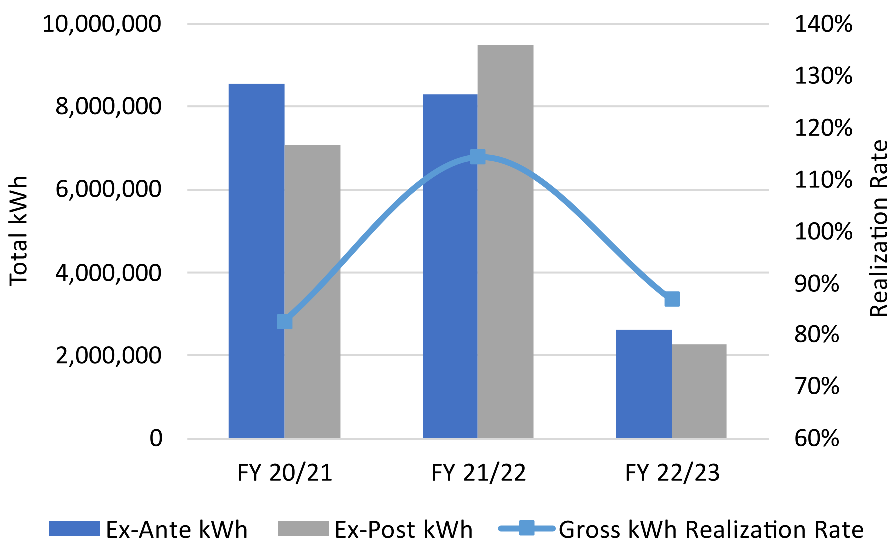
This chapter summarizes the impact and process evaluation of the Consumer Rebate Program (CRP) that LADWP offered customers during Fiscal Years 20/21 to 22/23 (Concurrent Period).

The primary objective of this evaluation was to calculate energy savings and peak demand reductions attributable to CLIP, as well as to perform a summary process evaluation.

11.1 Program Performance Summary

The CRP provides prescriptive incentives for a range of residential home energy improvements, including attic insulation, pool pumps, heating and cooling system replacement, cool roofs, dual pane windows, and appliances. Figure 11-1 compares Ex-Ante and Ex-Post energy savings across the Concurrent Period.

Figure 11-1 CRP Performance Summary



11.1.1 Key Evaluation Takeaways

- The overall kWh realization rate was 87% during FY 22/23 and 97% during the Concurrent Period.
- California Energy Commission adopted the US Department of energy (DOE) efficiency requirements for dedicated purpose pool pumps manufactured after July 19, 2021. Site visits during the FY 21/22 period, 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%. Actual usage from the metering of pool pumps in 2022 indicated higher run duration than 20% requirement for the high flow schedule.

- For future program years, reduced savings are expected, as more pump motors manufactured after 7/19/21 can be expected, with savings determined by a normal replacement baseline (e.g., a variable speed pool pump with a compliant WEF).
- Overall program satisfaction was reasonably high across the three-year period. Overall satisfaction rates were 90% for FY 20/21, 81% for FY 21/22, and 82% for FY 22/23. Lower rates for the second two years may have been due to longer incentive processing times due to the high volume of attic insulation rebates.

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 an 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

Fiscal Year	Measure	Number of Enrollments	Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
20/21	Attic Insulation	19,897	3,869,182	1,764.93
	Central Air Conditioner	227	92,123	42.02
	Central Heat Pump	26	11,448	4.53
	Cool Roof	487	624,801	285.00
	Dual Pane Windows	39	4,373	1.99
	Pool Pump and Motor	2,431	3,952,326	747.79
	Whole House Fan	2	848	0.16
	Total	23,109	8,555,101	2,846.43
21/22	Attic Insulation	12,160	2,339,956	534.45
	Central Air Conditioner	504	192,464	213.43
	Central Heat Pump	64	27,984	23.11
	Cool Roof	724	880,309	976.19
	Dual Pane Windows	106	9,079	10.06
	Pool Pump and Motor	3,006	4,835,666	1,109.36
	Whole House Fan	4	1,696	1.88

Fiscal Year	Measure	Number of Enrollments	Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
	Total	16,568	8,287,153	2,868.48
22/23	Attic Insulation	444	88,637	39.61
	Central Air Conditioner	62	23,552	10.53
	Central Heat Pump	27	12,720	4.70
	Cool Roof	314	827,721	369.91
	Dual Pane Windows	22	2,027	0.91
	Pool Pump and Motor	1,054	1,668,264	276.43
	Whole House Fan	2	424	0.19
	Total	1,925	2,623,345	702
3 year Total		**41,602**	**19,465,599**	**6,417.18**

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	0	132
Cool Roof	Billing Analysis	0	51
HVAC	Billing Analysis	15	37
Variable Speed Pool Pump/Motor	IPMVP Option A	0	134
Energy Star Windows	Engineering Calculation	0	9
Whole House Fan	Engineering Calculation	0	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 52% 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
Installed	100%	100%	100%	100%	100%	100%
Early Replacement	0%	0%	19%	52%	0%	0%
Responses	0	4	1	13	0	0
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 FY 22/23 program energy realization rate is 87% with 2,277,334 kWh savings. The program peak demand reduction totaled 521.73 kW, resulting in a 62% realization rate. The decrease from the prior year is primarily due to less attic insulation enrollments. 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

Fiscal Year	Measure	ESP Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
20/21	Attic Insulation	3,869,182	4,573,069	118%
	Central Air Conditioner	92,123	58,625	64%
	Central Heat Pump	11,448	14,781	129%
	Cool Roof	624,801	273,988	44%
	Dual Pane Windows	4,373	38,616	883%
	Pool Pump/Motor	3,952,326	2,108,875	53%
	Whole House Fan	848	965	114%
	Total	8,555,101	7,068,919	83%
21/22	Attic Insulation	2,339,956	5,679,470	243%
	Central Air Conditioner	192,464	118,898	62%
	Central Heat Pump	27,984	24,803	89%
	Cool Roof	880,309	359,797	41%
	Dual Pane Windows	9,079	111,730	1231%
	Pool Pump and Motor	4,835,666	3,183,405	66%
	Whole House Fan	1,696	1,711	101%
	Total	8,287,153	9,479,814	114%
22/23	Attic Insulation	88,637	51,555	58%
	Central Air Conditioner	23,552	11,620	49%
	Central Heat Pump	12,720	8,892	70%
	Cool Roof	827,721	74,884	9%
	Dual Pane Windows	2,027	18,306	903%
	Pool Pump and Motor	1,668,264	2,111,333	127%
	Whole House Fan	424	744	175%
	Total	2,623,345	2,277,334	87%
	3 year Total	**19,465,599**	**18,826,068**	**97%**

Table 11-5 CRP kW Evaluation Results

Fiscal Year	Measure	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
20/21	Attic Insulation	1,764.93	2,086.01	118%

Fiscal Year	Measure	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
	Central Air Conditioner	42.02	26.74	64%
	Central Heat Pump	4.53	5.85	129%
	Cool Roof	285.00	124.98	44%
	Dual Pane Windows	1.99	17.61	883%
	Pool Pump and Motor	747.79	399.11	53%
	Whole House Fan	0.16	0.16	98%
	Total	2,846.43	2,660.46	93%
21/22	Attic Insulation	534.45	1,297.17	243%
	Central Air Conditioner	213.43	131.85	62%
	Central Heat Pump	23.11	20.47	89%
	Cool Roof	976.19	398.98	41%
	Dual Pane Windows	10.06	123.90	1232%
	Pool Pump and Motor	1,109.36	730.31	66%
	Whole House Fan	1.88	1.90	101%
	Total	2,868.48	2,704.58	94%
22/23	Attic Insulation	39.61	44.25	111.7%
	Central Air Conditioner	10.53	5.16	49.1%
	Central Heat Pump	4.70	3.28	69.9%
	Cool Roof	369.91	64.27	17.4%
	Dual Pane Windows	0.91	11.32	1249.3%
	Pool Pump and Motor	276.43	309.25	111.9%
	Whole House Fan	0.19	0.14	74.1%
	Total	702.27	437.68	62%
3 year Total		**6,417.18**	**5,802.72**	**90%**

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 thCOVID-19 Era, compared to the prior period. Table 11-6 lists the typical year annual savings, along with the savings influenced by COVID-19 Era.

Table 11-6 FY 22/23 CRP COVID-19 Era Impact on Ex-Post Gross Energy Savings

Measure	Typical 1st Year Annual Ex-Post kWh Savings (A)	COVID-19 Era Adjusted Annual Ex-Post kWh Savings (B)	COVID-19 Era Incremental Change Ex-Post kWh Savings (B-A)	COVID-19 Era % Change Ex-Post Savings [(B-A)/A]
Attic Insulation	51,555	55,109	3,554	7%
Central Air Conditioner	11,620	12,463	843	7%
Central Heat Pump	8,892	9,306	413	5%
Cool Roof	74,884	80,268	5,384	7%
Dual Pane Windows	18,306	19,308	1,002	5%
Pool Pump and Motor	2,111,333	2,111,333	0	0%
Whole House Fan	744	777	33	4%
Total	**2,277,334**	**2,288,563**	**11,229**	**0.5%**

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 Evaluators performed a summary process evaluation of the program in FY 21/22 and a full process evaluation in FY 20/21.

Key findings of the full process evaluation were:

the FY 20/21 process evaluation were:

- CRP products can substantially affect a household’s energy use (and utility bills) which directly supports Los Angeles as it seeks to improve the quality of housing and reduce household burden.
- 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 recommendations made, detailed in Section A.10.3.1, were to conduct internal reviews forms, provide a way for customers to track rebate process online, and review the payment process.

Detailed findings can be found in Appendix A, Section A.10.3. The key findings from the FY 22/23 summary process evaluation are:

Updates were made to the program incentive process. During FY 22/23 the program updated their incentive processes to ensure fiscal responsibility and be aligned with the program Terms & Conditions (T&C). In late October/early November of 2022, the program started to more carefully scrutinize applications to ensure that all T&Cs were being met. The program is very clear about the importance of T&Cs as the first item in the CRP application “How to Apply” section is to “Read the Terms and Conditions.”

Program staff were cross-trained to facilitate incentive processing times. The cross training addressed an issue of a limited knowledge base for specific measures.

A transition in banks for incentive payment was made. This transition delayed incentive payment for approximately 650 customers.

Overall program satisfaction was reasonably high across the three-year period. Overall satisfaction rates were for 90% for FY 20/21, 81% for FY 21/22, and 82% for FY 22/23. Lower rates for the second two years may have been due to longer incentive processing times due to the high volume of attic insulation rebates.

11.7 Cost Effectiveness Results

Table 11-7 presents benefits, costs, and the results of cost-effectiveness testing for the CRP. Overall, the program was cost effective.

Table 11-7 FY 22/23 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	$2,332,702	$2,332,702	$6,828,183	$2,332,702	$2,332,702
Total Costs	$3,981,438	$3,407,891	$1,441,197	$8,794,877	$3,407,891
Benefit/Cost Ratio	0.59	0.68	4.74	0.27	0.68

11.8 Program Key Findings and Recommendations

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

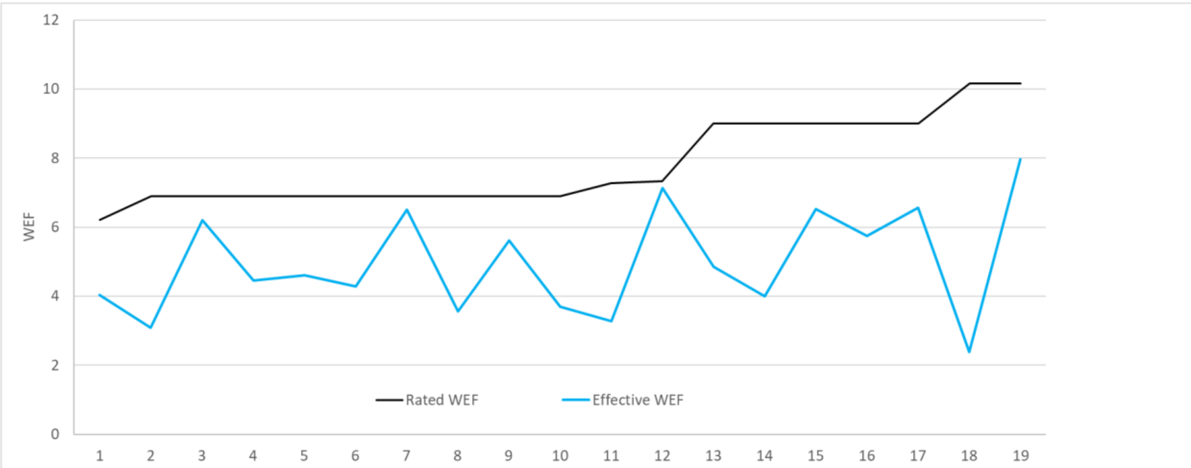
11.8.1 CRP Impact Key Findings and Recommendations

11.8.1.1 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 11-2 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 11-8 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 11-8 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 11-9 CRP Pool Pump Peak Demand Scheduling

Measure	Motor Speed/Flow	n
Operates only night off peak	53%	39
Daytime peak and nights	7%	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 11-10 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%**

11.8.1.2 Cool Roofs

The Los Angeles Municipal code requires low rise residential roof replacements for over 50% of the roof area, to meet minimum SRI values by the roof slope type, effective 11/5/21. The SRI measure bins of 16 and 75 are less than code for roof replacements, and the SRI bins of 20 and 78 just meet or exceed the code requirement. Above code savings increase in the 35 and 85 SRI bins. Recommend for the program to only incentivize roof replacements that exceed the code.

11.8.1.3 Central Air Conditioners

The Ex-Post energy savings were determined by a billing analysis. The site visits included metering of either a central air conditioner (13 sites) or heat pump (2 sites). The results of the metered units during the cooling season from August to October are listed in the table below.

Table 11-11 CRP HVAC Metering

Climate Zone	EFLH cooling_occupants	EFLH cooling_load model	Percent operating only off peak
CZ06	SF	600	1,200
CZ08	SF	49	248
CZ08	SF	54	265
CZ08	SF	532	704
CZ08	SF	776	1,344
CZ08	SF	933	1,433
CZ09	SF	63	1,093

Climate Zone	EFLH cooling_occupants	EFLH cooling_load model	Percent operating only off peak
CZ09	SF	187	783
CZ09	SF	488	1,822
CZ09	SF	546	2,320
CZ09	SF	550	730
CZ09	SF	807	1,921
CZ09	SF	877	1,408
CZ09	SF	1,493	2,758
CZ09	MF	2,063	2,708
Average		**668**	**1,382**

Table 11-11 listed two values for the EFLH, as all of the homes had scheduling either by a smart thermostat or a scheduled thermostat. Some homes reduced hours of use per day, and others reduced whole operating days from running their HVAC. The EFLH cooling load model considers the periods when the outdoor air exceeded the typical threshold (range 62F to 69F), but the HVAC did not operate for 1.8 hours of more. It did not include the time between normal operating cycles. There is some uncertainty in the model when the EFLH was low, as the number of data points per temperature bin were less, as the metering data collection interval was 5 minutes.

The high variation in EFLH between participants will produce variation in energy savings for HVAC measures. The recommendation is for the implementer to utilize billing data for each participant to develop end-use energy usage and estimate an EFLH.

11.8.2 CRP: Process Key Findings and Recommendations

Overall program satisfaction was reasonably high across the three-year period. Overall satisfaction rates were for 90% for FY 20/21, 81% for FY 21/22, and 82% for FY 22/23. Lower rates for the second two years may have been due to longer incentive processing times due to the high volume of attic insulation rebates.

The Evaluator does not have additional recommendations for CRP.

12 Efficient Product Marketplace

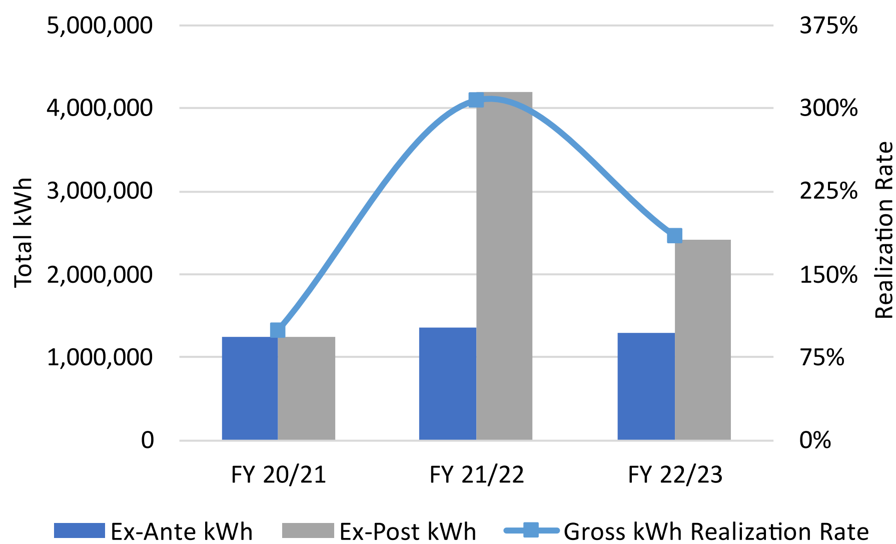
This chapter summarizes the impact and process evaluation of the Efficient Products Marketplace (EPM) that LADWP offered customers during Fiscal Years 20/21 to 22/23 (Concurrent Period).

The primary objective of this evaluation was to calculate energy savings and peak demand reductions attributable to EPM, as well as to perform a process evaluation.

12.1 Program Performance Summary

EPM is an online marketplace for residential customers, offering efficient options including lighting, smart thermostats, advanced power strips, refrigerators, clothes washers, televisions, and room air conditioners. Room air conditioners were also offered in FY 22/23 to income qualified rate plan participants with higher incentives through the Cool LA initiative. Figure 12-1 compares Ex-Ante and Ex-Post energy savings across the Concurrent Period.

Figure 12-1 EPM Performance Summary



12.1.1 Key Evaluation Takeaways

- The overall kWh realization rate was 185% during FY 22/23 and 201% during the Concurrent Period.
- The participant survey identified that LED lamps are still replacing less efficient lighting technology, with a baseline mix of Incandescent 39%/ CFL 30%/ LED 20%/ Halogen 2%/ Unknown 10%.
- The new window air conditioning measure with higher incentives offered by Cool LA, produced a tenfold increase in participation. The enrollment average for the air

conditioner measure was 315 for the past three years, compared to 3,324 enrollments for the Cool LA initiative.

- Customer overall satisfaction was high for each of the three fiscal years. Each year, 94% of customers that received incentives through the program were satisfied with the service overall. Similarly high shares of customers also thought that it was easy to find what they wanted and to complete the instant rebate purchase.

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

Fiscal Year	Measure	Number of Enrollments	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
20/21	Window AC	315	9,790	4.47
	LED Light Bulb	183	2,244	0.25
	Smart Power Strip	58	22,260	4.21
	ES Refrigerator	2,363	119,592	22.63
	ES Television	8	1,176	0.22
	Smart Thermostat	4,941	1,096,003	499.94
	Total	7,868	1,251,065	531.72
21/22	Window AC	274	8,546	9.48
	LED Light Bulb	3,106	69,430	9.28
	Smart Power Strip	31	11,236	2.15
	ES Refrigerator	2,052	105,586	20.22
	ES Television	4	477	0.09
	Smart Thermostat	5,167	1,167,043	1,294.15
	Total	10,634	1,362,318	1,335.38
22/23	Window AC	355	10,778	4.82
	Cool LA AC	3,324	100,019	44.70
	LED Light Bulb	278	5,921	0.69
	Smart Power Strip	66	21,200	3.64
	ES Refrigerator	1,822	89,435	15.34
	ES Television	6	409	0.07

Fiscal Year	Measure	Number of Enrollments	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
	Smart Thermostat	4,786	1,074,061	480.00
	Total	10,637	1,301,823	549.26
3 year Total		**29,139**	**3,915,206**	**2,416.35**

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 informed the 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
Lighting customer installation rates and usage	Participant site visits with light metering

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 is located 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 listed again in this section by energy savings and then by demand savings with discussion of the realization rates.

Ex-Post gross energy savings and their realization rates for each measure are listed in Table 12-3. Although there is a high variability in the realization rates among the measure types, the total program Ex-Post first year savings for FY 22/23 was 2,410,140 kWh with an 185% realization rate, similar to the three year realization rate of 200%.

Table 12-3 EPM kWh Evaluation Results

Fiscal Year	Measure	ESP Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
20/21	Window AC	9,790	45,288	462%
	LED Light Bulb	2,244	35,780	1,594%
	Smart Power Strip	22,260	21,779	98%
	ES Refrigerator	119,592	139,634	117%
	ES Television	1,176	346	30%
	Smart Thermostat	1,096,003	1,003,067	92%
	Total	1,251,065	1,245,894	100%
21/22	Window AC	8,546	32,066	375%
	LED Light Bulb	69,430	2,197,486	3,165%
	Smart Power Strip	11,236	9,683	86%
	ES Refrigerator	105,586	121,029	115%
	ES Television	477	114	24%
	Smart Thermostat	1,167,043	1,832,036	157%
	Total	1,362,318	4,192,414	308%
22/23	Window AC	10,778	26,572	247%
	Cool LA AC	100,019	106,981	107%
	LED Light Bulb	5,921	68,118	1,150%
	Smart Power Strip	21,200	15,998	75%
	ES Refrigerator	89,435	104,003	116%
	ES Television	409	511	125%
	Smart Thermostat	1,074,061	2,087,956	194%
	Total	1,301,823	2,410,140	185%
3 year Total		**3,915,206**	**7,848,448**	**200%**

Table 12-4 presents the measure types and Ex-Post peak kW reduction and Ex-Ante kW along with realization rates. The largest contributor to the peak demand savings are those measures with a cooling load profile, such as the window air conditioner and smart thermostat measures, along with the refrigerator measure operating up to 24 hours per day.

Table 12-4 EPM kW Evaluation Results

Fiscal Year	Measure	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
20/21	Window AC	4.47	20.66	463%
	LED Light Bulb	0.25	3.93	1,594%
	Smart Power Strip	4.21	4.12	98%
	ES Refrigerator	22.63	26.42	117%
	ES Television	0.22	0.07	29%
	Smart Thermostat	499.94	457.55	92%
	Total	**531.72**	**512.74**	**96%**
21/22	Window AC	9.48	35.56	375%
	LED Light Bulb	9.28	293.83	3,165%
	Smart Power Strip	2.15	1.85	86%
	ES Refrigerator	20.22	23.18	115%
	ES Television	0.09	0.02	24%
	Smart Thermostat	1,294.15	2031.57	157%
	Total	**1,335.38**	**2386.02**	**179%**
22/23	Window AC	4.82	11.64	241.8%
	Cool LA AC	44.70	46.12	103.2%
	LED Light Bulb	0.69	8.83	1,273.0%
	Smart Power Strip	3.64	2.10	57.8%
	ES Refrigerator	15.34	16.16	105.3%
	ES Television	0.07	0.08	113.2%
	Smart Thermostat	480.00	919.53	191.6%
	Total	**549.26**	**1,004.46**	**183%**
3 year Total		**2,416.35**	**3,903.23**	**162%**

12.5.1 COVID-19 Impacts on Energy Use

The billing analysis identified any changes in energy usage during COVID-19 Era for various end uses. The measure billing analysis or end use factors were used to develop Table 12-5.

Table 12-5 FY 22/23 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]
Window Air Conditioner	26,572	28,965	2,392	9%
Cool LA Air Conditioner	106,981	114,739	7,758	7%
LED Light Bulb	68,118	70,416	2,298	3%
Smart Power Strip	15,998	16,546	549	3%
ES Refrigerator	104,003	104,003	0	0%
ES Television	511	527	16	3%
Smart Thermostat	2,087,956	2,508,854	420,897	20%
Total	**2,410,140**	**2,844,051**	**433,911**	**18%**

12.6 Process Evaluation

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

- Review of program tracking data
- Interviews with program staff
- Surveys of participating customers

The Evaluators performed a full process evaluation in FY 20/21.

Key findings of the full process evaluation were:

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

to households who own a house as well as products of interest to households who rent like window air conditioners, televisions, or air purifiers. However, 63% of households in Los Angeles rent, but only 30% are taking advantage of rebates through EPM.

The key findings from the FY 21/22 summary process evaluation were:

- 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 equipment were the main reasons customers purchased instant discount measures instead of rebated measures.
- 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.

The key findings of the FY 22/23 summary process evaluation are:

- The rebates and instant discounts were not available through the marketplace website between February and May 2023. The marketplace website was not available because of factors related to the internal process of completing the task order between SCPPA and the website vendor. Paper rebate submissions were processed during this period.
- Two products, clothes washers, and electric heaters were removed from the program during the fiscal year for reasons related to the contract with SCPPA.
- Significantly more window AC units were rebated during FY 22/23 than in the previous year. This increase was due to the Cool LA initiative that provided higher rates for qualified customers.[3]
- Customer overall satisfaction was high for each of the three fiscal years. Each year, 94% of customers that received incentives through the program were satisfied with the service overall. Similarly high shares of customers also thought that it was easy to find what they wanted and to complete the instant rebate purchase.

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

[3] Customers on discount rates qualified for Cool LA incentives (EZ-Save Program, Senior Citizen/Disability Lifeline Rate Program, Life-Support Equipment Discount, and Physician Certified Allowance Discount).

12.7 Cost Effectiveness Results

Table 12-6 presents benefits, costs, and the results of cost-effectiveness testing for the EPM Program. Overall, the program was cost effective.

Table 12-6 FY 22/23 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	$3,662,289	$3,662,289	$5,993,139	$3,662,289	$3,662,289
Total Costs	$3,274,723	$2,034,783	$172,722	$7,855,201	$2,034,783
Benefit/Cost Ratio	1.12	1.80	34.70	0.47	1.80

12.8 Program Key Findings and Recommendations

Since there may be a new program vendor following the conclusions of LADWP's contract with SCPPA, our two recommendations are future looking. In both cases, we recommend that LADWP perform an early, small, assessment of the data provided by the vendor, but with different purposes.

- If a new vendor is chosen to replace the current vendor, we recommend this small assessment occur sometime in the first three months of the vendor starting up an active website to ensure that the new vendor is providing all the data required by any future evaluation team. The required data would include identification of the measures and any necessary specifications to estimate savings, including efficiency and unit size/capacity metrics, the incentive amounts paid, and customer information including account and contact information.
- If the same vendor remains and LADWP adds electrification measures, we recommend that the assessment occur after one or two months of electrification measure data collection and focus on checking the quality of any data required to back up removal of gas equipment.

13 Energy Savings Assistance Program

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

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

13.1 Program Performance Summary

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

13.1.1 Key Evaluation Takeaways

- ESAP performance during FY 20/21 was similar to prior years.
- The overall program realization rate was 62%.
- The last year of implementation for the program was FY 20/21. There were no savings during FY 21/22 and FY 22/23.

13.2 Program Description

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

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

Table 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
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.

13.3 Methodology

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

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

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

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

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

13.4 Impact Evaluation

The Evaluator estimated verified energy savings and peak demand reduction impacts from ESAP for FY 20/21 using a billing analysis methodology which is presented in greater detail in Section A.12.2. The billing analysis steps are summarized below:

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

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

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

13.5 Ex-Post Gross Savings

Table 13-4 summarizes the household-level Ex-Post kWh savings and peak kW reduction for FY 20/21. These values were calculated as part of the billing analysis.

Table 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	62%

The Evaluator verified a total of 1,695,641 kWh energy savings for ESAP across 9,987 participating households. The verified gross realization rate was 62% 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	62%

The Evaluator calculated a total of 204.42 peak kW reduction for ESAP during FY 20/21. The peak kW realization rate was 62% for FY 20/21.

13.5.1 Covid-19 Impact on Energy Use

The method for estimating COVID-19 impacts for ESAP follows the method detailed for billing data regression in Appendix A. Table 13-7 presents the typical first year Gross Ex-Post savings and COVID-19 adjusted Gross Ex-Post savings. For interpretation purposes, the COVID-19 savings are presented as full 12-month annual adjusted savings.

Table 13-7 FY 20/21 ESAP COVID-19 Era Impact to Ex-Post Gross Energy Savings

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

13.6 Process Evaluation

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

13.7 Cost Effectiveness Results

Table 13-8 presents benefits, costs, and the results of cost-effectiveness testing for the ESAP. Overall, the Total Resource Cost (TRC) test indicates there could be areas for improvement to make the program cost effective.

Table 13-8 FY 20/21 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 Home Energy Improvement Program

This chapter presents an evaluation of the Home Energy Improvement Program (HEIP) that LADWP offered customers during Fiscal Year 22/23 (FY 22/23 or Concurrent Year 3).

The primary objective of this evaluation was to calculate energy savings and peak demand reductions attributable to HEIP, as well as to perform a summary process evaluation.

14.1 Program Performance Summary

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.

14.1.1 Key Evaluation Takeaways

- The HEIP overall realization rate was 123% for kWh and 29% for kW
- Most savings adjustments were due to installation rates determined through participant surveys; these installation rates can be used by LADWP going forward.
    - Aerators: 64%
    - Toilets: 95%
    - LEDs: 67%
    - Showerheads: 72%
    - Weather stripping: 96%
- The site visits conducted for the evaluation of this program included installing lighting loggers to a subset of homes. The lighting loggers indicated that the typical HEIP participant used their LED lighting more than deemed DEER estimates. This led to high realization rates for this measure, despite low in-service rates (67%).
- Participant satisfaction with HEIP is high (90% satisfied with the program overall and the individual program components). Additionally, many participants reported non-energy benefits.

14.2 Program Description

The measures offered through the HEIP program is summarized in Table 14-1.

Table 14-1 HEIP Ex-Ante Savings Summary

Measure	Number of Enrollments	Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
AC Window Unit	335	144,175	77.16
LED	18,295	1,498,016	234.23
Pipe wrap	87	7,676	0.29
Toilet	1,038	48,186	7.62
Showerhead	1,263	40,666	17.45
Aerator	372	3,766	2.37
Attic Insulation	158	86,553	91.13
Duct Sealing	98	29,204	15.72
Air Sealing	24	2,208	2.32
Weather Stripping	621	208,494	219.52
Toilet Gasket	66	14,256	0.00
Total	**22,357**	**2,083,200**	**400.24**

LADWP offers HEIP participation to residential customers to improve the energy and water savings performance in their homes. The priority of the HEIP is to serve low income customers but is also provided at no cost to any eligible customers. Trained technicians perform an assessment of the home to identify the most appropriate and effective improvements. Recommendations for energy efficient upgrades and repairs are made, and repair technicians complete the work. A quality assurance review is done on all homes. Table 14-2 below outlines the measures offered in the HEIP during CY 3.

Table 14-2 HEIP Measures

Measure Category	Measures
Building Shell	Blower Door Diagnostic Testing Air Sealing Insulation Door Repair/Replacement Window Repair Weather-stripping
HVAC	Window AC
Plumbing	Low Flow Toilets Low Flow Showerheads Faucet Aerators Hot water pipe wrap Toilet gaskets
Lighting	Interior Energy Efficient Lamp & Fixtures Exterior Energy Efficient Lamps & Fixtures

14.3 Methodology

This section provides a brief summary of the methodology used by the Evaluator in the impact evaluation of the HEIP Program during the Retrospective Period. The following activities were performed:

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

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 in the form of site visits. 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 14-3.

Table 14-3 HEIP 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
Project documents	A sample of participant household documents were reviewed to ensure measure types and counts were documented in the tracking database properly
Site Visits	A sample of participant households were visited to visually verify installation of measures and lighting loggers were placed to calculate participant annual HOU and coincident peak factor

A detailed evaluation methodology for engineering calculations and billing analysis can be found in Appendix A, Section A.13.1.

14.4 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.13.1.

14.5 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 14-4 HEIP Evaluation Results

Measure	Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate	ESP Data Ex-Ante Peak kW Savings	ESP Data Ex-Post Peak kW Savings	Gross Peak kW Realization Rate
AC Window Unit	144,175	176,872	123%	64.43	77.16	120%
LED	1,498,016	1,806,888	121%	175.49	234.23	134%
Pipe wrap	7,676	9,417	123%	0.62	0.29	46%
Toilet	48,186	46,399	96%	3.87	7.62	197%
Showerhead	40,666	106,356	262%	3.26	17.45	535%
Aerator	3,766	14,435	383%	0.30	2.37	785%
Attic Insulation	86,553	106,182	123%	38.68	91.13	236%
Duct Sealing	29,204	35,827	123%	13.05	15.72	120%
Air Sealing	2,208	2,709	123%	0.99	2.32	236%
Weather Stripping	208,494	255,778	123%	93.18	219.52	236%
Toilet Gasket	14,256	0	0%	6.37	0.00	0%
Total	**2,083,200**	**2,560,863**	**123%**	**400.24**	**667.83**	**167%**

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. Site visits were conducted for visual verification of measures that were incentivized. In-service rates were determined through site visits and virtual verification of the measures reported to be installed through project documents. If a customer installed 10 LEDs, but the site visits verified that 8 were installed and functioning, the in-service rate for the LEDs for this project is 80%. ISRs were calculated across all site visits by measure. The in-service rates from visual verification are tabulated in Table 14-5.

Table 14-5 HEIP In-service Rates

Operating Condition	Aerators	Toilets	LEDs	Showerheads	Weather Stripping
ISR	64%	95%	67%	72%	96%
Total Responses	**19**	**17**	**25**	**20**	**15**

The Evaluators reviewed a sample of documents to summarize any discrepancies in measure type or quantity documented between each source. A discrepancy in quantity means that the tracking data displayed a quantity different than the quantity described in project-level HEIP documents. For example, if the tracking data indicated 10 LED measures were installed, but project documents indicated that 8 LED measures were installed, the quantity discrepancy for this project is 80%. The Evaluators provide a summary of the percent quantity discrepancy and total projects reviewed for each measure in Table 14-6. The Evaluators recommend LADWP incorporate additional QA/QC processes to ensure the tracking database matches the project documentation measure types and quantity.

Table 14-6 HEIP Document Review Measure Count Discrepancy

Measure	Quantity Discrepancy	Total Projects Reviewed
AC Window Unit	100%	61
LED	79%	180
Pipe wrap	N/A	N/A
Toilet	92%	22
Showerhead	95%	45
Aerator	102%	27
Attic Insulation	100%	1
Duct Sealing	N/A	N/A
Air Sealing	N/A	N/A
Weather Stripping	91%	33
Toilet Gasket	N/A	N/A

*No project documents were delivered by LADWP

The Evaluators summarize the precision achieved from visual verification during site visits in Table 14-7.

Table 14-7 HEIP Visual Verification Precision

Measure	Population (Unique Households)	Site Visits Achieved (Unique Households)	Population (Units)	Site Visits Achieved (Units)	Precision
AC Window Unit	199	0	335	3	N/A*

Measure	Population (Unique Households)	Site Visits Achieved (Unique Households)	Population (Units)	Site Visits Achieved (Units)	Precision
LED	1,303	25	18,295	402	16.36%
Pipe wrap	58	1	87	1	82.25%
Toilet	556	17	1,038	28	19.73%
Showerhead	634	20	1,130	38	18.18%
Aerator	298	19	625	33	18.42%
Attic Insulation	210	0	97,081	1,604	N/A*
Duct Sealing	93	0	159	0	N/A*
Air Sealing	17	0	37,985	0	N/A*
Weather Stripping	496	15	946	28	21.00%
Toilet Gasket	42	0	59	10	N/A*
Total	**3,906**	**97**	**157,740**	**2,147**	**8.28%**

*Measure was evaluated through billing analysis or no savings verified

Ex-Post gross energy savings and their realization rates for each measure are listed in Table 14-8. Although there is a high variability in the realization rates among the measure types, the total program Ex-Post first year savings of 2,560,863 kWh has a 123% realization rate.

The primary contributor to the high rate is the measure Light Bulb with a 121% realization rate. There is one main factor in the savings algorithm that influenced the annual energy savings. The input to the algorithm for annual hours of operation was higher, as the lighting loggers placed during site visits indicated lighting was used more frequently than DEER deemed inputs assumed. Although the in-service rate for LEDs revealed by site visits was 67%, the increase in annual hours of operation more than offset this savings reduction, leading to a high overall realization rate.

Table 14-8 HEIP kWh Evaluation Results

Measure	Quantity	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross Realization Rate
AC Window Unit	335	144,175	176,872	123%
LED	18,295	1,498,016	1,806,888	121%
Pipe wrap	87	7,676	9,417	123%
Toilet	1,038	48,186	46,399	96%
Showerhead	1,263	40,666	106,356	262%
Aerator	372	3,766	14,435	383%
Attic Insulation	158	86,553	106,182	123%
Duct Sealing	98	29,204	35,827	123%

Measure	Quantity	ESP Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross Realization Rate
Air Sealing	24	2,208	2,709	123%
Weather Stripping	621	208,494	255,778	123%
Toilet Gasket	66	14,256	0	0%
Total	**22,357**	**2,083,200**	**2,560,863**	**123%**

Table 14-9 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 14-9 HEIP kW Evaluation Results

Measure	Quantity	ESP Data Ex-Ante kW Savings	ESP Data Ex-Post Gross kW Savings	Gross Realization Rate
AC Window Unit	335	64.43	77.16	120%
LED	18,295	175.49	234.23	134%
Pipe wrap	87	0.62	0.29	46%
Toilet	1,038	3.87	7.62	197%
Showerhead	1,263	3.26	17.45	535%
Aerator	372	0.30	2.37	785%
Attic Insulation	158	38.68	91.13	236%
Duct Sealing	98	13.05	15.72	120%
Air Sealing	24	0.99	2.32	236%
Weather Stripping	621	93.18	219.52	236%
Toilet Gasket	66	6.37	0.00	0%
Total	**22,357**	**400.24**	**667.83**	**167%**

14.5.1 COVID-19 Impacts on Energy Use

The billing analysis identified savings for the post COVID-19 Era, based on higher usage of the home for the LED measure. Also, the billing analysis developed end-use factors that were applied to the other measures as part of the engineering analysis. In the retrospective period (FY 15/16 through FY 20/21), the COVID-19 % change in Ex-Post Savings was -61.3%. Therefore, it seems as though HEIP customers have gradually increased energy usage of these measures with respect to pre-COVID-19 energy usage, which has led to an increase in measure-level savings due to COVID-19 effects.

Table 14-10 FY 22/23 HEIP 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]
LED	1,806,888	2,012,327	205,438	11%
Toilet	46,399	48,181	1,782	4%
Showerhead	106,356	110,440	4,084	4%
Aerator	14,435	14,989	554	4%
Toilet Gasket	0	0	0	-
Total	**1,974,078**	**2,185,936**	**211,858**	**11%**

14.6 Process Evaluation

The full process evaluation of FY 22/23 focused on hearing about the program from the LADWP project managers and providing feedback to LADWP from HEIP participants. The FY 21/22 process evaluation included a detailed review of the program design and processes, but there were too few participants to complete a survey of them that year. The Evaluator included material from the FY 21/22 evaluation on the program design and operations in this evaluation report for comprehensiveness.

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

Key findings of the full process evaluation were:

- **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. The program increased their staffing during FY 22/23 with four additional staff to process applications and keep up with the level of work. Two new leads are also being added to the program to help oversee and instruct the work.
- **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.
- **Program satisfaction is high.** About 90% of HEIP customers indicate being very satisfied or satisfied with the program overall and components such as the work

done by the LADPW or scheduling the work. While overall, only three customers were dissatisfied, these few comments received pointed to poor quality products, inadequate solutions, and lack of notification.

- **Many respondents reported non-energy benefits from participating in HEIP.** Many of the HEIP respondents felt that their home was less drafty after HEIP installed measures in their homes. About equal number felt their home was safer after receiving either carbon monoxide or smoke alarms. (See the call out box in the next section for an example). Additionally, many felt that the measures helped the home feel warmer.
- **Renter participation is lower than the population generally.** While the program is open to renters, few are participating.

Detailed process evaluation findings can be found in Appendix A, Section A.13.4.

14.7 Cost Effectiveness Results

Table 14-11 presents benefits, costs, and the results of cost-effectiveness testing for the HEIP Program. Overall, the Total Resource Cost (TRC) test indicates there could be areas for improvement to make the program cost effective.

Table 14-11 FY 22/23 HEIP 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	$3,573,100	$3,573,100	$7,603,968	$3,573,100	$3,573,100
Total Costs	$11,156,757	$11,127,069	$557,207	$18,173,830	$11,127,069
Benefit/Cost Ratio	0.32	0.32	13.65	0.20	0.32

14.8 Program Key Findings and Recommendations

Since there may be a new program vendor, our two recommendations are future looking. In both cases, we recommend that LADWP perform an early, small, assessment of the data provided by the vendor, but with different purposes.

- If a new vendor is chosen to replace the current vendor, we recommend this small assessment occur sometime in the first three months of the vendor starting up an active website to ensure that the new vendor is providing all the data required by any future evaluation team.
- If the same vendor remains and LADWP adds electrification measures, we recommend that the assessment occur after one or two months of electrification measure data collection and focus on checking the quality of any data required to back up removal of gas equipment.

The Evaluators provide three impact-related recommendations for the program.

- For future program years, remove claimed savings for toilet gaskets. The Evaluators were unable to qualify deemed savings for this measure from appropriate workpapers.
- The Evaluators found that program documents and project installation records are not documented for air sealing projects. The Evaluators recommend that appropriate documentation is requested and stored for these projects to appropriately verify savings in future evaluations.
- The Evaluators found discrepancies between the tracking database measure quantities and the project document quantities. The Evaluators recommend additional QA/QC efforts are conducted by LADWP program staff to ensure correct tracking of project details and savings.

15 Low Income Refrigerator Exchange Program

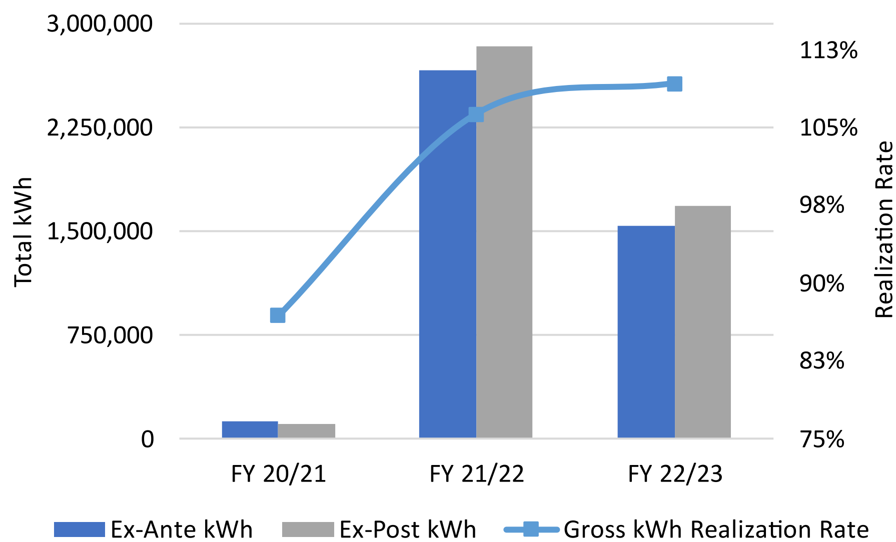
This chapter summarizes the impact and process evaluation of the Refrigerator Exchange Program (REP) that LADWP offered customers during Fiscal Years 20/21 to 22/23 (Concurrent Period). The REP Program was administered by LADWP with implementation services provided by ARCA, Inc. (ARCA).

The primary objective of this evaluation was to calculate energy savings and peak demand reductions attributable to REP, as well as to perform a summary process evaluation.

15.1 Program Performance Summary

REP targets low income customers and replaces old, operable refrigerators in their homes with new ENERGY STAR-rated units. Once replaced, 95% of the materials from the removed refrigerator are recycled. This prevents the resale of old, inefficient units in the secondary market. Figure 15-1 compares Ex-Ante and Ex-Post energy savings across the Concurrent Period.

Figure 15-1 REP Performance Summary



15.1.1 Key Evaluation Takeaways

- REP saw a substantial decrease in program activity in FY 22/23 compared to FY 21/22, which can be attributed to service issues related to the program implementation service provider.
- The overall kWh realization rate was 109% during FY 22/23 and 107% during the Concurrent Period.

- The program continued to be affected by challenges in sourcing replacement refrigerators. The program is exploring diversifying brands to increase supply of replacement units.
- Overall satisfaction was at or near 100% for both institutional and residential participants in FY 21/22 and FY 22/23.

15.2 Program Description

LADWP's REP Program is designed to help customers reduce their energy consumption by removing old, working refrigerators from their homes to recycle them, and providing a new ENERGY STAR 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 17.

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

Table 15-1 REP Ex-Ante Savings Summary

Fiscal Year	Number of Units	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	152	121,954	34.30
FY 21/22	3,341	2,671,812	511.73
FY 22/23	1,952	1,537,854	263.83
Total	**5,445**	**4,331,620**	**809.87**

15.3 Methodology

This section provides an overview of the methodology used by the Evaluator in the impact evaluation of the REP Program during FY 22/23. The following activities were performed:

- Tracking data review;

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

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

15.4 Impact Evaluation

This section presents an overview of the impact evaluation of the REP during FY 22/23. 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 15-2 summarizes the full year UEC estimate for refrigerators during FY 22/23.

Table 15-2 REP Full Year Average UEC Estimates

Appliance Type	Average Full Year UEC
Refrigerator	1,200

Per-unit gross peak demand reduction for refrigerators for FY 22/23 is presented in Table 15-3.

Table 15-3 REP Per-Unit kW Reduction

Appliance Type	Per-unit kW Reduction
Refrigerator	0.10

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

15.5 Ex-Post Gross Savings

This section presents program-level Ex-Post gross energy savings and demand reduction for the Concurrent Period. Table 15-4 and Table 15-5 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 15-4 REP kWh Evaluation Results

Fiscal Year	Quantity	ESP Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross Realization Rate
20/21	152	121,954	105,988	87%
21/22	3,341	2,671,812	2,841,247	106%
22/23	1,952	1,537,854	1,680,724	109%
Total	**5,445**	**4,331,620**	**4,627,959**	**107%**

Table 15-5 REP kW Evaluation Results

Measure	Quantity	ESP Data Ex-Ante kW Savings	ESP Data Ex-Post kW Savings	Gross Realization Rate
20/21	152	34.30	29.81	87%
21/22	3,341	511.73	544.18	106%
22/23	1,952	263.83	261.11	99%
Total	**5,445**	**809.87**	**835.11**	**103%**

15.5.1 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 for 8,760 annual hours.

15.6 Process Evaluation

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

- An interview with program staff
- Surveys of participating residential and institutional customers

The Evaluator performed a full process evaluation in FY 21/22.

Key findings of the full process evaluation were:

- **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 to institutional participants and postcard 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 capture key appliance attributes.** The program data capture 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.

The key findings of the FY 22/23 summary process evaluation are:

- **Program staff noted that continued disruption in the supply of new refrigerators remained an issue throughout the program year.** Because of these disruptions, the program did not market the program using its most effective tactic – a postcard campaign. As a result, participation was likely less than could have otherwise been achieved. Staff noted that they are looking to diversify the number of manufacturers of new refrigerators to try to mitigate the risk of supply disruptions.
- **A comparison of key metrics based on participant survey results demonstrate that customers remain satisfied with the program and that the quality of customer service remains high**. Overall satisfaction was at or near 100% for both institutional and residential participants in FY 21/22 and FY 22/23.

Detailed process evaluation findings can be found in Appendix A, Section A.14.3.

15.7 Cost Effectiveness Results

Table 15-6 presents benefits, costs, and the results of cost-effectiveness testing for the REP. Overall, the program was cost effective.

Table 15-6 FY 22/23 REP Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$1,724,531	$1,724,531	$5,796,103	$1,724,531	$1,724,531
Total Costs	$2,052,039	$733,365	$37,088	$6,492,381	$733,365
Benefit/Cost Ratio	0.84	2.35	156.28	0.27	2.35

15.8 Program Key Findings and Recommendations

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

16 Refrigerator Turn-in and Recycle Program

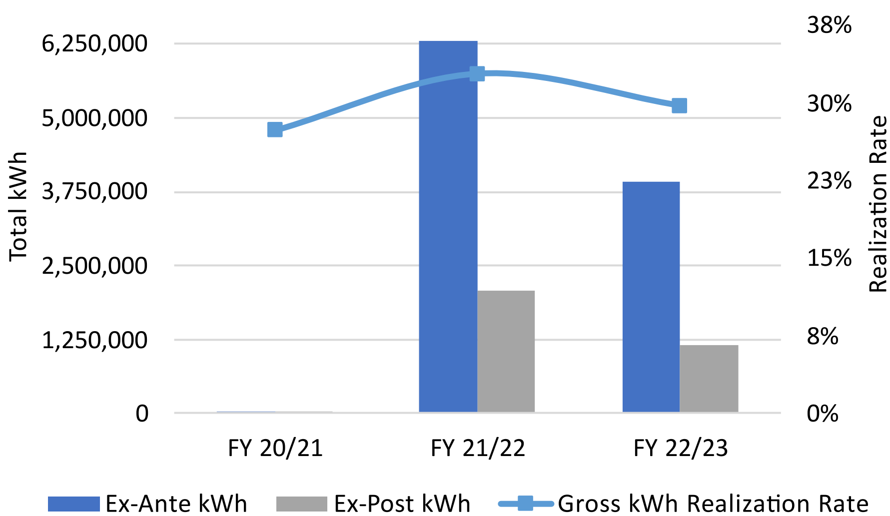
This chapter presents an evaluation of the Refrigerator Turn-in and Recycle Program (RETIRE) that LADWP offered customers during Fiscal Years 20/21 to 22/23 (Concurrent Period). The RETIRE Program was administered by LADWP with implementation services provided by ARCA, Inc. (ARCA).

The primary objective of this evaluation was to calculate energy savings and peak demand reductions attributable to RETIRE, as well as to perform a summary process evaluation.

16.1 Program Performance Summary

RETIRE provides incentives for LADWP residential customers to recycle and dispose of older, operable refrigerators in an environmentally conscientious manner. Units include older models that customers are replacing with a new unit as well as secondary refrigerators, stand-alone freezers, and window air conditioners. Figure 16-1 compares Ex-Ante and Ex-Post energy savings across the Concurrent Period.

Figure 16-1 RETIRE Program Performance Summary



16.1.1 Key Evaluation Takeaways

- The RETIRE Program saw a substantial decrease in program activity in FY 22/23 compared to FY 21/22, which can be attributed to service issues related to the program implementation service provider.
- The overall kWh realization rate was 30% during FY 22/23 and 32% during the Concurrent Period.
- There were not any changes to the design, or scheduling procedures. Although the pickup procedures remained the same, the implementation contractor has

developed some capacity for completing pickups without the use of a third-party contractor.

- Overall program satisfaction was 99% in FY 21/22 and 98% in FY 22/23.

16.2 Program Description

LADWP's RETIRE Program is designed to help customers reduce their energy consumption by removing old, working refrigerators, freezers, and window air conditioners 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 $60 rebate for each refrigerator/freezer unit, and $25 for window air conditioners. By offering financial incentives and free pick up services, LADWP seeks to remove unnecessary secondary units, prevent the continued use of older appliances as secondary units after new primary units are purchased, and prevent older units from being resold or transferred to other LADWP customers when no longer needed in the participant home.

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

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

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

Table 16-1 presents ESP summary savings for the RETIRE Program Concurrent Evaluation.

Table 16-1 RETIRE Ex-Ante Savings Summary

Fiscal Year	Measure	Number of Projects	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
20/21	Air Conditioner	0	0	0.00

Fiscal Year	Measure	Number of Projects	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
	Freezer	0	0	0.00
	Refrigerator	6	11,676	3.28
20/21 Total		6	11,676	3.28
21/22	Air Conditioner	75	3,164	3.50
	Freezer	124	241,304	46.22
	Refrigerator	3,115	6,061,790	1,161.02
21/22 Total		3,314	6,306,258	1,210.74
22/23	Air Conditioner	54	2,284	1.02
	Freezer	68	132,328	22.70
	Refrigerator	1,940	3,775,240	647.67
22/23 Total		2,062	3,909,852	671.40
Total		**5,382**	**10,227,786**	**1,885.42**

16.3 Methodology

This section provides an overview of the methodology used by the Evaluator in the impact evaluation of the RETIRE Program during FY 22/23. The following activities were performed:

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

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

16.4 Impact Evaluation

This section presents an overview of the impact evaluation of the RETIRE Program during FY 22/23. 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 16-2 summarizes the full year UEC estimate for refrigerators during FY 22/23.

Table 16-2 RETIRE Full Year Average UEC Estimates

Appliance Type	Average Full Year UEC
Freezer	1,069
Refrigerator	1,200

Table 16-3 summarizes the part-use UEC estimate for refrigerators during FY 22/23.

Table 16-3 RETIRE Part-use Average UEC Estimates

Appliance Type	Average Full Year UEC
Freezer	909
Refrigerator	593

Per-unit gross peak demand reduction for refrigerators for FY 22/23 is presented in Table 16-4.

Table 16-4 RETIRE Per-Unit kW Reduction

Appliance Type	Per-unit kW Reduction
Freezer	0.11
Refrigerator	0.07

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

16.5 Ex-Post Gross Savings

This section presents program-level Ex-Post gross energy savings and demand reduction by fiscal year. Table 16-5 and Table 16-6 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 16-5 RETIRE kWh Evaluation Results

Fiscal Year	Measure	Quantity	ESP Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross Realization Rate
20/21	Air Conditioner	0	0	0	N/A
	Freezer	0	0	0	N/A
	Refrigerator	6	11,676	3,193	27%
20/21 Total		6	11,676	3,193	27%
21/22	Air Conditioner	75	3,164	34,479	>100%
	Freezer	124	241,304	81,058	34%
	Refrigerator	3,115	6,061,790	1,954,324	32%
21/22 Total		3,314	6,306,258	2,069,861	33%
22/23	Air Conditioner	54	2,284	24,122	>100%

Fiscal Year	Measure	Quantity	ESP Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross Realization Rate
	Freezer	68	132,328	61,783	47%
	Refrigerator	1,940	3,775,240	1,077,541	29%
22/23 Total		2,062	3,909,852	1,163,446	30%
Total		**5,382**	**10,227,786**	**3,236,500**	**32%**

Table 16-6 RETIRE kW Evaluation Results

Fiscal Year	Measure	Quantity	ESP Data Ex-Ante kW Savings	ESP Data Ex-Post kW Savings	Gross Realization Rate
20/21	Air Conditioner	0	0.00	0.00	N/A
	Freezer	0	0.00	0.00	N/A
	Refrigerator	6	3.28	0.90	27%
20/21 Total		6	3.28	0.90	27%
21/22	Air Conditioner	75	3.50	38.23	>100%
	Freezer	124	46.22	15.52	34%
	Refrigerator	3,115	1,161.02	374.31	32%
21/22 Total		3,314	1,210.74	428.07	35%
22/23	Air Conditioner	54	1.02	10.42	>100%
	Freezer	68	22.70	9.89	44%
	Refrigerator	1,940	647.67	167.40	26%
22/23 Total		2,062	671.40	187.72	28%
Total		**5,382**	**1,885.42**	**616.69**	**33%**

16.5.1 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. The method for estimating COVID-19 impacts for RETIRE for Room Air Conditioners follows the method detailed for billing data retrofit isolation in Section 11.5.2. COVID-19 impacts for Room ACs were calculated using FY 21/22 typical 1st year Ex-Post gross kWh savings as reference.

Table 16-7 FY 22/23 RETIRE 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	24,122	15,921	-8,201	-34%

16.6 Process Evaluation

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

- An interview with program staff
- Surveys of participating customers

The Evaluators performed a full process evaluation in FY 21/22.

Key findings of the full process evaluation were:

- **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.
- **Postcard 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% though that the pickup crews were professional.

- **RETIRE and EPM are cross-promoted and a sizable share of RETIRE participants also participated in EPM during FY 21/22.** 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 the pick-up crew did not check that the unit was working.
- **Program data capture 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 key findings of the FY 22/23 summary process evaluation are:

- **Overall, the program design and implementation approach did not change in FY 22/23.** There were not any changes to the design, or scheduling procedures. Although the pickup procedures remained the same, the implementation contractor has developed some capacity for completing pickups without the use of a third-party contractor. This change led to an increase in pickups during the year, which was impacted by a change in ownership of the implementation contractor.
- **A comparison of key metrics based on participant survey results demonstrate that customers remain satisfied with the program and that the quality of customer service remains high.** Overall program satisfaction was 99% in FY 21/22 and 98% in FY 22/23.

A detailed process evaluation findings can be found in Appendix A, Section A.14.3.

16.7 Cost Effectiveness Results

Table 16-8 presents benefits, costs, and the results of cost-effectiveness testing for the RETIRE Program. Overall, the program was cost effective.

Table 16-8 FY 22/23 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	$433,385	$433,385	$1,380,046	$433,385	$433,385

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Costs	$611,411	$668,814	$179,233	$1,869,626	$668,814
Benefit/Cost Ratio	0.71	0.65	7.70	0.23	0.65

16.8 Program Key Findings and Recommendations

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

17 Residential Lighting Efficiency Program

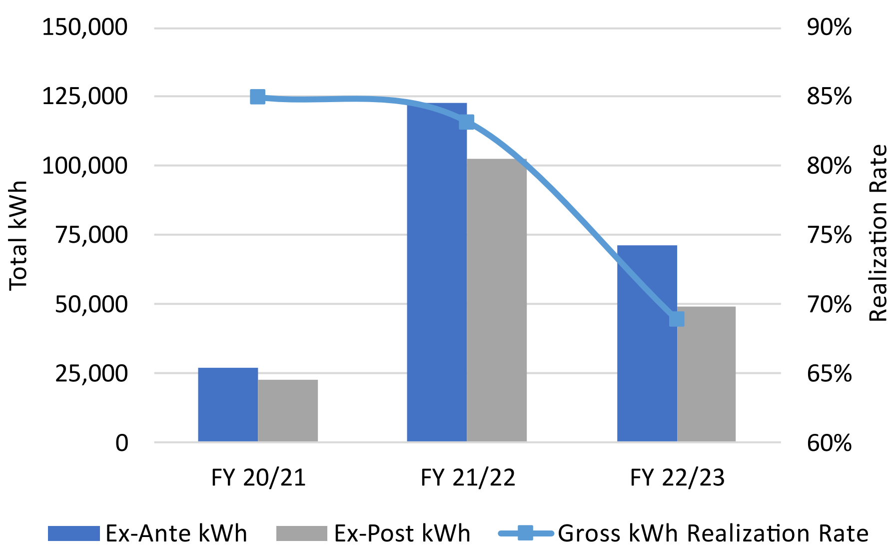
This chapter summarizes the impact and process evaluation of the Residential Lighting Efficiency Program (RLEP) that LADWP offered customers during Fiscal Years 20/21 to 22/23 (Concurrent Period).

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

17.1 Program Performance Summary

RLEP is designed to distribute free LED bulbs in a cost effective way and to deliver energy efficiency directly to all LADWP residential customers, both in single family and multifamily homes. LADWP has distributed free LED bulbs to all its customers in each of three major campaigns. LED bulb kits are also distributed for free through the ESAP, LIREP, and RETIRE Program, and other community outreach events. During the FY 22/23 period, the program focused delivering LED bulbs in conjunction with refrigerator exchanges. Figure 17-1 compares Ex-Ante and Ex-Post energy savings across the Concurrent Period.

Figure 17-1 RLEP Program Performance Summary



17.1.1 Key Evaluation Takeaways

- The overall kWh realization rate was 69% during FY 22/23 and 79% during the Concurrent Period.
- In FY 22/23, all LED lighting kits were distributed along with REP and RETIRE refrigerator deliveries.

- RLEP has reached its full potential and is complete; future RLEP offerings with GSL lighting would generate greatly reduced energy savings as the baseline mix of incandescent/halogen/CFL/LED lamps migrates to 100% LED.

17.2 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 17-1 RLEP Program Ex-Ante Savings

Fiscal Year	Number of LED Kits	Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	777	26,954	2.96
FY 21/22	3,533	122,996	16.45
FY 22/23	2,055	71,287	8.35
Total	**6,365**	**221,237**	**27.76**

17.3 Methodology

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

The LED lamp metering study completed in 2023 for the EPM and HEIP programs was leveraged for the savings algorithm input of annual usage hours. The baseline wattage was weighted by the responses from the 2019 California Statewide Residential Appliance Saturation Study for the LADWP service territory. The waste heat interactive factors were weighted for the types of residences and climate zone in the service territory, as participants were not tracked. A detailed evaluation methodology and impact evaluation can be found in Appendix A, Section A.16.2.

17.4 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 HOU for annual hours of use was leveraged from the LED GSL lamp metering study with a value of 779 hours. The remaining useful life was estimated with 1/3 the useful life of each type of lamp in the base mix, divided by the HOU. After this period, the baseline shifts to a normal replacement base wattage. Data from the CA Modern Appliance Database filtered for JA8 standard compliance, A-lamp shape, omnidirectional estimated a baseline wattage of 18. These lamps all exceed the CA Title 20 GSL requirement of 45 lumens/watt. The 2021 General Population Survey indicated an installation rate of 75%. The Uniform Methods Project for lighting lists a method to estimate the additional lamps that shift from storage to installation over a three year period. When applied to the initial ISR, the 3rd year ISR increases to 86%. Gross energy savings and peak demand for the program were calculated using the following equations, respectively:

kWh_early replacement =

$$Kits\ x \frac{Lamps}{Kit} x\left(watt_{baseER}\ -\ watt_{eff}\right) x \frac{1000W}{kW}\ x\ HOU\ x\ ISR_{3year}$$ *Equation 17-1*

kWh_normal replacement =

$$Kits\ x \frac{Lamps}{Kit} x\left(watt_{baseNR}\ -\ watt_{eff}\right) x \frac{1000W}{kW}\ x\ HOU\ x\ ISR_{3\ year}$$ *Equation 17-2*

$$kW = \frac{kWh_{savings}}{HOU}\ x\ CF$$ *Equation 17-3*

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

Table 17-2 RLEP Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
$Kits$	Quantity verified in tracking data to ESP data	RLEP tracking data	Variable
$Lamps/kit$	LED lamps per kit	RLEP tracking data	2
HOU	Annual Hours of use	ADM 2023 LED bulb residential metering study	HOU: 779 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, GSL A-lamps, 1000-1350 lumens	18 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)
ISR_{3year}	In Service Rate, first 3 year average	Uniform Methods Project, lighting	86%
CF	Coincident Factor	ADM 2023 LED bulb residential metering study	0.0796
RUL	Remaining Useful life	1/3 x EUL of weighted baseline lamp mix/HOU	3.4 years
EUL	Effective Useful Life	DEER Resources, max EUL	15 years

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

17.5 Ex-Post Gross Savings

Table 17-3 summarizes the FY 22/23 gross kWh realization rate for the RLEP by delivery channel. Table 17-4 shows the overall kWh and peak kW realization rate for the program during FY 22/23.

Table 17-3 RLEP kWh Evaluation Results

Delivery Channel	Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
Deliveries with Refrigerators	67,818	46,744	69%
Grantee distribution	3,469	2,391	69%
Total	**71,287**	**49,135**	**69%**

Table 17-4 RLEP kW Evaluation Results

Delivery Channel	ESP Data Ex-Ante kW Savings	ESP Data Ex-Post kW Savings	Gross kW Realization Rate
Deliveries with Refrigerators	7.94	6.03	76%
Grantee distribution	0.41	0.31	76%
Total	**8.35**	**6.37**	**76%**

17.5.1 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 1.04 for the non-weather load, which includes the lighting end-use. The factor was applied to the hours of use, resulting in the savings values in Table 17-5.

Table 17-5 FY 22/23 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	49,135	51,090	1,955	4%

17.6 Process Evaluation

A process evaluation was not completed for FY 22/23 because the door-to-door delivery of LEDs remained suspended. The findings from the summary process evaluation completed in FY 21/22 were:

- Door to door distribution has been on hold since 2020.
- 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.

RLEP has continued to distribute LEDs at events and through the REP.

- 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. Events during February 2023 handed out 100 kits (for 200 lamps and an estimated 3,622 kWh savings).
- 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 2022 through June 2023, REP handed out 1,955 kits (for 3,910 lamps and an estimated 45,512 kWh in savings).

17.7 Cost-Effectiveness Results

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

Table 17-6 FY 22/23 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	$47,266	$47,266	$142,067	$47,266	$47,266
Total Costs	$6,324	$939	$0	$143,007	$939
Benefit/Cost Ratio	7.47	50.31	0.00	0.33	50.31

17.8 Program Key Findings and Recommendations

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. The lifetime energy savings for LED bulbs has a mid-life baseline shift; the normal replacement baseline lamp must be compliant to CA Title 20 after the remaining useful life (RUL) of the existing baseline lamp expires. The RUL was determined by an estimate of the mix of incandescent lamps, CFL and LED from survey responses, proportioned to the annual hours of use. The survey responses were obtained in LADWP service territory from the 2019 Residential Appliance Saturation Study (2019 RASS). The mid-life baseline shift with baseline wattage was determined using the CA Modern Appliance Database for GSL lamp certification.

18 Air Conditioning Optimization Program

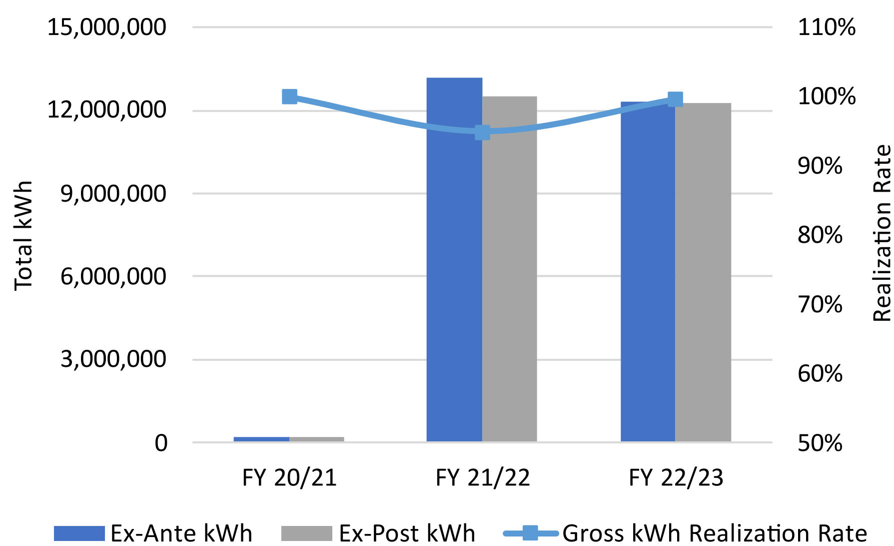
This chapter summarizes the impact and process evaluation of the Air Conditioning Optimization Program that LADWP offered customers during Fiscal Years 20/21 to 22/23 (Concurrent Period).

The primary objective of this evaluation was to calculate energy savings and peak demand reductions attributable to ACOP, as well as to perform a summary process evaluation.

18.1 Program Performance Summary

ACOP is a cross-sector program that provides incentives for heating and cooling system tune-ups, replacements, and installation of system controls that reduce energy use through reduction of systems' dehumidification process. Figure 18-1 compares Ex-Ante and Ex-Post energy savings across the Concurrent Period.

Figure 18-1 ACOP Performance Summary



18.1.1 Key Evaluation Takeaways

- ACOP has returned to a pre-pandemic level of program activity.
- The overall kWh realization rate was 100% during FY 22/23 and 97% during the Concurrent Period.
- Program savings were somewhat lower, possibly because of cooler and wet spring period. Staff noted that while the heat pump electrification component was working well, changes in efficiency standards decreased the availability of the units.

18.2 Program Description

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

Free of charge services offered include:

- Replacement or cleaning of standard air filters;
- Outdoor coil cleaning;
- System diagnostic test;
- Refrigerant charge adjustment (up to 2 lbs. of refrigerant will be provided, if applicable); 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 18-1 summarizes the ACOP Ex-Ante energy savings and peak demand reduction for FY 21/22.

Table 18-1 ACOP Ex-Ante Savings Summary

Fiscal Year	Number of Projects	ESP Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings
FY 20/21	1,829	199,741	57.12
FY 21/22	33,053	13,175,749	9,452.03
FY 22/23	27,631	12,336,807	5,429.64
Total	**62,513**	**25,712,297**	**14,938.78**

18.3 Methodology and Impact Evaluation

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

- Tracking Data Review
    - The Evaluator reviewed available program data and counted the total number of unique measures completed in FY 22/23. 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.

18.4 Ex-Post Gross Savings

Table 18-2 summarizes the measure-level per-unit Ex-Post kWh savings and peak kW reduction for FY 20/21, 21/22, and 22/23.

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

Fiscal Year	Measure	Per-unit Ex-Post kWh Savings	Per-unit Ex-Post Peak kW Savings
20/21	Commercial	109	0.03
	Multi-Residential	73	0.03
	Single Family	118	0.05
	Mobile Home	-	-
21/22	Commercial	855	0.24
	Multi-Residential	345	0.2
	Single Family	480	0.35
	Mobile Home	480	0.35
22/23	Commercial	971	0.15
	Multi-Residential	411	0.18
	Single Family	601	0.27
	Mobile Home	601	0.27
Total		**400**	**0.20**

The Evaluator extrapolated the above measure-level energy and demand savings with the total number of unique measures presented in the program tracking data. Table 18-3 summarizes the program-level ESP Ex-Ante and Ex-Post energy savings for FY 20/21, 21/22, and 22/23.

Table 18-3 ACOP kWh Evaluation Results

Fiscal Year	Measure	Quantity	Ex-Ante kWh Savings	Ex-Post Gross kWh Savings	Gross Realization Rate
20/21	Commercial	1467	159,993	159,993	100%
	Multi-Residential	68	4,989	4,989	100%
	Single Family	294	34,759	34,759	100%
	Mobile Home	0	0	0	-
21/22	Commercial	446	415,628	381,251	92%
	Multi-Residential	25,991	9,548,318	8,955,573	94%
	Single Family	6,583	3,201,383	3,158,504	99%
	Mobile Home	33	10,420	15,833	152%
22/23	Commercial	247	308,662	239,830	78%
	Multi-Residential	23,119	9,728,201	9,490,722	98%
	Single Family	4,142	2,247,150	2,490,585	111%
	Mobile Home	123	52,794	73,960	140%
Total		**62,513**	**25,712,296**	**25,005,999**	**97%**

Table 18-4 summarizes the program-level Ex-Ante and Ex-Post peak demand savings for FY 20/21, 21/22, and 22/23.

Table 18-4 ACOP kW Evaluation Results

Fiscal Year	Measure	Quantity	ESP Ex-Ante Peak kW Savings	Ex-Post Gross Peak kW Savings	Gross Realization Rate
20/21	Commercial	1467	39.31	39.31	100%
	Multi-Residential	68	1.97	1.97	100%
	Single Family	294	15.83	15.83	100%
	Mobile Home	0	0	0	-
21/22	Commercial	446	124.07	112.7	91%
	Multi-Residential	25,991	5,795.34	5,439.00	94%
	Single Family	6,583	3,521.06	3,473.83	99%
	Mobile Home	33	11.56	17.56	152%
22/23	Commercial	247	61.97	48.15	78%
	Multi-Residential	23,119	4,345.09	3,728.73	86%
	Single Family	4,142	998.99	1,107.22	111%
	Mobile Home	123	23.58	33.04	140%
Total		**62,513**	**14,938.78**	**14,017.33**	**94%**

18.4.1 COVID-19 Impacts on Energy Use

The billing analysis approach used to calculate COVID-19 impacts for ACOP is found in Appendix A, Section A.17.1.4. Table 18-5 presents the COVID-19 Impacts to ACOP energy savings.

Table 18-5 FY 22/23 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	255,368	239,830	-15,538	-6.08%
Multifamily	8,909,528	9,490,722	581,194	6.52%
Single Family	2,336,341	2,490,585	154,244	6.60%
Mobile Home	69,380	73,960	4,580	6.60%
Total	**19,969,689**	**25,014,447**	**5,044,758**	**25%**

18.5 Process Evaluation

The Evaluator completed a summary process evaluation in FY 22/23 of the ACOP based on an interview with LADWP staff.

The Evaluator performed a full process evaluation in FY 21/22. The key findings of the full process evaluation were:

- **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.

The key findings of the FY 22/23 summary process evaluation are presented below. A detailed process evaluation can be found in Appendix A, Section A.17.2.

- **LADWP staff noted that program savings were down somewhat from FY 21/22 in FY 22/23.** While it is difficult to discern the exact reason for the change in performance, LADWP staff suggested that the wet winter and spring period may have lessened participation in the program. Staff thought that the heat pump electrification component had performed pretty well but noted that the change in efficiency standards (i.e., the new SEER2 standards) had made it more difficult to get heat pumps.
- **Program marketing approaches remained largely the same.** A mailing effort was made in FY 22/23 to recruit additional multifamily properties.

18.6 Cost Effectiveness Results

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

Table 18-6 FY 22/23 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	$9,877,593	$9,877,593	$26,303,045	$9,877,593	$9,877,593
Total Costs	$21,059,285	$9,618,322	$1,624,957	$34,296,409	$9,618,322
Benefit/Cost Ratio	0.47	1.03	16.19	0.29	1.03

18.7 Program Key Findings and Recommendations

In general, there is a large discrepancy between Tracking Ex-Ante and ESP Portfolio Ex 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 be 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 Evaluator does not have any additional recommendations based on the summary process evaluation performed during FY 22/23.

19 California Advanced Homes Program

This chapter presents a summary of the California Advanced Homes Program (CAHP) that LADWP offered customers during Fiscal Years 21/22 to 22/23 (Concurrent Period).

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

19.1 Program Description

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

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

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

Table 19-1 CAHP Incentives for Multifamily Low-rise

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

For multifamily high-rise projects (four stories or more), the minimum baseline qualification is 10 percent above 2016 Title 24 building code, with increasing incentives for 15 percent, 20 percent, and 30 percent or more above 2016 Title 24 building code; see Table 19-2.

Table 19-2 CAHP Incentives for Multifamily High-rise

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

Table 19-3 summarizes the CAHP Ex-Ante energy savings and peak demand reduction for FY 21/22.

Table 19-3 CAHP Ex-Ante Savings Summary

Fiscal Year	Measure	Ex-Ante kWh Savings	Ex-Ante Peak kW Savings
20/21	Appliances	85	0.02
	Heating & Cooling	16,042	6.76
	New Construction	40,359	6.77
20/21 Total		56,486	13.55
21/22	Appliances	5,855	0.69
	HVAC Cooling	7,917	1.30
	HVAC Heating	1,745	0.00
	Water Irrigation	-369	-0.05
	Whole Building	31,766	4.30
21/22 Total		46,914	6.24
22/23	Appliances	16	0.00
	Domestic Hot Water	125	0.01
	Indoor Fan	523	0.23
	Pump	-369	-0.06
	New Construction	137,242	21.40
	HVAC Cooling	8,377	3.74
	HVAC Heating	6,879	0.00
	Whole House Fan	5,953	2.66
22/23 Total		158,745	27.99
Total		**262,145**	**47.78**

19.2 Ex-Post Gross Savings

Table 19-4 summarizes the program-level ESP Ex-Ante and Ex-Post energy savings for FY 21/22.

Table 19-4 CAHP kWh Evaluation Results

Fiscal Year	Measure	Ex-Ante kWh Savings	Ex-Post Gross kWh Savings	Gross Realization Rate
20/21	Appliances	85	85	100%
	Heating & Cooling	16,042	16,042	100%
	New Construction	40,359	40,359	100%
20/21 Total		56,486	56,486	100%
21/22	Appliances	5,855	5,855	100%
	HVAC Cooling	7,917	7,917	100%
	HVAC Heating	1,745	1,745	100%
	Water Irrigation	-369	-369	100%
	Whole Building	31,766	31,766	100%
21/22 Total		46,914	46,914	100%
22/23	Appliances	16	16	100%
	Domestic Hot Water	125	125	100%
	Indoor Fan	523	523	100%
	Pump	-369	-369	100%
	New Construction	137,242	137,242	100%
	HVAC Cooling	8,377	8,377	100%
	HVAC Heating	6,879	6,879	100%
	Whole House Fan	5,953	5,953	100%
22/23 Total		158,745	158,745	100%
Total		**262,145**	**262,145**	**100%**

Table 19-5 summarizes the program-level Ex-Ante and Ex-Post peak demand savings for FY 21/22.

Table 19-5 CAHP kW Evaluation Results

Fiscal Year	Measure	Ex-Ante Peak kW Savings	Ex-Post Gross Peak kW Savings	Gross Realization Rate
20/21	Appliances	0.02	0.02	100%
	Heating & Cooling	6.76	6.76	100%
	New Construction	6.77	6.77	100%
20/21 Total		13.55	13.55	100%

Fiscal Year	Measure	Ex-Ante Peak kW Savings	Ex-Post Gross Peak kW Savings	Gross Realization Rate
21/22	Appliances	0.69	0.69	100%
	HVAC Cooling	1.30	1.30	100%
	HVAC Heating	0.00	0.00	100%
	Water Irrigation	-0.05	-0.05	100%
	Whole Building	4.30	4.30	100%
21/22 Total		6.24	6.24	100%
22/23	Appliances	0.00	0.00	131.5%
	Domestic Hot Water	0.01	0.00	41.1%
	Indoor Fan	0.23	0.09	39.8%
	Pump	-0.06	-0.05	93.9%
	New Construction	21.40	21.40	100.0%
	HVAC Cooling	3.74	3.29	88.0%
	HVAC Heating	0.00	0.00	-
	Whole House Fan	2.66	1.06	39.8%
22/23 Total		27.99	25.80	92%
Total		**47.78**	**45.59**	**95%**

19.3 Cost Effectiveness Results

Table 19-6 presents benefits, costs, and the results of cost-effectiveness testing for the CAHP. Overall, the program was cost effective.

Table 19-6 FY 22/23 CAHP Benefit/Cost Tests

Test Category	Program Administrator Cost Test	Total Resource Cost Test	Participant Cost Test	Ratepayer Impact Measure	Modified Total Resource Cost Test
Total Benefits	$135,618	$135,618	$431,442	$135,618	$135,618
Total Costs	$101,661	$98,487	$88,192	$441,737	$98,487
Benefit/Cost Ratio	1.33	1.38	4.89	0.31	1.38

20 City Plants Program

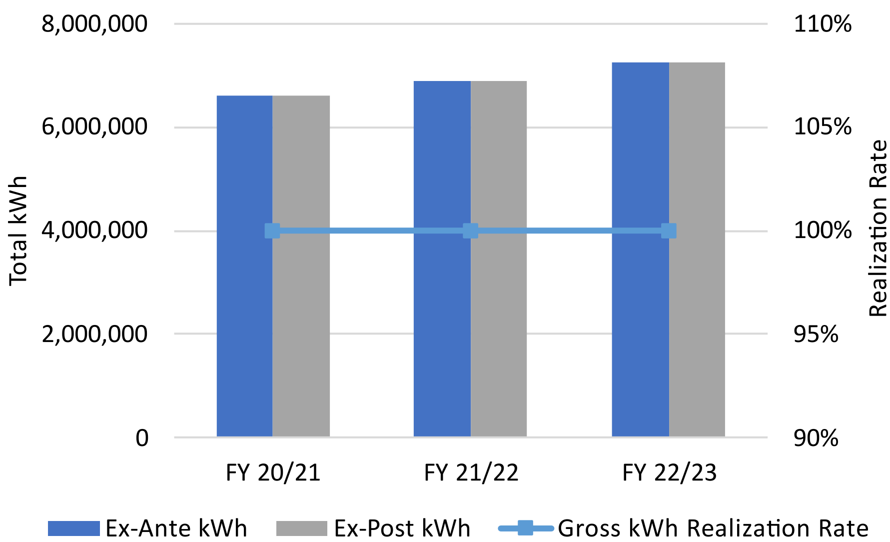
This chapter summarizes the impact and process evaluation of City Plants (CP)that LADWP offered customers during Fiscal Years 20/21 to 22/23 (Concurrent Period).

The primary objective of this evaluation was to calculate energy savings and peak demand reductions attributable to CP, as well as to perform a summary process evaluation.

20.1 Program Performance Summary

The City Plants Program continues to operate and collaborate with various partners in Los Angeles to grow a greener, healthier, and more sustainable city for future generations. Figure 20-1 compares Ex-Ante and Ex-Post energy savings across the Concurrent Period.

Figure 20-1 CP Program Performance Summary



20.1.1 Key Evaluation Takeaways

- The overall kWh realization rate was 100% during FY 22/23 and 100% during the Concurrent Period.
- Tree planting affects the urban micro-climate in urban cities such as Los Angeles, which is an important reason for the successful implementation of the CP.
- No significant changes were made to the program design during FY 22/23. The program continued its enhanced services pilot (discussed in the FY 21/22 report) that provides additional assistance with tree selection, location, and planting to would-be adopters. Additionally, the program also continued its Tree Ambassador initiative with its second cohort of ambassadors. The program has continued to grow its partnership with Commonwealth Nursery to grow trees for the program.

20.2 Program Description

LADWP and City Plants are working in partnership to provide free shade trees for residents and property owners in the City of Los Angeles, along with 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.

20.3 Methodology

This section presents the findings of the tracking data review and the methodology used to calculate verified Ex-Post energy savings for the program. As part of the impact evaluation, the Evaluator performed the following data collection activities outlined in Table 20-1.

Table 20-1 CP Data Sources for Impact Evaluation

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

20.4 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.

20.5 Ex-Post Gross Savings

Table 20-2 shows Ex-Post kWh savings compared to Ex-Ante savings. The program realization rate is 99.5%.

Table 20-2 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
20/21	6,617,573	6,617,573	100%	3,018.61	3,018.61	100%
21/22	6,896,107	6,896,107	100%	7,647.19	7,647.19	100%
22/23	7,243,165	7,243,165	100%	3,236.96	3,236.96	100%
Grand Total	**20,756,845**	**20,756,845**	**100%**	**13,902.77**	**13,902.77**	**100%**

20.5.1 COVID-19 Impacts on Energy Use

The Evaluator determined COVID-19 era impacts as shown in Table 20-3. It is believed that about a third of U.S. workers who can work from home now do so all the time, 3 years after pandemic, based on an article by the Pew Research Center. These estimates are based on the assumption that workers use more air conditioning while working from home, thereby contributing more to cooling savings due to shade trees.

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[4]. 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 20-3 FY 22/23 CP COVID-19 Era Impact on Ex-Post Gross Energy Savings

Measure	Typical 1st Year Ex-Post kWh Savings (A)	COVID-19 Era Adjusted Annual Ex-Post kWh Savings (B)	COVID-19 Era Incremental Change Ex-Post kWh Savings (B-A)	COVID-19 Era % Change Ex-Post Savings [(B-A)/A]
Shade Trees	7,243,165	7,873,320	630,155	8.7%

20.6 Process Evaluation

The Evaluator completed a summary process evaluation of the CP Program based on an interview with program staff. During the interview, the following topics were discussed:

- Changes made to the program design;
- Changes made to operational procedures;
- Response to recommendations made in the previous evaluation.

The Evaluators performed a full process evaluation in FY 21/22. Key findings of the full process evaluation were:

- **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

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

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 personal benefits of shade trees, such as shade and the availability of fruit, are a more influential argument 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.**

The key findings of the FY 22/23 summary process evaluation are:

- **A couple of additions to the partner group during the fiscal year.** One group that works with the LADWP Community Partnership Grants program began hosting tree adoptions and has now fully joined as a Planting Partner. The group provides services in South Los Angeles. This group can now offer adoption events without program support.
- **No significant changes were made to the program design during FY 22/23.** The program continued its enhanced services pilot (discussed in the FY 21/22 report) that provides additional assistance with tree selection, location, and planting to would-be adopters. Additionally, the program also continued its Tree Ambassador initiative with its second cohort of ambassadors.
- **The program is continuing to grow their partnership with Commonwealth Nursery, located in Griffith Park, to grow trees for the program.** This collaboration aims to cultivate trees specifically for the program, focusing on those native to the region or those that offer enhanced biodiversity benefits. The objective is to diversify the selection of tree sizes, thereby accommodating a broader spectrum of spaces.

Additional details of the summary process evaluation can be found in Appendix A, section A.18.3.

20.7 Cost Effectiveness Results

Table 20-4 presents benefits, costs, and the results of cost-effectiveness testing for the CP. Overall, the program was cost effective.

Table 20-4 FY 22/23 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	$26,220,095	$26,220,095	$26,819,126	$26,220,095	$26,220,095
Total Costs	$2,255,682	$1,577,869	$1,571,767	$26,825,228	$1,577,869
Benefit/Cost Ratio	11.62	16.62	17.06	0.98	16.62

20.8 Program Key Findings and Recommendations

Trees improve the spaces surrounding buildings aesthetically and contribute to controlling 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 20-5, 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.

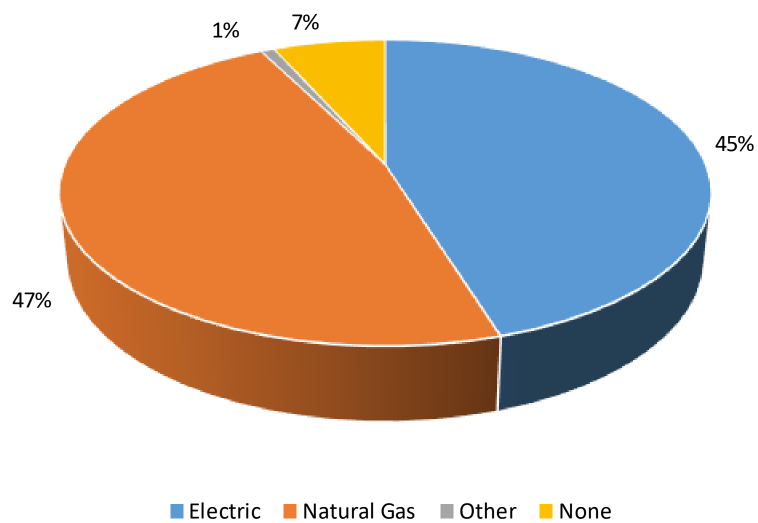
Table 20-5 CP Energy Saving Estimates by Different Methods

Method/ Orientation	South	East	West	North	Average (Shade Only)	Climate Only
1. EcoLayers	not calculated	not calculated	not calculated	not calculated	41.5	14.94
i-Tree Design	86.0	80.87	93.1	N/A	86.6	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)	51.8	55.2	75.7	25.6	57.6	20.5

The Ex-Ante energy savings consider the summer savings only, due to the tree shade. Winter savings associated with 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, the Evaluator obtained information on the heating source from a sample of 376 participants. As shown in Figure 20-2, 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 20-2 CP 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.

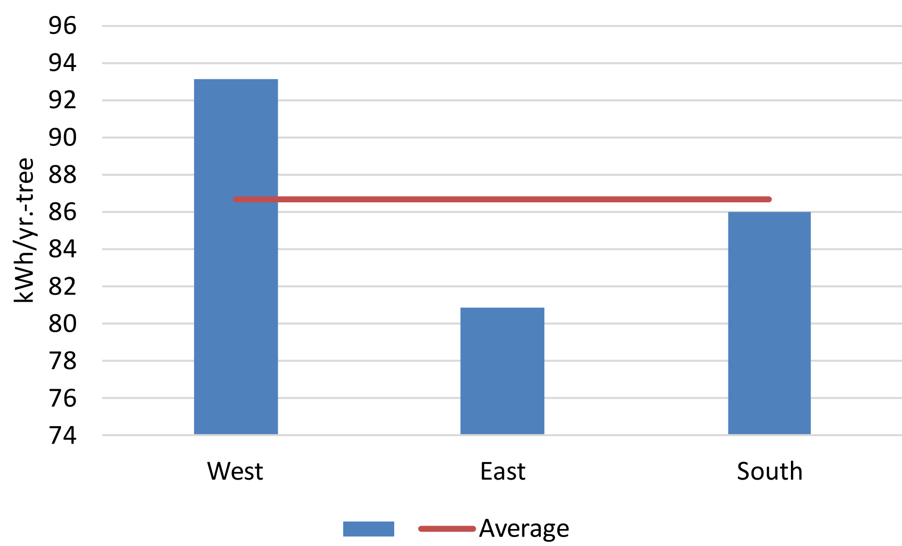
A building's physical characteristics will affect the building's cooling-energy use by lowering or raising it. In summer, trees block unwanted solar radiation entering the building and, if placed properly around the building, can reduce the cooling load; while in winter, tree shade can increase the heating 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 20-3, 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[5]. 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 20-3 CP Per Tree Energy Savings by Orientation



McPherson et al.[6] 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. 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[7]. 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, would not have any impact on the energy usage.

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

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

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

As the results show in Figure 20-3 , 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[8]). 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 3 years to determine tree survival rates more accurately. The mortality rates could vary from year to year due to the variations in weather and availability of water. The survey results will also help determine which particular species have higher mortality rates and consequently assist with 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.

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

- 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.

21 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 22/23 (FY 22/23 or Concurrent Year 3).

21.1 Program Description

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. The program was initially funded using formula-based Energy Efficiency and Conservation Block Grant (ARRA) funding from U.S. Department of Energy. It was considered successful and was extended using rate-payer funding. The program has completed nine major rounds of funding and three sub-rounds of awards including 251 grants totaling more than $14 million. At the time of this evaluation, the program was in Phase 1 of its 2023 grant cycle.

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.

21.2 Process Evaluation

For FY 22/23, the Evaluator performed a summary process evaluation of POCP. This included an in-depth interview with LADWP program staff.

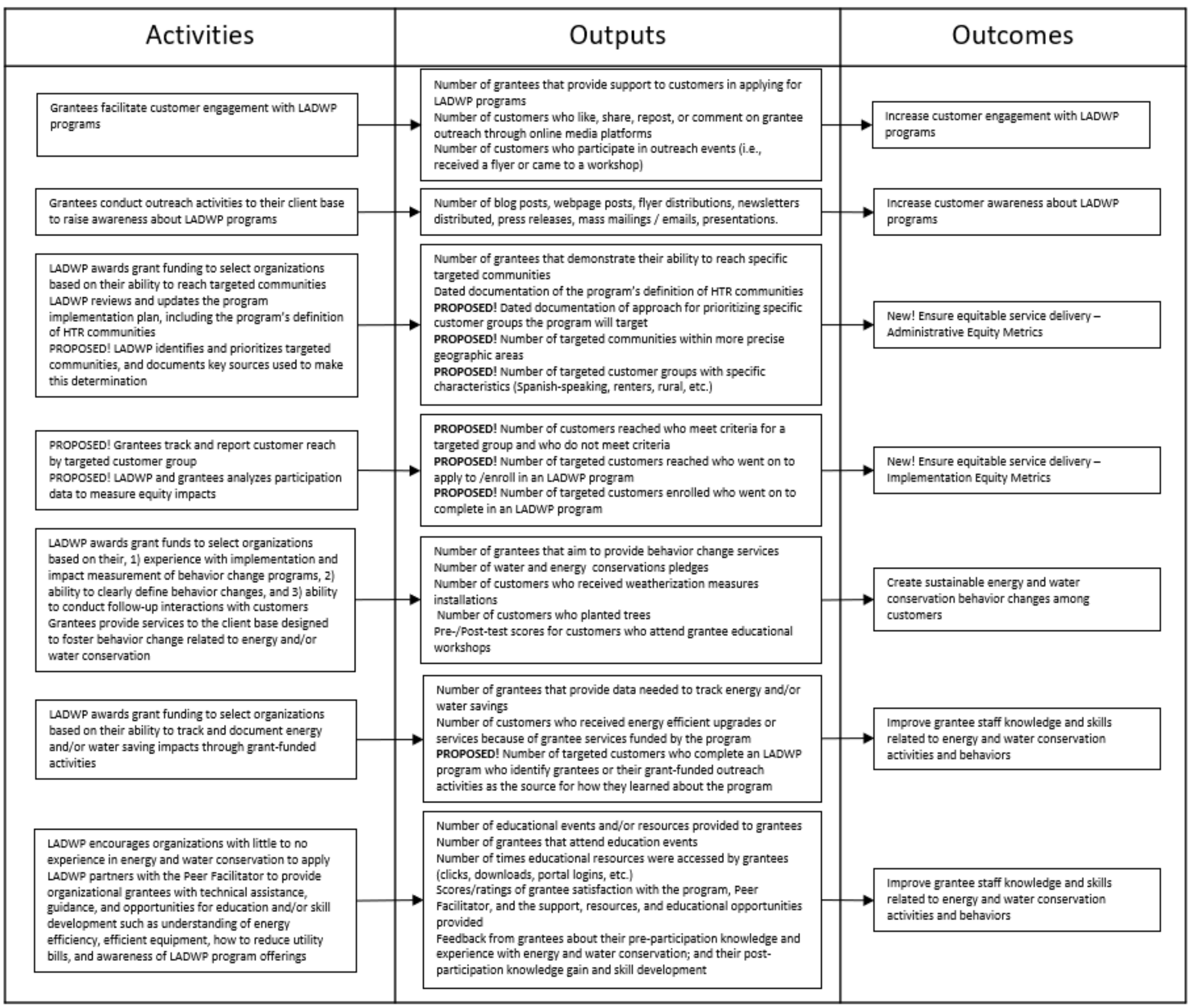
The Evaluators performed a full process evaluation of PCOP in FY 20/21. Key findings from that evaluation included:

- Services grantees' organizations provide have broad benefits for the region including creating a more resilient future for all communities, reducing electricity and water usage, and supporting the LA100 initiative optimizing the efficiency of how customers use electricity.
- Grantees had very good experiences with the overall grant process. They described good working relationships with LADWP based on flexibility, reasonable reporting requirements, clear rules, trust, and helpfulness of the peer facilitator (grantee funded to assist the other grantees).
- Grantees were very satisfied with the program and LADWP.

- Grantees employed outreach strategies to overcome known barriers such as customers' limited access to technology, cultural relevance, and trust, and limited English-speaking communication skills.
- The equity metrics audit included findings related to the program's definition of hard-to-reach customers, process for ensuring the program serves those customers, and suggestions for overcoming barriers to collecting customer information that could inform progress toward equity goals.

A key work product of the previously completed process evaluation of POCP was the development of a baseline logic model. A simplified version of the logic model is presented in Figure 21-1. A more detailed logic model can be found in Section A.19.2.

Figure 21-1 POCP Baseline Logic Model



21.3 Program Key Findings and Recommendations

The key findings and recommendations of the FY 22/23 summary process evaluation are:

- **The program design and delivery is largely the same as it was during the previous two years.** Program goals are unchanged, and the focus remains on customer engagement and behavior change, by educating customers. Grant offerings vary each round, and target needs outside of efficiency, such as water quality, solar, and electric vehicles. In a recent round they emphasized hiring community members to help with enrollments and financial assistance programs.
- **Staff noted some of the challenges they face.** One challenge is that the program is understaffed and has a third position that has been open for the past three years. Another challenge is attracting a larger number of quality applicants to select from for funding. Lastly, the turnover of staff at the grantee organization has impacted their ability to meet reporting deadlines.
- **Potential enhancements being considered are using electronic payments and online applications to reduce staff time.**

The Evaluator has the following recommendation based on the FY 22/23 summary process evaluation.

- **Address staffing resource issues.** The Evaluators recommend that LADWP explore options to hire additional PCOP staff or make resources available to current staff to enable them to provide deeper services to grant applicants and better utilize program data to improve the program over time.

22 Codes, Standards, and Ordinances Program

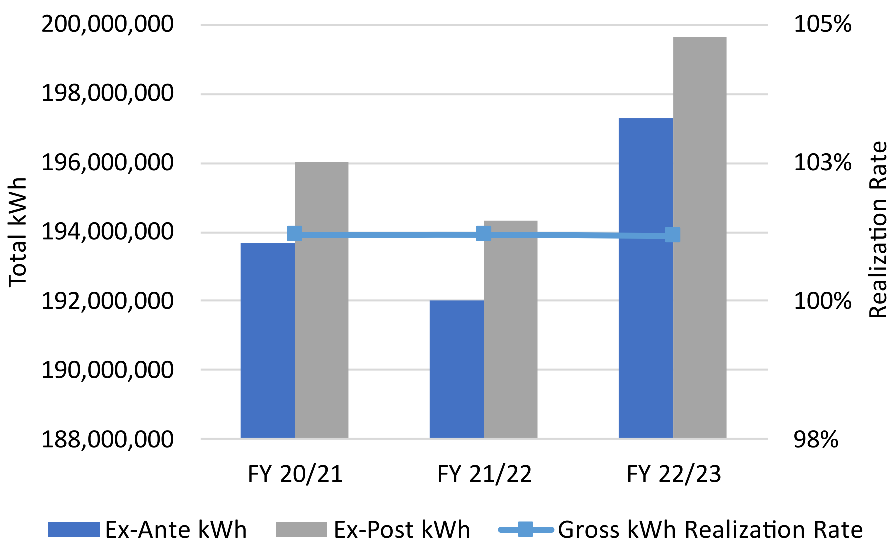
This chapter presents an evaluation of the Codes, Standards, and Ordinances (CSO) Program that LADWP offered customers during Fiscal Years 20/21 to 22/23 (Concurrent Period).

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 summary process evaluation.

22.1 Program Performance Summary

CSO conducts advocacy to improve code requirements for building, appliance, and water use efficiency. CSO aggregates the impacts of enhancements to statewide codes and standards (Title 20 and Title 24) in addition to local codes. This evaluation period included Title 24, LA Plumbing Ordinance, and LA Cool Roof Ordinance. Figure 22-1 compares Ex-Ante and Ex-Post energy savings across the Concurrent Period.

Figure 22-1 CSO Program Performance Summary



22.1.1 Key Evaluation Takeaways

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

22.2 Program Description

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

Table 22-1 CSO Title 24 Editions & Adoption Dates

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

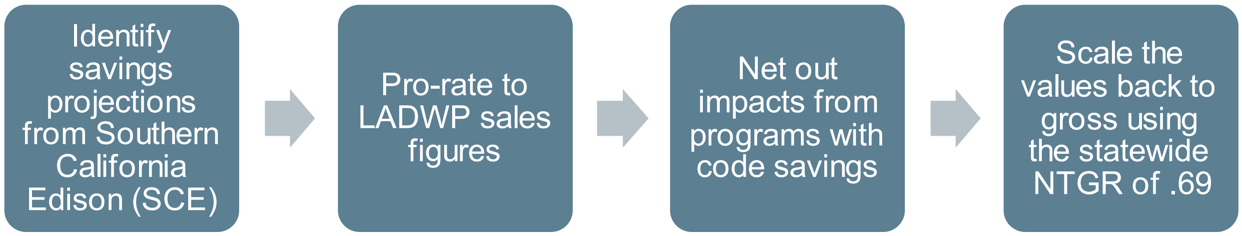
In addition, the CSO program incorporates impacts from the following Los Angeles ordinances:

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

22.3 Methodology

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

Figure 22-2 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.

22.3.1 Ex-Ante Savings Review

Savings estimates for CSO were aligned between data provided by LADWP to the Evaluator and to that filed by LADWP in ESP. Ex-ante savings estimates are summarized in Table 22-2.

Table 22-2 CSO Ex-Ante Savings Summary

Fiscal Year	Measure	ESP Data Ex-Ante kWh	ESP Data Ex-Ante Peak kW
20/21	Plumbing Ordinances	1,319,760	178.40
	Title 20/24	192,363,020	26,002.67
21/22	Plumbing Ordinances	1,319,760	163.95
	Title 20/24	190,691,232	32,050.59
22/23	Plumbing Ordinances	1,319,760	185.86
	Title 20/24	195,956,514	32,316.31
Total		**582,970,046**	**90,897.78**

22.4 Impact Evaluation

This section presents the findings of the impact evaluation of the CSO Program during FY 21/22. Ex-post gross energy savings and peak demand reduction are presented at the measure level.

22.4.1 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 22-3.

Table 22-3 CSO Plumbing Ordinance Savings

Fiscal Year	Ex-Ante kWh	Ex-Post kWh	Gross Realization Rate	ESP Data Ex-Ante kW	ESP Data Ex-Post kW	Gross Realization Rate
20/21	1,319,760	1,819,619	138%	178.40	245.97	138%
21/22	1,319,760	1,819,619	138%	163.95	226.04	138%
22/23	1,319,760	1,819,619	138%	185.86	239.00	129%
Total	**3,959,280**	**5,458,857**	**138%**	**528.21**	**711.01**	**135%**

22.4.2 Title 20/24

LADWP assigns savings for Title 20/24 on a pro-rated basis, comparing total sales to Southern California Edison. In LADWP's prior evaluation, savings for code attribution were adjusted upwards due to an adjustment to how LADWP pro-rated impacts; formerly, 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 22-4.

Table 22-4 CSO Title 20/24 Savings

Fiscal Year	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
20/21	192,363,020	194,199,475	101%	26,002.67	26,250.91	101%
21/22	190,691,232	192,511,723	101%	32,050.59	32,356.58	101%
22/23	195,956,514	197,827,272	101%	32,316.31	32,663.51	101%
Total	**579,010,766**	**584,538,470**	**101%**	**90,369.57**	**91,271.00**	**101%**

22.5 Ex-Post Gross Savings

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

Table 22-5 CSO Realization Rate Summary

Fiscal Year	Ex-Ante kWh	Ex-Post kWh	Gross Realization Rate	ESP Data Ex-Ante kW	ESP Data Ex-Post kW	Gross Realization Rate
20/21	193,682,780	196,019,094	101%	26,181.06	26,496.88	101%
21/22	192,010,992	194,331,342	101%	32,214.54	32,582.62	101%
22/23	197,276,274	199,646,891	101%	32,502.17	32,902.51	101%
Total	**582,970,046**	**589,997,327**	**101%**	**90,897.78**	**91,982.01**	**101%**

22.5.1 COVID-19 Impacts on Energy Use

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

22.6 Process Evaluation

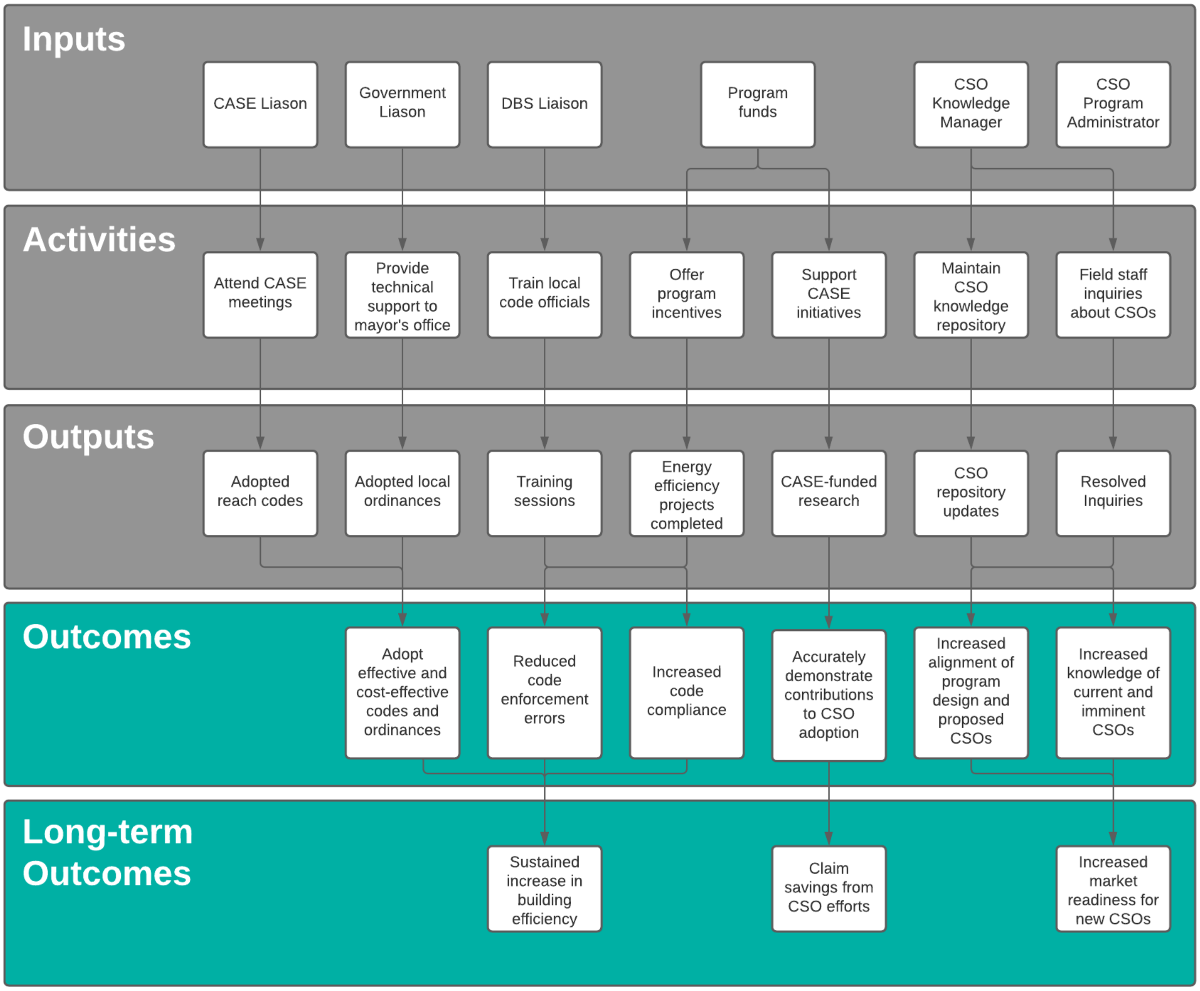
For FY 22/23, the Evaluator performed a summary process evaluation of the CSO program. This included an in-depth interview with LADWP program staff to understand and explore the following:

- 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 Evaluator performed a full process evaluation of the CSO program in FY 20/21, and a summary process evaluation in FY 21/22.

A primary work product of the FY 20/21 process evaluation was to develop a logic model for the program. Figure 22-3 presents the logic model.

Figure 22-3 CSO Base Program Logic Model



Other key findings of the full process evaluation were:

- **Interviews with resource program staff identified an opportunity for the CSO program to lead staff training and to participate more directly in program design and redesign conversations.** Training would ideally occur twice per year. Some program staff said that training would help program staff prepare for the impacts of new codes and standards on their program processes and the savings they can claim.
- **CSO program staff have unique visibility into proposed codes and standards.** By participating in program design and redesign, CSO program staff could identify ideas for new programs or changes to existing programs that could help prepare the market for proposed code changes.
- **Staff interviews identified an opportunity for the CSO program to track and monitor some of its outputs.** Tracking CSO program outputs would provide useful information to the CASE program about the CSO-related activities being conducted by LADWP, which could help with attributing and allocating C&S savings to

LADWP's activities and could be useful for other utilities. Tracking these outputs could also help the CSO program to improve over time, as this documentation will increase the evaluability of the program, leading to additional insights about program improvements.

Key findings of the FY 21/22 summary process evaluation were:

- **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.**
- **Program staff highlighted that they were focusing on the development of customer guidance documents on code and standard design information to inform implementation and developing a stronger link between CSO and resource program measure offers that are ready to become a code, standard, or ordinance.**

The Evaluator completed a summary process evaluation that was limited in scope for FY 22/23 CSO. The key findings of that process evaluation were:

- The program staff are working towards being more proactive in their approach to codes, standards, and ordinances by monitoring proposed 2025 code measures to better anticipate their impacts on the program.
- Staffing remains a challenge despite adding two new members, as they are shared among various departments, which hinders deep engagement in code changes and benefits analysis. There is a suggestion for a fully allocated single person to CSO to bolster progress on goals.
- To supplement staffing, part-time involvement of electrical engineering staff and increased access to subject matter experts (SMEs) are utilized. In the future, the CSO staff aims to engage more with industry contacts like IAPMO to support water conservation projects and emerging tech research.
- **Staff have developed customer guidance information documents**. Program staff have compiled documents on measures such as electrification to help customers navigate installation challenges and barriers. They described gathering "a lot of information" to help customers avoid pitfalls including things like permitting and feasibility of placement. In addition to including this information in marketing materials, they are exploring options to publish the information more broadly.
- **Staff are assisting with regarding local all-electric buildings ordinance.** With the adoption of the local All-Electric Buildings Ordinance No. 187714 (requiring new buildings and residences be all electric), CSO staff are dedicating resources to ensure they understand the requirements.

Additional details Findings are summarized in Appendix A, Section A.20.2.

22.7 Cost Effectiveness Results

Table 22-6 shows benefits and costs and the results of cost effectiveness testing for the CSO Program.

Table 22-6 FY 22/23 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	$240,080,173	$240,080,173	$554,786,183	$240,080,173	$240,080,173
Total Costs	$1,608,304	$1,608,304	$0	$556,394,486	$1,608,304
Benefit/Cost Ratio	149.28	149.28	0.00	0.43	149.28

22.8 Program Key Findings and Recommendations

The Evaluator offers the following program recommendations:

- **Because CSO expertise is in regular demand within LADWP, and existing staff are having challenges finding time to devote to program objectives, adding personnel to the CSO program could enable more effective work on objectives, while also making personnel with codes expertise available to other departments who need it.** Designating whether staff act as a liaison to other departments or as a staff member dedicated exclusively to program objectives and activities would be beneficial.

23 Emerging Technology Program

This chapter presents the process evaluation of LADWP's Emerging Technology Program (ETP) that operated during Fiscal Year 22/23 (FY 22/23 or Concurrent Year 3).

23.1 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.

23.2 Process Evaluation

For FY 22/23, 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 FY 20/21 and a summary process evaluation in FY 21/22. The key findings form the full process evaluation were:

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

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

Key findings from the FY 21/22 summary process evaluation were as follows:

- Staff continued to test and refine the project intake and evaluation workflow process developed with NREL.
- The program continued partnering with Los Angeles Clean Tech Incubator (LACI) to identify areas for collaboration.
- The program identified primary focus areas including decarbonization, equity and extreme heat, flexible loads, and addressing data access for developers.

23.3 Program Key Findings and Recommendations

The Evaluator's findings from the summary process evaluation are as follows:

- **Project Intake and Evaluation Enhancement.** The program continued development and refinement of the workflow process initiated with NREL, aiming for a broader and more flexible evaluation of technologies with increased resources. Additionally, two technologies have been implemented, but neither have advanced to the pilot stage yet.
- **Shift in Focus to Greenhouse Gas Mitigation.** The program is now placing a greater emphasis on addressing greenhouse gas emissions, with particular attention to end use and whole building electrification.
- **Emerging Technology Program Realignment.** The program moved to the Power group, aligning more closely with power generation efforts. Exploration of low GWP refrigerants for heating applications and hydrogen-blended natural gas for generation has been initiated. A notable collaboration with Mitsubishi and other municipal utilities is underway to study the use of blended natural gas and green hydrogen for re-powering a former coal-fired plant.
- **New Leadership and Collaborations (as of June 2022).** A new lead was named for the program, resulting in increased interaction with the Los Angeles Clean Tech Incubator (LACI), Emerging Technologies Coordinating Council (ETCC), and Rocket Fund from CalTech. The latter helps in identifying worthy technologies, aiding in prototype development, and connecting them with venture capitalists.
- **No formal program metrics have been established to measure the program's progress.** Once they have completed the full cycle of their project intake and evaluation workflow process program staff stated they will be in a better position to explore performance metrics.
- **Current areas of focus.** The program is focused on decarbonization of space and water heating and decarbonizing fossil fuel generation. They are also focused on electrification of transportation including exploration of battery technologies and fuel cells and increasing greater penetration of EVs through EVSE chargers and charger maintenance programs.

Additional findings are summarized in Appendix A, Section A.21.3.

The Evaluator does not have new recommendations for ETP.

24 Marketing, Education, and Outreach

This chapter presents the process evaluation of LADWP's Marketing, Education, and Outreach (MEO) that operated during Fiscal Year 22/23 (FY 22/23 or Concurrent Year 3).

24.1 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.

24.2 Process Evaluation

For FY 22/23, the Evaluator performed a summary process evaluation of MEO that was based on an in-depth interview with LADWP program staff.

The Evaluators performed a full process evaluation of MEO in FY 20/21. Key findings from that evaluation included:

- Marketing efforts are largely distributed outside of the Efficiency Solutions portfolio. There did not appear to be a consolidated effort across the portfolio to streamline or consolidate marketing to customers or to leverage participants in one program when marketing to other programs.
- MEO did not provide coordination or crossover support between programs.
- The current structure appeared to enable participation in the Efficiency Solutions portfolio.
- The current program activities are not cohesive enough for the Evaluator to recommend specific metrics to be tracked.
- The customer pathway included challenges at the Program Awareness, Program Entry/Application, and Rebate/Program Closeout stages.

For FY 21/22, a process evaluation based on a general population survey was completed. The key findings of that were:

- **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.

- **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.
- **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.

24.3 Program Key Findings and Recommendations

The Evaluator's findings from the summary process evaluation are as follows:

- Marketing within MEO (Marketing, Education, and Outreach) is conducted through individual programs, but improved collaboration has been seen in sharing resources and opportunities across these programs.
- Educational initiatives are being carried out through partnerships with LA Unified School District and the POCP program, targeting students, families, and hard-to-reach communities with information on energy and water conservation.
- Outreach efforts are channeled through partnerships with initiatives like LA Better Buildings Challenge and Gateway to Green, promoting LADWP efficiency programs to commercial and multi-family rental property owners.
- An emphasis on equity has been renewed following the LA100 study, with the initiation of the LA100 Equity Strategies study to examine ways to enhance equity in transitioning to 100% renewable energy.
- MEO does not measure program progress toward goal. While they feel the program is effective, they do not necessarily have the data to measure that effectiveness. As an example, they believe that their outreach and marketing strategies are reaching the targeted groups but add that they really do not get the data to identify if there are gaps or if some customers are getting too frequent communications or the wrong medium.
- Challenges faced include insufficient access to customer or market data, inadequate tracking data, and understaffing, which hamper the optimization of program outreach and the measurement of program effectiveness.
- More robust data and additional staff could potentially improve program targeting, effectiveness measurement, and ultimately, customer satisfaction and participation in the efficiency programs.

The recommendations for the program based on the FY 22/23 evaluation are:

- **Expand MEO staff access to market, customer, and tracking data.** This will enable them to enhance the effectiveness of their actions and make more informed, data-driven decisions.
- **Continue to seek ways to coordinate efforts with the Central Communications Office.** Coordinated communications may reduce duplication of effort, gaps in coverage, and areas of oversaturation.
- **Establish and institutionalize cross-program promotion so that recent participants in efficiency programs are routinely referred to other relevant programs that would benefit them.** This would improve participation rates and provide greater benefits to customers.

25 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 22/23 (FY 22/23 or Concurrent Year 3).

25.1 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[9]. 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.

25.2 Process Evaluation

For FY 22/23 the Evaluator completed a summary process evaluation of the PADP. An interview in August 2023 with LADWP program staff informed the summary process evaluation.

The Evaluator conducted a Full Process Evaluation of the PADP over the course of FY 20/21 and FY 21/22. The findings and recommendations form the FY 21/22 evaluation where as follows:

- **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 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.

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

- **Establish metrics that track PADP progress towards short and long-term outcomes, such as those recommended in the FY 21/22 evaluation.** 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.

25.3 Program Key Findings and Recommendations

The Evaluator's findings from the summary process evaluation are as follows:

- **Collaborative prioritization and planning.** The Program Design and Liaison (PDL) team and the Engineering team work collaboratively to develop a list of activities for the program to focus on, scope them out, and assign responsibility for each. PADP research and support activities help determine what projects, pilots, or studies LADWP should invest in each year.
- **Program efforts supported by external partners.** Staff work with an external engineering service provider that assists with new measure development and emerging technology reviews. They also interact with the California Technical Forum on development of new measures.

PADP staff described the following activities conducted during FY 22/23:

- **Designed process flow.** Staff designed and implemented a process flow for the program, including a tracking system for activities, and a form to help keep track of requests for assistance from program teams. These requests are often about new measures or proposed incentive changes that fall under the Engineering team, but there are also process-related questions that are addressed by PDL. Staff report that while the process flow is still a work-in-progress, it thus far is working well and they have continued to refine it over time.

- **No performance metrics yet.** Staff noted that they had not established performance metrics but as the new process flow matures, they are making progress on establishing a performance baseline. They noted that the portfolio business plan document gave them a roadmap to make improvements and changes to the programs effectively, and that in future evaluations, evaluators could start measuring some performance indicators.
- **Expect to need a variety of metrics.** Staff pointed out that both a strength and a weakness of the program is that it is a group of functions pieced together. To evaluate these functions will require appropriate metrics for each. They offered some ideas on possible metrics such as number of tasks completed, improvements on realization rates for measures over time, and gap analysis for programs compared to estimated potential.

26 Program Cost-Benefit Analysis

This chapter provides an overview of cost effectiveness for the LADWP energy efficiency portfolio, along with total program costs and benefits, as well as a summary of the cost effectiveness analysis. Costs include program costs incurred in the implementation of the LADWP energy efficiency portfolio during the Concurrent Period. Cost effectiveness results by program are available in Section 26.2.

26.1 Cost Effectiveness Summary

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

To calculate the cost-effectiveness of each program, measure lives were assigned on a measure-by-measure basis. When available, measure life values were obtained from DEER workpapers. Additionally, assumptions regarding incremental/full measure costs were necessary. Avoided energy, capacity, and transmission/distribution costs used to calculate cost-effectiveness were provided by LADWP.

During the Concurrent Period, the LADWP portfolio consisted of twenty-two programs with verified gross kWh savings of 959,948,221. Total spending in the Concurrent Period equaled $365,636,842. Table 26-1 lists benefits and costs along with cost effectiveness results for each fiscal year during the Concurrent Period. Cost effectiveness results are shown for the Total Resources Cost (TRC) Test, Program Administrator Cost (PAC) Test, the Rate-payer Impact Measure (RIM) Test, Participant Cost Test (PCT), and Modified Total Resources Cost (MTRC) Test.

Table 26-1 Concurrent Period Portfolio Level Cost Effectiveness Results

Fiscal Year	PAC		TRC		PCT		RIM		MTRC	
	Benefits/ Costs*	Ratio	Benefits/ Costs*	Ratio	Benefits/ Costs*	Ratio	Benefits/ Costs*	Ratio	Benefits/ Costs*	Ratio
20/21	$250,487	2.35	$250,487	2.65	$718,870	15.24	$250,487	0.33	$250,487	2.65
	$106,601		$94,448		$47,178		$766,140		$94,448	
21/22	$323,674	1.79	$323,674	1.70	$880,482	7.79	$323,674	0.34	$323,674	1.70
	$180,997		$190,424		$113,023		$957,884		$190,424	
22/23	$352,837	3.03	$352,837	3.67	$839,975	17.35	$352,837	0.40	$352,837	3.67
	$116,438		$96,020		$48,423		$887,572		$96,020	
Grand Total	$926,998	2.29	$926,998	2.43	$2,439,327	11.69	$926,998	0.35	$926,998	2.43
	$404,035		$380,893		$208,624		$2,611,596		$380,893	
*Dollar amounts in thousands of dollars										

26.2 Cost Effectiveness Program Results

Table 26-2 provides a summary of program cost effectiveness results for PAC, TRC, PCT, RIM, and MTRC. Measure-level cost effectiveness program results are presented in Appendix B.

Table 26-2 FY 20/21 Program Level Cost Effectiveness Results

Program	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
CDI	0.22	0.38	362.42	0.11	0.38
CLIP	0.63	0.87	17.10	0.19	0.87
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
ACOP	0.83	0.62	1.66	0.38	0.62
CAHP	0.61	0.61	2.20	0.31	0.61
CP	4.84	4.84	13.41	0.98	4.84
CSO	11.45	11.45	0.00	0.32	11.45
MFWB	1.27	1.50	12.54	0.30	1.50
Portfolio Total	**2.35**	**2.65**	**15.24**	**0.33**	**2.65**

Table 26-3 FY 21/22 Program Level Cost Effectiveness Results

Program	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
CDI	0.47	0.47	3.00	0.19	0.47
CLIP	1.19	1.96	24.18	0.24	1.96

Program	PAC Ratio	TRC Ratio	PCT Ratio	RIM Ratio	MTRC Ratio
CPP	2.01	2.09	14.33	0.31	2.09
FSPC	0.06	0.06	3.18	0.05	0.06
FSP_POS	0.22	0.18	2.49	0.13	0.18
LADWP Facilities	0.02	0.04	189.11	0.02	0.04
LAUSD_DI	0.18	0.18	1.86	0.12	0.18
SBD	1.28	1.50	13.28	0.35	1.50
UHVAC	1.80	1.01	3.10	0.43	1.01
CRP	0.49	0.35	1.56	0.24	0.35
EPM	1.46	1.85	20.15	0.44	1.85
LIREP	0.61	0.61	4.07	0.23	0.61
RETIRE	1.41	1.20	10.51	0.26	1.20
RLEP	0.71	0.71	5.95	0.17	0.71
ACOP	0.30	0.35	2.19	0.20	0.35
CAHP	0.20	0.20	2.29	0.13	0.20
CP	6.30	6.30	21.23	0.89	6.30
CSO	11.42	7.53	54.38	0.39	7.53
Portfolio Total	**1.79**	**1.70**	**7.79**	**0.34**	**1.70**

Table 26-4 FY 22/23 Program Level Cost Effectiveness Results

Program	PAC Ratio	TRC Ratio	PCT Ratio	RIM Ratio	MTRC Ratio
CDI	0.51	1.82	286.40	0.20	1.82
CLIP	0.87	1.53	21.89	0.23	1.53
CPP	3.08	0.48	1.05	0.46	0.48
FSPC	0.32	0.28	3.54	0.17	0.28
LADWP Facilities	0.11	11.76	137.25	0.09	11.76
LAUSD_DI	0.29	0.87	71.98	0.17	0.87
SBD	4.04	8.02	14.73	0.55	8.02
UHVAC	5.32	5.32	8.93	0.60	5.32
ZBD	0.12	0.12	14.80	0.10	0.12
CRP	0.59	0.68	4.74	0.27	0.68
EPM	1.12	1.80	34.70	0.47	1.80

Program	PAC	TRC	PCT	RIM	MTRC
	Ratio	Ratio	Ratio	Ratio	Ratio
HEIP	0.32	0.32	13.65	0.20	0.32
LIREP	0.84	2.35	156.28	0.27	2.35
RETIRE	0.71	0.65	7.70	0.23	0.65
RLEP	7.47	50.31	0.00	0.33	50.31
ACOP	0.47	1.03	16.19	0.29	1.03
CAHP	1.33	1.38	4.89	0.31	1.38
CP	11.62	16.62	17.06	0.98	16.62
CSO	149.28	149.28	0.00	0.43	149.28
Portfolio Total	**3.03**	**3.67**	**17.35**	**0.40**	**3.67**

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 22/23.

A.1 Commercial Direct Install Program

This section details the impact evaluation for the Commercial Direct Install (CDI) program that LADWP offered customers during FY 22/23. The primary objective of this evaluation was to calculate energy savings and peak demand impacts attributable to the CDI Program, as well as to complete a process evaluation.

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 2022 and June 2023 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 Evaluator's previous samples (FY 20/21, FY 21/22), and current sample (FY 22/23) were in total enough to estimate the total achieved savings with ±7.1% precision at a 90% confidence interval. The resulting sample of 979 measures consisted of nine categories, or strata.

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 CDI Population Statistics used for Sample Design

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	297	29	15,327	4,483,070
Int_Light_Control_2	500 – 5,000	1,599	60	1,099	2,536,444
Int_Light_Control_1	<500	460	29	94	143,885
Int_Light_3	>5,000	1,341	35	8,687	13,345,530
Int_Light _2	500 – 5,000	24,228	344	948	33,409,465
Int_Light _1	<500	38,880	309	120	9,009,273
Ext_Light _3	>5,000	861	54	21,481	10,980,412
Ext_Light _2	500 – 5,000	3,916	82	1,085	6,869,345
Ext_Light _1	<500	1,672	37	117	446,351
Total	**NA**	**73,254**	**979**	**3,527**	**81,223,775**

A.1.1.3 Baseline Assumptions Review

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

$$kWh = \frac{Watt_{base} * HOU_{base} * Qty_{base} - Watt_{installed} * HOU_{installed} * Qty_{installed}}{1000} * IEFe$$

Equation A-1

$$\Delta kW = (Watt_{base} - Watt_{installed}) * CF * IEFd/1000$$

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 interview or hours calculated from the installation of lighting loggers.

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): HVAC interactive factor for annual energy savings. The utilized value for energy interactive effects were sourced from tables taken from DEER. HVAC interactive effects refers to the change in HVAC energy usage due to the installation of LEDs that directly change electric energy use within the conditioned space of a building. The values were dependent upon space type, climate zone, and installed fixture type.

Interactive Effects, Demand Reduction (IEFd): HVAC interactive factor for peak demand savings. The utilized value for energy interactive effects were sourced from tables taken from DEER. HVAC interactive effects refers to the change in HVAC energy usage due to the installation of LEDs that directly change electric energy use within the conditioned space of a building. 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 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
FY 20/21	4,315,466	4,345,377	0.7%	300.56	338.41	11.2%
FY 21/22	44,233,732	44,233,732	0.0%	5,875.57	8103.33	38%
FY 22/23	32,644,66	32,644,666	0.0%	4,861.34	5,134.73	6%
Total	**81,193,864**	**81,233,775**	**0.0%**	**11,037.47**	**13,576.47**	**23%**

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, the Evaluator 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, 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 22/23, the program level Ex-Post energy savings realization rate was 116% when compared to Ex-ante savings.

Table A-4 CDI Concurrent Year 3 Stratum Savings Summary

Stratum	Program Data Ex-Ante kWh Savings	Program Data Ex-Post kWh Savings	Gross kWh Realization Rate
Int_Light_Control_3	1,955,734	1,614,619	83%
Int_Light_Control_2	1,409,157	1,636,784	116%
Int_Light_Control_1	49,970	59,926	120%
Int_Light_3	5,985,689	7,034,942	118%
Int_Light _2	12,791,864	16,848,276	132%
Int_Light _1	3,410,710	3,456,535	101%
Ext_Light _3	4,369,460	4,550,541	104%
Ext_Light _2	2,508,268	2,568,583	102%
Ext_Light _1	163,815	226,445	138%
Total	**32,644,666**	**37,996,651**	**116%**

The program level realization rate of 116% was a result of the sampled projects seen below in Table A-5. 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 3 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	80,687	96,835	120%
Project 2	34,753	23,958	69%
Project 3	25,449	16,691	66%
Project 4	19,450	20,863	107%
Project 5	47,025	45,970	98%
Project 6	541,788	570,791	105%
Project 7	95,066	140,157	147%
Project 8	78,066	110,299	141%
Project 9	81,342	70,968	87%
Project 10	39,317	35,248	90%
Non-sampled Projects	31,601,723	36,864,870	117%
Total	**32,644,666**	**37,996,651**	**116%**

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

- Project 1: The discrepancy in the energy savings between Ex-Ante and Ex-Post calculations is mainly due to a difference in operating hours. The Ex-Ante calculations used an annual hour's value of 4,100 or 4,004 hours for all cases. The

Ex-Post calculations used as-found values and in some cases, monitored values. These values consisted of either monitored hours (4,561, 3,492, 4,363, 4,831) or 8,760 (interviewed) hours of use annually as well as external hours of use of 4,377 hours. The evaluator installed 6 pendant intensity loggers at this facility as the retrofit included lighting controls. The loggers were left in place and gathered 22 days of data. Which was utilized to estimate the as-found hours stated above.

- Project 2: The discrepancy in the energy savings between Ex-Ante and Ex-Post calculations is mainly due to a difference in operating hours. The Ex-Ante calculations used an annual hour's value of 3,612 hours for all cases. The Ex-Post calculations used the values that were a result of the installation of 9 lighting loggers for a total of 22 days of logged data to establish hours of operation for different areas and the impact of the occupancy sensor in the warehouse area. The logging resulted in annual use hours of 75, 3316, 2469, 296, and 2,249 hours annually. Additionally, the Evaluator used no interactive effects for all fixtures which was applied to all spaces as a site visit found no heating or air conditioning. Ex-ante calculations applied an interactive effect of 1.08 to all spaces.
- Project 3: The Ex-Ante used a deemed interactive effects value of 1.14 while the Evaluator utilized factors of 1 as no interactive effects should be present as all fixtures are external or in unconditioned areas (storage, stairwell, etc.). Additionally, based on a site visit some storage rooms were found to only be utilized for 131 hours annually accounting for additional differences.
- Project 4: The discrepancy in the energy savings between Ex-Ante and Ex-Post calculations is mainly due to a difference in operating hours. For most cases, the Ex-Ante calculations used an annual hour's value of 4,100 or 3,612 hours. The Ex-Post calculations used as-found values of either 4,563 (6 am to 6:30 pm), 8760 (24/7), or 2,817 (7 am to 4 pm) based on the site visit conducted. Additionally, the Ex-Ante used a deemed interactive effects value of 1.08 for all areas. The Evaluator utilizes no interactive effects for all external fixtures.
- Project 5: The discrepancy in the energy savings between Ex-Ante and Ex-Post calculations is mainly due to a difference in operating hours. The Ex-Ante calculations used an annual hour's value of 4100. The Ex-Post calculations used an as-found value of 4,328 hours for photocell active use hours that are off on holidays. Additionally, the Ex-Ante used a deemed interactive effects value of 1.08 while the Evaluator utilized factors of 1 as no interactive effects should be present as all fixtures are external.
- Project 6: The discrepancy in the energy savings between Ex-Ante and Ex-Post calculations is mainly due to a difference in operating hours. The Ex-Ante calculations used an annual hour's value of 4100. The Ex-Post calculations used an as-found value of 4,328 hours for photocell active use hours that are off on holidays. Additionally, the Ex-Ante used a deemed interactive effects value of 1.08 while the Evaluator utilized factors of 1 as no interactive effects should be present as all fixtures are external.
- Project 7: The discrepancy in the energy savings between Ex-Ante and Ex-Post calculations is mainly due to a difference in operating hours. The Ex-Ante

calculations used an annual hour's value of 3,612 hours for all cases. The Ex-Post calculations used an as-found value of 5,475 (Monday to Sunday 5 am to 9 pm) based on the site visit conducted. Additionally, the Evaluator used no interactive effects for all external fixtures.

- Project 8: The discrepancy in the energy savings between Ex-Ante and Ex-Post calculations is mainly due to a difference in operating hours. The Ex-Ante calculations used an annual hour's value of 3,612 hours for most cases. The Ex-Post calculations used as-found values of either 8760 (24/7), 4377 (dusk to dawn), or 522 (10 Hrs./week) based on the site visit conducted. Additionally, the Ex-Ante used a deemed interactive effects value of 1.08 for all areas. The Evaluator utilizes no interactive effects as the fixtures are in an unconditioned parking garage.
- Project 9: The discrepancy in the energy savings between Ex-Ante and Ex-Post calculations is mainly due to a difference in operating hours. The Ex-Ante calculations used an annual hour's value of 8,376 hours for all cases. The Ex-Post calculations used as-found values of 8,760 for many cases based on the site visit conducted. In some cases (Mech rooms, elevator room, storage, etc.) however, fixtures were found to be rarely used or only used a few hours per week resulting in annual hours of 52, and 262. Additionally, Ex-Post calculations use an interactive effect of 0 for most areas as they are external, but in one case an interactive effect of 1.1 is used and in another, 1.09 is used.
- Project 10: The discrepancy in the energy savings between Ex-Ante and Ex-Post calculations is mainly due to a difference in operating hours. The Ex-Ante calculations used an annual hour's value of 2,808 hours for all cases. The Ex-Post calculations used as-found values of either 2,910 based on the site visit interview conducted or in 2 cases, 2 loggers were installed to log data for 22 days. These logged values resulted in annual use hours of 2,794 and 1,601. Ex-ante calculations also utilized an interactive effect value of 1.17 whereas Ex-Post utilized an interactive effect value of 1.08. Additionally, Ex-Post calculations used no interactive effects for all external fixtures.

Project-level and measure-level results can be found in the project site-level reports, which can be viewed in Appendix D. For confidential and privacy considerations of participants, Appendix D was not published with the public version of the report. Appendix D was provided only to LADWP as reference to supplement this EM&V report.

Description of Factors Affecting Gross Realized Savings

The Evaluator determined 2 main factors that contributed to discrepancies in the realized savings of the CY3 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-2 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, interior fixtures with controls, and exterior fixtures were generally 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 CDI Factors Affecting Gross Realized Savings

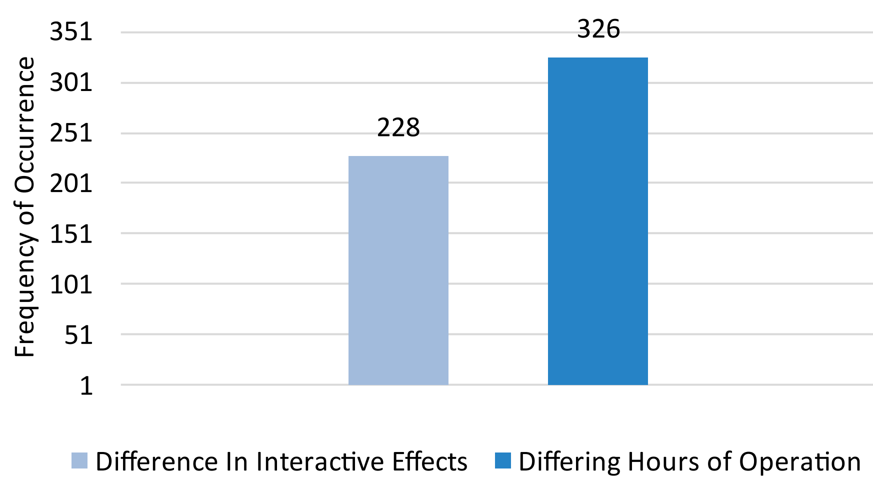
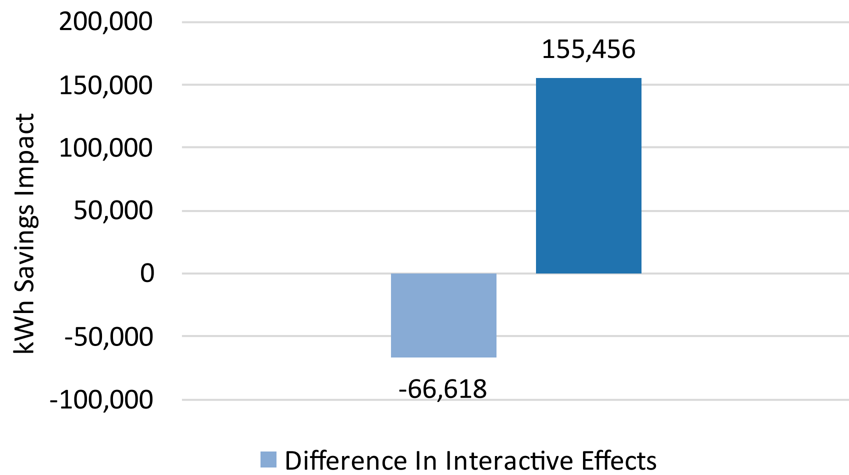


Figure A-2 CDI Impact of Factors Affecting Gross Realized Savings



A.1.3 Process Evaluation

The Evaluator completed a full evaluation of the CDI Program for FY 21/22. The following sections describe the methods and findings of the summary process evaluation completed for FY 22/23.

A.1.3.1 Process Evaluation Approach and Methodology

The Evaluators completed a summary process evaluation that was limited in scope for FY 22/23. The evaluation 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 program performance
- Barriers and opportunities going forward
- Other topics as relevant

The Evaluators performed a full process evaluation of CDI in FY 21/22. The key findings from that process evaluation are summarized below:

- The program operated as intended from the perspectives of customers, energy service representatives and program staff.
- The primary form of outreach is door-to-door canvassing by energy service representatives.
- Customers were motivated by the prospect of saving money on their energy bills and getting free lighting upgrades.
- Surveyed customers were highly satisfied with all aspects of the program.

A.1.3.2 Process Evaluation Findings

The following sections include a summary of findings informed by the LADWP program staff interview conducted in August 2023.

A.1.3.2.1 Program Design and Delivery

LADWP staff note that CDI's program design and delivery is largely the same as the previous fiscal year, although they will be ending the contract with SCPPA in December 2023. At the time of the interview, staff was working on an RFP for an administrator contractor to start in 2024. The program still works primarily with Willdan, which implements the program and subcontracts out the work.

Staff indicated that the program has made no major changes to the processes or operations in the past year. Internally, these changes were made to the program: 1) modified the invoice review and check-off process to improve accountability and help with documentation for audits; 2) moved from the Customer Service division into Efficiency Solutions division, then, within the past few months, to the Power System division.

The measures offered through the program remained consistent with some additions. Specifically, the program added refrigeration measures including case lighting, EC fan motors for walk-in coolers and freezers, and auto door closers for coolers and freezers. These measures have been approved by the program, but they are awaiting final approval from SCPPA's legal team before contractors can start installing them.

A.1.3.2.2 Program Customer Engagement and Participation Process

Program staff indicate that the methods of customer engagement are largely unchanged from previous years and that those methods seem to be working "pretty good," although participation is down from pre-pandemic levels. The program does not conduct internal marketing campaigns. Instead, program staff described two primary types of outreach used to reach customers.

The first is in-person visits from Willdan electric service representatives (ESRs). These ESRs are functionally the face of the program. They will walk neighborhoods going door-to-door visiting businesses marketing the program face-to-face. These visits also enable them to keep lists of businesses to return to when the program offers new measures.

The second type is through partnership with community-based organizations (CBOs). The program has partnerships with six to seven CBOs located throughout LADWP service territory. These CBOs also canvas their neighborhoods and call customers to see if they are interested in the program.

Staff noted that they do not get much feedback from contractors on how the program is going, but what they do hear is mostly requests that the program offer additional measures.

A.1.3.2.3 Barriers and Opportunities

Program staff highlighted the following barrier:

- **Measures approval process**. Staff see getting approval to add new measures to the program as the biggest barrier this past fiscal year. Under the new organizational structure and updated procurement policy with SCPPA, adding new measures requires additional documentation and justifications, then several internal approvals followed by a review by the SCPPA legal team. This has proven to be an extremely slow process. Prior to the new policy, approval of new measures took about a month, but now it can be three to more than six months.

Program staff see additional opportunities as described below:

- **End of SCPPA contract**. Program staff expect the end of the SCPPA contract in December 2023 to allow a more streamlined approval process for adding new measures because there is one less signature required. They expect that moving the process to entirely in-house will give them more control and allow them to expedite new measure approvals.
- **New refrigeration measures**. Staff expects to see increased participation when new refrigeration measures are given final approval.

A.1.3.2.4 Previous Evaluation Recommendations

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

Table A-6 Previous CDI Recommendations & Program Response

Summary of Past Recommendations	Program Response
Communicate to customers the pathway to participate in additional energy efficiency opportunities through LADWP	Not implemented yet.
Perform additional marketing and outreach to non-English speaking audiences	Not done yet. The current fact sheet offers Spanish and Korean language versions also. They think a Japanese language version may be under development.
Proactively communicate the program process and project status to customers	Not implemented yet.

A.1.4 Recommendations

The Evaluator does not have any new recommendations for CDI.

A.2 Commercial Lighting Incentive Program

This section details the impact evaluation for the Commercial Lighting Incentive Program (CLIP) program that LADWP offered customers during FY 22/23. 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 summary 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 22/23. 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 were designed 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 the period from FY 20/21 – FY 22/23, the sample resulted in a program level precision of ±9.83% at the 90% confidence interval using the Ex-Post 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-7 CLIP Population/Sample Statistics

Stratum	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
1	0 -25,000	79	836,062	10,583	6,858	0.65	6
2	25,000 - 115,000	142	8,980,050	63,240	25,942	0.41	8
3	115,000 - 220,000	77	12,799,128	166,222	27,664	0.17	3
4	220,000 - 450,000	91	28,987,435	318,543	65,798	0.21	8
5	450,000 - 680,000	26	14,780,710	568,489	57,517	0.10	2
6	680,000 - 1,500,000	19	17,101,822	900,096	204,645	0.23	3
7	1,500,000 – 6,000,000	6	16,499,444	2,749,907	1,694,546	0.62	3
Totals		**440**	**99,984,650**	**227,238**	**410,916**		**33**

A.2.1.3 Baseline Assumptions Review

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

$$kWh_{Savings} = \frac{Watt_{Baseline} * HOU_{Baseline} * Qty_{Baseline} - Watt_{Installed} * HOU_{Installed} * Qty_{Installed}}{1000} * IEFe \qquad \textit{Equation A-3}$$

$$kWh_{Code} = \frac{Watt_{Code} * HOU_{Baseline} * Qty_{Baseline} - Watt_{Installed} * HOU_{Installed} * Qty_{Installed}}{1000} * IEFe \qquad \textit{Equation A-4}$$

$$\Delta kW = (Watt_{Baseline} - Watt_{Installed}) * CF * IEFd/1000 \qquad \textit{Equation A-5}$$

$$Dual\ Baseline\ Lifetime\ Savings = kWh_{Savings} * \frac{EUL}{3} + kWh_{Code} * (EUL - \frac{EUL}{3}) \qquad \textit{Equation A-6}$$

Equation A-3 and Equation A-5 detail the equations used to determine energy savings and demand reduction for lighting measures. Dual baseline lifetime savings were calculated as a part of the program analysis, detailed in Equation A-6. Calculation of dual baseline lifetime savings required the use of savings using code standards found using Equation A-4. Baseline assumptions made for energy savings and demand reduction are detailed below:

Baseline Wattage: For the Ex-Post savings analysis, the baseline wattage is considered as the wattage of the pre-retrofit lighting fixture. However, for the purpose of calculating dual baseline lifetime savings, savings were also calculated using a code-specified baseline wattage. For Tube LEDs, High Bay LEDs, and LED Troffer Kits, the code baseline wattage was calculated using a code efficacy value taken from the SWLG009-02, SWLG011-03, and SWLG012-01 workpapers along with the lumens of the installed fixture. For Screw-In LEDs, the code baseline wattage was determined using a wattage reduction ratio taken from DEER workpapers applied to the installed fixture wattage.

Hours of Use (HOU): The hours of use utilized were the hours confirmed during the virtual verification process. Deemed values from DEER workpapers dependent upon space type and climate zone were also used.

Summer Peak Coincidence Factor (CF): The summer peak coincidence factor is a ratio determined by light usage during the peak demand period of 1pm-5pm on weekdays from July to September.

Interactive Effects, Energy Savings (IEFe): The utilized value for energy interactive effects come from tables taken from DEER. The values are dependent upon space type, climate zone, and installed fixture type.

Interactive Effects, Demand Reduction (IEFd): The utilized value for energy interactive effects come from tables taken from DEER. The values are dependent upon space type, climate zone, and installed fixture type.

A.2.1.4 Ex-Ante Savings Review

Table A-8 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-8 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
FY 20/21	26,663,687	26,798,030	0.5%	2,921.98	4,730.59	38.2%
FY 21/22	32,058,688	32,058,688	0%	3,542.55	4,897.00	38%
FY 22/23	41,127,932	41,127,932	0%	5,192.92	6,475.40	25%
Total	**99,850,307**	**99,984,650**	**0.13%**	**11,657.46**	**16,102.99**	**38%**

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.

1. **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, which can be viewed in Appendix D. For confidential and privacy considerations of participants, Appendix D was not published with the public version of the report. Appendix D was provided only to LADWP as reference to supplement this EM&V report. 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

For the FY 22/23 analysis, the Evaluator determined 3 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 Interactive Effects.” For 9 of the 10 sampled projects, “Differing Hours of Operation” was a factor in the realization rate discrepancy. Explanations of how each factor affected realized savings are found below, along with frequency of occurrence as illustrated in Figure A-3. Figure A-4 quantifies the impact of these identified factors on the gross realized savings of the project sample.

- **Differing Interactive Effects:** This factor was chosen for projects in which the interactive effects utilized in the Ex-Ante savings calculations differed from the Ex-Post savings calculations. 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 DEER Workpaper 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.
- **Differing Analytical Approach:** Differing analytical approach was listed as a factor affecting gross realized savings for one CLIP project. In this instance, it was due to reconciliation method used to adjust quantities installed. The Ex-Ante calculations reduce savings for any reduction in fixture by the average savings per fixture instead of removing it from a line item. The Ex-Post savings were calculated by identifying the line item that was affected by reconciliation, resulting in a slight (1%) difference in savings for the project where this factor was noted.

Figure A-3 CLIP Factors Affecting Gross Realized Savings

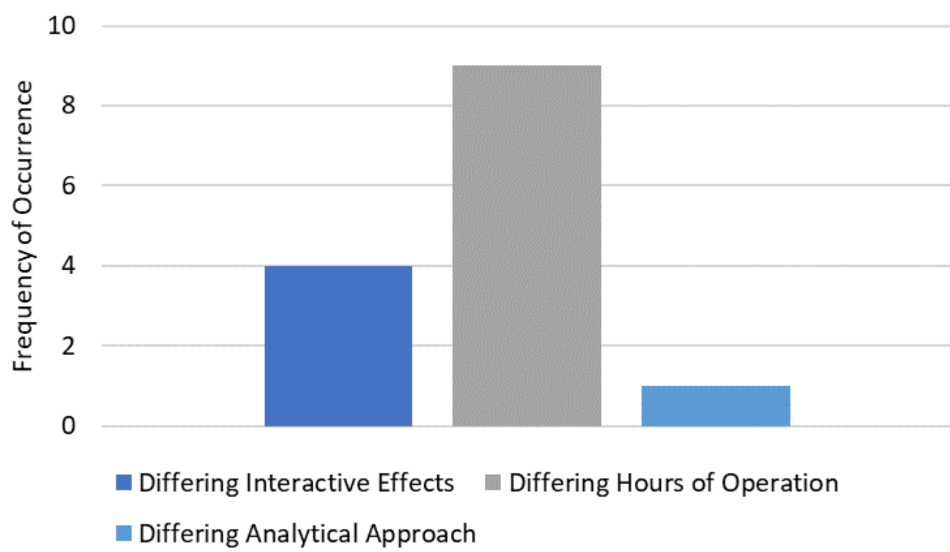
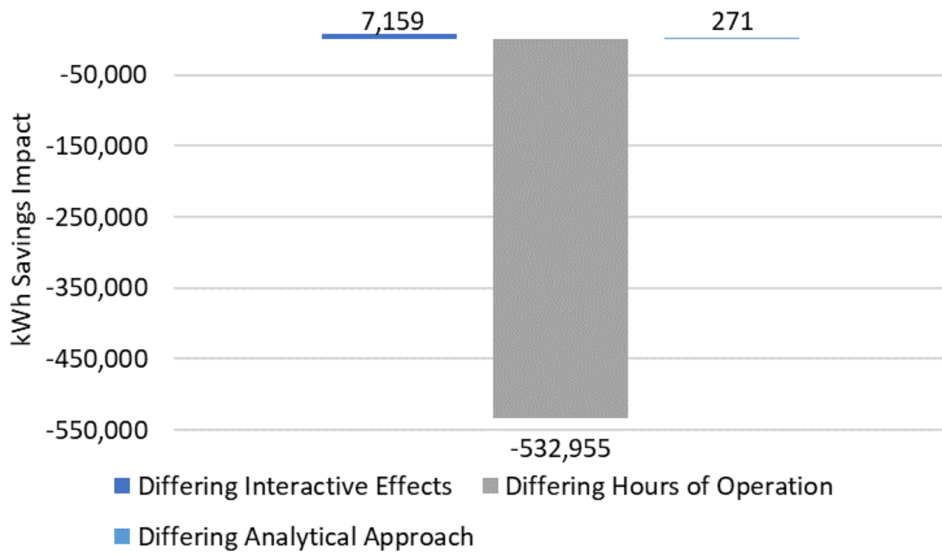


Figure A-4 CLIP Impact of Factors Affecting Gross Realized Savings



A.2.3 Process Evaluation

This section presents the process evaluation for the Commercial Lighting Incentive Program (CLIP).

A.2.3.1 Process Evaluation Approach and Methodology

For FY 22/23, 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 FY 20/21, and a summary process evaluation in FY 21/22.

The key findings from the FY 20/21 full process evaluation are:

- 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 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.

The key findings from the FY 21/22 summary process evaluation are:

- Staff believe customers and vendors are generally happy with the program and incentive rates.
- Staff felt internal operations, including application processing, was going smoothly.
- Staff made progress toward their hiring and onboarding goals by standardizing their procedures and training for hiring new personnel and adding six staff members.

A.2.3.2 Results and Findings

The following sections include a summary of findings informed by the LADWP program staff interview conducted in August 2023.

A.2.3.2.1 Program Design and Delivery

LADWP staff note that CLIP's program design and delivery is largely the same as the previous fiscal year. 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 generally unchanged from the previous year, program staff note that they are exploring some possible program updates that could start in January 2024. These include updated program requirements, terms and conditions, and possibly higher incentives.

Staff noted that internal communications has emerged as a particular strength for their group and that effective communication leads to efficiencies because issues are resolved more quickly, and improvements are easily shared. Ultimately this leads to quicker project completion and payment of rebates.

As an example of this communication, for organizations that are completing larger projects, program staff have continued to use a team approach, meeting frequently, sometimes on a weekly basis, with utility management, field staff, the customer, and their contractor. This helps keep them all up to date on progress and ensures projects go smoothly. The staff also still plan to work more closely with key account advisors and their customers, marketing directly to them, and helping manage expectations throughout the process.

Staff use an Excel spreadsheet to organize, track, and communicate information on the projects. The structure of this Excel spreadsheet has been frequently updated to add new functionality. However, they feel it has started to show its limits.

Program staff also note that internal operations, including application processing, are going smoothly. To help ensure that this continues even when new personnel are hired, they have produced a detailed training manual to help new program staff quickly step into their roles and be effective.

A.2.3.2.2 Barriers and Opportunities

Program staff highlighted the following barriers:

- **Lack of an online portal for application submittal or information distribution.** Customers and vendors must email all application materials to the program, which can be a slow and laborious process. Program staff note that they are working on a portal and strive to be more like Amazon for information flow which would speed up the project life cycle and enhance the customer experience.
- **Requirement that customers have at least 200kW demand.** Contractors are providing a lot of feedback that they would like to do projects through the program for customers below that threshold. Staff indicated that they also worried some customers might fall into that gap and they would be better served by CLIP than available alternatives. However, they note that lowering that threshold could cause them to be quickly backlogged with projects at their current staff levels.
- **Availability of field personnel for verification.** Sometimes when the application reviewers need a field verification, the field group is not available which leads to longer processing times for projects and delays in sending out payments. The team is heavily focused on service to the customer and is exploring this and other ways to reduce processing time before payment.

Program staff see additional opportunities in the following areas:

- **Increased focus on lighting controls.** Program staff note that they expect to become more reliant on installation of lighting controls and networked control systems for savings. The management group and LADWP engineering are exploring possible incentive increases for controls for 2024.
- **Expect to launch a revised Recognized Vendor Program renamed Recognized Contractor Program.** The updated program will include a contractor liaison who will act as the primary contact for contractors with the program and will be their go-to person if they have issues with a project. This should allow for quicker responses to contractor inquiries, which can shorten project timelines.

- **Planned program updates to encourage participation.** The staff hope to make some program changes in 2024 to encourage greater participation. These may include program requirements, terms and conditions, or increased incentive levels.

A.2.3.2.3 Previous Evaluation Recommendations

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

Table A-9 Previous CLIP Recommendations & Program Response

Summary of Past Recommendations	Program Response
Support vendors in identifying eligible customers	No changes. The program is designed to help customers find vendors but not the reverse. Also, they cannot endorse specific vendors.
Communicate with vendors early and often about program changes	No changes. The team plans to meet with vendors in December 2023 to give them an early look at proposed program changes for 2024.
Simplify program forms and processes	The program has not changed external forms or processes. However, they are still working with the department to explore an online portal and equipment documentation processes. These may provide efficiencies for customers in the future and could help address issues with their current Excel-based system.
Build trust with Recognized Vendors	The program is planning to launch a redesign of the Recognized Vendor Program in January 2024. The new program will be called the Recognized Contractor Program and will include a contractor liaison.

A.2.4 Recommendations

The Evaluator does not have any recommendations for CLIP at this time.

A.3 Custom Performance Program

This section details the impact evaluation and process evaluation for the Custom Performance Program (CPP) program that LADWP offered customers during FY 22/23. 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 and tracking data were reviewed for completeness and for identification of outliers and anomalies. Completed projects were checked for installation and incentive dates to validate 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 HVAC, Lighting, Process, Refrigeration, and Food Service. A summary of FY 22/23 projects by measure type category is shown in Table A-10.

Table A-10 Summary of CPP FY 22/23 Projects by Measure Categories

Stratum	Total Program Projects	Total Ex-Ante Annual kWh	Ex-Ante kWh Minimum Boundary	Ex- Ante kWh Maximum Boundary	Percent of Population
HVAC	91	0	65.93	974,793	0.0%
Lighting	4	290,214	1727.315	234,039	5.2%
Process	14	2,951,350	1208	888,484	52.5%
Refrigeration	29	2,378,911	5686.55	123,858	42.3%
Food Service	3	0	4987	13,228	0.0%
Total	**141**	**5,620,474**	**66**	**974,793**	**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 are 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. As presented in Table A-11, 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. The overall precision for the 3-year sample is 9.5%.

Table A-11 CPP Evaluation Sample for 3-year Concurrent Period

Strata	Strata Boundaries	Population Size	CV	Total kWh	Sample Size	Contribution to Variance	Precision
Census	All	3	1.03	9,355,301	17	4,877,296,274,773	38.7%
Commercial HVAC	<220,000	168	0.20	6,334,858	2	710,936,636,290	21.8%
Commercial HVAC 2	220,000 - 449,999	21	0.16	4,750,619	2	150,943,241,290	13.4%
Commercial HVAC 3	450,000 - 799,999	7	0.47	3,341,699	3	748,239,780,343	42.5%
Commercial HVAC 4	800,000 - 2,500,000	5	1.21	2,680,017	6	1,541,346,126,413	76.0%
Commercial HVAC 5	> 2,500,000	1	0.15	2,098,667	1	84,990,640,479	22.8%
Commercial Refrigeration	<199,999	42	0.89	5,752,551	15	1,267,235,606,640	32.1%
Commercial Refrigeration 2	>200,000	1	0.79	483,081	2	24,519,299,741	53.2%
Custom HVAC, HVAC Controls, EMS, Window Film	<200,000	52	0.39	7,391,337	2	2,522,220,163,990	35.2%
Custom HVAC, HVAC Controls, EMS, Window Film 2	200,000 - 349,999	8	0.24	3,739,762	1	676,409,185,888	36.1%
Custom HVAC, HVAC Controls, EMS, Window Film 3	350,000 - 799,999	8	0.22	10,099,616	2	2,312,394,833,353	24.7%
Custom HVAC, HVAC Controls, EMS, Window Film 4	> 880,000	1	0.02	1,356,682	2	0	0.0%
Custom Lighting	<289,999	54	0.00	722,757	1	0	0.0%
Custom Lighting 2	290,000 - 649,999	26	0.80	1,096,166	3	0	0.0%
Custom Lighting 3	> 660,000	2	0.00	7,567,917	1	0	0.0%
Custom Motors	All	3	0.00	888,484	1	0	0.0%
Grand Total	**-**	**-**	**-**	**67,659,515**	**61**	**14,916,531,789,200**	**9.4%**

For FY 22/23, the sample resulted in a program level precision of ±29.8% at the 90% confidence interval using Ex-ante estimates. A summary of the sample is shown in Table A-12. The selected sample represents about 27% of the CPP population.

Table A-12 FY 22/23 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
Census	All	3	3	294,063	1,096,166	1,096,166
Commercial HVAC	<220,000	82	3	54,092	4,269,540	158,131

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	220,000 - 450,000	8	0	49,415	2,360,071	0
Commercial HVAC 3	450,000 - 800,000	1	0	0	1,226,923	0
Commercial HVAC 4	>800,000	2	1	69,786	1,850,893	925,447
Commercial Refrigeration	All	30	2	28,200	2,423,607	161,574
Custom HVAC, HVAC Controls, EMS, Window Film	<200,000	8	3	64,044	378,153	141,807
Custom HVAC, HVAC Controls, EMS, Window Film 3	200,000 - 800,000	1	1	0	353,705	353,705
Custom HVAC, HVAC Controls, EMS, Window Film 4	>800,000	1	1	0	888,484	888,484
Custom Lighting	All	4	1	108,424	290,214	72,553
Custom Motors	All	1	1	0	32,800	32,800
Total	**N/A**	**141**	**16**	**668023**	**15,170,555**	**3,830,667**

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 M&V Plans. A review of energy savings calculations by the Evaluator focused on the key factors and assumptions used to determine energy use, including operating hours, usage patterns, and load factors. The review included the following:

- Review of energy efficiency improvements considered;
- Review of energy analysis input assumptions; and
- Review of methods used to calculate energy savings.

When applicable and feasible, a desk-review of the provided calculations was completed to prepare for primary data collection. Regenerating energy savings estimates ensured that all issues and concerns were identified prior to communicating with the site contact.

Available billing data was reviewed and analyzed to identify the potential for use in either a billing regression analysis or calibration of an energy simulation.

A.3.1.4 Site Specific Measurement and Verification Plans

After a full review of program documentation, project documentation, and billing data, the Evaluator developed M&V 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 most sites for this evaluation. The first step was to ensure the M&V Plans provided defensible methodologies to facilitate data collection through 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 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 FY 22/23.

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 44 different measure types were implemented during the program year. For reporting purposes, measure types were categorized into Building Controls, HVAC, Lighting, Refrigeration, Food Service, and Process. 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 FY 22/23 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. A summary of FY 22/23 data collection activities for the sample is shown in Table A-13.

Table A-13 CPP FY 22/23 Evaluation Data Collection by Measure

Stratum	M&V Plans	On-Site Verification	Evaluated
Census	3	3	3
Commercial HVAC	3	3	3
Commercial HVAC 4	1	1	1
Commercial Refrigeration	2	2	2
Custom HVAC, HVAC Controls, EMS, Window Film	3	3	3
Custom HVAC, HVAC Controls, EMS, Window Film 3	1	1	1
Custom HVAC, HVAC Controls, EMS, Window Film 4	1	0	1
Custom Lighting	1	1	1
Custom Motors	1	1	1
Total	**16**	**15**	**16**

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 2022/2023 fiscal year. Evaluation protocols were classified using the IPMVP Options. A summary of the protocols used is shown in Table A-14.

Table A-14 CPP Evaluation Protocols by Measure

IPMVP Option	Number of Measures FY 2022 – 2023
Option A: Spreadsheet or Basic Bin Analysis	1
Option A-: TRM (Or other Deemed) Analysis	4
Option A+: Engineering Analysis (Based on Trend or Monitored Data)	6

IPMVP Option	Number of Measures FY 2022 – 2023
Option C: Whole Building Retrofit	3
Option D: Calibrated Simulation	2
Total	**16**

A summary of FY 22/23 evaluated measures by measure types selected from the population is shown in Table A-15. The sample projects was randomly selected based on magnitude of energy savings. Samples from fiscal years 2020/2021, 2021/2022, and 2022/2023 were combined to meet an overall precision of +/- 10% at the 90% confidence interval.

Table A-15 CPP FY 22/23 Evaluated Measures by Category and Protocol

Measure Type	Option A: Spreadsheet or Basic Bin Analysis	Option A-: TRM (Or other Deemed) Analysis	Option A+: Engineering Analysis (Based on Trend or Monitored Data)	Option C: Whole Building Retrofit	Option D: Calibrated Simulation	Total
Commercial HVAC	1	1	4	0	0	6
Commercial HVAC 4	0	0	0	0	1	1
Commercial Refrigeration	0	2	0	0	0	2
Custom HVAC, HVAC Controls, EMS, Window Film	0	1	1	1	0	3
Custom HVAC, HVAC Controls, EMS, Window Film 3	0	0	0	1	0	1
Custom HVAC, HVAC Controls, EMS, Window Film 4	0	0	0	1	0	1
Custom Lighting	0	0	1	0	0	1
Custom Motors	0	0	0	0	1	1
Total	**1**	**4**	**6**	**3**	**2**	**16**

Project-level and measure level results can be found in the provided site-level reports, which can be viewed in Appendix D. For confidential and privacy considerations of participants, Appendix D was not published with the public version of the report. Appendix D was provided only to LADWP as reference to supplement this EM&V report. Sampled measures represented 25% 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-16.

Table A-16 CPP FY 22/23 Evaluation Sample Savings Summary

Measure	Ex-Ante kWh Savings	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
Census	1,096,166	1,138,213	104%	250	207	83%
Commercial HVAC	4,269,540	4,288,415	100%	893	943	106%
Commercial HVAC 2	2,360,071	2,389,427	101%	361	318	88%
Commercial HVAC 3	1,226,923	1,242,184	101%	-259	-228	88%
Commercial HVAC 4	1,850,893	1,818,344	98%	195	176	90%
Commercial Refrigeration	2,423,607	2,159,041	89%	165	123	74%
Custom HVAC, HVAC Controls, EMS, Window Film	378,153	364,588	96%	33	52	156%
Custom HVAC, HVAC Controls, EMS, Window Film 3	353,705	353,705	100%	0	0	0%
Custom HVAC, HVAC Controls, EMS, Window Film 4	888,484	1,008,807	114%	157	167	106%
Custom Lighting	290,214	180,882	62%	235	0	0%
Custom Motors	32,800	32,415	99%	5	5	99%
Total	**15,170,555**	**14,976,022**	**99%**	**2,034**	**1,761**	**87%**

Evaluation sample savings impacts by measure category are shown in Table A-17.

Table A-17 CPP FY 22/23 Evaluation Savings by Measure Category

Measure Category	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
HVAC	9,521,650	9,640,086	101%	999.07	880.51	88%
Lighting	290,214	180,882	62%	234.60	0.00	0%
Process	2,951,350	3,013,017	102%	637.48	762.03	120%
Refrigeration	2,378,911	2,113,411	89%	158.41	114.28	72%

Measure Category	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
Food Service	28,432	28,626	101%	4.58	4.61	101%
Total	**15,170,555**	**14,976,022**	**99%**	**2,034.14**	**1,761.43**	**87%**

The largest project in the evaluation sample consists of Whole Building Monitoring Based retro-commissioning. This project was placed under the HVAC measure category.

A.3.2 Process Evaluation

This section presents the process evaluation for the Custom Performance Program (CPP).

A.3.2.1 Process Evaluation Approach and Methodology

For FY 22/23, 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 Evaluators performed a full process evaluation of CPP in FY 20/21, and a summary process evaluation in FY 21/22. The key findings from the full process evaluation were:

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

- **The division of the project into express and custom calculated tracks has improved the efficiency of the program.** The addition of the express track for simpler measures, for which deemed savings values can be used, has simplified the program process, and allowed staff to reallocate efforts to larger projects that are more impactful on overall program results.

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

The key findings from the FY 22/23 summary process evaluation include:

- The CPP design and delivery are largely unchanged from the previous fiscal year.
- The participation process was smooth for participants.
- Program staff were able to continue conducting in-person site visits as COVID receded.
- Staff noted challenges in scheduling a few site visits.

A.3.2.2 Results and Findings

The following sections include a summary of findings informed by the LADWP program staff interview conducted in August 2023.

A.3.2.2.1 Program Design and Delivery

LADWP staff note that CPP’s program design is largely the same as the previous fiscal year, including the same list of incentivized measures. 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. That said, at the time of the interview, program staff is currently working on program updates with the goal of introducing them to contractors/vendors in December 2023, to take effect in January 2024.

Program staff note that they are currently short-staffed by two project managers, so existing staff are covering more areas, which affects response time and limits interactions with customers. Although short staffed, customer and contractor engagement is important; therefore, LADWP program staff are making concerted efforts to more proactively reach out to customers and contractors to understand any issues they are having in applying to the program and their experiences with the program.

As noted in the discussion on barriers below, low participation is a concern, which led staff to consider activities to increase participation. As examples, they are reaching out to different industries to promote participation in the program and have a table presence at three upcoming events. They are also leveraging the key accounts group to get more participation from customers.

At the time of the interview, the program had not conducted any workshops for FY 22/23 but planned on hosting two later in the year. Currently they are working on developing a workshop for organizations who need to comply with the electric vehicle ordinance, and another in December to introduce the program updates for 2024. Furthermore, they plan to explore advertisements in relevant publications.

Lower than anticipated savings and participation plagued the program, as articulated above. Many of the reasons attributed to the lower participation are internally related, such as staff constraints and turnover, as well as supply chain issues. However, it may be worth a more focused market assessment to identify other root factors and opportunities to increase participation, such as contractor and customer awareness and understanding of the CPP, applicability of equipment offered through the program, and barriers and opportunities introduced through program requirements.

A.3.2.2.2 Barriers and Opportunities

Program staff highlighted the following barriers:

- **Low participation.** Staff note they will need to increase participation if they hope to meet savings goals in the coming year. Staff are hopeful that more frequent workshops, the launch of the updated program at the end of the year, and increased outreach at events and through account managers will provide a needed boost to participation.
- **Contracting for engineering services.** LADWP is currently negotiating contracts for engineering services to perform on-site verification and develop energy use baselines and savings estimates. Staff note that delays in finalizing these contracts may cause a gap in service for program applicants.

Program staff see additional opportunities in the following areas:

- **Project manager engagement.** Despite being understaffed by two project managers, staff note that the project managers on staff are knowledgeable, involved, and responsive to projects and can assist customers when questions or issues arise.
- **Upcoming program relaunch.** The staff are optimistic that the redesign and relaunch of the CPP program slated for 2024 will help boost participation and program savings. The updated program will increase incentives, offer additional rebates for qualifying measures, expand marketing, and outreach, and streamline

processes resulting in quicker project completions and payouts. Staff are also hopeful that the new building electrification incentives will be part of this re-launch and will boost participation in CPP as well as other programs.

- **Possible cross-program offerings.** LADWP staff are still considering other offerings that may cut across several programs, such as a whole-building incentive as well as offering additional incentives for projects located in designated disadvantaged communities.

A.3.2.2.3 Previous Evaluation Recommendations

The table below includes a summary of previous recommendations (i.e., PY20/21, evaluators offered no new recommendations in PY21/22) and the program's response to date.

Table A-18 Previous CPP Recommendations & Program Response

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 currently tracked at every stage, but they have not done analytics because projects are so different, making them difficult to compare. Performance is instead assessed on a case-by-case basis.
Review the application process and identify opportunities to streamline	The program is not currently working on these options.

A.3.3 Recommendations

The Evaluator offers the following recommendation for improving CPP.

LADWP should consider a more focused market assessment to identify root factors affecting current participation levels and opportunities to increase participation. Better information on contractor awareness of CPP, understanding of offered services, relevant market segments, and barriers and opportunities due to program requirements would help inform strategies to boost participation.

A.4 Food Service Program – Comprehensive

This section details the impact evaluation and process evaluation for the Food Service Program – Comprehensive (FSPC) that LADWP offered customers during Fiscal Year 20/21, FY 21/22, and FY 22/23 (FY 20/21 or Concurrent Year 1, FY 21/22 or Concurrent Year 2, FY 22/23 or Concurrent Year 3). 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-19.

Table A-19 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 2020 and June 2023 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. Over all three years, the sample projects were enough to estimate the total Ex-Post savings with ±9.3% precision at a 90% confidence interval.

Projects were categorized to each stratum measure. Table A-20 presents the number of projects and tracking Ex-ante kWh savings for the sampled projects by stratum.

Table A-20 FSPC Population Statistics used for FY 22/23 Sample Design

	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
Ice Machines	2	2,789	1,394.38	1,030.33	1.32	2
Fridges/Freezers	18	7,195	399.73	106.11	0.35	13
Hot Food Cabinets	1	1,068	1,067.62	-	-	1
Oven	1	3,357	3,357.16	-	-	1
Oven 2	1	22,557	22,557.00	-	-	1
Totals	**23**	**36,966**	**-**	**-**	**-**	**18**

The resulting sample of three projects consisted of two categories, or strata. The sample precision based on Ex-Post gross annual energy savings (kWh) for FY 22/23 was ±2.4%.

A.4.1.3 Baseline Assumptions Review

The Evaluator utilized DEER workpaper baseline assumptions (idle energy rates, production capacities, cooking efficiencies, etc.) for all measures. Workpaper approval dates were cross-checked with the FY 20/21, FY 21/22 and FY 22/23 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.

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-21 compares Ex-Post energy impacts to Ex-Ante claimed savings from the tracking data. For FY 22/23, the program level Ex-Post energy savings realization rate was 75% when compared to tracking data Ex-Ante savings.

Table A-21 FSPC FY 22/23 Stratum Savings Summary

Stratum	Tracking Data Ex-Ante kWh Saving	Ex-Post kWh Savings	Gross kWh Realization Rate
Ice Machine	2,789	7,099	255%
Refrigerator/Freezer	7,195	7,798	108%
Hot Food Cabinet	1,068	347	32%
Oven	3,357	5,600	167%
Oven 2	22,557	6,820	30%
Total	**36,966**	27,664	**75%**

The program level realization rate for all three concurrent years combined of 97% was a result of the sampled projects seen below in Table A-22.

Table A-22 FSPC FY 21/22 Sampled and Non-Sampled Savings Summary

Project	Tracking Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
CY1 Project 1	25,822	22,737	88%
CY1 Project 2	11,497	20,218	176%
CY1 Project 3	808	685	85%
CY1 Project 4	22,994	6,640	29%
CY1 Project 5	8,916	14,730	165%
CY1 Project 6	1,067	82	8%
CY2 Project 7	3,665	4,235	116%
CY2 Project 1	427	353	83%
CY2 Project 2	1,810	1,809	100%
CY2 Project 3	2,064	2,093	101%
CY3 Project 1	3,357	5,600	167%
CY3 Project 2	446	506	113%
CY3 Project 3	1,152	1,113	97%
CY3 Project 4	1,118	1,498	138%
CY3 Project 5	854	790	93%

Project	Tracking Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
CY3 Project 6	22,557	6,820	30%
CY3 Project 7	2,366	7,108	300%
CY3 Project 8	2,236	1,076	48%
CY3 Project 9	446	475	107%
CY3 Project 10	446	491	110%
CY1 Non-Sampled Projects	44,220	52,980	120%
CY2 Non-sampled Projects	9,968	9,955	100%
CY3 Non-sampled Projects	1,981	2,187	110%
Total	**170,223**	**164,181**	**96%**

The Evaluator sample included 20 projects. The specific factors affecting the projects' realization rates were as follows.

For CY1

Project 1: This site involved the installation of a convection oven, commercial ventilation, a hot food cabinet, and door auto closers. For the convection oven calculations, the Evaluator used the purchased units' efficient parameters in lieu of the default DEER workpaper values used in the Ex-Ante estimate. It was found that only one of the two units was operational at any given point, leading to further discrepancy savings. For the hot food cabinet, the Evaluator used the purchased units' efficient parameters in lieu of the default DEER workpaper values used in the Ex-Ante estimate. It was clear that the Ex-Ante calculations utilized the default values of 25 cubic feet for an unknown volume and 11.3 watts per cubic foot, whereas the Evaluator utilized the as found values of 21.5 cubic feet and 19.16 watts per cubic foot. The reasoning for the discrepancy in the auto-closer and commercial ventilation calculations is indeterminate.

Project 2: Multiple attempts to reach this site were ultimately unsuccessful so a desk review was conducted with available project information. This site involved the installation of one commercial refrigeration and one commercial freezer unit where the Evaluator used the purchased units' efficient parameters in lieu of the default DEER workpaper values used in the Ex-Ante estimate. This discrepancy could be further explained by the averaging taking place in Ex-Ante estimations.

Project 3: This site involved the installation of a combination oven where the Evaluator used the purchased units' efficient parameters in lieu of the default DEER workpaper values used in the Ex-Ante estimate

Project 4: This site involved the installation of a combination oven where the Evaluator used the purchased units' efficient parameters in lieu of the default DEER workpaper values used in the Ex-Ante estimate. A site visit found a significant reduction in hours of use as well as cooker food per day when compared to the default DEER workpaper values. In addition, it was found that only one of the two units was operational at any given point, leading to further discrepancy savings.

Project 5: This site involved the installation kitchen hood DCV site where the Ex-Post savings sourced from the DEER workpapers were greater than the Ex-Ante savings; the source of the Ex-Ante values was unknown. In addition, the commercial freezer found to be on site was not ENERGYSTAR certified, leading to further discrepancy in savings.

Project 6: This site involved the installation of a hot food cabinet where the Evaluator used the purchased units' efficient parameters in lieu of the default DEER workpaper values used in the Ex-Ante estimate. In addition, the Evaluator used the hours found during a site visit of 780 instead of the default value of 4,380.

Project 1: The Evaluator was unable to determine a factor affecting realization rate; however, the most likely factor affecting savings is differing equipment parameters.

For CY2

Project 1: This site involved the installation of commercial refrigeration where the Evaluator used the purchased units' efficient parameters in lieu of the default DEER workpaper 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: This site involved the installation of commercial refrigeration where, although the reasoning for the discrepancy is indeterminate, it is highly likely it is due to the Evaluator using the purchased unit's efficient parameters in lieu of the default DEER workpaper values used in the Ex-Ante estimate.

Project 3: This site involved the installation of commercial refrigeration units and ice machines. Although the reasoning for discrepancies in the calculations is indeterminate, it is likely due to the Evaluator using the purchased units' efficient parameters in lieu of the default DEER workpaper values used in the Ex-Ante estimate. In addition, further discrepancy could arise from the averaging taking place in Ex-Ante calculations.

For CY3

Project 1: This site involved the installation of a convection oven where the Evaluator used the purchased units' efficient parameters in lieu of the default DEER workpaper values used in the Ex-Ante estimate.

Project 2: This site involved the installation of commercial refrigeration where the Evaluator used the purchased unit's efficient parameters in lieu of the default DEER workpaper values used in the Ex-Ante estimate. The Ex-Ante estimate used a volume of 44 cu ft. The Ex-Post calculation used values from the product specification sheet of 41.47 cu ft.

Project 3: This site involved the installation of commercial refrigeration where the Evaluator used the efficient parameters of a different unit than the unit an Ex-Ante site visit found. The Ex-Ante calculations utilize the values for the Turbo Air Solid Door Freezer Model #M3F24-1-N which was not found to be on site. However, a similar model Turbo Air Solid Door Freezer Model #M3F47-2-N was found to be on-site and was assumed to be the unit purchased instead.

Project 4: This site involved the installation of commercial refrigeration where the Evaluator used the purchased units' efficient parameters in lieu of the default DEER workpaper values used in the Ex-Ante estimate. The Ex-Ante estimate used a volume of 44 cu ft. for all units The Ex-Post calculation used values from the product specification sheets of 43.5 cu ft., 44.8 cu ft., and 42.2 cu ft.

Project 5: This site involved the installation of commercial refrigeration where the Evaluator used the purchased unit's efficient parameters in lieu of the default DEER workpaper 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 8.48 cu ft.

Project 6: This project involved the installation of a deck oven. The source of the discrepancy was mainly due to the Ex-Ante assumption of the installation of three triple deck ovens, the actual implementation featured only a singular triple deck oven. This realization rate factor is described as missing equipment.

Project 7: Attempts to reach this site were ultimately unsuccessful, therefore a desk review was conducted with available project documentation. This site involved the installation of four ice maker units and a commercial refrigeration unit. For the refrigeration unit the Evaluator used the purchased unit's efficient parameters in lieu of the default DEER workpaper values used in the Ex-Ante estimate. The Ex-Ante estimate used a volume of 24 cu ft. The Ex-Post calculation used values from the product specification sheet of 23.34 cu ft. The discrepancy in calculations for the ice maker units is unknown, but it is likely due to the utilization of different ice harvesting rates.

Project 8: This site involved the installation of ice maker units, a hot food cabinet and two commercial refrigeration unit. Although the discrepancy in calculations for the commercial refrigeration units is unknown, it is likely due to Evaluator using the purchased unit's efficient parameters in lieu of the default DEER workpaper values used in the Ex-Ante estimate. This reasoning accounts for the discrepancy in calculations for the ice maker unit on this site where the Evaluator used the purchased unit's efficient parameters in lieu of the default DEER workpaper values used in the Ex-Ante estimate. This reasoning also accounts for the discrepancy in calculations for the hot food cabinet, where the Ex-Ante estimate used a volume of 25 cu ft. The Ex-Post calculation used values from the product specification sheet of 15.6 cu ft.

Project 9: This site involved the installation of commercial refrigeration where the Evaluator used the purchased unit's efficient parameters in lieu of the default DEER workpaper values used in the Ex-Ante estimate. The Ex-Ante estimate used a volume of 44 cu ft. The Ex-Post calculation used values from the product specification sheet of 42.1 cu ft.

Project 10: This site involved the installation of commercial refrigeration where the Evaluator used the purchased unit's efficient parameters in lieu of the default DEER workpaper values used in the Ex-Ante estimate. The Ex-Ante estimate used a volume of 44 cu ft. The Ex-Post calculation used values from the product specification sheet of 21.7 cu ft.

Project-level and measure-level results can be found in the project site-level reports, which can be viewed in Appendix D. For confidential and privacy considerations of participants, Appendix D was not published with the public version of the report. Appendix D was provided only to LADWP as reference to supplement this EM&V report.

The frequency and impact of the specific factors affecting realized savings listed above are illustrated in Figure A-5 and Figure A-6 below.

Figure A-5 FSPC Factors Affecting Gross Realized Savings

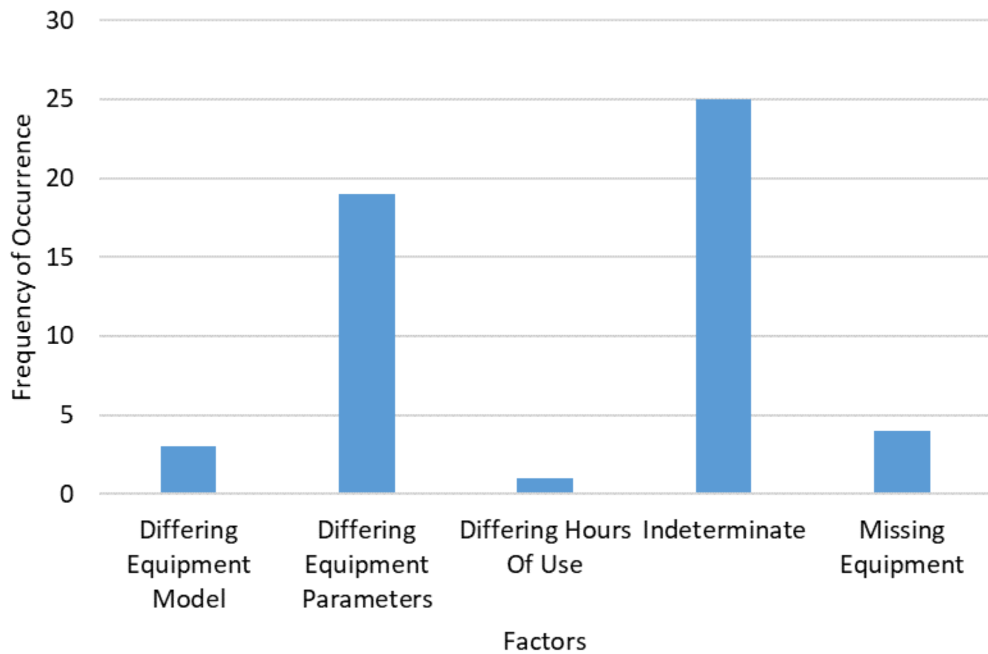


Figure A-6 FSPC Impact of Factors Affecting Gross Realized Savings

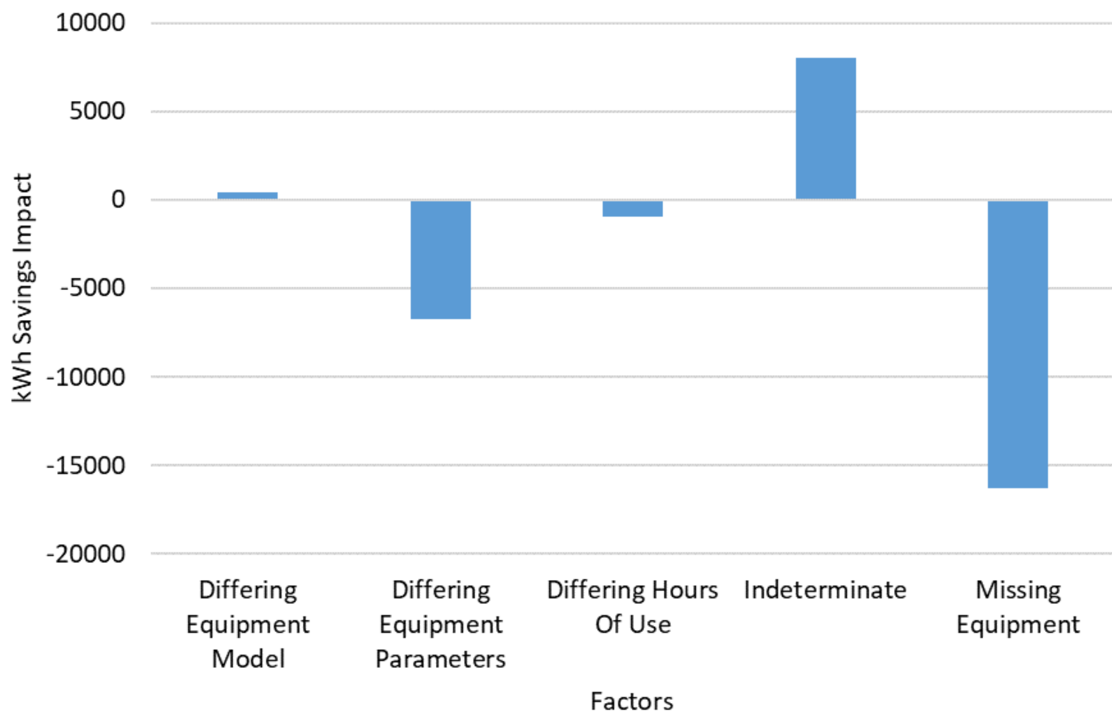


Table A-23 compares Ex-Post energy savings to Ex-ante claimed savings from the tracking data at the measure level. For all three concurrent years combined, the program level Ex-Post energy savings realization rate was 97% when compared to Ex-Ante ESP Data savings.

Table A-23 FSPC Measure Summary

Measure	ESP Data Ex- Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
Auto Closer	1,612	1,419	88%
Combination Oven	57,485	66,225	115%
Convection Oven	6,837	8,664	127%
Electric Deck Oven	22,557	6,820	30%
Hot Food Holding Cabinet	6,077	3,900	64%
Ice Machine	6,758	10,539	156%
Kitchen Hood DVC	37,773	36,227	96%
Refrigerator/Freezer	30,056	30,387	98%
Totals	**169,155**	**164,181**	**97%**

A.4.3 Process Evaluation

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

A.4.3.1 Process Evaluation Approach and Methodology

For FY 22/23, 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 summary process evaluation of FSP in FY 21/22 and a full process evaluation in FY 20/21.

Key findings of the full process evaluation were:

- The pandemic exacerbated challenges reaching the food service market in FY 20/21.
- Dealers generally found the equipment rebates to be helpful in selling efficient equipment, although some would like electric equipment rebate amounts to be higher. Overall, dealers were happy with both the Comprehensive and POS

programs. Likewise, dealers offered positive feedback on other aspects of the program, including the enrollment process and the sales and administrative trainings.

- All dealers highlighted program paperwork as a key pain point in the overall participation process. In particular, dealers struggled to collect customer signatures, which is required to complete different application forms for both the POS and comprehensive programs. Securing a customer signature can be challenging for dealers, particularly when not interacting with customers in-person.

Summarized key findings from the FY 20/21 summary process evaluation include:

- Comprehensive program design and delivery was largely the same as the previous year.
- The program offered a 50% bonus incentive at the beginning of 2022 which was well received.
- Though the Point-of-Sale program ended, dealers who had been participants agreed to help promote the comprehensive program with information on their invoices.
- Chip and semi-conductor shortages caused delays in shipment and increased prices for equipment.
- Inflation reduced available budgets for food service industry businesses.
- The program continued to face challenges with eligibility confirmation, increasing demands on staff time.

A.4.3.2 Results and Findings

The following sections include a summary of findings informed by the LADWP program staff interview conducted in August 2023.

A.4.3.2.1 Program Design and Delivery

Program staff note that the Comprehensive program design and delivery is mostly unchanged from the previous fiscal year, with the primary difference being equipment must now be electric. Other than that, the incentives offered, and incentive structure are unchanged.

Staff reported participation decreased this year, likely a result of decreased marketing and not offering the bonus. Staff said that they did not market the program this fiscal year because of the lingering pandemic impact on the industry; restrictions were just lifted in January 2023. They also did not offer the bonus incentive during this fiscal year like they did during the previous.

Staff feel that they are doing many things well. They note improvements in application processing and getting rebates to customers within their goal of four to six weeks. Other areas they feel are going well are in communication to customers on rebate eligibility and values, as well as follow-up on application issues.

A.4.3.2.2 Barriers and Opportunities

Program staff highlighted the following barriers:

- Lingering effects from COVID-19. Staff note that COVID-19 with the accompanying shutdowns was especially hard on the food service industry, and by extension, the Food Service Program. Continuing issues include:
  - Supply chain shortages
  - Economy is still ramping up and people are getting used to being back open with no restrictions.
  - Business closings that contribute to a lively second-hand equipment market that does not qualify for incentives and typically has more affordable options than rebate-eligible new equipment.
  - Fewer customers dining out due to increased food costs, which in effect reduce budgets for food service businesses making them less likely to buy equipment upgrades.
- Few efficient electric food service equipment options. There are few electric food service equipment models to choose from compared to what is offered for gas equipment, and gas equipment tends to be less expensive than their electric counterparts, which reduces the opportunity for the program.

Program staff see additional opportunities in the following areas:

- **The changing industry landscape.** Staff observed that shared kitchens are growing in popularity, and the city is now allowing residential properties to cook commercially. In addition, “ghost kitchens” are becoming more popular due to the growing use of food ordering and delivery apps, and pop-up food services that might also present opportunities for the program. The program is exploring how to adapt to these new provisions.
- **Incentive levels.** They are not able to offer as high an incentive as they would like. The program staff continue to push for higher incentives to help their customers be able to afford the new, more expensive electric options.
- **Increasing marketing and community events.** Program staff plan to increase marketing efforts and participate in more community events to expand outreach and hope to bring in more participants as the food service industry continues its recovery.

It is clear that the food service market is evolving considerably. And while the program targets many sectors, including liquor and convenience stores, the primary target customer is food service and restaurants. As staff are looking to reinvigorate the program and launch marketing event, it may be worthwhile to explore this sectors’ emerging needs and how the program can best support those needs. It may also be worthwhile to investigate program design and delivery opportunities to encourage electric measure adoption over gas, which will be increasingly important as California continues to meet decarbonization goals.

A.4.3.2.3 Previous Evaluation Recommendations

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

Table A-24 Previous FSP Recommendations & Program Response

Summary of Past Recommendations (Comprehensive only)	Program Response
Consider targeted marketing to boost participation to achieve program goals	Program marketing has been on hold this fiscal year. COVID-19 restrictions were just fully lifted in early 2023, and supply chain issues are still prevalent. They expect to greatly expand marketing and outreach efforts in the coming fiscal year. They advertised in a small business newsletter to a very targeted group but saw little if any increase in program activity.
Create materials to educate customers about why LADWP promotes energy efficiency	No action on this. Staff noted that the program is listed on the state program website which includes tips and tricks for industries.
Create follow-up materials on the importance of maintenance for continued efficient operation of equipment	They do not have any LADWP-specific material.

A.4.4 Recommendations

The Evaluator does not have any recommendations for FSP at this time.

A.5 Food Service Program – Point of Sale

This chapter details the impact evaluation and process evaluation for the Food Service Program – Point of Sale (FSP POS) that LADWP offered customers during FY 20/21 and FY 21/22. Due to the premature conclusion of this program, no savings were present during FY 22/23. 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-25.

Table A-25 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 2020 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 Evaluator's combined sample (FY 20/21, FY 20/21) will in total be enough to estimate the total achieved savings with ±21% precision at a 90% confidence interval. Due to the premature conclusion of this program, the sample encapsulates only two years of data instead of the projected three. Consequently, the precision of our results did not attain the targeted 10% 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-26 presents the number of projects and tracking Ex-ante kWh savings for the sampled projects by stratum.

Table A-26 FSP POS Population Statistics used for Sample Design

Strata	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
CY1-1	<1,930	10	29,210	411	177	.43	2
CY1-2	1,930 – 11,498	5	23,418	1,561	549	.35	4
CY1-3	>11,498	6	43,177	7,196	6,116	.85	2

Strata	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
CY2-FF1	<400	87	8,027	287	78	0.27	2
CY2-FF2	1000>FF2>400	28	6,678	556	176	0.32	3
CY2-FF3	>1000	12	4,602	4,602	-		1
CY2-HFC1	>0	1	13,058	1,865	2,247	1.20	6
CY2-ICE	>0	7	3,007	601	144	0.24	2
CY2-OVEN1	<3500	5	8,393	2,098	839	0.40	2
CY2-OVEN2	>3500	4	147,996	16,444	6,508	0.40	7
Totals		**165**	**287,566**				**29**

The resulting sample of 22 projects consisted of seven categories, or strata. The Ex-Post gross annual energy savings (kWh) precision was ±15.7%.

A.5.1.3 Baseline Assumptions Review

The Evaluator utilized DEER workpaper baseline assumptions (idle energy rates, production capacities, cooking efficiencies, etc.) for all measures. Workpaper approval dates were cross-checked with the FY 20/21 and FY 21/22 start dates 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.

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-27 compares Ex-Post energy impacts to Ex-Ante claimed savings from the tracking data. For the combined FY 20/21 and FY 21/22, the program level Ex-Post energy savings realization rate was 45% when comparing to tracking data Ex-Ante savings. There were no savings for FY 22/23.

Table A-27 FSP POS Stratum Savings Summary

Stratum	Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
CY1-1	29,210	26,234	90%
CY1-2	23,418	10,521	45%
CY1-3	43,177	17,196	40%
CY2-FF1 (Fridge/Freezers 1)	8,027	5,239	65%
CY2-FF2 (Fridge/Freezers 2)	6,678	7,245	108%

Stratum	Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
CY2-FF3 (Fridge/Freezers 3)	4,602	4,804	104%
CY2-HFC (Hot Food Cabinets)	13,058	8,967	69%
CY2-ICE (Ice Machines)	3,007	1,372	46%
CY2-Oven1 (Ovens 1)	8,393	1,563	19%
CY2-Oven2(Ovens 2)	147,996	57,583	39%
Total	**287,566**	**140,725**	**49%**

The program level realization rate of 45% was a result of the sampled projects as shown below in Table A-28.

Table A-28 FSP POS Sampled and Non-Sampled Savings Summary

Project	Ex-Ante kWh Savings	E- Post kWh Savings	Gross kWh Realization Rate
CY1 Project 1	9,361	10,689	114%
CY1 Project 2	2,135	-	0%
CY1 Project 3	3,203	2,342	73%
CY1 Project 4	18,722	766	4%
CY1 Project 5	259	213	82%
CY1 Project 6	1,068	1,439	135%
CY1 Project 7	3,357	-	0%
CY1 Project 8	931	856	92%
CY2 Project 1	3,357	625	19%
CY2 Project 2	15,038	4,715	31%
CY2 Project 3	4,602	4,804	104%
CY2 Project 4	666	377	57%
CY2 Project 5	666	231	35%
CY2 Project 6	11,501	-	0%
CY2 Project 7	11,501	-	0%
CY2 Project 8	30,190	14,806	49%
CY2 Project 9	558	576	103%
CY2 Project 10	11,501	11,501	100%
CY2 Project 11	558	574	103%
CY2 Project 12	486	551	113%
CY2 Project 13	423	276	65%
CY2 Project 14	575	600	104%

Project	Ex-Ante kWh Savings	E- Post kWh Savings	Gross kWh Realization Rate
CY2 Project 15	558	-	0%
CY1 Non-sampled Projects	56,769	37,647	66%
CY2 Non-sampled Projects	99,578	47,137	47%
Total	**287,566**	**140,725**	**49%**

The Evaluator sample included 23 projects. The specific factors affecting the projects realization rates were as follows:

For CY1

Project 1: The Ex-Post calculation utilized the pre-heat length and pre-heats per day found from a site visit as well as the equipment parameters from the specifications sheet in lieu of default DEER work paper values used in the Ex-Ante estimate. The Ex-Ante calculations utilize 6.43 pans, 1 preheat per day, a pre heat energy of 1.776, an idle energy rate of .286, a cooking efficiency of 70.39%, a production capacity of 122.07, 9.25 hours of operation per day and 310.58 days of operation per year. The Ex-Post calculations utilize the as found values of 6 pans, 1.5 preheat per day, a pre heat energy of 2, an idle energy rate of .1, a cooking efficiency of 70%, a production capacity of 127, 8.78 hours of operation per day and 362 days of operation per year.

Project 2: The equipment was not installed or operational during the 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 3: The Ex-Post calculation utilized the ENERGYSTAR database to determine a volume for the hot food cabinet in question. This cabinet was found to be 18 cubic feet. This value was utilized in Ex-Post calculations. Ex-Ante calculations utilize the deemed value for an unknown volume of 25 cubic feet.

Project 4: The Ex-Post calculation utilized the pre-heat length and pre-heats per day found from a site visit as well as the equipment parameters from the specifications sheet in lieu of default DEER work paper values used in the Ex-Ante estimate. The Ex-Ante calculations utilize 6.43 pans, 1 preheat per day, a pre heat energy of 1.776, an idle energy rate of .286, a cooking efficiency of 70.39%, a production capacity of 122.07, 9.25 hours of operation per day and 310.58 days of operation per year. The Ex-Post calculations utilize the as found values of 6 pans, .5 preheat per day, a pre heat energy of 1.66, an idle energy rate of .29, a cooking efficiency of 79%, a production capacity of 132, .57 hours of operation per day and 363 days of operation per year.

Project 5: 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 31.34 cu ft.

Project 6: The Ex-Post calculation utilized the ENERGYSTAR database to determine a volume for the hot food cabinet in question. This cabinet was found to be 18 cubic feet and .67 watts per cubic foot. This value was utilized in Ex-Post calculations. Ex-Ante calculations utilize the deemed value for an unknown volume of 25 cubic feet and 12 watts per cubic foot.

Project 7: The equipment was not installed or operational during the 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 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 72 cu ft. The Ex-Post used volume value from the product specification sheet of 69.35 cu ft.

For CY2

Project 1: The Evaluator was unable to determine a factor affecting realization rate; however, the most likely factor affecting savings is hours of operation.

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 installed or operational during the 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 installed or operational during the 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.

The frequency and impact of the specific factors affecting realized savings listed above are illustrated in Figure A-7 and Figure A-8 below. Note the sum of the frequency of factors is greater than the number of sites as some sites have multiple factors affecting realization rate.

Figure A-7 FSP POS Factors Affecting Gross Realized Savings

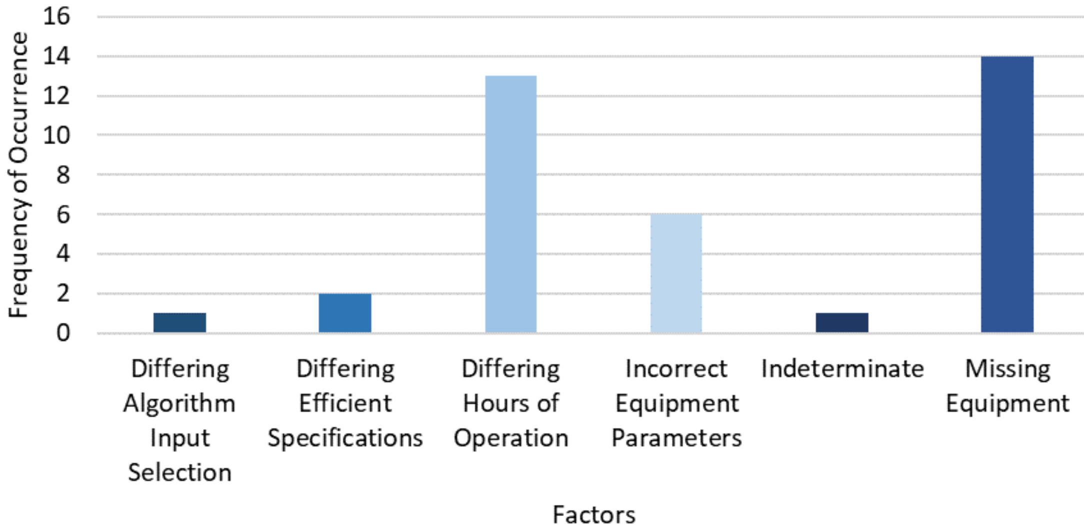


Figure A-8 FSP POS Impact of Factors Affecting Gross Realized Savings

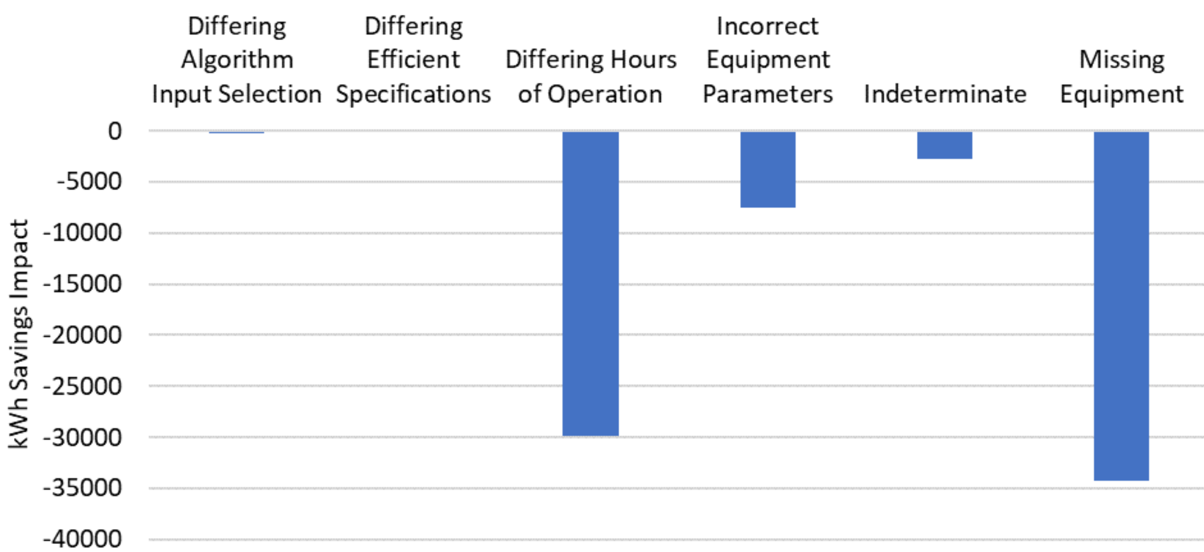


Table A-29 compares Ex-Post energy impacts to Ex-Ante claimed savings from the tracking data at the measure level. For FY 20/21 and FY 21/22 combined, the program level Ex-Post energy savings realization rate was 45% when compared to Ex-Ante savings.

Table A-29 FSP POS Combined FY 21/22 & FY 22/23 Measure Summary Savings

Measure	Program Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
Combination Ovens	99,198	39,732	40%
Convection Oven	16,786	3,654	22%

Measure	Program Data Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
Deck Ovens	30,076	10,566	35%
Hot Food Holding Cabinet	33,343	18,984	57%
Ice Machine	6,428	4,522	70%
Refrigerator/Freezer	54,932	44,527	81%
Steamers	46,804	18,739	40%
Totals	**287,566**	**140,725**	**49%**

A.5.3 Process Evaluation

The process evaluation for the FSPC and FSP-POS are combined and reported in Section A.4.3.

A.5.4 Recommendations

The Evaluator does 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 22/23. 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, 2022, and June 30, 2023. 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 five projects participated in the LADWP Facilities Program during FY 22/23. Two of the projects were street lighting projects in which on-site verification is not reasonable. The other projects consisted of lighting retrofits at LADWP facilities. The three lighting retrofit projects were sampled for evaluation.

A.6.1.3 Baseline Assumptions Review

The projects completed under the LADWP Facilities program during FY 22/23 were found to consist of lighting measures only. Generally, for projects involving lighting measures, savings can be calculated as follows:

$$kWh_{Savings} = \frac{Watt_{Baseline} * HOU_{Baseline} * Qty_{Baseline} - Watt_{Installed} * HOU_{Installed} * Qty_{Installed}}{1000} * IEFe \quad \textit{Equation A-7}$$

$$kWh_{Code} = \frac{Watt_{Code} * HOU_{Baseline} * Qty_{Baseline} - Watt_{Installed} * HOU_{Installed} * Qty_{Installed}}{1000} * IEFe \quad \textit{Equation A-8}$$

$$\Delta kW = (Watt_{Baseline} - Watt_{Installed}) * CF * IEFd/1000 \quad \textit{Equation A-9}$$

$$Dual\ Baseline\ Lifetime\ Savings = kWh_{Savings} * \frac{EUL}{3} + kWh_{Code} * (EUL - \frac{EUL}{3}) \quad \textit{Equation A-10}$$

Equation A-7 and Equation A-9 detail the equations used to determine energy savings and peak demand reduction for lighting measures. Dual baseline lifetime savings were calculated as a part of the program analysis, detailed in Equation A-10. Calculation of dual baseline lifetime savings required the use of savings using code standards found using Equation A-8. 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 using lighting on/off loggers. Street lighting hours are based on a dusk-to-dawn analysis with the assumption that all streetlights are operated by photocells.

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-30 LADWP Facilities Ex-Ante Savings Source Comparison

Project	ESP Data Ex-Ante kWh	Program Data Ex-Ante kWh	ESP Data Ex-Ante kW	Program Data Ex-Ante kW
FY 20/21	969,545	841,940	152.63	101.42
FY 21/22	81,874	81,874	3.72	7.15
FY 22/23	441,771	441,771	64.43	48.91
Total	**1,493,190**	**1,365,585**	**220.78**	**157.48**

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. Projects selected for M&V 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-31.

Table A-31 LADWP Facilities program Evaluation Data Collection Progression

Fiscal Year	M&V Plans	Contact Attempted	Virtual Verification	On-Site Verification	Evaluated
FY 20/21	3	3	0	3	3
FY 21/22	2	2	0	2	2
FY 22/23	3	3	0	3	3
Total	**8**	**8**	**0**	**8**	**8**

The Evaluator conducted on-site lighting monitoring on three of the five LADWP Facilities projects. The other two projects involved street lighting which was deemed not appropriate for monitoring.

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 was completed 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

Site-level M&V was conducted on three out of five projects from FY 22/23. Project-level and measure-level results can be found in the provided site-level reports, which can be viewed in Appendix D. For confidential and privacy considerations of participants, Appendix D was not published with the public version of the report. Appendix D was provided only to LADWP as reference to supplement this EM&V report. In the previous year, M&V was conducted on a street lighting project. The results (realization rate) from this project were extrapolated to the FY 22/23 street lighting projects. Of the nine LADWP facilities projects in the past three program years, the FY 22/23 street lighting projects were the only projects not included in the evaluation samples. The table below presents the FY 22/23 projects.

Table A-32 LADWP CY3 Facilities Program Savings by Project

Project	Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate	Program Data Ex-Ante kW Savings	Program Data Ex-Post kW Savings	Gross kW Realization Rate
Project 1	57,314	58,809	103%	8.02	10.03	125%
Project 2	36,400	38,651	106%	5.18	6.48	125%
Project 3	324,545	139,376	43%	35.7	42.49	119%
Project 4	3,491	5,357	153%	0.00	0.00	NA
Project 5	20,021	30,720	153%	0.00	0.00	NA
Total	**441,771**	**272,913**	**62%**	**48.91**	**59.00**	**121%**

A.6.2.3 Extrapolation of Results

Extrapolation was conducted on the two street lighting projects (Projects four and five in the table above). Evaluation findings from the street lighting project from CY2 was used to determine Ex-Post savings through application of the projects realization rate. All other projects were evaluated individually.

A.6.3 Process Evaluation

A process evaluation was not performed for the LADWP Facilities Program. A full process evaluation was completed for FY 20/21. The key findings from that evaluation were as follows:

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

A.7 LAUSD Direct Install Program

This section details the impact evaluation and process evaluation for the LAUSD Direct Install Program that LADWP offered customers during FY 22/23. 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, 2022, and June 30, 2023. Final program data was provided which showed the energy savings for each unique fixture type and locations. 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 was 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 FY 20/21, FY 21/22, and FY 22/23. Sampling for FY 20/21 was based on stratification by project size (annual energy savings). Sampling for FY 21/22 has been modified to represent sample strata by measure type, and this method was used for FY 22/23. After initial sampling, the Evaluator 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, it is classified as a retrofit. Stratifying by measure type and magnitude of Ex-Ante annual energy savings, the 151 line items sampled at four schools for CY3 represent a sample design of 14.28% 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-33 provides program population and sample statistics.

Table A-33 LAUSD DI Program Population and Sample Statistics (CY3)

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	305	421,606	1,382	2,264	1.64	28
Exterior Sensor	2172	575,950	265	764	2.88	31
Retrofit Interior 1	903	177,309	196	80	0.41	9
Retrofit Interior 2	459	424,167	924	474	0.51	18
Retrofit Interior 3	420	1,276,815	3,040	1,065	0.35	28
Retrofit Interior 4	12	147,585	12,299	2,668	0.22	4
Interior Sensor 1	1265	292,687	231	158	0.68	7
Interior Sensor 2	426	547,428	1,285	882	0.69	18
Interior Sensor 3	53	226,584	4,275	1,371	0.32	7
Interior Sensor 4	1	13,268	13,268	NA	NA	1
Total	**6,016**	**4,103,398**	**682**	**1040**	**NA**	**151**

A precision of 18.62% was calculated when applying Ex-Pos results to the sampling plan shown in the table above.

Combined samples across CY1, CY2, and CY3, when stratified by measure type only represent a precision of 6.64% when considering all measure associated with the sampled schools using Ex-Post annual energy savings. Sample statistics across all three program years is shown in the table below.

Table A-34 LAUSD DI Program Population and Sample Statistics (CY1-CY3)

Strata Boundaries	Population Size	Total Ex-Post kWh Savings	Average Ex-Post kWh Savings	Standard Deviation of Ex-Post kWh Savings	Coefficient of Variation	Final Design Sample
Retrofit Exterior	1820	3,109,259	1,708	2,623	1.55	161
Retrofit Interior	3013	990,184	329	1,161	3.55	170
Exterior Sensor	10221	8,574,126	839	1,267	1.51	1,123
Interior Sensor	9762	1,911,698	196	413	2.10	1,011
Total	**24,816***	**14,585,268**	**588**	**1,258**	**NA**	**2,465**

*Line items without associated savings were not included in precision calculations.

A.7.1.3 Baseline Assumptions Review

The projects completed under the LAUSD DI Program during FY 22/23 were found to consist of lighting measures only. Generally, for projects involving lighting measures, savings were determined as follows:

$$kWh_{Savings} = \frac{Watt_{Baseline}*HOU_{Baseline}*Qty_{Baseline} - Watt_{Installed}*HOU_{Installed}*Qty_{Installed}}{1000} * IEFe \quad \text{Equation A-11}$$

$$kWh_{Code} = \frac{Watt_{Code}*HOU_{Baseline}*Qty_{Baseline} - Watt_{Installed}*HOU_{Installed}*Qty_{Installed}}{1000} * IEFe \quad \text{Equation A-12}$$

$$\Delta kW = (Watt_{Baseline} - Watt_{Installed}) * CF * IEFd/1000 \quad \text{Equation A-13}$$

$$Dual\ Baseline\ Lifetime\ Savings = kWh_{Savings} * \frac{EUL}{3} + kWh_{Code} * (EUL - \frac{EUL}{3}) \quad \text{Equation A-14}$$

Equation A-11 and Equation A-13 detail the equations used to determine energy savings and demand reduction for lighting measures. Dual baseline lifetime savings were calculated as a part of the program analysis, detailed in Equation A-14. Calculation of dual baseline lifetime savings required the use of savings using code standards found using Equation A-12. Baseline assumptions made for energy savings and demand reduction are detailed below:

Baseline Wattage: For the Ex-Post savings analysis, the baseline wattage is considered as the wattage of the pre-retrofit lighting fixture. However, for the purpose of calculating dual baseline lifetime savings, savings were also calculated using a code-specified baseline wattage. For Tube LEDs, High Bay LEDs, and LED Troffer Kits, the code baseline wattage was calculated using a code efficacy value taken from 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-35 LAUSD DI Ex-Ante Savings Summary

Fiscal Year	ESP Data Ex-Ante kWh	Program Data Ex-Ante kWh	ESP Data Ex-Ante kW	Program Data Ex- Ante kW
20/21	5,348,832	5,288,066	560.17	1,538.78
21/22	7,001,196	7,001,196	504.10	1,860.33
22/23	4,103,398	4,103,398	765.53	798.17
Total	**16,453,426**	**16,392,659**	**1,829.79**	**4,197.28**

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-36.

Table A-36 LAUSD DI program Evaluation Data Collection Progression

Stratum	M&V Plans	Contact Attempted	On-Site Verification	Evaluated
Exterior Retrofit	4	1	4	4
Interior Retrofit	4	1	4	4
Exterior Sensor	4	1	4	4
Interior Sensor	4	1	4	4

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 4 of the 12 randomly sampled projects from CY 22/23. Project-level and Measure-level results can be found in the provided site-level reports, which can be viewed in Appendix D. For confidential and privacy considerations of participants, Appendix D was not published with the public version of the report. Appendix D was provided only to LADWP as reference to supplement this EM&V report. 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-37.

Table A-37 LAUSD DI CY3 program Savings by Strata

Stratum	Ex-Ante kWh Savings	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
Exterior Retrofit	421,606	412,422	98%	27.30	21.45	79%
Interior Retrofit	2,025,875	1,563,391	77%	397.68	180.67	45%
Exterior Sensor	575,950	600,220	104%	126.82	99.63	79%
Interior Sensor	1,079,966	792,193	73%	246.37	108.78	44%
Total	**4,103,398**	**3,368,226**	**82%**	**798.17**	**410.53**	**51%**

The overall annual energy savings realization rates varied for all strata categories. The variation in realization rates can be attributed to a difference in hours, a difference in baseline wattage assumptions, and a difference in control savings factors. Detailed information regarding Ex-Ante calculations was not available.

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. Detailed Ex-Ante calculations were not available for review, so assumptions were made as to what inputs may have been assumed such that realization rate factors to be addressed. The impact of these realization rate factors by magnitude of energy savings and percentage of Ex-Ante savings is shown in Table A-38.

Table A-38 LAUSD DI Factors Affecting kWh by Strata

Stratum	Annual Operating Hours	Interactive Effects	Quantities and Wattages	Control Savings Factors
Exterior Retrofit	32,135	-	(41,319)	-
Interior Retrofit	(591,515)	156,339	(27,308)	-
Exterior Sensor	43,899	-	-	(19,629)
Interior Sensor	(315,329)	79,219	-	(51,664)
Total	**(830,810)**	**235,558**	**(68,627)**	**(71,293)**

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 8-4.

A.7.4 Process Evaluation

A process evaluation was not performed for the LAUSD DI Program. A full process evaluation was completed for FY 20/21.

- **The program funds retrofits in approximately 12 schools per year.** The schools consist of a mix of high schools, middle schools, and elementary schools.
- **Projects are initiated with an audit that leads to a proposed retrofit with estimated energy savings and costs**. The program supervisor reviews the cost and cost effectiveness and approves anything that costs $3/kWh or less.
- **All sites receive a walk-through inspection to verify that the measures are installed and working.**
- **LAUSD is very pleased with the program and does not believe they could implement these retrofits without the assistance of the program.**
- **COVID-19 has increased installation costs because installations must be performed at night and contractors must sanitize the classrooms before they enter and leave a classroom.**

A.8 LADWP SBD/ ZBD Program

This section details the impact evaluation for the Saving by Design (SBD) and Zero by Design (ZBD) Program that LADWP offered customers during FY 22/23. 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 were 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 are 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 or concurrent year CY3. The combined program level precision is 8.8% at the 90% confidence interval using Ex-Ante Savings estimates. 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. Table A-39 shows SBD Population Statistics and Strata Boundaries used for 3-year Concurrent Period Sample Design.

Table A-39 SBD Population Statistics and Strata Boundaries used for 3-year Concurrent Period Sample Design

Strata	Strata Boundaries	Population Size	CV	Total kWh	Sample Size	Contribution to Variance	Precision
1	< 43,000	18	0.59	378,424	7	4,417,590,387	28.8%
2	43,000 - 159,999	18	0.39	1,573,586	3	100,377,824,424	33.0%
3	160,000 - 199,999	9	0.07	1,547,005	2	4,391,793,733	7.0%
4	200,000 - 599,999	11	0.34	3,590,011	3	355,642,002,280	27.2%
5	200,000 - 999,999	3	0.19	2,409,117	3	0	0.0%
6	> 1,000,000	2	0.21	2,726,548	2	0	0.0%
Grand Total		**61**		**12,224,691**	**20**	**464,829,210,823**	**9.1%**

For FY 22/23, the sample resulted in a program level precision of ±35% 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. The LADWP ZBD program included only two projects and both were evaluated.

Table A-40 presents population statistics and strata boundaries used for the sample design.

Table A-40 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	<40,000 kWh	9	0.58	205,215	1	12,380,738,490	88.9%

Strata	Strata Boundaries	Population Size	CV	Total kWh	Sample Size	Contribution to Variance	Precision
2	40,000 - 149,999 kWh	8	0.35	515,311	1	28,418,126,759	53.7%
3	150,000 - 199,999 kWh	4	0.09	681,989	1	2,885,330,795	12.9%
4	>200,000 kWh	7	0.35	2,519,618	1	655,925,953,526	52.7%
Total	**NA**	**28**	**1.07**	**3,922,133**	**4**	**699,610,149,570**	**35.0%**

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; and
- 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, the Evaluator developed M&V Plans as needed, which described 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 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 M&V 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. For a few projects, on-site data collection was not possible, so the information was collected remotely, via interviewing the site personnel.

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, the Evaluator 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, the Evaluator explored the impact of COVID-19 on energy impacts from the installed measures. Through data analysis efforts the Evaluator explored the effects on operating schedules, mechanical systems, and any other consumption effects. All of the facilities evaluated reported "business as usual" during CY3 period. Therefore, COVID-19 impact on energy use did not apply and was not quantified. The Evaluator has concluded that the typical year's energy savings are the same as the Ex-Post savings for CY3.

A.8.2 Impact Evaluation

This section describes various procedures undertaken to conduct the impact evaluation of the SBD program. Program Data Review.

Project level descriptions in program tracking data indicated that 27 projects were classified as New Construction and one as modernization under SBD. Two projects were identified as New Construction under ZBD. 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 able to obtain monthly billing data from LADWP for each 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.

A.8.2.1 Data Collection

The Evaluator sought data collection from site contacts for four of the seven SBD sampled projects. The two ZBD projects were treated as desk reviews using project documentation, billing data and information obtained from the site contacts remotely. The Evaluator did not conduct any on-site monitoring. Data collection activities are shown in Table A-41.

Table A-41 SBD/ZBD Evaluation Data Collection by Project

Stratum	M&V Plans	Desk Reviews	Evaluated
Savings by Design (SBD)			
1	1	0	1
2	1	0	1
3	1	0	1
4	1	0	1
Zero by Design (ZBD)			
1	2	2	0
Total	**6**	2	4

A.8.2.2 Project Level Results

The evaluation analyses were conducted on 4 completed SBD program projects in fiscal year 2022-2023. A total of three projects were considered to be new construction and one project modernization. Two projects were evaluated as New Construction under ZBD. 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-42. Project-level and measure-level results can be found in the project site-level reports, which can be viewed in Appendix D. For confidential and privacy considerations of participants, Appendix D was not published with the public version of the report. Appendix D was provided only to LADWP as reference to supplement this EM&V report.

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-42 SBD/ ZBD Project-level Results

Program	IPMVP Option	Ex-Ante kWh Savings	Ex-Post kWh Savings	Gross kWh Realization Rate
SBD	Option D	3,922,133	3,730,365	95.11%
ZBD	Option D	33,096	33,096	100.00%

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-43.

Table A-43 SBD/ ZBD Savings Variance by End Use

Program	End Use	Savings Variance (kWh)
SBD	Whole Building	-191,767
ZBD	Whole Building	0

A.8.3 Process Evaluation

LADWP replaced the statewide Savings by Design (SBD) program that ended in December 2020 with LADWP's ZBD program in 2021. LADWP's redesign of SBD allowed for non-residential 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 uses the California Building Energy Efficiency Standards (Title 24, Part 6) as a reference baseline for comparison. The program encourages projects to perform better than mandated by Title 24 by at least 10%, increasing energy savings potential. The program promotes high-performance building design and construction and offers a variety of solutions to building owners and design teams including owner and design team incentives. LADWP ZBD offers pathways where owners and designers can receive incentives for specific individual measures incorporated into the new building (express) or incentives based on whole building performance (whole building). The program also offers complimentary design assistance and review to aid them in reaching their projects' maximum efficiency potential.

The program's primary objective is to integrate energy efficiency into the design of buildings when more advanced measures can be implemented at lower cost than for retrofit projects. To encourage an integrated strategy, the program provides financial incentives along with feasibility studies, training and education, conferences and workshops, and program marketing activities. Additional objectives include:

- Incentivize cost-effective energy efficiency upgrades in non-residential new construction
- Create a greater awareness of sustainable design, the latest technologies and design practices, and green building practices
- Encourage project design engineers and architects to educate customers about the program and its benefits
- Transform the non-residential new construction market to incorporate energy efficiency in the design phase, thus increasing the energy efficiency of new construction.

A.8.3.1 Process Evaluation Approach and Methodology

The LADWP ZBD new construction incentive program had a full process evaluation in FY 22/23. This evaluation was designed to answer the following research questions in Table A-44.

Table A-44 Research Questions

Primary Research Questions
What role did the owner or design team member play on the project and what are their responsibilities? (Beyond are they the developer or on the design team – want to know what their influence is on the project and applying).
Does the project have sustainability goals? Is it going for other certifications LEED, Energy Star, etc.?
How did the [owner or design team member] become aware of the LADWP ZBD program? Why did they want to participate? What was most important in their decision?
What were [owner or design team members'] experiences with the program: communication, administration, design, and program processes? How satisfied are they with the various elements?
Did they participate in the former Savings by Design program? If they participated in SBD in the past, how does the experience compare so far – easier/harder/about the same?
How does the design process inform ultimate decisions related to equipment and building specifications? What were/are the trade-offs [owner or design team members] made or considered in these decisions, and how did the program inform these trade-offs?
How have owners or design team members' practices changed since the Title 24 2022 standards went into effect this year?

Primary Research Questions
What can LADWP do to make adding electrification options or otherwise complying with Title 24 easier?

This full process evaluation included a review of program tracking data and relevant program materials, and in-depth interviews with LADWP ZBD program staff, the program implementer, and eight market actors. The findings from these sources are described in this chapter.

A.8.3.1.1 Documents Review

As part of the documents review, the Evaluator reviewed the “Zero by Design Program (ZBD) Business Plan FYs 2021/22 – 2030/31,” LADWP ZBD Workshop Presentation from October 2021, the program fact sheet, program process flow chart, the organization chart, and 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 vendors, how program processes work together, objectives, and intended outcomes. This information was used, along with findings from staff and implementer interviews, to construct the market actor interview data collection instrument and provided context for findings by these research activities.

A.8.3.1.2 Staff Interview

The Evaluator interviewed program staff in April 2023 to get background on how the program is working this year, participation, and their outlook for the future. We also sought input on what staff would like to learn through this evaluation.

A.8.3.1.3 Implementer Interview

On July 18, 2023, the Evaluator interviewed a Senior Advisor at the implementing company, Okapi Architecture, to get her insights into how the program works. The Evaluator also asked questions about what is working well for them and what challenges they are facing. Okapi representative also described marketing and outreach strategies and her thoughts on resources that would help them succeed. She described her company as having a “good rolodex” of architectural firms and builder contacts.

A.8.3.1.4 Market Actors In-Depth Interviews

The Evaluators conducted eight interviews with identified market actors connected to the LADWP ZBD program. The interviews were semi-structured conversations intended to guide the discussion. Note that the Evaluator asked interview questions as they were relevant and as time permitted.

The LADWP ZBD program staff provided a list of market actors for recruiting that was composed of:

- 41 owner/developer organizations with 52 contact emails
- 39 design teams with 59 contact emails

These organizations and teams included those with paid and pending LADWP ZBD projects, those who have contacted LADWP for information on LADWP ZBD, and organizations from the previous SBD outreach and marketing lists.

The Evaluator’s goal was to interview seven to nine market actors including 4-5 owner/developers and 3-4 design team members. A secondary goal was to have up to one-third of respondents be involved with multi-family residential projects. Our interview completions included:

- 5 owner/developers
- 3 design team members

Two of the completions were owner/developers involved with current LADWP ZBD multi-family projects. None of the owner/developers that completed an interview were the owner/developer for either of the two LADWP ZBD projects completed during FY 22/23. Findings from the market actors’ in-depth interviews are discussed in the Results and Findings section.

A.8.3.1.5 Net-to-Gross Approach

To estimate the net savings attributable to LADWP ZBD, the Evaluator completed interviews with building owners to understand how the program impacted their decisions to exceed Title 24 requirements. During the interviews, respondents were asked:

- Whether they were planning to incorporate the energy efficiency features before or after learning about the program.
- The role that the program and services had on their decision to incorporate the energy efficiency features.
- If there were any specific energy saving choices that were included in the project because of the program and the incentives.

A.8.4 Results and Findings

The following are the LADWP ZBD process evaluation results and findings.

A.8.4.1.1 Participation Summary

The tracking data for LADWP ZBD included 34 in progress projects and 2 listed as paid. The in-progress projects were reportedly at various stages of development/approval in the program. All submitted projects in the program tracking data are listed as whole building performance so far. Table A-45 below summarizes the statuses of these projects.

Table A-45 Application Status of In-Progress Projects

Application Status	Count
Pending Application Documents	1
Pending Application Documents; Design phase	1
Pending Clarification on Energy Model and Application Documents	2

Pending Clarification on Envelope documentation for Title 24	1
Pending Customer Documents (T24)	2
Pending Design Plans	1
Pending Electrification Tool	5
Pending Review	10
Pending RFP	1
Issued Notice to Proceed	10
Grand Total	**34**

Of the 34 in-progress projects, 17 are with the Los Angeles Unified School District, and 3 are with the Los Angeles Community College District.

A.8.4.1.2 Staff Insights

The new program is still ramping up.

Staff indicated that participation in LADWP ZBD is still in the ramp-up phase and that they expect to see it increase over time. They feel that the new program "runs very easy" and that it "feels like a big improvement." They noted that the two main challenges are getting the applications in and then completing the project because new building projects can sometimes take years to complete.

Staff were uncertain how well the word about the program is getting out to prospective applicants based on responses they have seen so far. They said communication once an application is received is going great, and that after moving all forms in-house the process is "more-streamlined and easier."

Incentivizing electrification is a challenge they plan to address.

California's Title 24 2022 update to building code for new construction encourages adoption of efficient heat pumps for non-residential space and water heating applications. Staff see LADWP ZBD as a means of making compliance with Title 24 easier for builders and encouraging them to perform even better than code.

Electrification goals are a major component of the Title 24 2022 update. Staff therefore are investigating options for incentivizing electrification measures. However, at the time of the staff interview the program had not yet set the electrification incentives; the options were still under consideration. Additionally, staff noted the challenge of claiming impacts for electrification because it can often increase electric use and therefore may not be an energy saving measure for an electric utility. Identifying how to address this challenge in "savings" reports and through the model will be important for implementing those types of measures. Staff said the electrification whole building workbook and prescriptive electrification measures were the next two phases they planned to incorporate into the program, and they expect participation to pick up once those become available. They also mentioned some other planned actions to encourage participation in the program, such as bonuses, kickers, and training.

A.8.4.1.3 Implementer Insights

The implementer leverages relationships to connect with market actors.

The implementer uses established relationships for marketing and outreach for the program. They have had greatest success with institutions that are repeat participants and entities connected to the city of Los Angeles who often connect with the implementer through LADWP.

She noted they have had greatest success with institutions that are repeat participants. Projects with these organizations tend to have multiple teams working on them and it can sometimes be challenging for follow-up to determine who they decided would file the application and documents with the program. One example is the city of Los Angeles which has been a big participant. She said that most of the project interest for them has come through LADWP.

Market actors expressing interest in the program often do not submit applications.

She sees a substantial discrepancy between the number of contacts who show interest in having their projects in the program and those who ultimately file applications. “Something is getting in the way between them saying ‘Yes, this sounds like a good program,’ and project submission.” She feels that program applications tend to get lost in the myriad of tasks developers typically have, and incentives are relatively small compared to overall project costs. So, even for market actors who have interest, the task of filling out and submitting the application is often overlooked or does not rise to the top of their task list. She believes that a potential solution to this issue is to have DWP or the implementer support completing the application, and that doing so would lead to many more projects in the program.

Lack of electrification guidance leads to inefficient handling of prospective participants.

The implementer also felt constrained by the lack of formal guidance on electrification options. The LADWP engineering team, rather than the implementer, had to work on any electrification projects that were submitted because they did not have a solution when the program was rolled out. At the time of the interview, Okapi needed to refer customers to the utility when they had electrification questions. She said that their engineers would like to have more conversations with the LADWP engineering team regarding electrification so there would be fewer hand-offs of applicants between the two and the service could be more of a “one-stop shop.”

A.8.4.1.4 Market Actor Interview Findings

Market actors had influence over the decision to use LADWP ZBD.

Most of the market actors interviewed had a direct role in their projects’ decision to work with LADWP ZBD. Several had sustainability responsibilities along with management of people and processes required for project development. For a few projects it was a contractual requirement that they work with the program, and some also had worked with the SBD program previously, so they saw participating in LADWP ZBD as a logical step. Some pointed out that LADWP ZBD was the only option for incentives.

Okapi outreach was a primary source of LADWP ZBD program awareness.

Interviewed market actors found out about LADWP ZBD in several different ways. The most common way was getting notice from LADWP or Okapi that SBD was ending and being replaced by LADWP ZBD. Several described being contacted directly by Okapi who asked if they had any projects for LADWP ZBD. One design team member said sometimes owners and architects instruct them to contact the program. One owner/developer said she heard about it through the LA Better Buildings Challenge.

Staff were worried participants from SBD were avoiding the new program, but interviews do not suggest that is the case.

Although staff noted that there were customers who participated in the SBD program but had not yet done a project with LADWP ZBD even though they are continuing to build. All interviewed market actors shared their intention to participate in the future and that any gaps in their program participation were the result of timing of program changes and their organization’s construction schedules. None indicated apprehension about participating in LADWP ZBD.

Rebates and recognition or verification of sustainability were top reasons for participating.

The most common reasons given for participation were to get rebates and recognition or verification of their sustainability efforts. Incentives help owners offset costs and help design teams provide better value for clients. Owners and design team members alike valued the verification and recognition the program provides, and having an independent third-party show that the building is meeting the intended sustainability goals. One design team member said working with the program was a contract requirement for their client, and another said working with such programs was a key part of their job. Some also pointed out that the program fit well with the basic philosophy of their firms; the values the program promotes align well with what they want to do as a company.

> *“The DWP program really kind of capitalized on the efforts we were already thinking, and it was just one more step we could show the sustainability measures being taken.” – Design Team Member*

> *“We use the incentives as another catalyst to make that decision to go very eco-friendly and energy efficient.” – Owner/Developer*

Most projects had sustainability goals beyond code compliance.

Most of the market actors with projects in LADWP ZBD or its predecessor, SBD, described having sustainability goals beyond complying with Title 24 2022 requirements. The most frequently mentioned were getting certification through LEED gold or platinum, and Collaborative for High Performance Schools (CHIPS). One owner/developer said their tenant’s organization’s standards for performance were higher than LEED, so they did not use that certification. Another had used LEED and CHIPS for several previous projects but decided as an organization to only do the latter to save the time and expense of applying for LEED. One owner/developer said they were undecided about whether they would go for LEED certification of their current project, and another said they just wanted to be compliant with the California code.

Program experience was generally positive and participating market actors appreciated the easy process.

The interviewed market actors had a lot of positive things to say about working with the program, and the implementer Okapi in particular. The most active owner/developer participant said:

> *"We have a really good partner at Okapi Architecture who is running the whole building analysis portion of (LADWP) ZBD … and had been really great." – Owner/Developer*

Another design team market actor said it was a very easy process to get through and easy to follow requirements:

> *"So, they were very clear and understandable and the goals that were set forth with that, once they were established, it was really easy for the team to pick up and run with that information." – Design Team Member*

Virtually all interviewees praised the people at Okapi for responsiveness and as being easy to work with.

Interviewees had positive things to say about certain program components or practices as well. One said that the program analysis report that provides a dollar amount on the incentive and savings estimates is valuable.

> *"When they tie their incentive monies to the savings estimates within their report (it) helps make sure everybody is on the same page. It helps us not get put in a bad spot if those savings estimates are tied differently to those different energy efficiency measures." – Design Team Member*

Regarding program information requirements one design team member said he felt the program did not request too much information beyond what they had already documented as part of their designs. He said there was no "jumping through hoops. We shared our calculations and moved on."

They also offered some ideas for improvements. One owner/developer said he experienced some frustration because DWP uses a different prescriptive energy model than they do that does not calculate some things (e.g., he mentioned mini-splits).

Another owner/developer who works with many architectural firms says firms who are not yet familiar with the program sometimes have difficulties such as including the right people on communications or submitting the right documents. He pointed out that experienced firms do not have these problems, suggesting there is a learning curve.

Most market actors preferred the whole building performance option for program compliance but some said that the prescriptive measures might work best for some retrofit projects.

To date, all submitted projects in the program tracking data are listed as whole building performance, with no prescriptive path projects. Interviewees noted that the whole building approach provides greatest flexibility for new construction in that designers can decide how they will achieve target efficiency levels. Some said they may opt for the prescriptive approach for a project because it is simpler and does not require energy modeling but said that approach was more appropriate for retrofit projects than new construction. Some market actors said they analyze both approaches and see which one gives them the best results. The Evaluator asked market actors what they thought about the two approaches.

Some challenges they noted about the express/prescriptive approach include:

- It seems most suitable for building renovation projects where the envelope is not being touched
- For Title 24 compliance they typically do the prescriptive approach because they know what that is and can quantify it in their plans and feel it is an easier process with the city
- With larger projects it is harder to get all the efficiency measures on the prescriptive track because plans go through many details and iterations
- The prescriptive incentives are “dramatically less lucrative”

Some benefits they described with the whole building performance approach include:

- Most new building construction projects use this for flexibility, and this choice is often architecturally-driven
- If they chose a mechanical prescriptive approach then decide they want to do something else, they have to go through the whole building performance approach
- They do the modeling approach because they do the modeling anyway

Market actors saw LADWP ZBD as more streamlined and quicker than SBD but more opaque regarding application progress.

Some of the market actors interviewed had experience with only the previous SBD program, some had experience only with LADWP ZBD and some worked with both. The Evaluator asked those market actors who had worked with both programs how they compare.

One difference they mentioned was that with LADWP ZBD the program does not make recommendations on design changes, which was one area that slowed down a lot of SBD projects. As a result, LADWP ZBD is more streamlined and quicker.

Another difference they mentioned is that projects can still join the program once they have started the construction phase, whereas with SBD they needed to start in the design phase. One owner/developer said “we might not notice that a project did not apply for LADWP ZBD until construction is about to start. Under this program we can still apply, but under SBD we would not have been able to.”

One owner/developer said the application processing is more of a “black box” in terms of what goes in and “(we) don’t see the progress.” He felt he got more information on savings and how incentives work out under SBD. This was helpful for him because he needs to quantify the impacts of projects for his boss and director. He needs to report on project costs, incentives, and payback periods.

Some market actors pointed out that LADWP ZBD only incentivizes a reduction in electricity use not natural gas. Because LADWP projects under SBD also included SoCal Gas, they included incentives for reductions in natural gas use.

Design team recommendations involve a complex web of decisions and tradeoffs considering numerous factors.

Design teams pointed out that they make recommendations for equipment, performance guidelines, and designs and operation based on requirements set by the owner and considering other factors. Tradeoffs considered vary per project, per client and based on ownership goals. In some cases, owners/developers are also very involved in the design.

Some tradeoffs they typically examine include:

- Costs/incentives available (initial cost versus long-term operational cost)
- Energy efficiency
- Maintenance operations
- Mechanical, electrical, plumbing and lighting systems
- Sequence of operations
- Shell characteristics or architectural systems (e.g., amount of glass)
- Amount of shading
- Requirements of the system running and monitoring the equipment
- Sustainability standards whether for client’s industry or self-imposed
- Specialized needs based on facility type and use

Only a few of these factors directly relate to energy efficiency.

Another factor design teams must consider is with some new technologies, owners may need specialized training to operate them successfully. One design team member noted: “If they have to retrain their cadre (of technicians) district-wide, it is just not realistic.” For this reason, sometimes they need to go with the second or third most efficient because it is something the owner is comfortable with.

Design teams provide options that weigh these different components and help owners make informed decisions that meet their needs.

Most market actors changed their practices after T24 2022 rules came into effect.

Six market actors, including three design team members and three owner/developers, said they changed their practices, or planned to change their practices, since the California Title 24 2022 building code requirements took effect. Changes they made include:

- Updating design specs
- Using different tools to model projects to account for issues with the state-provided compliance model
- Making slight changes in their marketing to inform clients how Title 24 relates to LEED status.

Market actors had suggestions for LADWP that could make their compliance with Title 24 easier.

Owner/developers and design team members had several ideas on how LADWP could help make Title 24 compliance easier for them (some of which are outside of LADWP ZBD specifically). These included:

- Distributed energy resources
  - Help customers with electric fleets set up for overnight off-peak charging, and use electric vehicles as emergency on-site power or sell it back to the grid
  - Simplifying the solar installation and permitting process – interconnection agreements for solar installations are pain points
  - Find ways to help customers with availability of necessary solar and storage equipment like transformers (one owner reported a 72 week wait on ordering)
- Participation and application
  - Design the application for LADWP ZBD to use information in the Title 24 report or an energy model so it is less time-consuming to fill out
  - Find a way to guarantee some incentive amounts prior to construction, either prescriptive on the equipment or for design team efforts so that the uncertainty about getting paid does not discourage firms from pursuing higher efficiency options
- Electrification
  - Find ways to assist customers with electrification options when emergency replacements are needed
  - Increase incentives to move from natural gas to electricity to help mitigate the costs and increased electric use from electrification, improving first cost and ROI.

“When you tell them it takes up more space, it is more expensive, and it will actually cost more to operate, it’s a hard sell.” – Design Team Member

  - Update their software to accommodate prescriptive modeling, make sure it can handle equipment like ductless mini-splits
- Communication and education
  - Educate customers on the importance of “future-proofing” buildings for energy use – “(You) want the building to be an asset and not a liability in ten years.”

- Help coordinate communications and progress for them between departments within DWP to keep installation of substations for larger projects on track
- Provide education on what it means to be fully electric

"Education is key to making sure clients and designers know what is needed to properly roll these things out." – Design Team Member

- Encourage account managers to more aggressively reach out to customers and stakeholders to inform them about opportunities with LADWP ZBD

"I think it should be less of us scouting for this information or us relying on LA Better Buildings Challenge group." – Owner/developer

LADWP ZBD is inducing designs above code.

Four of the five owner/developers interviewed said the program prompted them to build to higher performance standards beyond Title 24 requirements. Each provided additional details as described below.

Owners/developers said that LADWP ZBD pushes them to maximize their investments in efficiency and look at options they would not normally consider. Some noted they are now planning projects with knowledge of the program incentives, so gauging the influence is more difficult.

"It … helps determine … how best to update (the buildings). If we do (LADWP) ZBD, we have to focus on (the envelope) as well." – Owner/Developer

"…it is exposing us to a lot more things that we didn't think about previously that are now on the radar for us." – Owner/Developer

"Some efficiency measures were planned, and we added more. We planned for LEED gold and the incentives let us go to platinum." – Owner/Developer

One design team member said he thought the program was "very generous" and it "really motivated us to kind of help push as far as we could … for the performance we had to meet."

Are there other types of assistance LADWP could provide to motivate/support developers in making their buildings above Title 24 code?

Interviewees offered following suggestions on assistance LADWP could provide to support more building design beyond basic code compliance.

- Incentives and technologies
    - More incentives (although they feel the program is already generous)
    - Provide guidelines for energy efficient roofing that could be incentivized with solar
    - Consider adders based not just on income levels, but for areas that experience more extreme heat

  - Do more on water efficiency, waste management including after it leaves the property, where it is going and how it is getting repurposed
  - Better incentives for renewables including options to partner with the utility on installations
  - Structure incentives so that they guarantee some payment amounts up front such as prescriptive on equipment, for design team efforts, or incentive dollars per square foot when owners hit EUI targets (differentiating between all-electric and mixed fuel buildings) so that owners can use it in their underwriting
  - Incentivize green construction practices such as use of electric cranes, efficient temporary buildings and sustainable building materials, water conservation, waste management, grounds design and upkeep

- Services and program design
  - Assign a personal representative to participants to provide quick answers that larger developers need
  - Help applicants identify, assess, and optimize financials including sources outside the program such as through the Inflation Reduction Act (IRA), Self-Generation Incentive Program (SGIP), Investment Tax Credits (ITC) and others, to find the best strategies for sustainability investments

"It's a complicated mess out there and there's a lot of money to be saved." – Design Team Member

  - Make the process a little easier to apply, have it go hand-in-hand with Title 24 submissions

- Outreach
  - Help spread the word about facilities being designed responsibly, conserving energy and natural resources, and providing healthier environments for users

A.8.4.1.5 Net-to-Gross Results

Interviews were completed with five building owners with a program project. None of these projects were administratively complete for FY 22/23, but the respondents were able to speak to how the program influenced decisions about building design and equipment.

Table A-46 summarizes the program and the Evaluator's assessment of the level of free ridership for the projects. This information provides some insight into the program's level of influence, but the Evaluator did not use the information to adjust the program net savings for the program because none of the interview respondent projects were completed during FY 22/23.

Table A-46 Summary of Program ZBD Influence and Free Ridership

Respondent	Summary of Program Influence	Assigned Free Ridership Score
Respondent 1	Respondent stated that they always strive for efficiency, but that the program was "absolutely" a factor in their decisions to incorporate above building code efficiency.	0.25
Respondent 2	Building planning was done in conjunction with an understanding of the program requirements and the program requirements influenced their decisions.	0.0
Respondent 3	The program was not influential. Stated that they did not make any changes to their plans based on program requirements.	1.0
Respondent 4	This respondent thought that some of the efficiency aspects of the building would have been made without the program, but not all.	0.5
Respondent 5	The respondent was not aware of any building design choices that were affected by the program.	1.0
Average		0.55

A.8.5 Recommendations

- **Study experiences of non-participants, especially those who expressed interest but then did not submit an application.** Better knowledge of impediments to program participation will enable effective action to overcome them. For example, if completing and submitting an application is the stopping point for potential participants (i.e., program staff and implementer agree that a major challenge is getting applications in the door, and the implementer noted that something is getting in the way of interested candidates ultimately submitting applications), LADWP could explore options for providing more extensive application development assistance.
- **Seek opportunities for more coordination between implementer engineers and the team at the utility, especially around electrification options.** The goal is to need fewer hand-offs between the two groups which could lead to more participation.
- **Look for options to increase public recognition for market actors who participate in the program and are therefore going above and beyond Title 24 compliance.** Program verification and recognition of their sustainability efforts can be as important to participants as the offered incentives.
- **Find ways to provide more transparency within LADWP ZBD on application progress and more certainty on expected savings and incentives, especially for larger institutional participants.** This will help sustainability professionals in their reporting to decision makers on impact quantification, costs, incentives, and payback periods.
- **Adapt application materials to be more in line with what is already required for Title 24 compliance, thus reducing the information burden on participants.**

- **Seek innovative solutions that could support customers in adopting technologies and options that add value to electrification such as a combination of electric vehicle/fleet off-peak charging, on-site PV generation and storage, and interconnection agreements enabling grid sales and emergency backup power.** All-electric options tend to be costly, and enabling additional functionality or services can improve the value of the investments. Also, exploring options for incentivizing reductions in fossil fuel use (natural gas, vehicle fuels) could further elevate electric options.
- **Help customers with tools and/or assistance for organizing economic incentives beyond LADWP ZBD to maximize the financial benefits of energy efficiency, distributed energy resources, and energy optimizing technology investments.** There are many options for reducing costs that most market actors do not have time to sort out.

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 22/23. 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 was 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-47. 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-47 UHVAC Evaluation Sample

Strata	Strata Boundaries	Program Line Items	Ex-Ante kWh	Sample Size (line items)	Sample Ex-Ante kWh
AC	<5.4	101	385,290	25	110,218
AC2	>=5.4	17	489,973	8	281,917
Chiller	18.8 - 149.8	2	166,351	1	48,728
HP	.75 - 13.17	74	583,853	11	49,846
VRF	<10	56	1,208,694	16	401,414
VRF2	>=10	11	756,867	6	483,722
Total	**NA**	**261**	**3,591,027**	**67**	**1,375,845**

The evaluation sample design resulted in an Ex-Post precision of +/- 23.16% at the 90% confidence interval. 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. In combining strata across FY 20/21, FY 21/22, and FY 22/23, The Evaluator was able to present the 3-year savings estimates with an Ex-Post precision of +/- 9.48% at the 90% confidence interval.

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 measure's 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

The DEER workpaper for VRF systems provides limited selection of system types and building types and is listed as discontinued. Therefore, the algorithm from the MidAtlantic TRM was used with adjustments made for the applicable California climate zones. Additionally, the DEER workpaper for chillers was not appropriate for the sampled chiller system and therefore an industry standard algorithm was applied using adjustments for California climate zones.

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

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, some equipment specifications, invoices, savings estimates, incentive tables, building types, and climate zones.

The Evaluator assessed all measures' facility type classifications and made comparisons where necessary. The impact on results due to this review was substantial, as facility types have become a critical element to selecting DEER workpaper savings rates. This is discussed further in A.9.2.5.

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 always 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, building vintage, climate zone, baseline equipment assumptions. All measures in the program sample relied on energy savings rates provided in workpapers associated with water sourced heat pumps, Mini-Split HPs, Ductless HPs, unitary air-cooled AC/HP, and air-cooled packaged chillers.

The associated workpapers used in this evaluation include:

- SWH014 Unitary AC or HP <65
- SWH013 Unitary AC or HP >65
- SWHC020-02 AC Chiller
- SWHC050-02 – Ductless Heat Pumps
- PGECOHVC162-R3 WSHP
- SCE13HC033.2 – Mini Split Heat Pumps

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 261 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-48.

Table A-48 UHVAC FY 22/23 Sample Ex-Post Results by Strata

Stratum	Count of Measures	Program Data Ex-Ante kWh	Program Data Ex-Post kWh	Gross kWh Realization Rate
AC	101	385,290	142,750	37%
AC2	17	489,973	174,943	36%
Chiller	2	166,351	166,351	100%
HP	74	583,853	392,143	67%
VRF	56	1,208,694	1,050,719	87%
VRF2	11	756,867	712,960	94%
Total	**261**	**3,591,027**	**2,639,865**	**74%**

Sample results aggregated by equipment type (AC, HP, VRF) are shown in Table A-49.

Table A-49 UHVAC FY 22/23 Sampled Sites' Ex-Post Results by Equipment Type

Equipment Type	Count of Measures	Program Data Ex-Ante kWh	Ex-Post kWh	Gross kWh Realization Rate
VRF	67	885,136	804,610	91%
AC	118	392,134	141,493	36%
HP	74	49,846	33,638	67%
Chiller	2	48,728	48,728	100%
Total	**261**	**1,375,845**	**1,028,470**	**75%**

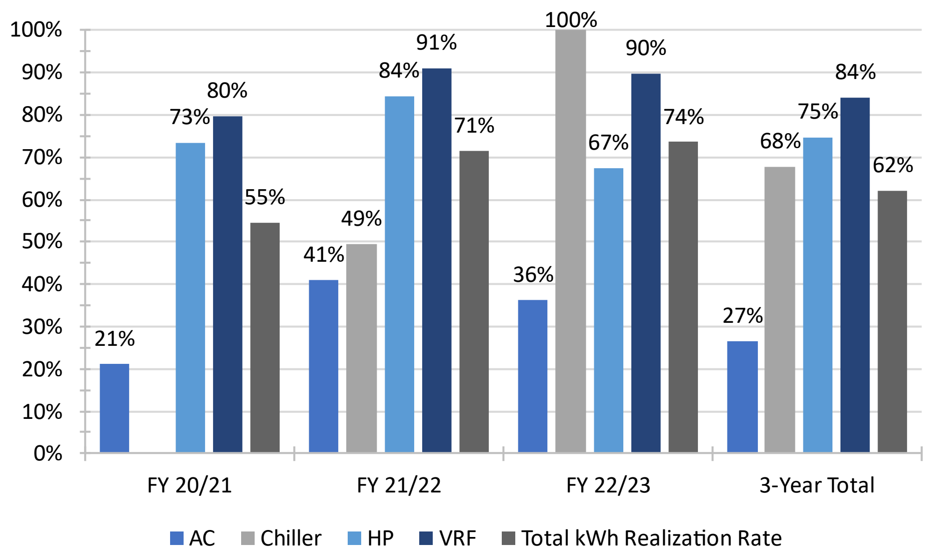
Discrepancies were found in energy savings across the three of four classifications of equipment type (AC, HP, VRF, Chiller) within the sample. Differences were attributed to the selection of appropriate DEER workpaper savings rates, equipment capacities, and calculation methodology. As the program is upstream with limited information from the site, the Evaluator assumes that units are all replaced upon burnout. Selection of savings rates in a workpaper are based on the equipment type, climate zone, replacement scenario, facility type, facility vintage, 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 ratings from sampled sites. The Evaluator used internet searches and mapping software to determine facility type and defaulted to DEER's miscellaneous building type ("Com") in instances where facility was unclear.

The progression of kWh realization rates can be seen in Figure A-9, where Ex-Post kWh savings were compared to Ex-Ante ESP kWh Savings. Initially, chillers were combined with AC when reporting savings, but were tracked in CY2 and CY3. Thus, while the absence of chiller information from CY1 may indicate there were no such devices, this might be a hasty assessment.

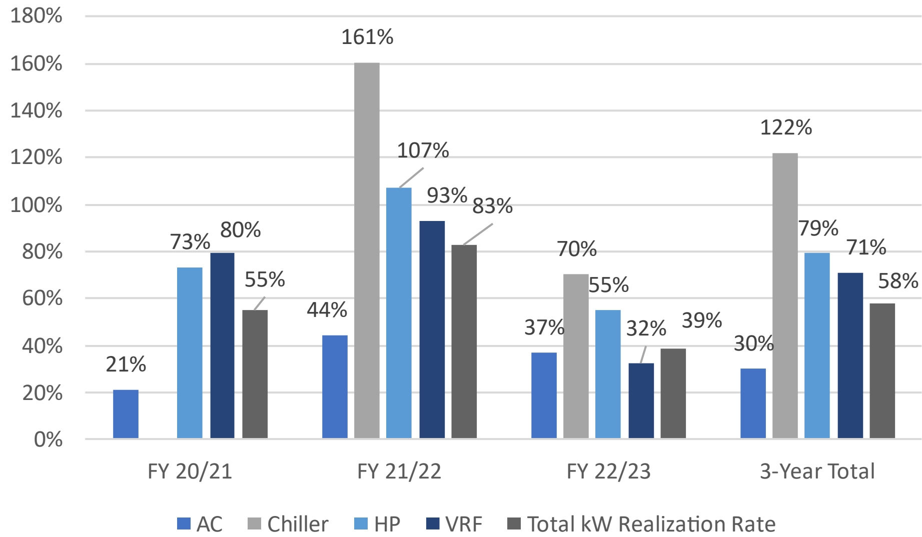
Throughout the three program years, AC equipment in particular has consistently demonstrated low realization rates. In FY 22/23, this was exclusively due to a difference in DEER workpaper savings rates. Since it was not possible to trace the origin of LADWP's savings rates, it was unclear whether these rates were different due to a difference in equipment classification, or because LADWP assumed a baseline condition less efficient than code. As previously stated, the Evaluator assumes a baseline condition that meets code when data is unavailable so as to not overestimate savings. This is noteworthy because several of the units classified as Unitary AC/HP >5.4 tons by the Evaluator had LADWP savings rates exceeding 539 kWh/ton. This value is the maximum kWh/ton possible when assuming baseline conditions that meet code. Therefore, these line items either mis-assessed the equipment or selected the savings rate with unreasonable baseline assumptions. Given the trend of low AC realization rates, the latter seems plausible.

Figure A-9 UHVAC Realization Rates by Equipment for CY1-CY3



Unlike the kWh realization rates, the kW reported in the program data was much lower than what The Evaluator found during the duration of the program. The exception to this was the 122% realization rate for chillers in the combined rollup, primarily due to the higher than expected demand savings from FY 21/22. All demand savings seem to spike in FY 21/22 but were smaller in PY 22/23. Since FY 20/21 and FY 22/23 had greater activity, this resulted in a net lower 3-year combined kW realization rate as shown in Figure A-10.

Figure A-10 UHVAC kW Realization Rates over time using program kW data.



A.9.2.3 Industry Standard Analysis

Due to the discontinuation of the workpaper for VRFs 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.

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 as utilized in FY 21/22. The Evaluator also used efficiencies and capacities from the AHRI database to accurately represent the efficient condition.

An advantage to using the industry standard analysis is that each measure does not require the categorical binning to determine a savings rate as does with the workpaper. Prior to its discontinuation, the DEER workpaper for VRFs only reported savings rates for small and large offices. It was for this reason along plus the discontinuation of the DEER workpaper that the Evaluator elected to pursue the industry standard calculation for VRFs in FY 22/23. Despite the change in methodology, the kWh realization rate for VRFs was not substantially different between FY 21/22 and FY 22/23.

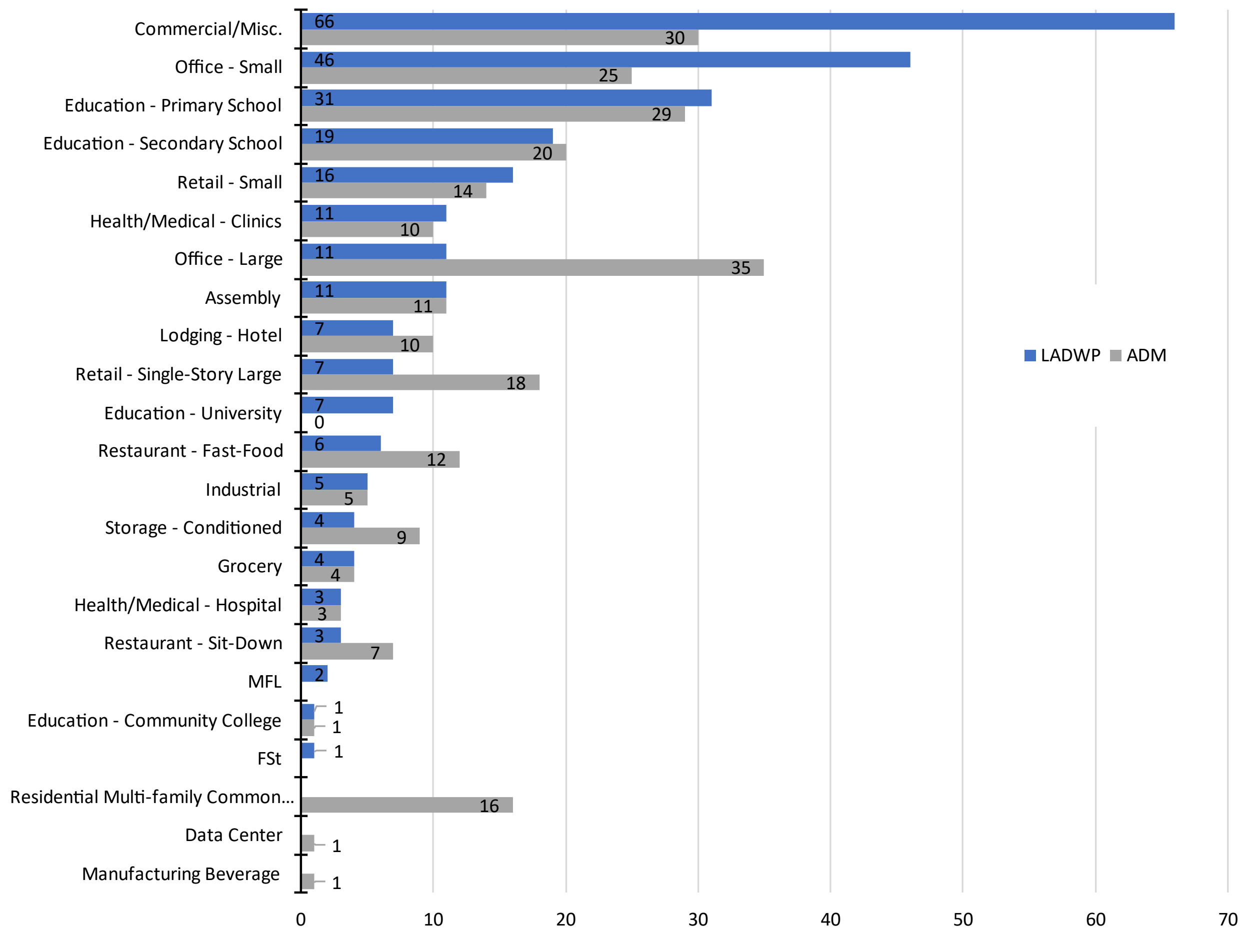
A.9.2.4 Billing Data Analysis

In FY 22/23, there were 37 sites selected as candidates for a billing regression. The Evaluator used LADWP's MV database to perform an assessment of the metering data. Upon review, it was found that most of these sites had insufficient billing data to perform an analysis. There were many instances where data was not available at all. In cases where data was available for download, it was found that there were substantial gaps during the installation period, making it impossible to derive any conclusions about the baseline versus post-installation energy consumption.

A.9.2.5 Building Type Review & Climate Zone Review

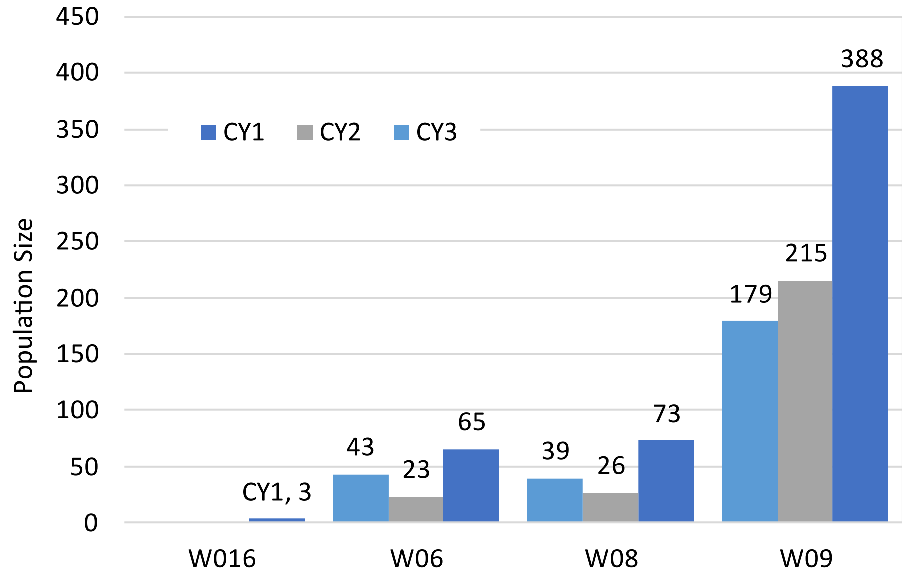
The Evaluator compared building types for the entire population, and classified sites as Miscellaneous Commercial if the function of the site was not plain. Through this effort, shown in Figure A-11, the Evaluator found several misclassifications that could result in differing savings rates. Some of these were simple errors, such as calling a standalone Home Depot a Retail – Small building instead of a Retail – Single-Story Large building.

Figure A-11 UHVAC FY 22/23 Building Type Comparison



The majority of equipment purchases were installed in climate zone 9. The number of units sold by climate zone is shown in the figure below.

Figure A-12 UHVAC Population Size by Climate Zone CY1-CY3.



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 FY 22/23, 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 FY 20/21, and a summary process evaluation in FY 21/22.

Key findings from the FY 20/21 full process evaluation were:

- **Overall, the UHVAC participation and application process is streamlined.** The program leverages an online tool and requires relatively few inputs. The inputs needed are essential from the perspective of estimating savings and ensuring that the sale is made to an LADWP customer and include equipment specification and quantities, as well as building location. The program does not require an account or a customer signature (as is required by the LADWP point-of-sale food services program).

- **Program staff has considered making equipment installation verification a requirement for the program but noted that this has been difficult because the customer may not be aware that they have participated in an LADWP sponsored program.**
- **The COVID-19 pandemic impacted program participation and the commercial HVAC market in general.**
- **Participating distributors who were more active in the program also tended to be more satisfied with the program than the less active distributors.**
- **Distributors believe that the program works best for plan and spec projects that allow for time to establish site and equipment eligibility and determine the incentive amounts.** The program is less well suited for emergency replacements.
- **The LADWP incentives are higher than the statewide incentives but do not affect stocking decisions, which are more likely to be based on the statewide program equipment list.**
- **The LADWP incentives support VRF installations in the region, which are not covered under the statewide program.**
- **The participating market actors reported an interest in increased communication and program support.** Participating market actors also reported varying levels of support from the Energy Solutions team. For example, one dealer noted that the ES team would provide them a clear list of what products were eligible for the rebates, while another distributor noted that they had to put it in the systems and check manually to see if a particular product was eligible.
- **Procedures are in place to ensure that UHVAC project savings are not counted in a downstream program and that the installation location receives service from LADWP.**

Key findings from the FY 21/22 summary evaluation included:

- **The program's design and delivery were largely unchanged from the previous year and operations are running smoothly.**
- **Program staff started meeting with sales staff to provide training and education about the program and received a positive response to the approach.**
- **Program staff noted customers experienced long delays in equipment delivery times and higher prices due to supply chain issues and inflation, the latter of which reduced the effectiveness of current incentives levels.**
- **Issues with slow permitting approvals delayed new construction projects.**

A.9.4 Results and Findings

The following sections include a summary of findings informed by the LADWP program staff interview conducted in July 2023.

A.9.4.1 Program Design and Delivery

LADWP staff noted that the UHVAC program's design and delivery is largely the same as the previous fiscal year, including the same measures and incentive levels. They noted that the program is mature and they have a longstanding working relationship with the program administrator. They believe the program is working well for distributors who are familiar with the program as they have had few complaints. They also point out that the expertise of the implementer means fewer LADWP staff resources are needed to facilitate discussions with customers. However, they also noted that staff turnover at the implementer likely led to some project delays as new personnel were trained on the program.

There were no major changes to the program delivery, although the program did reassess the distributor outreach process. Specifically, the program implementer, Energy Solutions (ES), near the beginning of the fiscal year, changed their approach to meeting with and encouraging distributors to participate in the program (as mentioned in the previous evaluation). ES marketing team started going to more conventions to meet sales point level distributors rather than working through the executive level. The staff noted that it is still too early to tell what effect this change is having but they also noted that they got some interest in the program from some other distributor contacts that they had not made before.

The program implemented a new rebate application deadline for distributors. They changed it from the end of the fiscal year in which the purchase is made, to 90 days from the date of purchase. This was done to avoid overlap with other programs such as Zero by Design and the Custom Performance Program. However, they are still working through some issues such as when a customer agrees to buy a unit that will not be produced until several months after the purchase. The unit has no serial number until produced so the distributor cannot apply for the rebate and may miss the new 90-day deadline.

They also felt the modified deadline could help avoid cases where both distributor and customer apply for a rebate and whoever applies second is disqualified. Quicker resolution of the distributor rebate reduces ambiguity that could result in double application.

Program staff report that, other than the timeframe for applying for the rebate, eligibility requirements have not changed, and no new measures are offered. They have a goal to establish new measure tiers based on changes to the federal code by the end of the year. They have only made internal changes to payment processes and records handling. LADWP staff feel the mature program, longstanding working relationship with the implementer, and established connections with distributors all lead to a smoothly running program.

A.9.4.2 Barriers and Opportunities

Program staff highlighted the following barriers or challenges:

- **Competition between participation at the distributor level and at the customer level.** Distributors may sell a product and file for a rebate and the customer buying it might also file for a rebate with another program. The timing of processing by each program could lead to the second filer not knowing a rebate was claimed by the other. This leads to the program needing to deny claims and re-issue invoices causing delays.

- **Staff turnover at the program implementer.** The implementer for the program has seen some turnover in the past year and the program staff see this as a challenge when this sometimes results in operational delays for the program.
- **Reduced incentives in the statewide upstream program.** Because incentives are lower statewide, distributors in neighboring service territories do not stock as much of the high efficiency products resulting in there being fewer eligible products on the market locally.
- **Staff worry about potential impact if incentives decreased.** Staff observed that the UHVAC program has had higher incentives than neighboring programs and that they hoped the program would be able to keep doing that. However, they also noted that if they were made to bring incentives down to improve cost-effectiveness, they might see lower participation or lower savings through the program.

Program staff see additional opportunities in the following areas:

- **Federal code changes.** Program staff said that they intend to produce some updated measure tiers prompted by federal code changes to commercial HVAC equipment that affect minimum efficiency standards. Staff are working with the engineering department to determine what qualifies and what savings the program can claim. Their goal is to make these changes public in December 2023 so that the market has some time to know what is going to be available and plan for 2024.

A.9.4.3 Previous Evaluation Recommendations

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

Table A-50 Previous UHVAC Recommendations & Program Response

Summary of Past Recommendations (Comprehensive only)	Program Response
Create additional opportunities for market actor engagement	Energy Solutions staff are 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.9.4.3.1 Recommendations

The Evaluator has the following recommendations:

- **Look for options to tag HVAC equipment to prevent denying rebates for UHVAC discounted equipment.** Identify equipment in production, at the wholesaler or retailer once a rebate claim is made against it through the UHVAC or other

LADWP program so that contractors or customers are not surprised later on that it is ineligible because it was already rebated.

- **Consider secondary effects of reducing program incentives.** When assessing if incentives should be decreased to improve cost-effectiveness, consider secondary effects such as reduction in local equipment availability, the economic backdrop of inflation, and reduced program participation and progress toward savings goals.

A.10 Consumer Rebates Program

This section details the impact evaluation and process evaluation for the Consumer Rebate Program (CRP) that LADWP offered customers during FY 22/23. 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

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

Table A-51 CRP Program Data Collection

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

A.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 an Excel file provided securely by LADWP.

Table A-52 CRP Program Tracking Data Sources

Workbook File Name
CRP_FY 22-23.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-53 CRP Sampling Method by Measure

Strata	Sampling	Sample
Attic Insulation	Billing analysis	Qualified census*
Central Heat Pump/AC	Billing analysis, Site Visits	Qualified census*; 15 Site Visits
Cool Roof	Billing analysis	Qualified census*
Dual Pane Windows/Skylights	Desk review	Census
Pool Pump Replacement	Site visits	Census; 19 Site Visits (FY 21/22)
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 offering 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 in the FY 21/22 period and participant survey for both FY 21/22 and FY 22/23. There is a midlife baseline shift, as the pool pumps are subject to the July 2021 manufacturing effective date for inground, self-priming, dedicated pumps to meet a minimum WEF value. The first baseline consisted of a mix of 48% variable speed pumps, 26% single speed, 26% two speed, based on site visits and participant survey data. The second baseline was set at the minimum pump WEF factor informed by the hydraulic horsepower rating.

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 when tracking data was provided, 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-54. The energy savings and incentive costs were equal for all measures for both sources.

Table A-54 CRP ESP to Program Tracking – Savings Comparison

Measure	Energy (kWh)		Quantity (enrollments)	
	ESP Data Ex- Ante	Program Data Ex-Ante	ESP Data Ex-Ante	Program Tracking Ex-Ante
Attic Insulation	88,637	88,637	566,070	566,070
Central Air Conditioner	23,552	23,552	64	64
Central Heat Pump	12,720	12,720	30	30
Cool Roof	827,721	827,721	1,881,185	1,881,185
Dual Pane Windows	2,027	2,027	4,606	4,606
Pool Pump and Motor	1,668,264	1,668,264	1,054	1,054
Whole House Fan	424	424	2	2
Total	**2,623,345**	**2,623,345**	**2,453,011**	**2,453,011**

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-15 and Table A-55

$$kWh = \frac{kWh_{CZ}}{sf}\ x\ SF\ x\ ISR \qquad \textit{Equation A-15}$$

Table A-55 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	3.3 to 4.2 kWh/SF 0.006 kW/SF
SF	Square feet	Tracking data	19 – 532 SF
ISR	In Service Rate	LA County Building Permits	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-16 and Table A-56.

$$kWh = \frac{kWhsavings}{SF} x\ SF_{home} x\ x\ ISR$$

Equation A-16

Table A-56 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	2,101 to 2,133 SF
ISR	In Service Rate	LA County Building Permits	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 FY 22/23 data alone, data from FY 20/21 and FY 21/22 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:

$$Average\ Daily\ kWh = \frac{Total\ kWh}{Number\ of\ Days} \quad \text{Equation A-17}$$

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 Evaluator reviewed the post-installation data for each measure to determine the optimal post-installation period for each measure.
    - For FY 20/21, for Attic Insulation and Central Heat Pump, the optimal post-installation period was determined to be October 2020 through September 2021. For Central Air Conditioner and Cool Roof, the optimal post-installation period was determined to be September 2020 through August 2021. In all cases, participants were filtered for those participants that had a full 12 months of post-installation data.
    - For FY 21/22, 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 FY 22/23, for Attic Insulation and Cool Roof, the optimal post-installation period was determined to be June 2022 through May 2023. For Central Air Conditioner and Central Heat Pump, the optimal post-installation period was determined to be July 2022 through June 2023.
- For all measures, a pre-installation period of January 2019 through December 2019 was used to control 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 FY 20/21, FY 21/22, or FY 22/23.

- 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.
- In some circumstances, the number of participants post-data filtering may not have been sufficient to detect statistically significant savings and additional data from previous program years may have been included in the analysis to find statistically significant savings.
    - For FY 20/21, Central Heat Pump did not have enough participants in FY 20/21 to perform an independent billing analysis. Therefore, Retrospective data from FY 15/16 through FY 19/20 was appended to the FY 20/21 data set to evaluate the savings of the measure.
    - For FY 21/22, Central Heat Pump and Central Air Conditioner did not have enough participants in FY 21/22 to perform an independent billing analysis. Therefore, data from FY 21/22 was appended to the FY 20/21 data set to evaluate the savings of the measure.
    - For FY 22/23, the four measures did not have enough participants in FY 22/23 to obtain statistically significant results. Therefore, data from FY 20/21 and FY 21/22 was appended to the FY 22/23 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-57 below.

Table A-57 CRP Attic Insulation, CAC, CHP, and Cool Roof Participant Count

Fiscal Year	Strata	Number of Participants	Final Sample Size
20/21	Attic Insulation – MF	922	263
	Attic Insulation – SF	18,925	7,268
	Central Air Conditioner	217	77
	Central Heat Pump	169	73
	Cool Roof	462	137
21/22	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
22/23	Attic Insulation – MF	74	1,379
	Attic Insulation – SF	370	20,655
	Central Air Conditioner	62	75
	Central Heat Pump	27	11
	Cool Roof	314	417

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-18. 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.

$$Average\ Daily\ kWh_i = \alpha + \beta_1 \cdot post + \beta_2 \cdot CDD_{i,n} + \beta_3 \cdot HDD_{i,n} + \beta_4 \cdot CDD_{i,n} \cdot post + \beta_5 \cdot HDD_{i,n} \cdot post + \varepsilon \qquad \text{Equation A-18}$$

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 were treated as cooling load while weather-dependent load between November through April were treated as heating load.

CAC and CHP Savings Calculation

After calculating the post period weather-dependent load, the cooling load and heating load were then used to estimate the approximate effective full load hours (EFLHs) for cooling and heating for each customer. The equations for estimating the EFLHs are presented in Equation A-19 and Equation A-20. 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-19*

$$EFLH_{heat} = \frac{kWh_{heat,e} \cdot HSPF_e \cdot 1000}{CAPY_{heat}}$$ *Equation A-20*

The EFLHs obtained using the post period data were then applied to the equation presented in Equation A-21 and Equation A-22 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-21*

$$kWh_{heat} = \frac{EFLH_{heat} \cdot CAPY_{heat}}{1000 \cdot HSPF_b}$$ *Equation A-22*

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-58 with the 90% confidence interval of the savings estimate.

Table A-58 CRP CAC and CHP Participant-Level Savings

Fiscal Year	Measure	Scenario	Annual kWh Savings	90% Confidence Interval		Relative Precision (90% CL)
				Lower Bound	Upper Bound	
20/21	Central Air Conditioner	ER	536	599	473	12%
	Central Air Conditioner	ROB	179	207	151	16%
	Central Heat Pump	ER	1280	1056	1504	17%
	Central Heat Pump	ROB	414	323	505	22%
21/22	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%
	Central Heat Pump	ROB	354	282	426	20%
22/23	Central Air Conditioner	ER	410	361	458	12%
	Central Air Conditioner	ROB	129	113	145	12%
	Central Heat Pump	ER	739	315	1162	57%
	Central Heat Pump	ROB	194	66	322	66%

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-23.

$$\Delta kWh_{HVAC} = kWh_{HVAC\ Pre} - kWh_{HVAC\ Post}$$

Equation A-23

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-59.

Table A-59 CRP Attic Insulation and Cool Roof Participant-Level Savings

Fiscal Year	Strata	Annual kWh Savings	90% Confidence Interval		Relative Precision (90% CL)
			Lower Bound	Upper Bound	
20/21	Attic Insulation – MF	154	79	230	49%
	Attic Insulation – SF	234	210	257	10%
	Cool Roof	563	295	830	47%
21/22	Attic Insulation – MF	312	252	373	19%

Fiscal Year	Strata	Annual kWh Savings	90% Confidence Interval		Relative Precision (90% CL)
			Lower Bound	Upper Bound	
	Attic Insulation – SF	484	459	510	5%
	Cool Roof	496	225	768	55%
22/23	Attic Insulation – MF	246	157	335	36%
	Attic Insulation – SF	90	64	116	28%
	Cool Roof	238	100	377	57%

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 FY 21/22 may inadvertently be impacted by changes due to the COVID-19 pandemic. To account for this impact, the Evaluator created a series of adjustment factors for each measure by leveraging the non-participant billing data received from LADWP.

The creation of these adjustment factors largely followed the logic of the billing data retrofit isolation analysis in the following manner:

- The nonparticipant data was separated into a typical period (January 2019 through December 2019) and COVID-19-impacted period. For FY 20/21, the COVID-19 period was estimated as October 2020 through September 2021 for program non-participants. For FY 21/22, the COVID-19 period was estimated as May 2021 through April 2022 for program non-participants. For FY 22/23, the COVID-19 period was estimated as June 2022 through May 2023 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 residential measures that were not evaluated by residential billing analysis, COVID-19 adjustment factors were generated in a similar manner. 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 22/23 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 215 program participants received up to two emails from LADWP inviting them to complete the survey – 18 completed the survey, yielding a response rate of 8%.

The number of participants contacted to complete the survey was lower than in FY 20/21 and FY 21/22 because a significant share of the participation records were from projects marked as Fiscal Year 2021 projects. These projects were included in the FY 22/23 data because payment on them had been delayed due to a banking transition. Specifically, tracking data provided for the period through February 2023 included 8,186 records. Of these, 6,944 records were projects included under Fiscal Year 2021. These records were not included in the FY 22/23 sample survey sample because the Evaluator completed a survey of FY 21/22 participants in 2022 as part of the CY2 evaluation.

Table A-60 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%

Measure	# of Participants	% of Population	# of Responses	% of Response
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 FY 22/23 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 58% for first year savings, estimated by billing analysis.

The Ex-Ante savings method applied a deemed savings factor to the installed square feet of insulation by the permutations of climate zone, baseline insulation, added insulation, and building type. Installed products included loose fill insulation, blown insulation, R-30 batts, and R-38 batts. The savings method considers the presence or absence of existing insulation, which is significant, as the heat transfer reduction per R-value decreases non-linearly as the total attic insulation R-value increases, but there are other significant inputs.

The California eTRM Ceiling Insulation measure provides deemed savings tables with similar permutations, but also includes the type of HVAC system in the residence. Inclusion of the HVAC variable may reduce uncertainty in the Ex-Ante savings method. The following table lists the HVAC parameter contribution to the common permutation of Climate zone 09, Single Family, R30 insulation. The central air conditioner/gas furnace HVAC combination has approximately 1/3 the savings of a central heat pump.

Table A-61 CRP Attic Insulation: Recommended Input

HVAC CA eTRM code	HVAC Description	Energy savings per SF
rNCGF	no cooling, gas furnace	0.01
rWtd	standard weights	0.14
rDXGF	central AC with gas furnace	0.15
rDXHP	central heat pump with electric resistance backup	0.46

HVAC CA eTRM code	HVAC Description	Energy savings per SF
rNCEH	no cooling, electric baseboard heating	0.67

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 49% for energy savings. The AHRI reference number of the new unit was not provided in the tracking data for FY 22/23. The central air conditioner measure is subgrouped by the capacity (tons) and efficiency (SEER), but all permutations utilized the same deemed value of 368 kWh/unit.

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 70% for energy savings. The AHRI reference number of the new unit was not provided in the tracking data for FY 22/23. The central heat pump measure is sub grouped by the capacity (tons) and efficiency (SEER), but all permutations utilized the same deemed value of 424 kWh/unit.

A.10.2.1.4 Cool Roof

The Ex-Post savings for installing roofing with a Cool Roof SRI rating value were calculated through a billing analysis and produced a realization rate of 9% for energy savings. The Cool Roof measure is subgrouped by the roof slope (low), SRI value bin (16, 20, 35) and roof slope (steep) with SRI value bin (75, 78, 85). The Los Angeles Municipal code requires low rise roof replacements for over 50% of the roof area, to meet minimum SRI values by the roof slope type.

Table A-62 LA Municipal Code Cool Roof SRI

Climate Zone	3 Year SRI	kW/SF
<= 2:12	78	0.004
>2:12	20	0.003
CZ16	0.115	0.003

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. Table A-63 summarizes the survey responses for the portion of the roof replaced from FY 21/22 and FY 22/23.

Table A-63 CRP Cool Roof Participant Survey – Base Case

Base Case	Responses	% Responses
90% to 100% of the roof replaced	74	99%
50% to 90% of the roof replaced	1	1%
Less than 50% of the roof replaced	0	0%
Total	**75**	**100%**

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 windows in FY 21/22 indicated most (88%) met the program requirements for replacing existing single pane windows.

Table A-64 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 is modeled with a base case of single pane windows and efficient case of a window with a U-factor of 0.32.

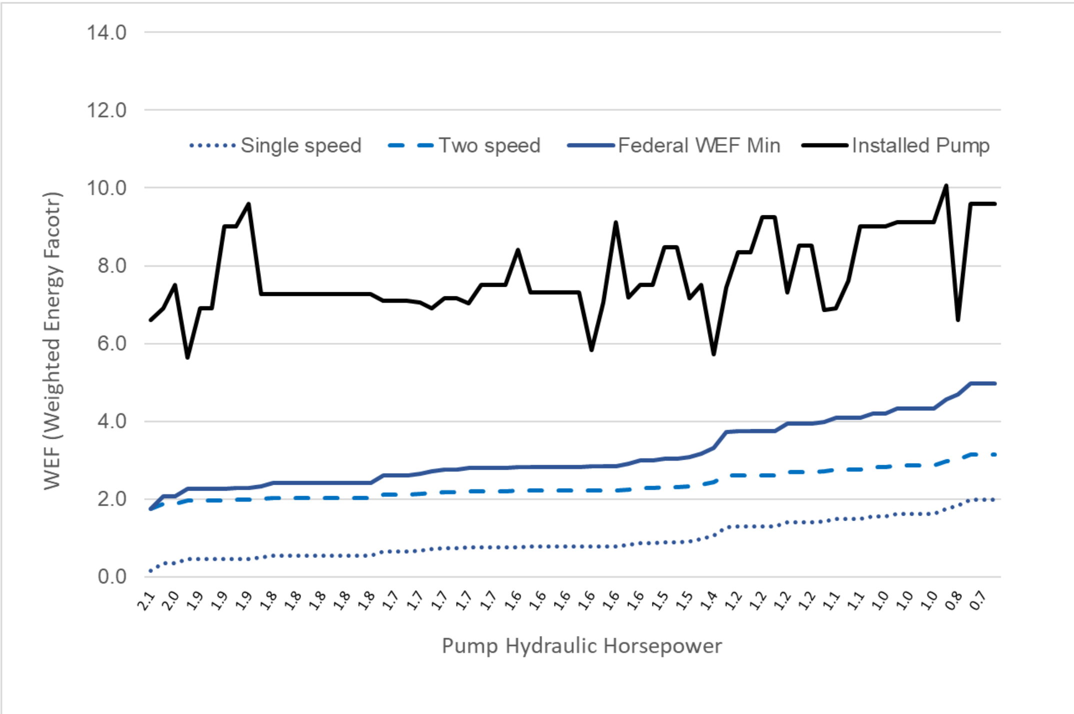
The Ex-Ante energy savings is deemed at 0.44 kWh/square feet of window installed. The CMUA TRM deemed savings value for CZ09 is 4.2 kWh/square feet, with the difference of the two deemed values having a magnitude of 10.

A.10.2.1.6 VSD Pool Pump and Motor

Pool pumps manufactured since July 2021 are subject to the testing requirements which require a minimum weighted energy factor (WEF) dependent on the hydraulic horsepower.

The following figure compares the WEF of each installed pool pump model, to the associated less efficient technology for the same hydraulic horsepower. The installed pool pumps are all more efficient than the minimum required for normal replacements. From participant surveys and site visits, approximately 52% are early replacements of working pumps, with half of those single speed and the other half two speed. The installed pump achieves savings over a normal replacement baseline, represented by the Federal WEF minimum line in the figure, but larger savings are realized for the early replacement baselines, represented by the single-speed and two-speed lines in the figure below.

Figure A-13 CRP – Installed VSD Pool Pump WEF, Compared to Less Efficient Technology



To meet the WEF 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 A-65 below presents the effective WEF from pool pump metering site visits during FY 21/22 period. The effective WEF was determined from the efficiency of gallons to energy usage at the metered operating speeds and time of day compared to the WEF test procedure at 80% low speed and 20% high speed. The average usage factor of 0.66 was utilized for the FY 22/23 pool pump savings method.

Table A-65 CRP Pool Pump Site Visit Operating Speed/Schedule

Nameplate WEF	Effective WEF	Usage Factor
6.22	4.05	0.59
6.90	3.09	0.45
6.90	6.20	0.69
6.90	4.46	0.65
6.90	4.60	0.51
6.90	4.28	0.62
6.90	6.51	0.94
6.90	3.56	0.40

Nameplate WEF	Effective WEF	Usage Factor
6.90	5.61	0.81
6.90	3.69	0.41
7.27	3.29	0.32
7.32	7.12	1.03
9.00	4.86	0.70
9.00	4.00	0.58
9.00	6.52	0.64
9.00	5.75	0.64
9.00	6.55	1.05
10.17	2.39	0.33
10.17	7.96	1.09
Average		**0.66**

Although the certified pool pump measure specifies the pool pump programming to operate during non-peak demand periods, only 51% of the pool pumps were programmed to run only during off peak periods, based on site visits and participant surveys.

Table A-66 CRP Pool Pump Peak Demand Scheduling

Operating Schedule	Number of Pumps	% Pumps
Operates only night off peak	41	51%
Daytime peak and nights	10	13%
Only daytime peak period	29	36%

Most (89%) 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 (22%). 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 A-67 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	9	2	22%

Measure	Survey responses and site visits	All schedules operate off peak	Percent operating only off peak
Certified Pool Pump Replacement	70	37	53%
Total	**79**	**39**	**49%**

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.

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, who make up 37% of housing unit occupants in Los Angeles. Although they could, renters typically do not purchase the type of measures included in CRP.

The program runs during a fiscal year (a fiscal year, FY, is July 1 to June 30). The program served 1,486 customers in FY 22/23 (July 1, 2022, through June 30, 2023) and offered rebates for six measures covering the building envelope (2 measures), HVAC (3), and pool pumps (1) as shown in the table below. Additionally, the program continued to install and pay for attic insulation within 444 homes from previous fiscal years (not included in the table below).

Across FY 20/21 through FY 22/23, LADWP paid 9,019 rebates for these six measures within CRP. Compared to the previous year, FY 22/23 saw a decrease in participation for all measures, but mainly in pool pumps (Table A-68). According to the program manager, the program saw fewer incentives paid this fiscal year due to a change in payment processes (described further below).

Table A-68 CRP Population of Measures

Category	Measure	Rebate Amounts	# of measures two years ago (FY 20/21)	# of measures last year (FY 21/22))	# of measures this year (FY 22/23))	Total over three years
Pool Pump	Pool Pump and Motor	$1,000 until June 1, 2023, and	2,431	3,006	1,054	6,491

Category	Measure	Rebate Amounts	# of measures two years ago (FY 20/21)	# of measures last year (FY 21/22))	# of measures this year (FY 22/23))	Total over three years
		then $500 each				
Building envelope	Cool Roof	Up to $0.30 per square foot (2020-2021) Up to $0.60 per square foot (2021-2023)	487	724	314	1,471
HVAC	Central Air Conditioner	$100-$120 per ton	203	504	64	771
Building envelope	Dual Pane Windows	$2.00 per square foot	38	105	22	165
HVAC	Central Heat Pump	$100-$200 per ton (2020-2021) $100-$120 per ton (2021-2023)	20	64	30	114
HVAC	Whole House Fan	$200 each	2	4	2	7
Total			**3,181**	**4,407**	**1,486**	**9,019**

A.10.3.1 Process Evaluation Approach and Methodology

The following sections discuss the CRP process evaluation methodology.

A.10.3.1.1 Document Review

The Evaluator 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 June 2023, the evaluation team interviewed the previous and current supervisor, a lead for CRP, and other LADWP staff (i.e., the LADWP evaluation team). This interview covered changes from the previous year.

A.10.3.1.3 Participant Survey

LADWP and ADM fielded a participant survey in May and June 2023 with fewer responses than desired. LADWP sent a survey link to 215 CRP participants (a census of available email addresses for customers who completed projects during FY 22/23) and 18 completed the survey (a response rate of 8%). Most of the completions (13) were from customers who had purchased a pool pump. Four more were for those that put in a Cool Roof, and one was from a customer who had received an incentive for a central air conditioner.[10]

Due to the low response rate, the Evaluator can only provide anecdotal type information from this survey.[11]

The survey had several intended uses, but for the process evaluation, the evaluation team wrote survey questions to 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. (Note that given the small number of respondents, we do not include this information in the report).

Additionally, the Evaluator summarized findings on key metrics developed from the surveys of program participants in FY 20/21 through FY 22/23.

The Evaluator performed a full process evaluation of CRP in FY 21/22. The key findings of the FY 20/21 process evaluation were:

- CRP products can substantially affect a household's energy use (and utility bills) which directly supports Los Angeles as it seeks to improve the quality of housing and reduce household burden.
- 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 recommendations made in the FY 21/22 evaluation were as follows:

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

[10] The tracking data provided for the period through February 2023 included 8,186 records. Of these, 6,944 records were projects included under Fiscal Year 2021. These records were not included in the survey sample because the Evaluator completed a survey of FY 21/22 in 2022 as part of the CY2 evaluation.

[11] A sample typically needs at least 68 responses to be 90% certain that the results from those respondents are within 10% of the population.

- **Provide a way for a customer to track their rebate online**. Many customers expressed dissatisfaction with knowing if LADWP had received their application and difficulty reaching a customer service person to figure it out. Enabling an online tracking system could reduce the stress levels of customers and increase satisfaction around rebate timing.
- **Review payment process for all measures and especially for Dual Pane Windows.** LADWP needs to determine how to best reduce the time for processing rebates when there is a surge in rebates (as occurred this program year).While there were few dual pane windows paid through the program (N=38), they had the highest average time between ordering and payment (194 days or about 6 months). Additionally, dual pane windows had higher average payment times for three of the four quarters of the fiscal year (almost double the time for a similar number of central heat pumps with rebates).
- **Consider tailoring the CRP Fact Sheet to address measure-specific messages around saving utility costs, comfort, etc.** Additionally, consider providing contractors with similar tailored messages that they could use.
- **Talk to participating CRP contractors to determine why the program is underserving Asian and Black communities.** The 2021-2029 Housing Element indicates that 39% of Asian households and 29% of Black households are homeowners. This year's program served only 18% across both groups. If the reason for lack of participation in these areas is a lack of contractors, CRP may want to work with other agencies within Los Angeles to help bring in additional contractors who will serve these communities.

A.10.3.2 Process Evaluation Findings

As noted above, in FY 22/23, the program saw decreases from FY 21/22 for all measures, with several installed measures that were more like FY 20/21. The program is considering adding heat pump water heaters in a future year.

A.10.3.2.1 Incentive Process Update

During FY 22/23 the program updated their incentive processes to ensure fiscal responsibility and be aligned with the program Terms & Conditions (T&C). In late October/early November of 2022, the program started to more carefully scrutinize applications to ensure that all T&Cs were being met. The program is very clear about the importance of T&Cs as the first item in the CRP application "How to Apply" section is to "Read the Terms and Conditions." There are 15 T&Cs with some general to any measure (e.g., all products must be new, receipts must be provided) and some pertaining only to a specific measure (e.g., Cool Roof solar reflectance index, HVAC permit). The quality control (QC) put in place by the program found applications that needed additional information to be in full compliance with the T&C's, causing delays in payment.

Previously, the program experienced delays in incentive processing because only certain staff processed certain measures. The program has now cross-trained their staff and the previous issue of a limited knowledge base for specific measure processing is gone.

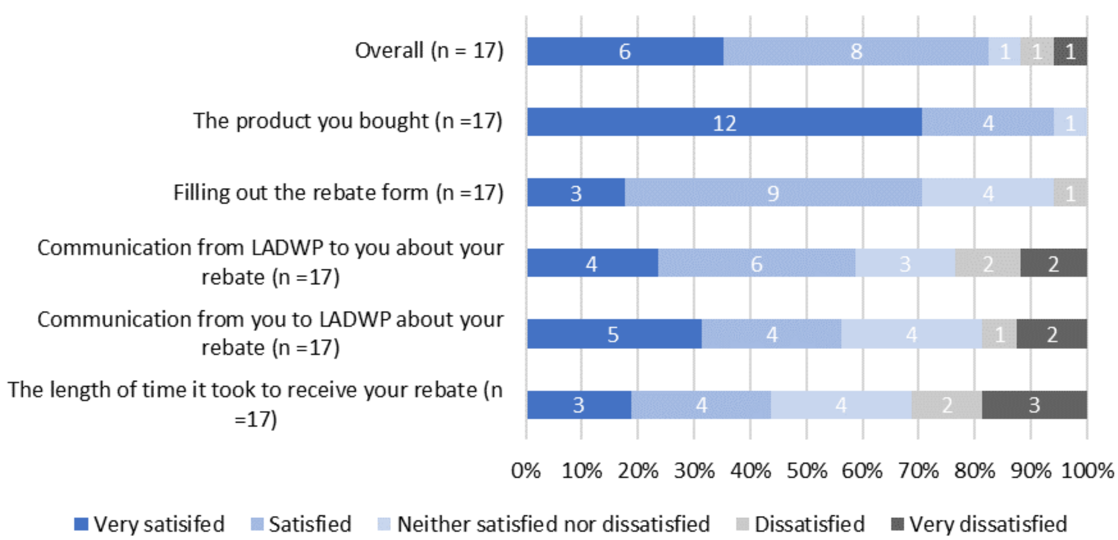
According to the program managers, the challenge is now that the QC process is followed in tandem with the processing of rebates with the QC requiring time to complete. While both the QC and incentive processing seek to pay rebates, the program lead indicated that a balance is needed between the two activities.

Additionally, in FY 22/23, the program transitioned banks. The program held back about 650 customers as they implemented the QC for the T&C and the bank transition. Applications are now being processed as they arrive, there is no banking delay, and the customers who were initially held back have been paid their incentive. However, these customers may have been one reason for the low satisfaction noted in the survey about the length of time it took to receive a rebate.

A.10.3.2.2 CRP Customer Satisfaction

Overall, customers were satisfied with the CRP program (82% very satisfied or satisfied). Customers were very satisfied with their purchased products and less satisfied with program processes. (See Figure A-14, where the level of satisfaction is somewhat lower for specific program processes).

Figure A-14 CRP - Overall Program Satisfaction and for Different Program Areas



Even though there were few survey responses, the responses are like the survey from the past year (all responses between the two years are statistically indistinguishable, so are essentially the same). Satisfaction for the product was high in both years and customers provided satisfaction ratings in essentially the same order as shown above, with the length of time to receive the rebate having the lowest satisfaction in both years. In general, satisfaction tended to be a bit higher during the first year of the concurrent period. The decline may reflect the challenges the program faced in processing large numbers of insulation applications.

Table A-69 – CRP Percent Satisfied

Online Sign Up	Percent of Respondents (FY 20/21) (n = 284)	Percent of Respondents (FY 21/22) (n = 307)	Percent of Respondents (FY 22/23) (n = 17)
Overall	90%	81%	82%
Product purchased	90%	88%	94%
Filling out the rebate form	83%	76%	71%
Communication from customer to LADWP about rebate	72%	59%	59%
Communication from you to LADWP about your rebate	68%	58%	56%
Length of time to receive your rebate	63%	46%	44%

A.10.3.2.3 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-70

Table A-70 CRP Demographics of Customers Obtaining a Rebate

Demographic Parameter	CRP Survey (FY 20/21)	CRP Survey (FY 21/22)	Population for City of Los Angeles (census data)	Notes
Home Ownership	**(n=244)**	**(n = 268)**	**Households**	
Owner - Single Family	88%	93%	37%	As expected, participant homeowners disproportionately obtained more rebates through CRP than renters
Owner - Multi Family	2%	3%		
Renter- Single Family	10%	4%	63%	
Renter - Multi Family	0%	0%		
Income	**(n=284)**	**(n = 243)**	**Owner Households***	
Low or Moderate	43%	35%	44%	Of those who provided the Evaluator with income data, many CRP participants are considered to be low or moderate income (based on number of people in the household and self-reported income)
Above Moderate	24%	31%	56%	
Declined to Say	33%	33%	-	
Age	**(n=272)**	**(n = 256)**	**Owner Householder****	
25-34	2%	4%	6%	

Demographic Parameter	CRP Survey (FY 20/21)	CRP Survey (FY 21/22)	Population for City of Los Angeles (census data)	Notes
35-54 55-64 65+	32% 27% 39%	31% 29% 36%	36% 25% 33%	The age of CRP participants align with the age of owner households in the population.
Self-Identified Ethnicity	**(n=257)**	**(n = 235)**	**Owner Householder*** **	
Caucasian (White) Hispanic (Latinx)[12] Asian Black Other	53% 23% 13% 5% 6%	65% 19% 9% 7% 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*

A.10.3.2.4 Previous Evaluation Recommendations

Table A-71 below includes a summary of previous recommendations and the program's response.

Table A-71 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 attic

[12] The Evaluator follows the lead of Los Angeles staff and applies the term Latinx rather than Hispanic (Housing Element 2021-2029, page 41).

Summary of Past Recommendations	Program Response
	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.11 Efficient Product Marketplace

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-72 below lists the data collection activities and sources of data for the EPM Program.

Table A-72 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

Data	Source
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)
Lighting usage data	Participant site visits

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-73 lists the workbooks referenced to aggregate the participant data and which was then compared to ESP measure level report data.

Table A-73 EPM Program Tracking Data Sources

Workbook File Name	Participant Records
FY 22 - 23.xlsx	10,638

The Evaluator was not provided Ex-Ante peak kW reduction by measure.

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-74.Thermostats are listed as "eligible census," after meeting requirements for non-participation in other programs to complete a billing analysis.

Table A-74 EPM Sample Design

Strata	Analysis Method	Sample
Advanced Power Strips	Engineering Analysis	Census
ENERGY STAR Lighting	Engineering Analysis	Census; Site visits
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-75 compares ESP and program tracking Ex-Ante kWh. The values were found to be equal from both data sources.

Table A-75 EPM ESP to Program Tracking - Savings Comparison

Measure	Energy (kWh)	
	ESP Data Ex- Ante	Program Data Ex-Ante
Air Conditioner	10,778	10,778
Cool LA Air Conditioner	100,019	100,019
Light Bulb	5,921	5,921
Power Strip	21,200	21,200
Refrigerator	89,435	89,435
Television	409	409
Thermostat	1,074,061	1,074,061
Total	**1,301,823**	**1,301,823**

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.11.1.3.1 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-24 and Table A-76.

$$kWh_{savings} = \frac{kWh}{strip} x\ ISR$$ *Equation A-24*

Table A-76 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.11.1.3.2 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-25 and Table A-77.

$$kWh = (UEC_{fed\_base} - UEC_{efficient}) x\ IE\ x\ ISR$$ *Equation A-25*

Table A-77 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, FY 22/23	100%
IE	Interactive Effects Factor by climate zone	DEER Interior Lighting	1.00 to 1.08

A.11.1.3.3 Energy Star Room Air Conditioner

The energy savings for the purchase of new Energy Star room air conditioners (non-Cool LA) 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-26 and Table A-78

$$kWh = EFLH\ x\ Capacity\ x\ \frac{\frac{1}{CEER_{base}} - \frac{1}{CEER_{eff}}}{1000}\ x\ ISR$$

Equation A-26

Table A-78 EPM Energy Star Room Air Conditioner Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
EFLH	Effective Full Load Hours	Billing analysis	411 hours
Capacity	Capacity of new unit, BTUh	Tracking Data Model and Energy Star Database	5,000 to 24,000 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	9.8 – 15.7 CEER
ISR	In Service Rate	Participant Survey, 2023	97%

A.11.1.3.4 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-27 and Table A-79

$$kWh = (UEC_{base} - UEC_{eff})\ x\ IE\ x\ ISR$$

Equation A-27

Table A-79 EPM FY 21/22 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

Variable Name	Input	Source	Value Range
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-80 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-80 EPM Television UEC Baseline – FTC Data

Screen size bin, inches	UES kWh/inch
18.5	51
54.6	230
64.5	238
74.5	321
84.5	366

A.11.1.3.5 Energy Star Lighting

The program offered many types of LED lamps, including general service A-lamp, reflectors, BR, PAR, and candelabra lamps. But over 97% 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 different values for the baseline watts.

$$kWh = HOU\ x\ \frac{(Watts_{base} - Watts_{efficient})}{1000}\ x\ IE\ x\ ISR \qquad \text{Equation A-28}$$

The variables for the lighting equations are listed in Table A-81.

Table A-81 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	8 – 74W
$watts_{base}\ ER$	Early replacement – baseline watts, weighted average	Participant survey – 22 responses for two	Incandescent 39% Halogen 3% CFL 30%

Variable Name	Input	Source	Value Range
		areas per home with replaced lamps	LED 230% None (LED) 10%
$watts_{efficient}$	Watts per lamp	Model data and Energy Star Database	3.8 - 18 W
HOU	Annual hours of use	2023 EPM & HEIP metering, FY 22/23 Participant Survey	926 hours
ISR	In Service Rate	Participant Survey, FY 22/23, Site visits FY 22/23	64%
ISR_{3year}	In Service Rate, first 3 year average	Uniformed Methods Project, Lighting Chapter 6	79%
IE	Interactive Effects Factor by climate zone	DEER Interior Lighting	kWh: 1.0 – 1.2 kW: 1.22 – 1.48

A.11.1.4 Billing Analysis Approach

The Evaluator performed a billing analysis to evaluate the energy 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 Evaluator used a billing data retrofit isolation approach to evaluate EPM Smart Thermostats and EPM Web-Enabled Thermostats.

A.11.1.4.1 Billing Data Retrofit Isolation

To evaluate Cool LA Room Air Conditioners, 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, propensity score matching (PSM), is a method which attempts to develop a comparison group for billing analysis from non-participant customers based on pre-treatment characteristics. The PSM method was not selected, as the HVAC-equipment type is unknown for a population. 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:

$$Average\ Daily\ kWh = \frac{Total\ kWh}{Number\ of\ Days} \qquad \textit{Equation A-29}$$

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 Evaluator reviewed the pre-installation data and post-installation data for each measure to determine the optimal pre-installation and post-installation period for each measure.
    - For the FY 20/21 analysis, most customers did not have a full year's worth of post-installation data. Therefore, the Evaluator used a pre-installation period of March 2019 through September 2019 and a post-installation period of March 2021 through September 2021.
    - For the FY 21/22 analysis, most customers did not have a full year's worth of post-installation data. Therefore, for Smart Thermostats, the Evaluator 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 Evaluator 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.
    - For the FY 22/23 analysis, most customers did not have a full year's worth of post-installation data. Therefore, for Smart and Web-Enabled thermostats, the Evaluator used a pre-installation period of January 2019 through May 2019 and September 2019 through December 2019 and a post-installation period of September 2022 through May 2023. For Cool LA Room Air Conditioners, a post-installation period of January 2023 through June 2023 was used.
- Participants must not have taken part in any other energy efficiency programs administered by LADWP during FY 20/21, FY 21/22, or FY 22/23.
- 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.

- For the FY 20/21 analysis, the results of the analysis were not statistically significant when performed on FY 20/21 data for EPM Smart Thermostat and EPM Web-Enabled Thermostat. Thus, data was supplemented using FY 15/16 through FY 19/20 data. Furthermore, EPM Web-Enabled Thermostats could not produce statistically viable results independently and were aggregated with EPM Smart Thermostats for analysis, creating the EPM Smart + Web-Enabled Thermostats measure.
- For the FY 21/22 analysis, the results of the analysis were not statistically significant when performed on FY 21/22 data for EPM Smart Thermostat and EPM Web-Enabled Thermostat. Thus, data was supplemented using FY 20/21 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.
- For the FY 22/23 analysis, the results for 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-82.

Table A-82 EPM Smart & Web-Enabled Thermostat Participant Count

Fiscal Year	Measure	Number of Participants	Final Sample Size
20/21	Cool LA Room Air Conditioners	-	-
	Smart Thermostat	12,992	2,118
	Smart + Web-Enabled Thermostat	13,472	2,205
21/22	Cool LA Room Air Conditioners	-	-
	Smart Thermostat	3,774	375
	Smart + Web-Enabled Thermostat	3,998	433
22/23	Cool LA Room Air Conditioners	3,443	864
	Smart Thermostat	3,693	582
	Smart + Web-Enabled Thermostat	4,787	651

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-30.

$$Average\ Daily\ kWh_i = \alpha + \beta_1 \cdot post + \beta_2 \cdot CDD_{i,n} + \beta_3 \cdot HDD_{i,n} + \beta_4 \cdot CDD_{i,n} \cdot post + \beta_5 \cdot HDD_{i,n} \cdot post + \varepsilon \quad \text{Equation A-30}$$

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 was treated as cooling load while weather-dependent load between November through April were treated as heating load.

Cool LA Room Air Conditioner Savings Calculation

After calculating the post period weather-dependent load, the cooling load was then used to estimate the approximate effective full load hours (EFLHs) for cooling for each customer. The equation for estimating the EFLHs is presented below. Equipment efficiency information including CEER and equipment capacity was obtained via the tracking data.

$$EFLH_{cool} = \frac{kWh_{cool,e} \cdot CEER_e \cdot 1000}{CAPY_{cool}}$$ *Equation A-31*

The EFLHs obtained using the post period data were then applied to the equation presented in the following equation to estimate baseline equipment consumption.

$$kWh_{cool} = \frac{EFLH_{cool} \cdot CAPY_{cool}}{1000 \cdot CEER_b}$$ *Equation A-32*

Federal standard baseline values were used for the savings calculation. Savings were then estimated by taking the difference in consumption between the baseline scenario and efficient equipment consumption. Savings are presented in the following table with the 90% confidence interval of the savings estimate.

Table A-83 Cool LA Room Air Conditioner Participant-Level Savings

Fiscal Year	Measure	Annual kWh Savings	90% Confidence Interval		Relative Precision (90% CL)
			Lower Bound	Upper Bound	
20/21	Cool LA RACs	-	-	-	-
21/22	Cool LA RACs	-	-	-	-
22/23	Cool LA RACs	31	24	38	23%

Smart and Web Thermostat 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-33.

$$\Delta kWh_{HVAC} = kWh_{HVAC\ Pre} - kWh_{HVAC\ Post}$$ *Equation A-33*

Because the FY 21/22 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-84

Table A-84 EPM Smart & Web-Enabled Thermostat Participant-Level Savings

Fiscal Year	Measure	Annual kWh Savings	90% Confidence Interval		Relative Precision (90% CL)
			Lower Bound	Upper Bound	
20/21	Smart Thermostat	180	116	244	35%
	Smart + Web-Enabled Thermostat	166	103	229	38%
21/22	Smart Thermostat	345	172	517	50%
	Smart + Web-Enabled Thermostat	310	156	464	50%
22/23	Smart Thermostat	438	227	650	48%
	Smart + Web-Enabled Thermostat	423	231	614	45%

A.11.1.4.2 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 FY 22/23 may inadvertently be impacted by changes due to the COVID-19 pandemic. To account for this impact, the Evaluator created a series of adjustment factors for each measure by leveraging the non-participant billing data received from LADWP.

The creation of these adjustment factors largely followed the logic of the billing data retrofit isolation analysis in the following manner:

- The nonparticipant data was separated into a typical period (January 2019 through December 2019) and COVID-19-impacted period. For FY 20/21, the COVID-19 period was estimated as October 2020 through September 2021 for program non-participants. For FY 21/22, the COVID-19 period was estimated as May 2021 through April 2022 for program non-participants. For FY 22/23, the COVID-19 period was estimated as June 2022 through May 2023 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 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. 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.11.1.5 Online Survey Data Collection

LADWP and ADM fielded a participant survey in May-June 2023. The survey was similar (but not identical) to the previous participant survey fielded in 2021 and 2022 to determine if there were differences between customer feedback.

Survey data were used to:

- Verify that the rebated equipment was in-place and operating (as applicable); and
- Assess customer experiences with the program.

A total of 2,166 program participants received up to three emails from LADWP inviting them to complete the survey – 215 completed the survey (5 were disqualified leaving 210 responses for the analysis), yielding an overall response rate of 9.9%.

The survey respondents provide a relatively good representation of the population of customers receiving a rebate through EPM. There are more people who purchased window air conditioners and fewer people who purchased thermostats within the surveyed population than in the actual population. Because our analysis is not measure specific, the Evaluator is comfortable using this data to discuss EPM.

Table A-85 EPM Summary of Survey Sample Measure Coverage

Measure	# of Customers	% of Customers	% of Measures	# of Responses	% of Responses
Light Bulb	4,096	63%	47%	25	12%
Refrigerator	1,350	31%	13%	61	29%
Smart Thermostat	956	15%	11%	94	45%
Window Air Conditioner	235	4%	27%	23	11%

Measure	# of Customers	% of Customers	% of Measures	# of Responses	% of Responses
Power Strip	49	1%	1%	7	3%
Television	1	0%	0%	0	0%

A.11.2 Impact Evaluation

This section presents the findings of the impact evaluation of the EPM during the FY 22/23 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 1,150%, due to two items. First, all measures in the tracking data had an Ex-Ante energy savings of 1.92 regardless of the quantity ordered. Second, 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 39% still with incandescent lamps, 2% halogen, 30% CFL with the remaining having an LED baseline. The incandescent proportion decreased from the FY 21/22 survey at 58% to 39% in FY 22/23.

A.11.2.1.2 Advanced Power Strip

The power strip energy savings realization rate was 75%. The Ex-Post referenced the CA eTRM Smart Power strip 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. The Ex-Post savings method included the ISR of 83% based on the participant survey responses.

A.11.2.1.3 Smart and Web Thermostat

The smart and web thermostat energy realization rate was 194% estimated by a billing analysis of participants. The Ex-Ante savings per unit is climate zone dependent but does not consider permutations for the type of HVAC in the home.

A.11.2.1.4 Refrigerator

The refrigerator realization rate was 116%. The Ex-Ante savings were deemed based on one of two Energy Star rating levels. The Ex-Post savings determined the minimum Federal Standard annual energy usage for each refrigerator and compared to the manufacturer refrigerator specifications annual usage sourced from the Energy Star database.

A.11.2.1.5 Television

The television energy realization rate was 125%. The participation was low with a total of 6 rebated Energy Star televisions. The Ex-Post savings were based on the difference of the manufacturer rating for annual energy use based on FTC Energy Guide data compared to non-Energy Star televisions, 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[13] , rebate information (for certain products), and ENERGY STAR rating (where applicable).

The program (with Enervee as the implementer) also maintains a similar website specifically for the Cool LA initiative. 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). 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 the customer immediately from an LADWP list. If not verified, the customer is sent to the regular marketplace website.

The program runs during a fiscal year (a fiscal year, FY, is July 1 to June 30). In this fiscal year, the program provided rebates to about 6,400 customers.

As of mid-July 2023, EPM included 20 different products. Customers can purchase six directly from the website (with five of them also including an LADWP rebate). One product has a rebate but cannot be purchased directly from the website. Compared to earlier in FY 22/23 (website accessed September 2022), the program removed two products. Clothes washers and electric water heaters were removed for contractual reasons. LADWP has a contract with Southern California Public Power Authority (SCPPA) for the Enervee services, which was renewed in early 2023. However, SCPPA cannot contract for services that are not specifically energy efficiency related (i.e., no water saving or electrification measures) and so these two measures were dropped from the website when the Enervee contract was renewed. (Figure A-15)

[13] 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.

Figure A-15 EPM Products

From about February to May 2023, both the EPM website and the Cool LA website were available as information-only sites. Customers could not obtain instant rebates or apply for regular rebates (although the program allowed the customer to put in paper applications). This was due to LADWP's internal processes that delayed a Task Order between LADWP and SCPPA for the program when Enervee's contract was renewed.

As shown Table A-86 even with the time where rebates were not being offered online (i.e., February to May 2023), significantly more window air conditioners went through EPM this year (FY 22/23) compared to last year (FY 21/22) most likely due to the Cool LA initiative. LADWP's marketing for Cool LA most likely increased traffic to the site and educated customers about potential rebates. Additionally, some customers who qualified for Cool LA may have obtained a post-purchase rebate under the standard EPM site. Cool LA was supposed to be available one-time but is currently active and expected to be available seasonally.

Other measures were slightly lower than previous years, which may have been due to the four or so months when instant and online rebates were not available.

Table A-86 EPM Products Rebated (FY 20/21 - FY 22/23)

Product Sold	Population			
	Sum of Products 2020-2021	Sum of Products 2021-2022	Sum of Products 2022-2023	Total over three years
Air Conditioner	337	283	371	991
Cool LA Air Conditioner	Not offered	Not offered	3,443	3,443
Light Bulb	1,169	35,992	3,084	40,245
Power Strip	105	53	100	258
Refrigerator	2,377	2,059	1,826	6,262
Television	17	7	6	30
Thermostat	5,585	5,844	5,437	16,866
Grand Total	**9,590**	**44,238**	**14,267**	**68,095**

Beginning in 2024, the program leads expect their offerings to change. LADWP will no longer rely on SCPPA to contract with vendors as the SCPPA/LADWP contract ends on December 10, 2023. LADPW has already put forward a Request for Proposals (RFP) for

Marketplace to start up in January 2024. Once a vendor is under the LADWP contract, water saving, and electrification measures may be added, and TVs may be removed.

A.11.3.1 Process Evaluation Approach and Methodology

The following sections discuss the EPM process evaluation 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 30 minutes, the Evaluator interviewed two (2) EPM staff in June 2023.

A.11.3.1.3 Participant Survey

The 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.
- **Customer Feedback –** Various feedback of interest, including:
  - the ease or difficulty of navigating the site
  - which different ways of learning about the website were most influential
  - why they purchased the product
- **Customer Demographics –** Included to explore how well EPM participation represented the population of Los Angeles and whether target marketing by demographics may be beneficial.

The Evaluator's analysis of EPM is focused on data obtained via an online survey from customers who received a rebate through the EPM website. This subset of customers includes a good set of email addresses to enable a survey, but limits understanding of the EPM website experience since customers who visit the site but do not obtain a rebate are not included.

The Evaluator performed a full process evaluation of EPM in FY 20/21. The key findings and recommendations of the FY 20/21 process evaluation were:

- **Consider adding more information on products of interest to customers.** Items suggested: water saving equipment, back-up batteries, and lawn equipment, as well as financing for efficient refrigerators.
- **Consider targeted marketing to begin to draw in renters and Hispanic (Latinx) customers.** While the survey did not ask questions to shed light on language capabilities, staff may want to determine if it is worthwhile to apply a language translation capability to the site so that people with English as a second language may be more comfortable using the site.
- **Cross-link programs to raise awareness of other LADWP customer opportunities.** While it may not be feasible to put in specific links to all LADWP

programs onto the EPM website, it may be good to have a single link that makes a person on the website want to go explore other LADWP programs. Specific options may include the following.

- About three quarters of EPM survey respondents are homeowners (70%) who might be able to benefit from Consumer Rebates Program (CRP) rebates, yet half to two-thirds of homeowner respondents were unaware of products available through CRP. As such, the EPM website may be a suitable location to add a link specifically to the CRP landing page.
- Close to a third of EPM respondents (who provided their income) are low income and may be able to participate in the Home Energy Improvement Program or appreciate knowing they could obtain free water conservation measures (through the Free Water Conservation items).
- Over half of EPM respondents are single family homeowners who may be grateful to know that there are ways to reduce their water bills through the Turf Replacement Program.

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

Overall, EPM is doing a good job based on the thousands of products being rebated through the website and feedback from survey respondents.

A.11.3.2.1 EPM Customer Satisfaction

Like the previous survey from two years ago, ninety-four percent (94%) of EPM survey respondents are satisfied with the site. Almost nine out of ten respondents are likely to recommend EPM to a friend, neighbor, or colleague to buy an energy-using product.

Compared to the previous survey, more respondents felt that the website helped them to decide about what to purchase (81% this survey compared to 73% and 74% in the previous surveys) and more said it gave information that they had not seen elsewhere (67% this year compared to 56% and 61%).

While the satisfaction rate is very high, some EPM customers were dissatisfied (7 individuals in our survey). Table A-87 shows the category and details of the few that provided some information regarding their dissatisfaction.

Table A-87 Category and Detailed Responses for Dissatisfaction with EPM

Category of Dissatisfaction	Detailed Response about Dissatisfaction
Bad product	A/C doesn't work, and it was not for my type of window.

Category of Dissatisfaction	Detailed Response about Dissatisfaction
Gift card issues	I could never get the Amazon gift card to work. It just sent me through an endless loop of entering it. Also, I purchased a 2nd refrigerator and a washer dryer and never got the gift card for that.
Hassle	As I recall, there were too many hoops to jump through for such a small rebate.
	Very tedious return process. The website did not show my order, so I had to call and send emails to acquire my receipt. The program representatives were unable to provide me with a receipt to refund the unit. Escalated to a higher rep but didn't respond. The return window was narrowing. This took 3 weeks of back and forth. I was able to get help from a Best Buy representative (location where the ac was ordered). Website needs drastic improvement.
	I purchased the product by mistake and wanted to return but they wanted to charge some extra fee which wasn't worth returning for a customer. Overall, didn't have a good experience.
Lack of program coordination	The AC Optimization Program implied that one of their partnered vendors would install the smart thermostat for me free of charge if I bought it from the Product Marketplace. However, after purchasing from the Marketplace, all the vendors I contacted told me that they don't install that thermostat model for free. I wouldn't have bought it if I knew that, and I believe the program's details are misleading.

Table A-88 – CRP Percent Satisfied and Perceptions of Marketplace

Online Sign Up	Percent of Respondents (FY 20/21) (n = 240)	Percent of Respondents (FY 21/22) (n =321)	Percent of Respondents (FY 22/23) (n = 210)
Percent satisfied with the program overall	94%	94%	94%
Percent that thought it was very easy or easy to find what they wanted on the website	90%	96%	96%
Percent that thought it was very easy or easy to complete the instant rebate purchase	NA	98%	97%
Percent who thought website helped them make a decision about what to purchase	73%	74%	81%
Percent who thought the website gave them information they had not seen elsewhere	58%	61%	67%
Percent that thought website saved them time on deciding what to purchase	NA	74%	82%

A.11.3.2.2 EPM Customer Feedback

Like the previous survey, most respondents (96%) said it was easy to find what they wanted on the site.

Customers learned about EPM from various sources but found only a few to be highly influential in motivating them to "participate in the program" (i.e., go to the EPM website). The gray lines in the table below highlight two examples of the results. Almost half of the customers found EPM through an internet search, but less than one in five of those thought it was influential in why they chose to participate. Digital advertising was considered influential for a quarter of those who saw the advertisement, but relatively few customers (8%) saw the ads.

Table A-89 How Customers Learned about EPM (Gray lines highlight two examples with high influence)

How learned about EPM	# learning this way	% learning this way (n = 202)	# indicating choice was influential	% indicating choice was influential
Internet research/found program on LADWP website	95	47%	17	18%
Printed or emailed material or outreach materials sent by the program	53	26%	11	21%
Past LADWP program participation	44	22%	7	16%
LADWP account representative or other LADWP staff	17	8%	2	12%
Social media	18	9%	1	6%
Digital advertisements (internet search results, banner ads)	16	8%	4	25%
Word of mouth (through friend, family, or business colleague)	11	5%	1	9%
Equipment vendor, distributor, or manufacturer	9	4%%	1	11%
Past participation in another state or utility incentive program	5	2%	1	20%
Contractor	1	0%	1	100%

Customers had several reasons for purchasing the EPM products. These reasons were very similar to what we heard in the previous survey.

Table A-90 Why customers Purchased EPM Products

Responses	Air Conditioner (n=94)	Refrigerator (n=61)	Thermostat (n= 25)	Light Bulb (n=23)	Advanced Power Strip (n=7)
Most Responses	Comfort	Save on electricity costs	Save on electricity costs	Save on electricity costs	**Rebate**
Second Most Responses	**Rebate**	Liked the features	**Rebates** / Features	**Rebate** / Good for the environment	Save on electricity costs
Third Most Responses	Save on utility costs	**Rebate**	Good for the environment / comfort	Easy to purchase on EPM	Easy to purchase on EPM

A.11.3.2.3 Demographics of Customers Obtaining a Rebate through EPM

This fiscal year, customers who used the EPM website to obtain a rebate were mainly single-family owners or low-to-moderate income. However, more EPM participants were multifamily renters than previously. Additionally, the renters who took advantage of rebates through EPM this fiscal year (46% of respondents) purchased all the EPM rebate products except for televisions. Almost all obtained a window air conditioner (78%) with only a few also receiving a rebate for a refrigerator (11%) and even fewer obtaining a thermostat or light bulbs (5% each).

Table A-91 EPM Demographics of Customers Obtaining a Rebate through EPM

Demographic Parameter	EPM Survey (FY 20/21)	EPM Survey (FY 21/22)	EPM Survey (FY 22/23)	Population for City of Los Angeles (census data)	Notes
Home Ownership	(n=231)	(n = 273)	(n=181)	Households	
Owner - Single Family	64%	59%	47%	37%	Significantly more renters obtained rebates through EPM this fiscal year, although homeowners continue to be disproportionate compared to home ownership in the City of Los Angeles
Owner - Multi Family	6%	10%	8%		
Renter- Single Family	12%	20%	17%	63%	
Renter - Multi Family	18%	10%	29%		
Income	(n=221)	(n = 302)	(n=193)	Households*	
Low or Moderate	34%	44%	61%	64%	Significantly more low to moderate income households obtained rebates through EPM this fiscal year and are now aligned with the income of typical City of Los Angeles households
Above Moderate	40%	38%	25%	36%	
Declined to Say	26%	18%	14%	--	
Age	(n=216)	(n = 296)	(n=190)	Householder**	
25-34	24%	10%	11%	17%	

Demographic Parameter	EPM Survey (FY 20/21)	EPM Survey (FY 21/22)	EPM Survey (FY 22/23)	Population for City of Los Angeles (census data)	Notes
35-54	48%	40%	51%	39%	EPM disproportionately fewer younger and older head of householder than typical for the City of Los Angeles.
55-64	14%	19%	20%	19%	
65+	14%	31%	18%	24%	
Self-Identified Ethnicity	(n=187)	(n = 283)	(n=183)	Householder**	
Caucasian (White)	49%	51%	28%	35%	Compared to the previous surveys, EPM saw a significant shift away from White households this fiscal year and towards Latinx households
Asian	24%	27%	25%	15%	
Hispanic (Latinx)14	19%	17%	36%	31%	
African descent	4%	5%	2%	7%	
Other	4%	6%	10%	13%	

**Appendix 1.1 City of Los Angeles Housing Element 2021-2029. Chart 1.1.28 Income Categories for Renters and Owners in LA City. Survey respondents with income of $100,000 were reported as low to moderate income.*

***Census data, ACS 2019, Table S2502*

A.11.3.2.4 Previous Evaluation Recommendations

Table A-92 below includes a summary of previous recommendations and the program's response to date.

Table A-92 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 (SCPPA). 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	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

[14] The Evaluator follows the lead of LADWP staff and applies the term Latinx rather than Hispanic (Housing Element 2021-2029, page 41).

Summary of Past Recommendations	Program Response
language may be more comfortable using the site.	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 LADWP programs. Specific options may include the following.	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.

A.11.4 Recommendations

Since there may be a new program vendor following the conclusions of LADWP's contract with SCPPA, our two recommendations are future looking. In both cases, we recommend that LADWP perform an early, small, assessment of the data provided by the vendor, but with different purposes.

- If a new vendor is chosen to replace the current vendor, we recommend this small assessment occur sometime in the first three months of the vendor starting up an active website to ensure that the new vendor is providing all the data required by any future evaluation team. The required data would include identification of the measures and any necessary specifications to estimate savings, including efficiency and unit size/capacity metrics, the incentive amounts paid, and customer information including account and contact information.
- If the same vendor remains and LADWP adds electrification measures, we recommend that the assessment occur after one or two months of electrification measure data collection and focus on checking the quality of any data required to back up removal of gas equipment.

A.12 Energy Savings Assistance Program

This section presents an evaluation of the Energy Savings Assistance Program (ESAP) that LADWP offered customers during FY 20/21.

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-93 ESAP Ex-Ante Savings Source Comparison

Fiscal Year	ESP Data Ex-Ante kWh	Program Data Ex-Ante kWh	ESP Data Ex-Ante Peak kW	Program Data Ex-Ante Peak kW
FY 20/21	2,745,787	2,747,700	331.02	N/A

The Evaluator was provided with tracking data that was nearly equal in terms of savings to the reported ESP Ex-Ante kWh savings. In addition, the program tracking data did not provide estimated peak kW reduction for the measures in the program, whereas the reported ESP Ex-Ante values reported peak kW impacts for FY 20/21.

A.12.1.4 M&V Approach

Table A-94 summarizes the data sources used in the ESAP impact evaluation.

Table A-94 ESAP Data Sources

Data	Source
Program tracking data	Data requested for all data tracking program participation, rebate applications, and measure details
Recipient billing data	Monthly billing data provided by LADWP for customers that have participated in ESAP in the study periods
Non-participant billing data	Monthly billing data provided by LADWP for customers that have not participated in ESAP in the study periods
Participation in other LADWP programs	Data provided by LADWP for all residential program participation in the study periods

The database review process started with a review of tracking data to ensure that sufficient information was provided to calculate energy savings and peak demand reduction.

Field data collection was not completed for ESAP. Savings were evaluated via billing analysis for the program. In addition, no sampling plan was required for this program, as savings were evaluated via billing analysis with a census of participants.

The approach the Evaluator used to determine Ex-Post kWh savings and peak kW reduction for ESAP was based on statistical analysis of billing data. The Evaluator took the following steps during the evaluation approach:

- First, the Evaluator conducted an exploratory data analysis that made use of all provided participant billing data;
- Second, the Evaluator used regression models to make longitudinal and cross-sectional comparisons of energy consumption before and after installation of energy efficiency measures to determine how electricity use changed after a measure was installed at a household; and

- Third, the Evaluator quantified whole home savings by extrapolating regression model outputs with weather and number of participants for FY 20/21.

Ex-Post savings were determined using the regression coefficients. Further details of the billing analysis approach are summarized in the following section.

A.12.2 Billing Analysis

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 Section A.10.1.6, the Evaluator used a billing data regression approach to evaluate the Program.

A.12.2.1 Billing Analysis Approach

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-34.

$$Average\ Daily\ kWh = \frac{Total\ kWh}{Number\ of\ Days} \quad \text{Equation A-34}$$

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-95.

Table A-95 ESAP Participant Count

Measure	All Participants	Qualified Participants	All Non-participants with Billing Data	Qualified Non-participants
ESAP	5,171	3,539	358,577	147,315

For all remaining participants in the participant and non-participant pool, the zip code for each customer's service address was geolocated to an approximate latitude and longitude and historical weather data was obtained through NOAA for the nearest weather station.

Propensity Score Matching (PSM)

The Evaluator utilized PSM to develop a comparison group from the non-participant pool. The Evaluator developed five pre-treatment variables for use in the PSM:

- The average daily kWh annually,
- The average daily kWh for winter (December through February),
- The average daily kWh for spring (March through May),
- The average daily kWh for summer (June through September), and
- The average daily kWh for fall (October through November).

Because the non-participant pool does not have established treatment start dates, the Evaluator reviewed the billing data to determine an optimal pre-treatment period for PSM. This period was set to 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-96. The distributions did not significantly differ between the participant group and the comparison group, suggesting a good PSM.

Table A-96 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-16. 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-16 ESAP Pre-Treatment Equivalency

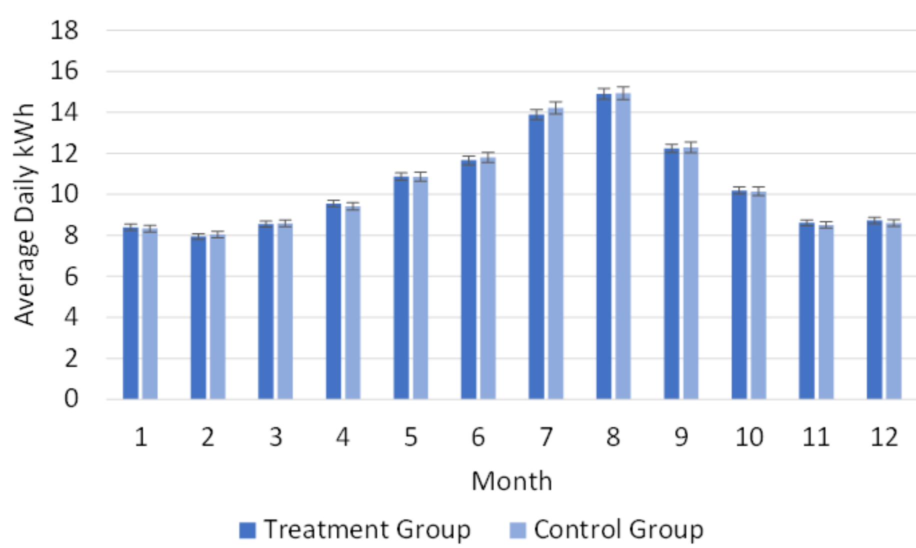


Table A-97 ESAP Pre-Treatment T-Test

Month	Participant Group (Average Daily kWh)	Non-Participant Group (Average Daily kWh)	T-value	P-value
1	8.404	8.329	-0.647	0.518
2	7.947	8.036	0.809	0.419
3	8.552	8.590	0.350	0.726
4	9.553	9.420	-1.097	0.273
5	10.867	10.857	-0.069	0.945
6	11.665	11.801	0.830	0.407
7	13.893	14.223	1.670	0.095
8	14.906	14.936	0.147	0.883
9	12.245	12.292	0.277	0.781
10	10.188	10.144	-0.316	0.752
11	8.620	8.508	-1.031	0.303
12	8.719	8.604	-0.997	0.319

The final participant count for the participant and comparison groups are presented in Table A-98.

Table A-98 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-35:

$$Average\ Daily\ kWh_i = \alpha + \beta_1 \cdot post + \beta_2 \cdot CDD_{i,n} + \beta_3 \cdot HDD_{i,n} + \beta_4 \cdot CDD_{i,n} \cdot post + \beta_5 \cdot HDD_{i,n} \cdot post + \varepsilon \quad \text{Equation A-35}$$

Where:

- i represents each individual customer for each month,
- n represents each iteration of base pairs,
- $post$ is an indicator variable indicating whether the period is in the post or pre period,
- $CDD_{i,n}$ is the CDD calculated for iteration n for customer i,

- $HDD_{i,n}$ is the HDD calculated for iteration n for customer i,
- α is the intercept term,
- β_1 is the main effect of the post period,
- β_2 is the main effect of CDD,
- β_3 is the main effect of HDD,
- β_4 is the additional effect of CDD on the post period,
- β_5 is the additional effect of HDD on the post period, and
- ε is the error term.

For each customer, all 16 combinations were tested to determine which combination provided the best fit. The pair of CDD and HDD bases that provided the highest adjusted R-squared for each customer was selected as that customer's respective CDD and HDD base.

Regression Model

To estimate participant savings, the Evaluator used a post-period regression with pre-period control variables. This model isolates the post-treatment period and uses customer-specific variables generated from the pre-treatment period to control for individual variation. The Evaluator developed four pre-treatment variables for use in the regression:

- The average daily kWh for winter (December through February),
- The average daily kWh for spring (March through May),
- The average daily kWh for summer (June through September), and
- The average daily kWh for fall (October through November).

The regression equation is specified by Equation A-36.

$$\begin{aligned} Average\ Daily\ kWh_i &= \alpha + \beta_1 \cdot treatment + \beta_2 \cdot CDD_i + \beta_3 \cdot HDD_i + \beta_4 \\ &\cdot CDD_i \cdot treatment + \beta_5 \cdot HDD_i \cdot treatment + \beta_6 \\ &\cdot pre\ usage\ winter_i + \beta_7 \cdot pre\ usage\ spring_i + \beta_8 \\ &\cdot pre\ usage\ summer_i + \beta_9 \cdot pre\ usage\ fall_i + \beta_{10} \\ &\cdot month_1 + \cdots + \beta_n \cdot month_{12} + \beta_{n+1} \cdot month_1 \\ &\cdot pre\ usage\ winter_i + \cdots + \beta_{n+x} \cdot month_{12} \\ &\cdot pre\ usage\ fall_i + \varepsilon \end{aligned}$$

Equation A-36

Where:

- i represents each individual customer for each month,
- $treatment$ is an indicator variable indicating whether the customer is in the participant or comparison group,
- CDD_i is the CDD calculated for iteration n for customer i,

- HDD_i is the HDD calculated for iteration n for customer i,
- $pre\ usage\ winter_i$, $pre\ usage\ spring_i$, $pre\ usage\ summer_i$, and $pre\ usage\ summer_i$ are the customer-specific pre-treatment control variables,
- $month_1$ through $month_{12}$ are indicator variables indicating if the month is January through December,
- α is the intercept term,
- β_1 is the main effect of the program participation,
- β_2 is the main effect of CDD,
- β_3 is the main effect of HDD,
- β_4 is the CDD-dependent effect of program participation,
- β_5 is the HDD-dependent effect of program participation,
- β_6 through β_9 are the main effects of pre-treatment consumption,
- β_{10} through β_n are the main effects of month,
- β_{n+1} through β_{n+x} are the interactive effects of month and pre-treatment consumption, and
- ε is the error term.

The regression coefficients of interest for estimating savings are β_1, β_4, and β_5. Table A-99 provides information regarding the regression coefficients for each model and the overall model fit.

Table A-99 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-37.

$$\begin{aligned}Annual\ Savings &= [Treatment\ Coefficient \\ &+ (Treatment\ x\ CDD\ Coefficient\ \cdot \overline{CDD}) \\ &+ (Treatment\ x\ HDD\ Coefficient\ \cdot \overline{HDD})] \cdot -1 \\ &\cdot 365.25\end{aligned} \qquad \text{Equation A-37}$$

Where:

- $\overline{CDD}$ is the average daily CDD for a typical weather year, and
- $\overline{HDD}$ is the average daily CDD for a typical weather year.

HDDs and CDDs were weighted relative to the nearest weather stations for the participants in each program year using TMY3. These weighted values are presented in Table A-100.

Table A-100 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-101.

Table A-101 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.12.2.2 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 Program

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 the fiscal year (a fiscal year, FY, is July 1 to June 30). It opened again in September 2022 after about a two-year COVID-driven hiatus. In the nine months the program was active in this fiscal year, they served 1,101 customers. The program had a previous backlog of ~1,600 interested customers from before the hiatus that they worked through during this fiscal year. Additionally, the program queued up another ~250 new customers who had come into the program from 5,000 applications sent out by the program (i.e., the program had a 5% response rate to the applications).

The program provides multiple free measures and/or repair activities to enable the customer to save on both energy and water costs. In this fiscal year, the average home received five measures or repair activities. As shown in Table A-102, 25% of homes received five to eight measures while 2% of the homes received almost everything in the program (61 to 70 different measures/ repair activities).

Table A-102 Range of HEIP Measures / Repair Activities per Household

Number of Measures Installed	# of Unique Households	% of All Households
1-2 measures	67	4%
3-4 measures	58	3%
5-8 measures	433	25%
9-23 measures	1078	63%
29-30 measures	2	0%
31-40 measures	7	0%
41-50 measures	5	0%
51-60 measures	14	1%
61-70 measures	42	2%

**No households received from 24-28 measures, so are not shown in the table.*

Many homes received LEDs (84%). The program also provides free smoke alarms and carbon monoxide alarms (i.e., safety measures) to a high percentage of homes. (Table A-103)

Table A-103 HEIP Measures / Repair Activities in FY 22/23

Measures / Repair Activities	# of Unique Households	# of All Measures
Safety Measures		
Carbon Monoxide Alarm	1,035	1,421
Smoke Alarm	1,041	2,826
Energy Saving Measures		
Attic or Kneewall Insulation *(1,000 square feet installed)*	299	97,081
Attic Vent Installed	71	71
Cover Plate Gasket	66	66

Measures / Repair Activities	# of Unique Households	# of All Measures
Door Weatherstripping	632	946
LEDs	2,204	18,295
Window AC	362	335
Water Heater Pipes Wrapped	80	87
Energy Saving Replacements / Repairs		
AC Filter Replacement	316	316
Door Repair	404	404
Door Replacement	80	80
Dryer Vents Repaired (minor)	24	24
Heater Filter Replacement	69	69
Stove Filter Replacement	63	63
Water Saving Measures		
Faucet Aerators	380	625
Showerheads	729	1,263
Toilet Installed	647	1,038

Besides the measures, repairs, and replacements indicated in the table above, the program also patched walls, performed asbestos tests, pre/post blower door tests, and dye tests (to determine if a toilet is leaking). Program staff checked for mold and determined combustion ventilation air for gas cooktops, gas log fireplaces (if present), gas heaters, gas oven and broilers, and gas water heaters to ensure that each appliance had sufficient ventilation (a safety issue).

A.13.1 Evaluation Methodology

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

A.13.1.1 Tracking Data Review

LADWP provided the Evaluator with the available program tracking data for measures installed between September 12, 2022, through June 30, 2023. 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, 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 each Retrospective fiscal year.

The Evaluator was not provided Ex-Ante peak kW reduction by measure and was unable to estimate program tracking data peak demand reduction. The Evaluator found the monthly measure count and savings summaries difficult to match with the measure-level tracking data. In many cases, the measure names in one data source did not match the measure names in another data source; therefore, measure-level counts were unable to be recreated using the available tracking data.

A.13.1.2 Ex-Ante Savings Review

The tables below outline the kWh savings and peak kW reduction by measure for HEIP in each fiscal year, comparing the savings found in the ESP with those found in the tracking data.

Table A-104 HEIP FY 22/23 Ex-Ante Savings Source Comparison

Measure	ESP Data Ex-Ante kWh	Program Data Ex-Ante kWh	ESP Data Ex-Ante kW	Program Data Ex-Ante kW
Window AC	144,175	144,175	64.43	216.86
Aerator	3,766	3,766	0.30	0.76
Air Sealing	2,208	2,208	0.99	11.52
Attic Insulation	86,553	86,553	38.68	44.94
Weather Stripping	208,494	208,494	93.18	389.61
Duct Sealing	29,204	29,204	13.05	149.67
LED	1,498,016	1,498,016	175.49	1,049.88
Pipewrap	7,676	7,676	0.62	2.02
Showerhead	40,666	40,666	3.26	0.00
Toilet	48,186	48,186	3.87	0.00
Toilet Gasket	14,256	14,256	6.37	26.64
Total	**2,083,200**	**2,083,200**	**400.24**	**1,891.90**

A.13.2 Impact Evaluation

For the Concurrent impact evaluation, the Evaluator performed the following data collection activities:

Table A-105 HEIP Data Sources for Impact Evaluation

Data	Source
Program Tracking Data	Data requested to LADWP for all data tracking program participation and rebate applications
Program Participant Surveys	Survey administered to a sample of customers who participated in the rebate program
Recipient and control group billing data	Data requested to LADWP for all relevant billing data in the study period
Participation in other LADWP programs	Data requested to LADWP for all residential program participation in the study period
Recipient and control group customer data	Data requested to LADWP for other customer information (e.g., demographics, etc.)

The database review process started with a review of tracking data to ensure that sufficient information was provided to calculate energy and peak demand impacts.

Field data collection was not completed for HEIP. Savings were evaluated for the program via billing analysis and engineering calculations. In addition, no sampling plan was required for this program, as savings were evaluated via billing analysis with a census of participants and desk reviews were performed on a census of projects.

The approach the Evaluator used to determine Ex-Post kWh savings and peak kW reduction for HEIP was based on statistical analysis of billing data for weather sensitive measures and desk reviews for lighting and water saving measures. The weather sensitive measures were window AC, pipe wrap, attic insulation, duct sealing and air sealing. The lighting and water savings measures were toilet, toilet gasket, aerator, and showerhead.

For the weather sensitive measures, the Evaluator took the following steps during the evaluation approach:

- First, the Evaluator conducted an exploratory data analysis that made use of all provided participant billing data.
- Second, the Evaluator used regression models to make longitudinal and cross-sectional comparisons of energy consumption before and after installation of energy efficiency measures to determine how electricity use changed after a measure was installed at a household.
- Third, the Evaluator quantified whole home 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.

A.13.2.1 ENERGY STAR Lighting

Verified energy savings for lighting measures (LEDs and CFLs) were calculated using lighting savings equations found in DEER Workpapers (Equation A-38 and Equation A-39). The savings equations were employed to estimate savings for each rebated lighting measure. The results were then adjusted by the measure ISR for the appropriate fiscal year and summed to provide measure-level savings for the program.

$$kWh = Qty_{ver} x\ HOU\ x\left(Watts_{base} - Watts_{efficient}\right) x \frac{IE_{kWh}}{1000\frac{Watt}{kW}} x\ ISR \qquad \textit{Equation A-38}$$

$$kW = Qty_{ver} x\ \left(Watts_{base} - Watts_{efficient}\right) x\ \frac{IE_{kW}}{1000\frac{Watt}{kW}}\ x\ CDF x\ \ ISR \qquad \textit{Equation A-39}$$

Table A-106 HEIP LED and CFL Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
kWh	Measure savings per program year		
Annual Hours of Operation	Annual Hours of Operation	Lighting Logger data, 2023	795
Interactive Effects (kWh)	Energy Interactive Effects (LED), Energy Interactive Effects (CFL)	DEER Workpapers	1.02 to 1.1504
WRR	Wattage Reduction Ratio	DEER Workpapers	2.96
∆Watts/lamp	Demand Difference (watts per lamp) = (W x WRR) - W	DEER Workpapers	117.6 to 294
Peak Coincidence Factor	Peak Coincidence Factor	Lighting Logger data, 2023	0.095
Interactive Effects (kW)	Energy Interactive Effects (LED), Energy Interactive Effects (CFL)	DEER Workpaper	0.12 to 0.15
ISR	In Service Rate	On-site visual verification	63%-78%

A.13.2.2 Low Flow Showerhead and Faucet Aerator

Verified energy savings for showerhead and aerator measures were calculated by multiplying climate zone 9 unit-level deemed savings in the DEER Workpapers by the quantity of measures in the tracking database for that household. The results were then adjusted by the measure ISR for the appropriate fiscal year and summed to provide measure-level savings for the program.

Table A-107 HEIP Aerator and Showerhead Deemed Savings by Weather Zone

Climate Zone	Faucet Aerators (1.0 GPM)		Low Flow Showerheads (1.5 GPM)	
	kWh	kW	kWh	kW
1	37.25	0.00374	132.36	0.0133
2	37.07	0.00372	131.73	0.01323
3	36.26	0.00364	128.88	0.01295
4	35.02	0.00352	124.44	0.0125
5	36	0.00362	127.93	0.01285
6	34.13	0.00343	121.28	0.01218
7	33.32	0.00335	118.43	0.0119
8	32.34	0.00325	114.94	0.01155
9	32.97	0.00331	117.16	0.01177
10	32.61	0.00328	115.89	0.01164
11	33.86	0.00347	120.33	0.01209
12	34.93	0.00351	124.13	0.01247
13	32.7	0.00329	116.21	0.01167
14	34.57	0.00347	122.86	0.01234
15	27.44	0.00276	97.53	0.0098
16	38.76	0.00389	137.74	0.01384

A.13.2.3 Water Efficient Toilet

Verified energy savings for the toilet measures were calculated using multiple sources of data. First, verified water savings for this measure was determined using the kWh savings per gallon value from the California Public Utilities Commission (CPUC) Water/Energy Nexus calculator[15], using inputs from the United States Environmental Protection Agency (US EPA) WaterSense calculator[16]. The verified water savings in gallons were then multiplied by the kWh savings per gallon value determined by the Water/Energy Nexus calculator to calculate verified energy savings for the measure. These results were summed to provide measure-level savings for the program. There were no ISRs gathered for the toilet measure during this evaluation and therefore the savings resulting from these calculations were not adjusted further.

kWh= (Water Savings for 0.8 GPF Toilet) x (kWh Savings Per Gallon)

kW= (kWh/8,760)

$$kWh = Water\ Saved\ per\ Toilet\ x\ kWh\ Savings\ per\ Gallon\ x\ ISR \qquad \text{Equation A-40}$$

[15] https://www.cpuc.ca.gov/nexus_calculator/

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

$$kW = \frac{kWh}{8{,}760} \; x \; ISR$$ *Equation A-41*

Table A-108 HEIP CPUC Water Energy Nexus Calculator kWh Savings per Acre Foot

Region	Extraction and conveyance	Treatment	Distribution	Wastewater collection and treatment	Outdoor (upstream of customer)	Indoor (all comps) kWh/AF	Gal per AF	kWh per Gallon (kWh/AF)/(Gallons per AF)
SC	0	490	470	1,245	961	2206	326,000	0.00676687

Table A-109 HEIP US EPA WaterSense Calculator Toilet Water Savings

Toilet Water Savings	
Average flushes per day	5.05
GPF pre 1980 toilet	5
GPF 1980-1994 toilet	3.5
Average GPF of pre 1994 toilet	4.25
Annual gallons used pre 1994 toilet	7,834
Annual gallons used 0.8 GPF toilet	1,475
Annual Water Savings (Gallons) of 0.8 GPF Toilet (Avg Gal pre 1994 toilet – Gal used 0.8 GPF toilet)	6,359

A.13.2.4 Billing Analysis Approach

The following sections describe the billing analysis procedures used for HEIP's weather sensitive measures, which include air sealing, attic insulation, duct sealing, pipe wrapping, and window air conditioners. The Evaluator used a billing data regression approach to evaluate these measures.

A.13.2.4.1 Billing Data Regression

This section describes the pooled billing data regression approach with a propensity score matched (PSM) comparison group used to evaluate HEIP weather sensitive measures.

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:

$$Average\ Daily\ kWh = \frac{Total\ kWh}{Number\ of\ Days} \quad \text{Equation A-42}$$

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.

After calendarization, customer billing data was 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 July 2021 through June 2022.
- For the sake of having post-treatment data in both the heating and cooling season, participants and non-participants must have at minimum post-installation data for all 6 months between January 2023 through June 2023.
- Participants and non-participants must not have participated in any other energy efficiency programs administered by LADWP from FY 20/21 through FY 22/23.

The number of qualified participants remaining in the data set after filtering for the above criteria are provided in the following table:

Table A-110 HEIP Weather Sensitive Participation Count

Fiscal Year	Measure	All Participants	Qualified Participants	All Non-Participants with Billing Data	Qualified Non-participants
22/23	HEIP WS Measures	547	132	460,242	68,953

For all remaining participants in the participant and non-participant pool, the zip code for each customer's service address was geolocated to an approximate latitude and longitude and historical weather data was obtained through NOAA for the nearest weather station.

Propensity Score Matching (PSM)

The Evaluator utilized PSM to develop a comparison group from the non-participant pool. The Evaluator developed five pre-treatment variables for use in the PSM:

- The average daily kWh annually,

- The average daily kWh for winter (December through February),
- The average daily kWh for spring (March through May),
- The average daily kWh for summer (June through September), and
- The average daily kWh for fall (October through November).
- Because the non-participant pool does not have established treatment start dates, the Evaluator reviewed the billing data to determine an optimal pre-treatment period for PSM. This period was set to between July 2021 through June 2022.

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 the following table. The distributions did not significantly differ between the participant group and the comparison group, suggesting a good PSM.

Table A-111 HEIP Pre-Treatment MANOVA

Fiscal Year	Measure	Pillai’s Trace	F-statistic	Num DF	Den DF	P-value
22/23	HEIP WS Measures	0.0066588	0.3459	5	258	0.8846

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 the following figure. 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.

Figure A-17 HEIP WS Measures Pre-Treatment Equivalency – FY 22/23

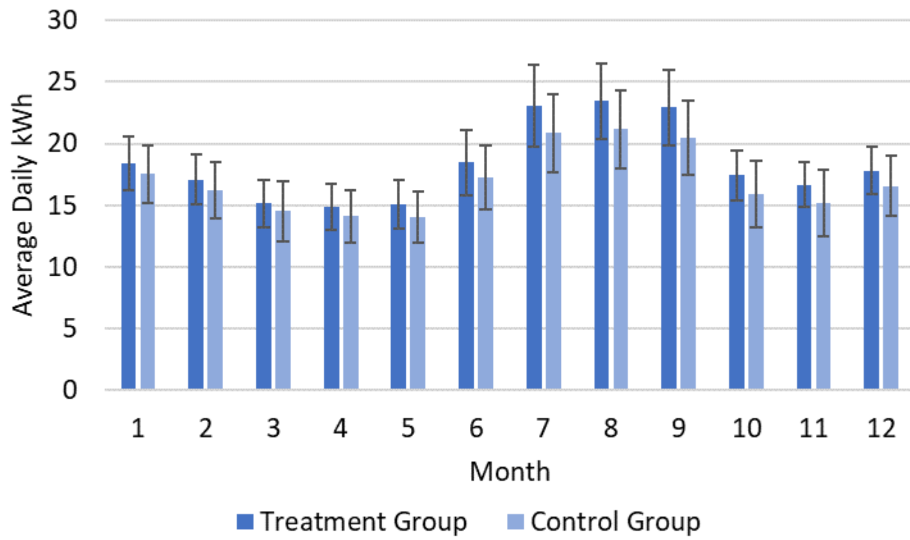


Table A-112 HEIP WS Measures Pre-Treatment T-Test – FY 22/23

Month	Participant Group (Average Daily kWh)	Non-Participant Group (Average Daily kWh)	T-value	P-value
1	18.419	17.564	-0.529	0.597
2	17.093	16.225	-0.555	0.579
3	15.137	14.511	-0.403	0.687
4	14.868	14.101	-0.531	0.596
5	15.112	14.058	-0.714	0.476
6	18.491	17.265	-0.648	0.518
7	23.041	20.868	-0.928	0.354
8	23.479	21.165	-1.034	0.302
9	22.930	20.472	-1.123	0.263
10	17.455	15.935	-0.883	0.378
11	16.680	15.164	-0.908	0.365
12	17.817	16.567	-0.790	0.430

The final participant count for the participant and comparison groups are presented in the following table:

Table A-113 HEIP WS Measures Final Sample Size

Fiscal Year	Measure	Participant Group Size	Non-participant Group Size
22/23	HEIP WS Measures	132	132

Degree Day Base Optimization

After preparing the billing data, the Evaluator proceeded to optimize the degree days 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. 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 the following equation:

$$Average\ Daily\ kWh_i = \alpha + \beta_1 \cdot post + \beta_2 \cdot CDD_{i,n} + \beta_3 \cdot HDD_{i,n} + \beta_4 \cdot CDD_{i,n} \cdot post + \beta_5 \cdot HDD_{i,n} \cdot post + \varepsilon \quad \text{Equation A-43}$$

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

Regression Model

To estimate participant savings for HEIP WS measures, the Evaluator used a pre/post difference-in-difference 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.

$$Average\ Daily\ kWh_i = \alpha_i + \beta_1 \cdot post + \beta_2 \cdot CDD_i + \beta_3 \cdot HDD_i + \beta_4 \cdot CDD_i \cdot post + \beta_5 \cdot HDD_i \cdot post + \beta_6 \cdot CDD_i \cdot treatment + \beta_7 \cdot HDD_i \cdot treatment + \beta_8 \cdot post \cdot treatment + \beta_9 \cdot CDD_i \cdot post \cdot treatment + \beta_{10} \cdot HDD_i \cdot post \cdot treatment + \varepsilon \quad \text{Equation A-44}$$

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
$treatment$	=	an indicator variable indicating whether the customer is a treatment customer or not
CDD_i	=	the CDD calculated for iteration *n* for customer *i*
HDD_i	=	the HDD calculated for iteration *n* for customer *i*
α_i	=	the customer-specific intercept term
β_1	=	the main effect of pre/post
β_2	=	the main effect of CDD
β_3	=	the main effect of HDD
β_4	=	the CDD-dependent effect of pre/post
β_5	=	the HDD-dependent effect of pre/post
β_6	=	the CDD-dependent effect of treatment group
β_7	=	the HDD-dependent effect of treatment group
β_8	=	the effect of post-treatment
β_9	=	the CDD-dependent effect of post-treatment
β_{10}	=	the HDD-dependent effect of post-treatment
ε	=	the error term

The regression coefficients of interest for estimating savings are β_9 and β_{10} as these are the savings that presumably attributable to the weather sensitive measures while other program measure savings would be represented by β_8. Table A-114 provides information regarding the regression coefficients for the model and the overall model fit.

Table A-114 HEIP WS Measures Regression Coefficients

Fiscal Year	Term	Regression Coefficient	Standard Error	T-value	P-value	Adjusted R-squared
22/23	Post x Treatment x HDD	0.146	0.113	1.289	0.197	0.796
	Post x Treatment x CDD	-1.458	0.510	-2.859	0.004	0.796

The savings were then calculated using the formula presented in the following equation:

$$Annual\ Savings = [(Post\ x\ Treatment\ x\ CDD\ Coefficient\ \cdot \overline{CDD}) + (Post\ x\ Treatment\ x\ HDD\ Coefficient\ \cdot \overline{HDD})] \cdot -1 \cdot 365.25$$

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 the following table:

Table A-115 HEIP WS Measures Weighted Average TMY3 HDD and CDD

Fiscal Year	Measure	Average Daily HDD	Average Daily CDD
22/23	HEIP WS Measures	2.513	1.551

Savings per household, 90% confidence intervals, and relative precision at the 90% confidence level are presented in the following table:

Table A-116 HEIP WS Measures Average Savings per Household

Fiscal Year	Measure	Annual kWh Savings	90% Confidence Interval		Relative Precision (90% CL)
			Lower Bound	Upper Bound	
22/23	HEIP WS Measures	692	187	1,197	73%

A.13.2.4.2 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 FY 22/23 may inadvertently be impacted by changes due to the COVID-19 pandemic. To account for this impact, the Evaluator created a series of adjustment factors for each measure by leveraging the non-participant billing data received from LADWP.

The creation of these adjustment factors largely followed the logic of the billing data retrofit isolation analysis in the following manner:

- The nonparticipant data was separated into a typical period (January 2019 through December 2019) and COVID-19-impacted period. For FY 22/23, the COVID-19 period was estimated as June 2022 through May 2023 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 HEIP WS measures evaluated via billing analysis in the following way:

- The observed savings, which were measured during the COVID-19-impacted period, were normalized for the impacts of COVID-19 by dividing the total savings by the HVAC COVID-19 adjustment factor.

For residential measures that were not evaluated by residential billing analysis, COVID-19 adjustment factors were generated in a similar manner. 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.13.3 Process Evaluation Approach and Methodology

This process evaluation of FY 22/23 focused on hearing about the program from the LADWP project managers and providing feedback to LADWP from HEIP participants. The FY 21/22 process evaluation included a detailed review of the program design and processes, but there were too few participants to complete a survey of them that year. The Evaluator included material from the FY 21/22 evaluation on the program design and operations in this evaluation report for comprehensiveness.

A.13.3.1 Document Review

The evaluation team reviewed the HEIP documentation from the website (i.e., HEIP Application and Fact Sheet).

A.13.3.2 Staff Interviews

Over a one-hour period, the evaluation team interviewed three (3) HEIP staff in July 2022. Additionally, over an hour period in May 2023, the evaluation team interviewed two (2) HEIP staff. Three other LADWP staff also attended (LADWP EM&V team members).

A.13.3.3 Participant Survey

LADWP and ADM fielded a participant survey in July 2023. The survey was sent to 906 HEIP customers (a census of available email addresses) who received an energy efficient product. A total of 155 completed the survey, a response rate of ~17%.

The survey had several uses, but for the process evaluation, the evaluation team wrote survey questions to determine:

- **Satisfaction with the Program** – What was the customer experience? Did the scheduling and completion of work meet their expectations?
- **Perception of Benefits** – Based on measures installed, do customers feel their home is safer, less drafty, cooler (or warmer)? Do they feel they are spending less on energy and/or water?
- **Customer Demographics** – A description of key participants' characteristics. This was included to explore how well HEIP participation represented the population of Los Angeles homeowners and whether target marketing by demographics may be beneficial.
- **How Learned about Program** - How customers learn about the program.

A.13.3.4 Tracking Data Review

The evaluation team reviewed the tracking database to determine the number and type of measures installed through the program. We noted that some of the records do not have the building type notes (i.e., it has missing information in the type of dwelling as shown in the table above).

A.13.4 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.

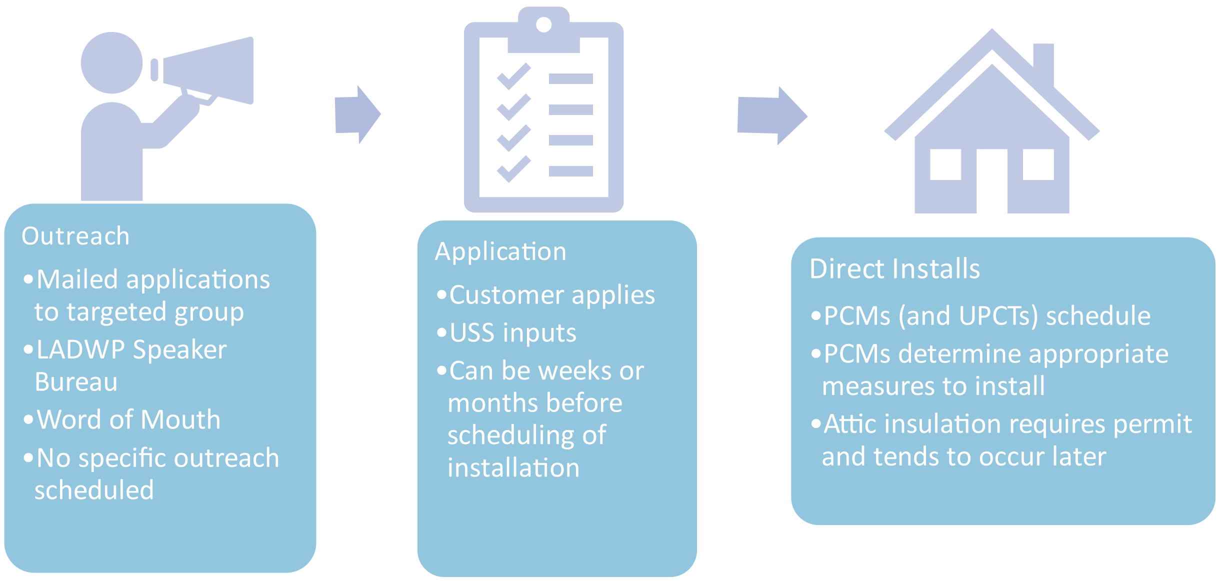
A.13.4.1.1 Program Staffing and Activities

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, which 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-18.

Figure A-18 HEIP High Level Program Activities



The program increased their staffing during FY 22/23 with four additional staff to process applications and keep up with the level of work. Two new leads are also being added to the program to help oversee and instruct the work.

A.13.4.1.2 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.13.4.1.3 Program Collaborations

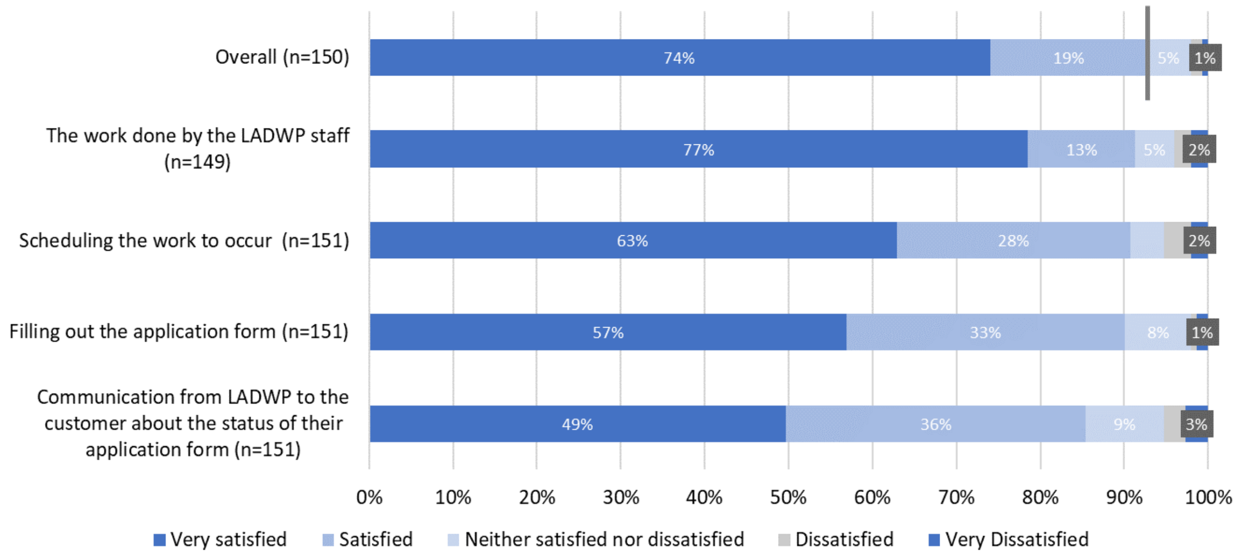
HEIP collaborates with two other LADWP programs. The HEIP team assesses the household for participation in the Refrigerator Exchange Program (REP) by asking about the refrigerator size criteria, whether the refrigerator is working, and customer interest in REP. These findings are placed back into the 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.

A.13.4.1.4 Participant Satisfaction

Satisfaction. About 90% of HEIP customers indicate being very satisfied or satisfied with the program overall and components such as the work done by the LADPW or scheduling the work. (Figure A-19)

Figure A-19 Satisfaction with HEIP Program



While overall, only three customers were dissatisfied, these few comments received pointed to poor quality products, inadequate solutions, and lack of notification. Specifically:

- **Poor Quality Products:** A customer complained about "cheap plastic showerheads" and "low quality light bulbs" while another indicated the showerhead broke within two weeks and had to be thrown away. A different customer thought their carbon monoxide alarm may have been faulty as it went off in the middle of the night, but when the gas company came to explore why, they found nothing amiss.
- **Inadequate Solutions:** A customer indicated that the program staff did not even investigate their attic crawlspace and only indicated that the customer could use LED lightbulbs to lower their energy bill even though the customer already was using LED bulbs. Another customer felt it was a waste of time as they indicated that the program staff inferred "Well, it is what it is; electricity is expensive."
- **Lack of Notification:** Several customers indicated never hearing from the program about COVID suspension.

A.13.4.1.5 Perception of Benefits

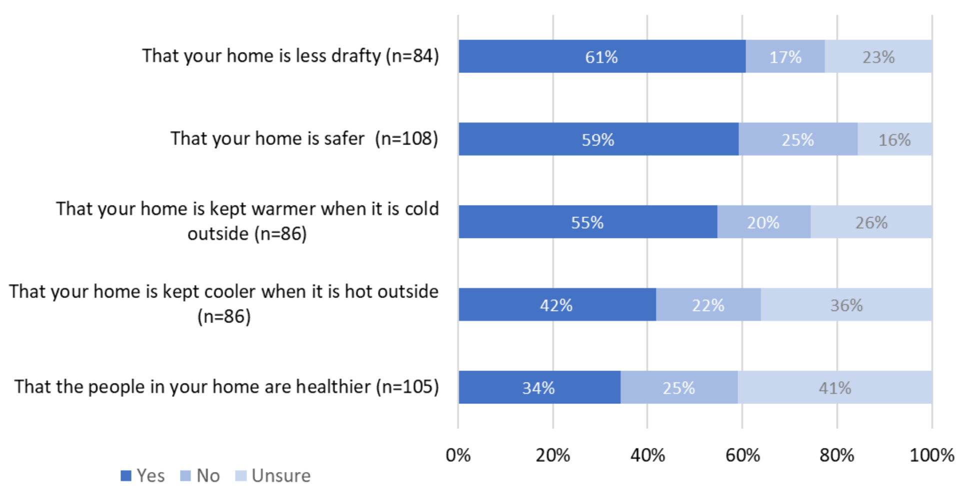
The Evaluator categorized measures with the likelihood of the specific non-monetary benefit as shown in Table A-117 and only included the customer response to the specific benefit if they had one or more of the noted measures installed.

Table A-117 Measures associated with Non-Monetary Benefit

Non-Monetary Benefit	Household had one or more of these specific measures installed
Safety	Carbon Monoxide Alarm Smoke Alarm
Less Drafty	Caulking Cover plate gasket Door repair/replacement/weatherstripping Window repair
Cooler when Warm Outside	Same as less drafty plus Duct repair Attic or Kneewall insulation Window AC
Warmer with Cold Outside	Same as Cooler when Warm Outside
Healthier	Same as Warmer or Cooler plus Carbon Monoxide Alarm

Many of the HEIP respondents felt that their home was less drafty after HEIP installed measures in their homes. About equal number felt their home was safer after receiving either carbon monoxide or smoke alarms. (See the call out box in the next section for an example). Additionally, many felt that the measures helped the home feel warmer (Figure A-20).

Figure A-20 Customer Perception of HEIP Program Non-Monetary Benefits



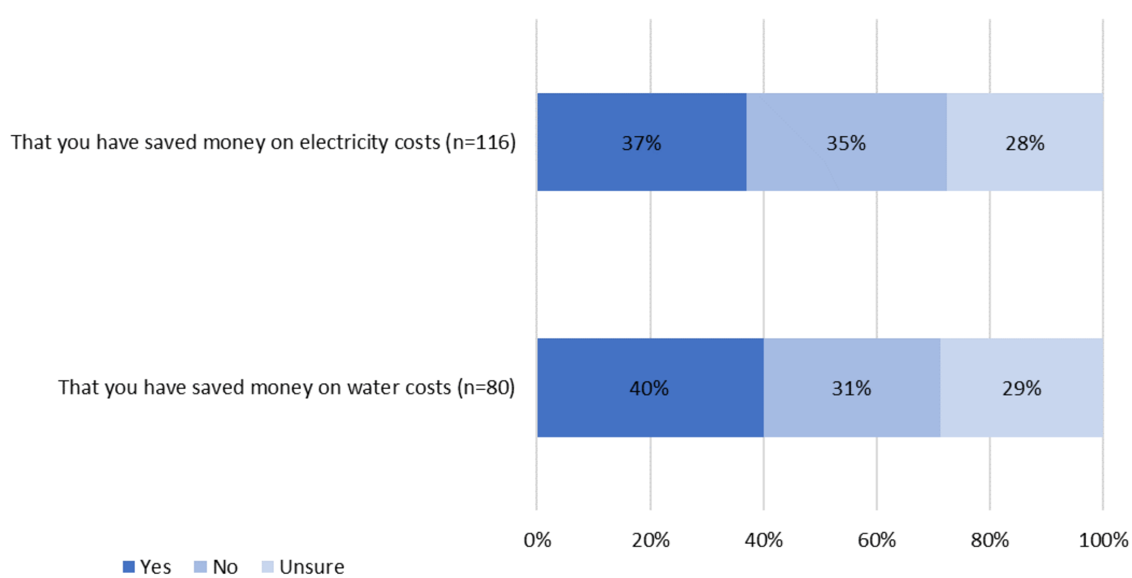
Like how the Evaluator handled non-monetary benefits, we categorized the likelihood of cost savings benefits based on specific measures (Table A-118) and only included the customer response to cost savings if they had one or more of the measures installed.

Table A-118 Measures associated with Monetary Benefit

Monetary Benefit	Household had one or more of these specific measures installed
Energy Bill Savings	Attic vent installed Caulking Cover plate gasket Pipe wrap Window AC Door weatherstripping Attic / Kneewall insulation LEDs
Water Bill Savings	Low flow water aerators Low flow showerhead Low flow toilet Toilet repair

Among customers who had received a utility bill since the HEIP installations and had one or more of the measures installed indicated above, about equal numbers felt they had saved money on electricity costs as did those who did not feel they had saved on costs. About the same percentage of customers perceived savings on water costs. However, about a quarter of customers were uncertain if there were cost savings. (Figure A-21)

Figure A-21 Customer Perception of HEIP Program Monetary Benefits



A.13.4.1.6 Successful Aspects

According to the program managers, the safety measures have been successful. For example, in one site, they heard that a fire from hot water exhaust piping was averted because the program extended piping that originally was not high enough above the roof. The program managers feel that this comprehensive approach is good for the customers and that the testing to look for excessive leaking gives the customers a unique perspective in their home to let them know that their safety is a top priority for LADWP. (See call out box to the left.)

A.13.4.1.7 Challenging Aspects

A consistent challenge for HEIP is that customers expect high ticket items when they apply for the program (e.g., toilets or attic insulation). However, the audit of the home determines what is installed. Asbestos is another challenge as the program determines the presence of asbestos but does not pay for any asbestos abatement. Customers are disappointed if asbestos is present as certain activities such as attic insulation cannot occur unless they pay for the abatement (which can be expensive). A third challenge revolves around toilets. Most of the HEIP homes have older plumbing that can require high water flow within the toilet system to work properly. According to the program manager, a low-flow toilet put in by HEIP can cause future problems that the customer may not be aware of until the new toilet stops working. Even though a plumber may have given a green light, plumbing challenges can be found after the fact. The program did go back to one site in the past to replace the low-flow with a regular-flow toilet.

A customer's headaches went away after the HEIP technician determined that the stove was leaking, and the gas company fixed the issue. This customer was very pleased to obtain the carbon monoxide alarm so this type of issue would not occur in the future.

A.13.4.1.8 Demographics of Customers Served by HEIP

The program is successfully serving their target market of low-to-moderate income households (and those on a fixed income). Among those who provided income, most were under $100,000. Additionally, a high percentage of participants were older (over 65) and so most likely on a fixed income. However, while the program is open to renters, few are participating (Table A-119).

Table A-119 Demographics of Customers Served by HEIP

Demographic Parameter	HEIP Survey	Population for City of Los Angeles (census data)	Notes
Home Ownership	(n=151)	Households	

Demographic Parameter	HEIP Survey	Population for City of Los Angeles (census data)	Notes
Owner - Single Family	91%	37%	Significantly more homeowners receive HEIP services than home ownership in the City of Los Angeles
Owner - Multi Family	7%		
Renter- Single Family	1%	63%	
Renter - Multi Family	1%		
Income	(n=151)	Households*	
Low or Moderate (<= 100% AMI)	51%	64%	We make no strong conclusions about income as close to one-third declined to indicate income
Above Moderate (>100% AMI)	18%	36%	
Declined to Say	31%	--	
Age	(n=144)	Householder**	
25-34	3%	17%	Disproportionately more older householders participate in HEIP than the typical City of Los Angeles householder
35-54	33%	39%	
55-64	22%	19%	
65+	41%	24%	
Self-Identified Ethnicity	(n=141)	Householder**	
Caucasian (White)	57%	35%	Significantly more White householders participate in HEIP than the typical City of Los Angeles householder
Asian	12%	15%	
Hispanic (Latinx)[17]	11%	31%	
African descent	9%	7%	
Other (including those identifying as two or more races)	11%	13%	

**Appendix 1.1 City of Los Angeles Housing Element 2021-2029. Chart 1.1.28 Income Categories for Renters and Owners in LA City*

***Census data, ACS 2019, Table S2502*

A.13.4.2 Recommendations

The level of satisfaction with the program is high so we have only a few small recommendations for the program to consider:

- Although there were only a few complaints from the survey, the program may want to review the available products and consider installing higher quality items such as all-metal showerheads versus showerheads with some plastic. If the budget is unable to accommodate higher quality items, then consider not installing them at all to ensure that customers do not feel like they are provided poor products.

[17] The Evaluator follows the lead of LADWP staff and applies the term Latinx rather than Hispanic (Housing Element 2021-2029, page 41).

- Review training of all staff who perform the on-site work to ensure they know they should do a thorough review of the site and not recommend products that already exist in the home.

Additionally, while the program is open to homeowners and renters, there are few renters participating. As a program that can provide benefits to renters from most available measures (except perhaps attic insulation or attic venting), the program may want to pilot exploring different outreach paths that go to property owners to see if that brings more renters into the program.

A.14 Low Income Refrigerator Exchange Program

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 21/22.

A.14.1.1 Tracking Data Review

LADWP provided the Evaluator with reports from ESP summarizing the program activity for FY 21/22. 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 3,341 refrigerator units recycled and installed during FY 21/22.

A.14.1.2 Ex-Ante Savings Review

Table A-120 shows a comparison of ESP savings and Program Tracking savings. The ESP and program tracking Ex-Ante kWh savings were closely aligned.

Table A-120 REP ESP and Program Tracking Saving Comparison

Fiscal Year	ESP Data Ex-Ante kWh	Program Data Ex-Ante kWh	ESP Data Ex-Ante kW	Program Data Ex-Ante kW
20/21	121,954	105,184	34.30	18.54
21/22	2,671,812	2,671,812	511.73	511.73
22/23	1,537,854	1,537,854	263.83	294.55
Total	**4,331,620**	**4,314,850**	**809.87**	**824.82**

A.14.1.3 M&V Approach

The Evaluator estimated gross energy and demand impacts for REP through a deemed savings calculation. To determine the appropriate baseline for REP, the Evaluator assumed that the average full year unit energy consumption (UEC) was equal to the UEC of the pre-existing refrigerator. The reason for this assumption was that participants in REP were expected to exchange their primary refrigerator and therefore the refrigerator being exchanged would be considered a primary unit for the evaluation. The full year UEC was calculated according to the method outlined in A.15.1.3 based on the RETIRE Program impact evaluation.

Then, the ENERGY STAR UEC[18] (ES UEC) for the efficient refrigerator was calculated using Equation A-46.

$$ES\ UEC = 7.26 * AV + 210.3 \qquad \text{Equation A-46}$$

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-47.

$$Gross\ Ex\ Post\ kWh\ = Full\ Year\ UEC - ES\ UEC \qquad \text{Equation A-47}$$

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

18 https://www.energystar.gov/sites/default/files/specs//ENERGY%20STAR%20Final%20Version%205.0%20Residential%20Refrigerators%20and%20Freezers%20Specification.pdf .

End-Use Load and Consumer Assessment Program (ELCAP) – a major end-use data collection program undertaken by the Bonneville Power Administration[19].

A.14.2 Impact Evaluation

The following sections describe the process that was performed by the Evaluator in FY 22/23 to calculate energy savings impacts and the realization rate for REP.

A.14.2.1 Full Year UEC Calculation

The calculation of full year UEC is the same as the method described in section A.15.2., based on the RETIRE Program impact evaluation. Table A-121 summarizes the full year UEC estimate for refrigerators during FY 22/23.

Table A-121 REP Full Year Average UEC Estimates

Fiscal Year	Appliance Type	Average Full Year UEC
FY 22/23	Refrigerator	1,200

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 22/23 is presented in Table A-122.

Table A-122 REP Per-Unit kW Reduction

Fiscal Year	Appliance Type	Per-unit kW Reduction
FY 22/23	Refrigerator	0.10

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 an additional 142,870 kWh in savings over expected savings.

[19] 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.14.3 Process Evaluation

The following sections describe the REP process evaluation methodology.

A.14.3.1 Process Evaluation Approach and Methodology

For FY 22/23, the Evaluator performed a summary process evaluation of REP. 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
- External factors affecting performance
- Barriers and opportunities going forward
- Other topics as relevant

Additionally, the Evaluator summarized findings on key metrics developed from the surveys of program participants in FY 21/22 and FY 22/23.

The Evaluator performed a full process evaluation of REP in FY 21/22. The key findings of the FY 21/22 process evaluation were:

- **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 to institutional participants and postcard 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 capture key appliance attributes.** The program data capture 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.

The recommendations made in the FY 21/22 evaluation were as follows:

- **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 air conditioners 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 materials could include tips on how to save on energy costs and information on applicable programs such as HEIP.

A.14.3.1.1 Staff Interviews

The Evaluator interviewed three LADWP staff in July 2023. The interviews provided information on program implementation processes, design, and potential future directions.

A.14.3.1.2 Participant Survey

The Evaluator conducted telephone surveys with participants of LADWP's Refrigerator Exchange Program (REP). The Evaluator 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 50 residential customers and four nonprofit institutions completed the FY 22/23 survey. Additionally, key metrics are shown for the 157 residential customers and eight nonprofit institutions completed the FY 21/22 survey.

A.14.3.2 Process Evaluation Findings

Overall, program staff reported that REP has continued to provide replacement refrigerators without significant changes to the program design, marketing approach, or delivery since FY 21/22. Two important external factors that the program contended with were continued issues procuring new refrigerators and disruptions resulting from changes in ownership of the implementation contractor.

A.14.3.2.1 Refrigerator Supply Issues

The difficulty in precuring the new replacement refrigerators persisted longer than the program anticipated, or at least hoped, and continued throughout FY 22/23. The primary effect of the supply issue was that it led program staff to not market the program through postcard campaigns, which limited the number of replacements the program made during the year. Program staff noted that in a typical year, they would market the program using a postcard campaign and typically see a 400% increase in participation in response to the campaign. LADWP's marketing group continued to market the program through avenues such as social media, but program staff noted these do not drive participation as much as the postcard campaigns. To address the supply issues, should they continue, the program is looking at purchasing replacement refrigerators from a larger set of manufacturers.

A.14.3.2.2 Change in Ownership of Implementation Contractor

A change in ownership of ARCA also impacted the program operations. On March 9, 2023, ARCA announced that the company's COO and CFO would purchase the company from its parent corporation, JanOne, Inc.[20] The change in ownership led to changes in contracting, such as with the third-party ARCA contract, pertaining to the pickup of old refrigerators and delivery of new ones, which resulted in some disruption of program operations. However, a potential benefit is that with the change in ownership, ARCA has begun to develop its own crews to complete the delivery and pickup. LADWP staff are optimistic that this will increase ARCA's capacity to provide the service to their customers.

A.14.3.2.3 Previous Evaluation Recommendations

Table A-123 summarizes the program response to previously made recommendations.

[20] https://arcarecyclinginc.com/news/announcing-new-ownership-of-arca-recycling/ (Retrieved 7/27/2023)

Table A-123 Previous REP Recommendations and Program Response

Summary of Past Recommendations	Program Response
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.	Program staff clarified that the plan they have considered would essentially entail providing a large rebate to the customer so that the customer could either choose a unit that is fully covered by the rebate, or choose a more expensive model that they prefer, and pay for the cost that exceeded the rebate amount. This plan is still under consideration, but program staff noted that there are logistical challenges to incorporating the recycling of the old units in the process.
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.	LADWP program staff indicated that this change would not improve their ability to monitor participation over time since they do the intake for institutional participants and therefore have that data.
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.	Program staff stated that this change has been made, but it impacts few customers because typically secondary verification of customer qualifications is needed after they sign up and before they can schedule the appointment.

A.14.3.2.4 Participant Survey Findings

Table A-124 presents the customer service metrics for the two fiscal years that the survey was administered. As shown, the results are favorable and there are not any notable differences between the two program years.

Table A-124 REP – Customer Service Metrics

Online Sign Up	Percent of Respondents (FY 21/22)	Percent of Respondents (FY 22/23)
Easy to find sign-up screen (n= 53 / n=19)	98%	90%
Website answered all of the participants questions (n=53 / n=19)	100%	95%
Telephone Sign Up	**Percent of FY 21/22 Respondents**	**Percent of FY 22/23 Respondents**
Representative was courteous (n=84 / n=22)	100%	100%
Representative answered all their questions (n=85 / n=22)	100%	100%

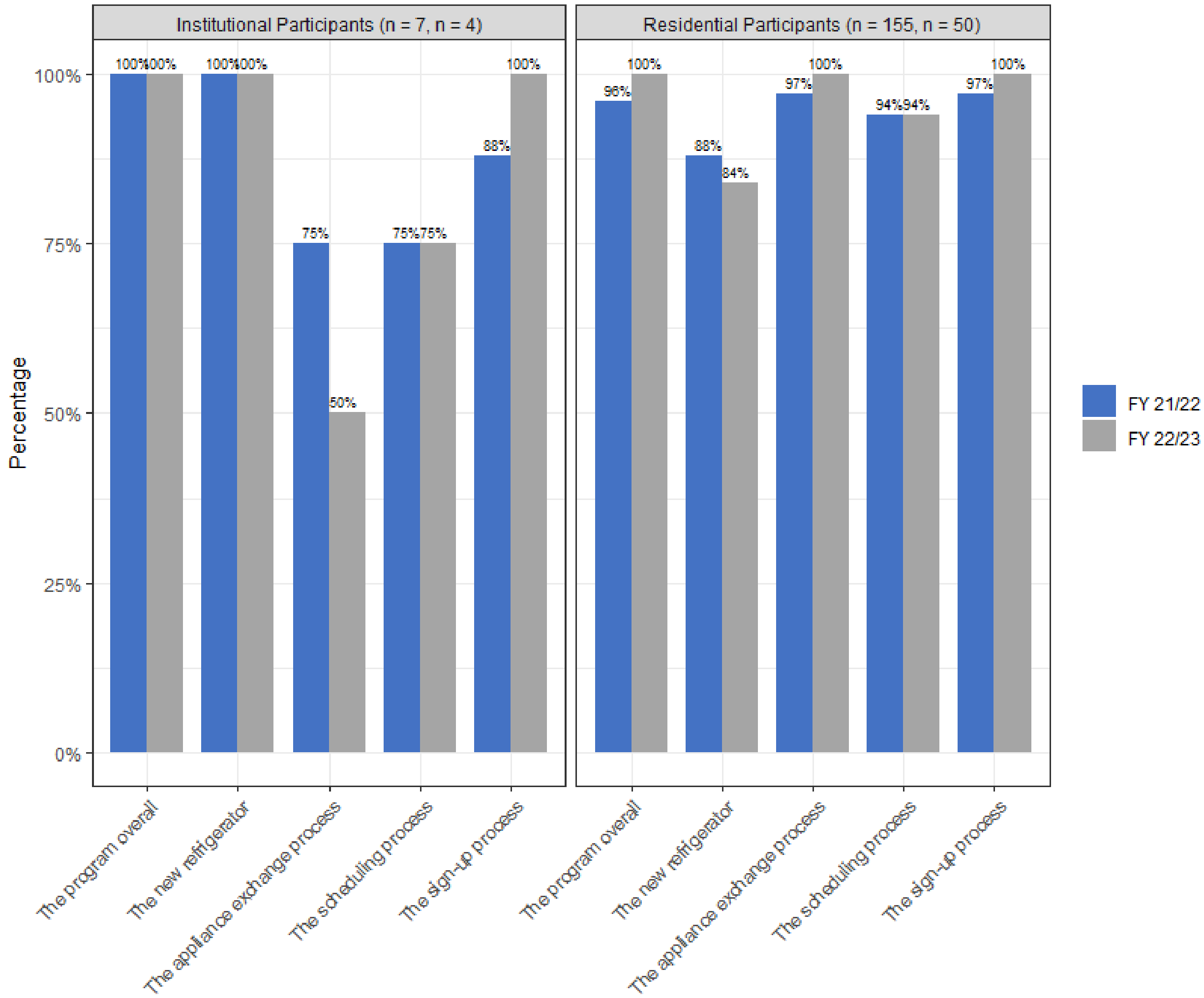
Scheduling		
Were you able schedule the exchange at a convenient time (n= 146 / n=44)	98%	98%
Appliance Pickup	**Percent of FY 21/22 Respondents**	**Percent of FY 22/23 Respondents**
Pickup crew was professional (n= 151 / n=43)	96%	98%

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 in the process of scheduling the exchange appointment.

Figure A-22 REP – Percent Satisfied



Participant Household Characteristics & Demographics

The following tables summarize the demographic characteristics of participants in the program. As shown, the program continues to reach a large share of renters and a diverse group of customers.

Table A-125 REP - Home Ownership and Fuel Type

Home Ownership	Percent of FY 21/22 Residential Respondents (n = 155)	Percent of FY 22/23 Residential Respondents (n = 50)
Own	19%	20%
Rent	81%	72%
Don't know / prefer not to state	0%	8%

Table A-126 REP - Language Spoken at Home and Preferences for Communication

Language Spoken at Home	Percent of FY 21/22 Residential Respondents (n = 155)	Percent of FY 22/23 Residential Respondents (n = 50)
Only English is spoken	41%	38%
Spanish	34%	42%
Mandarin	0%	0%
Vietnamese	0%	0%
Tagalog	1%	0%
Armenian	7%	6%
Korean	1%	0%
Russian	1%	0%
Persian (including Farsi, Dari)	1%	4%
Other	8%	8%
Prefer not to state	8%	4%
Preferred Language for LADWP Outreach and Informational Materials	**Percent of FY 21/22 Residential Respondents (n = 155)**	**Percent of FY 22/23 Residential Respondents (n = 50)**
English	73%	64%
Spanish	15%	28%
Mandarin	0%	0%
Vietnamese	0%	0%
Tagalog	0%	0%
Armenian	5%	2%
Korean	1%	0%
Russian	1%	0%
Persian (including Farsi, Dari)	0%	0%
Other	3%	0%
Prefer not to state	3%	0%

Table A-127 REP - Number of Household Members and Age of Respondents

Number of People Residing in the Home in 2021	Percent of FY 21/22 Residential Respondents (n = 155)	Percent of FY 22/23 Residential Respondents (n = 50)
1 person	32%	30%
2 people	15%	18%

Number of People Residing in the Home in 2021	Percent of FY 21/22 Residential Respondents (n = 155)	Percent of FY 22/23 Residential Respondents (n = 50)
3 people	14%	20%
4 people	12%	8%
5 people	7%	8%
6 people	3%	2%
7 people	0%	0%
8 or more people	0%	0%
Prefer not to state	17%	14%
Age	**Percent of FY 21/22 Residential Respondents (n = 155)**	**Percent of FY 22/23 Residential Respondents (n = 50)**
18 – 24	1%	2%
25 – 34	11%	10%
35 – 44	19%	8%
45 – 54	10%	14%
55 – 64	16%	16%
65 – 74	13%	26%
75 +	8%	4%
Prefer not to answer	22%	20%

Table A-128 REP - Race and Ethnicity of Respondents

Race/Ethnicity Respondent Identified With	Percent of FY 21/22 Residential Respondents (n = 155)	Percent of FY 22/23 Residential Respondents (n = 50)
American Indian or Alaska Native	1%	0%
East Asian	7%	2%
South Asian	2%	2%
Black or African American	19%	18%
Hispanic, Latino, or Spanish	30%	42%
Native Hawaiian or Other Pacific Islander	0%	0%
Middle Eastern or North African	1%	0%
White or Caucasian	15%	12%
Some other race, ethnicity, or origin	4%	10%
Prefer not to answer	23%	14%

Table A-129 REP - Annual Household Income

Income Level	Percent of FY 21/22 Residential Respondents (n = 155)	Percent of FY 22/23 Residential Respondents (n = 50)
Under $15,000	16%	8%
$15,000 to less than $25,000	14%	2%
$25,000 to less than $35,000	8%	2%
$35,000 to less than $50,000	8%	0%
$50,000 to less than $75,000	5%	6%
$75,000 to less than $100,000	1%	0%
$100,000 to less than $150,000	0%	0%
$150,000 or over	1%	0%
Prefer not to answer	48%	82%

A.14.3.2.5 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

The Evaluator does not have recommendations for REP at this time.

A.15 Refrigerator Turn-in and Recycle 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 RETIRE during FY 22/23 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 22/23. 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 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 for refrigerators and freezers via email communication:

- 1,946 kWh; and
- 0.3 kW.

LADWP provided the following Ex-Ante values for room air conditioners:

- 18.26, 30.24, and 44.05 kWh; and
- 0.01, 0.03, and 0.04 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 1,940 refrigerators, 68 freezers, and 54 air conditioners recycled during FY 22/23.

A.15.1.2 Ex-Ante Savings Review

The following section presents a comparison of ESP savings and program tracking savings. Program tracking data was provided by ARCA without per-unit energy savings, and LADWP provided per-unit energy savings. ESP summary savings were combined with the ARCA tracking data to develop per-unit energy savings by measure as discussed in Section A.15.1.1. Table A-130 shows a comparison of ESP savings and Program Tracking savings.

Table A-130 RETIRE ESP and Program Tracking Saving Comparison

Fiscal Year	Measure	ESP Data Ex-Ante kWh	Program Data Ex-Ante kWh	ESP Data Ex-Ante kW	Program Data Ex-Ante kW
20/21	Air Conditioner	0	0	0.00	0.00
	Freezer	0	0	0.00	0.00
	Refrigerator	11,676	11,676	3.28	3.28
21/22	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
22/23	Air Conditioner	2,284	2,284	1.02	2.11
	Freezer	132,328	132,328	22.70	20.40
	Refrigerator	3,775,240	3,775,240	647.67	582.00
Total		**10,227,786**	**10,227,786**	**1,885.42**	**1,597.51**

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[21]. 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 reasonable to suspect that a small percentage of non-operational appliances may enter the program despite these screening

[21] http://energy.gov/sites/prod/files/2013/11/f5/53827-7.pdf

efforts. If a non-operational unit is beyond reasonable repair, it offers no savings opportunity.

To account for this possibility, the Evaluator employed the following verification steps:

- Validating program tracking data provided by LADWP and ARCA by checking for duplicate or erroneous entries; and
- Conducting telephone surveys with a sample of program participants. The surveys were used to verify that customers listed in the program tracking database did indeed participate and that the number of appliances claimed to be recycled was accurate. Additionally, survey respondents were asked a series of questions to verify the working condition of their recycled appliances.

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).

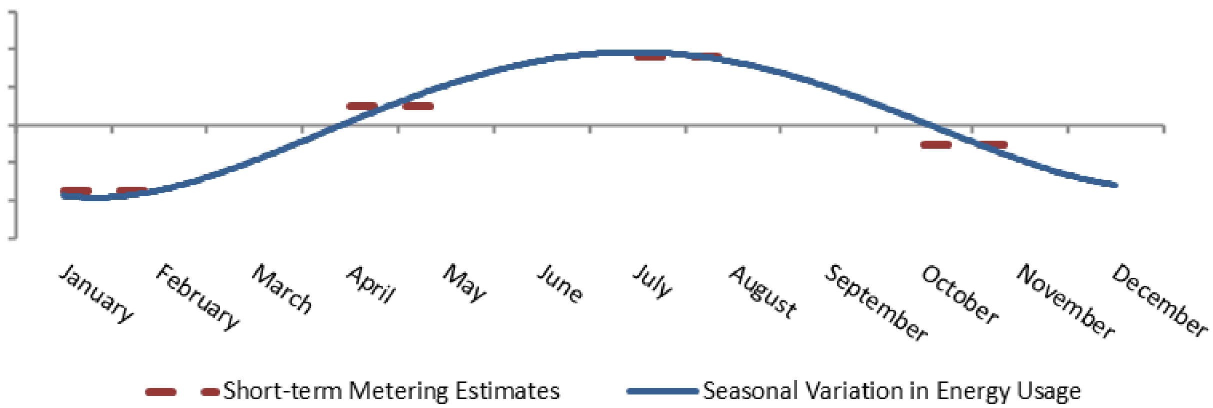
The second approach involves utilizing metered data that is collected from utility customer homes before an appliance is collected for recycling. The CA ARP protocol recommends using this in-situ (meaning “in its original place”) metering data to estimate a regression model because it accounts for environmental and usage patterns within program participating homes that might not be accurately reflected through DOE testing based metering. The Evaluator 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-23 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-23 RETIRE Bias of Simple Extrapolation due to Seasonality



To account for seasonality in extrapolating the short term metering data to full year UECs, the Evaluator used a model developed in an evaluation of the 2004-2005 California Statewide Appliance Recycling Program[22]. 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[23]. 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-131 provides the model for primary refrigerators with top freezers.

Table A-131 Top Freezer Extrapolation Model from 2004-2005 ARP Evaluation (Dependent Variable = watthour per hour)

Operating Condition	Coefficient	Standard Error
Intercept	-98.3825	1.1320

[22] http://www.calmac.org/publications/EM&V_Study_for_2004-2005_Statewide_RARP_-_Final_Report.pdf

[23] 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.

Operating Condition	Coefficient	Standard Error
Mean Watt Hours	0.9815	0.0005
January Dummy	3.8639	0.9129
February Dummy	-0.1099	0.9076
March Dummy	5.6952	0.9017
April Dummy	12.9591	0.9349
May Dummy	7.6151	0.9584
June Dummy	9.6176	1.0150
July Dummy	16.1311	1.0329
August Dummy	6.4387	1.0690
September Dummy	6.8108	1.0193
October Dummy	15.1539	1.1215
November Dummy	4.4912	0.9349
December Dummy	Suppressed	
Ambient Temperature (F)	1.4172	0.0186
Appliance Volume (cubic feet)	3.0881	0.0578
January Dummy * App Volume	-0.5238	0.0524
February Dummy * App Volume	-0.4686	0.0559
March Dummy * App Volume	-0.8596	0.0588
April Dummy * App Volume	-1.6752	0.0583
May Dummy * App Volume	-1.7853	0.0608
June Dummy * App Volume	-1.6470	0.0610
July Dummy * App Volume	-1.7913	0.0625
August Dummy * App Volume	-1.2161	0.0643
September Dummy * App Volume	-0.9315	0.0623
October Dummy * App Volume	-2.1263	0.0768
November Dummy * App Volume	-0.8015	0.0571
December Dummy * App Volume	Suppressed	
Ambient Temperature * App Volume	-0.0488	0.0010
January Dummy * App Volume * Ambient Temperature	0.0079	0.0007
February Dummy * App Volume * Ambient Temperature	0.0096	0.0008
March Dummy * App Volume * Ambient Temperature	0.0145	0.0007
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

Operating Condition	Coefficient	Standard Error
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 to 2015, and 2023. 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.

$$UEC = function\ of\ (V1, V2, V3, \ldots, Vn) \qquad \text{Equation A-48}$$

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 22/23 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 goes without any food refrigeration. For secondary refrigerators and freezers, the possibility of part-use becomes more likely.

The participant survey was used to estimate part-use factors for secondary refrigerators and freezers, separately. Respondents were asked to indicate whether the appliance they recycled was in full use, part use, or disuse during the 12 months prior to collection. If a respondent indicated part use, they were asked to estimate the number of months the unit was in operation (out of the prior 12 months). Gross baseline consumption of recycled appliances was calculated as the full year UEC estimates multiplied by the part-use factors.

Next, the part-use factors, which are based on historical usage of the recycled appliances, are combined with participants' self-reported actions had the program not been available. Specifically, whether they would have kept or discarded the unit. This information is important because it informs what type of 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[24].

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-132.

Table A-132 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 22/23. Ex-post gross energy savings and peak demand reduction are presented at the measure level. Topics are covered in the following order:

[24] 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.

- Verification of units recycled;
- Full year UEC calculation;
- Part-use factors;
- Per-unit gross impacts; and
- 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 22/23. 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-133 shows the resulting verification rates by measure.

Table A-133 RETIRE Claimed vs. Verified Units in Working Condition

Measure	Survey Sample Size (n)	Program Claimed Units	Verification Rate (%)	Verified Units
Freezer	4	68	100.0%	68
Refrigerator	90	1,940	96.0%	1,862

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 SMUD service territory and 28 appliances metered just before decommissioning in LADWP service territory. The short-term metering data was first extrapolated to full year UEC estimates as described A.15.1.3. 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-134.

Table A-134 UEC Regression Model Estimates

Independent Variable	Coefficient	t-ratio
Intercept	-166.13	-0.552
Appliance Age **	22.49	3.528
Dummy: Manufactured Pre-1990	116.32	0.996
Appliance Size (cubic feet)	24.05	2.103
Dummy: Freezer	0.62	0.006
Dummy: Refrigerator	Suppressed – base variable	
Dummy: Side-by-Side Configuration*	226.86	2.167
Dummy: All Other Refrigerator Configurations	Suppressed – base variable	
Dummy: Primary Usage Type	61.90	0.554
Dummy: Secondary Usage Type	Suppressed – base variable	
Dummy: 2006 Metering Cohort	290.08	1.660
Dummy: 2011 Metering Cohort *	346.84	2.241
Dummy: 2014 Metering Cohort	39.98	0.234
* Significant at the 0.10 level ** Significant at the 0.05 level *** Significant at the 0.01 level	R – Square = 0.38	

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-135 shows the average program values by appliance type.

Table A-135 RETIRE Average Program Appliance Characteristics

Coefficient	Refrigerators (n = 1,940)	Freezers (n = 68)
Average Age (Years)	22.	23.0
Percentage of Units Manufactured before 1990	3.0%	3.0%
Average Size (Cubic Feet)	20.0	15.7
Percentage Side-by-Side	27.3%	0%
Percentage Primary Usage*	72.2%	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-135 were used in conjunction with the parameter estimates to calculate annual UEC estimates for program participating refrigerators and freezers. Table A-136 summarizes the full year UEC estimates for refrigerators and freezers.

Table A-136 RETIRE Full Year Average UEC Estimates

Appliance Type	Number of Units	Average Full Year UEC
Refrigerator	1,862	1,200
Freezer	68	1,069

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-137 shows the calculation of the part-use adjusted UECs for refrigerators and freezers when partial use is taken into account.

Table A-137 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=25)			
Not running	0.0%	0	0

Operating Status of Unit	Percentage of Recycled Units in Category	Use Factor	Calculation of UEC to Adjust for Part Use
Running part time	20.0%	0.625	750
Running all time	80.0%	1	1200
Weighted Average for Secondary Refrigerators		**0.925**	**1,110**
Refrigerators – All (n=90)			
Not running	2.2%	0	0
Running part time	7.8%	0.521	625
Running all time	90.0%	1	1200
Weighted Average for Refrigerators		**0.941**	**1,129**
Freezers (n=4)			
Not running	0.0%	0	0
Running part time	0.0%	0	0
Running all time	100.0%	1	1069
Weighted Average for Freezers		**1**	**1,069**

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:

- 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.

A.15.2.4.2 Secondary Market Impacts

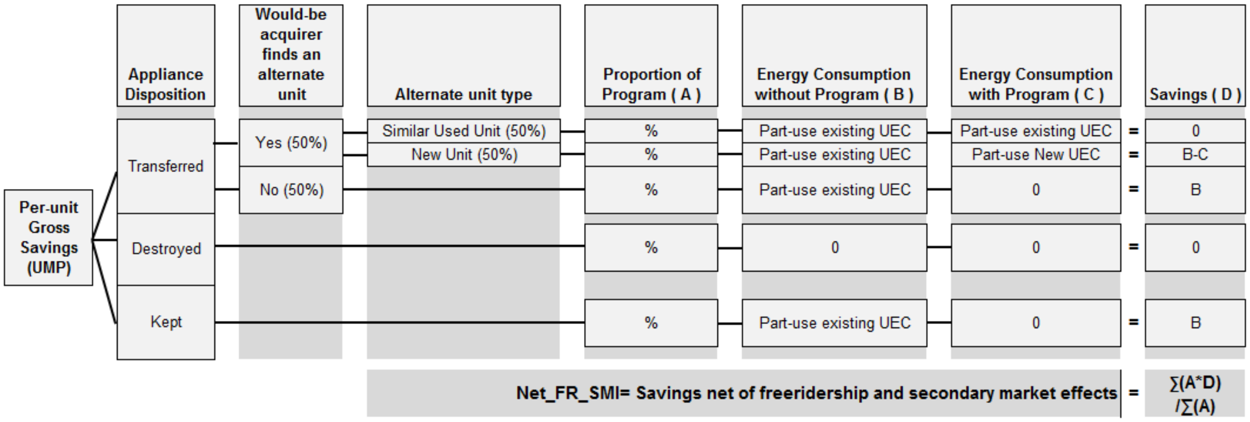
Secondary market impacts refer to the effect the program has on would-be acquirers of program participating units. In the event that a program unit would have been transferred to another customer (sold, gifted, donated), the question then becomes what other appliance acquisition decisions are made by 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-24 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-24 RETIRE 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 was 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-138.

Table A-138 RETIRE Prior Consideration of Disposal

	Measure	Response	Percent of Respondents (n=90 (ref), 4 (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	76%
		No	19%
		Don't know	6%
	Freezer	Yes	50%
		No	50%
		Don't know	0%
	Air Conditioner	Yes	100%
		No	%
		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 party for continued use, or destroyed.

Table A-139 shows refrigerator disposition based on participant survey responses. Table A-140 shows the same calculation for freezers, and Table A-141 shows the results for air conditioners.

Table A-139 RETIRE Refrigerator Discard/Keep Distribution

Discard/Keep	Proportion of Participant Sample (n = 90)	Discard Scenario	Proportion of Discards	Overall Proportion
Discard	77%	Transfer	51%	39%
		Destroy	49%	38%
Keep	23%			23%

Table A-140 RETIRE Freezer Discard/Keep Distribution

Discard/Keep	Proportion of Participant Sample (n = 4)	Discard Scenario	Proportion of Discards	Overall Proportion
Discard	50%	Transfer	100%	50%
		Destroy	0%	0%
Keep	50%			50%

Table A-141 RETIRE Air Conditioner Discard/Keep Distribution

Discard/Keep	Proportion of Participant Sample (n = 2)	Discard Scenario	Proportion of Discards	Overall Proportion
Discard	100%	Transfer	50%	50%
		Destroy	50%	50%
Keep	0%			0%

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 the program are considered in the secondary market impact analysis. As detailed in Section A.15.1.3.6, 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 shows the same calculation for freezers and air conditioners.

Figure A-25 RETIRE Net-to-Gross Calculation – Refrigerators

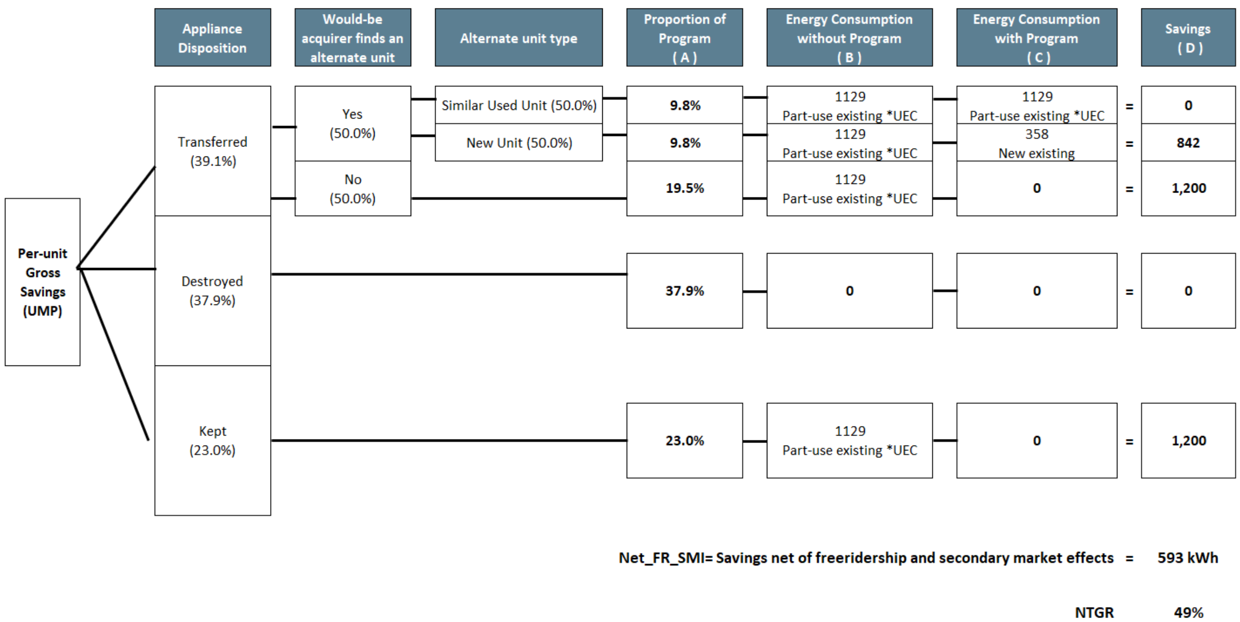
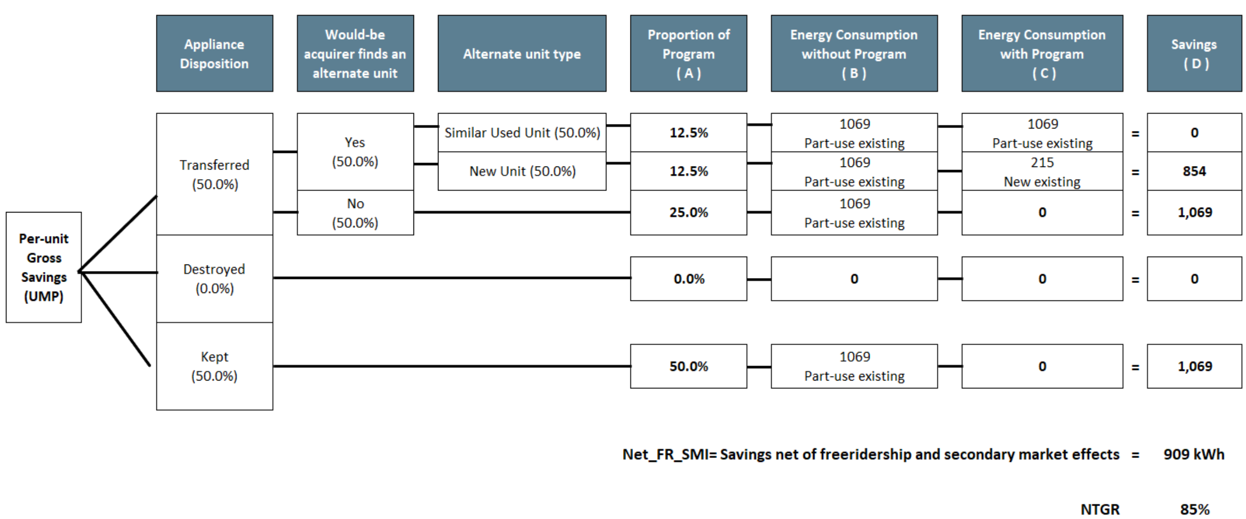


Figure A-26 RETIRE Net-to-Gross Calculation – Freezers



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-142.

Table A-142 RETIRE Part-use Adjusted UEC Estimates

Appliance Type	Number of Units	Part-use Adjusted UEC
Freezer	68	909
Refrigerator	1,862	593

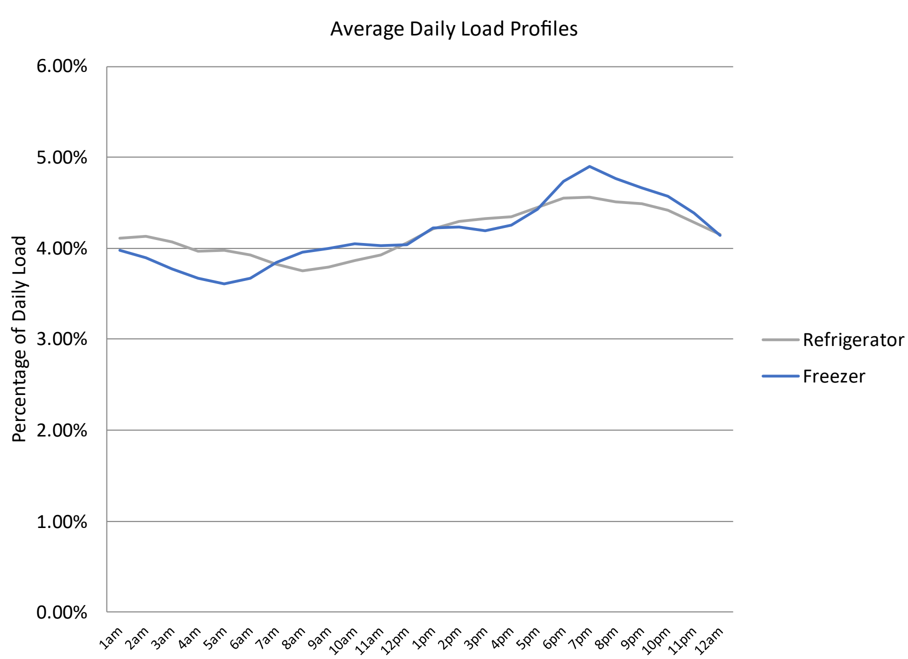
A.15.2.4.4 Per-Unit Gross Peak Demand Reduction

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-143.

Table A-143 RETIRE Per-Unit kW Reduction

Appliance Type	Number of Units	Per-unit kW Reduction
Freezer	68	0.108
Refrigerator	1,862	0.069

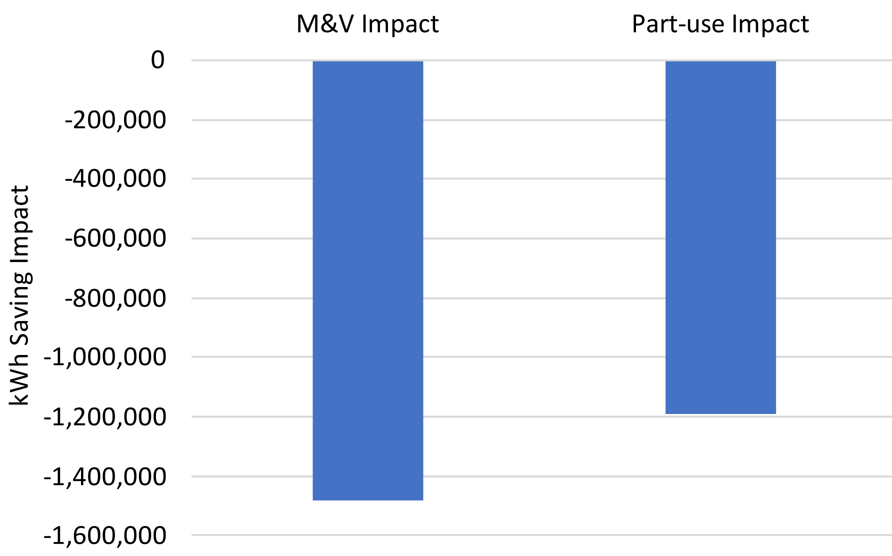
Figure A-27 RETIRE Average Daily Load Profile



A.15.2.5 Description of Factors Affecting Gross Realized Savings

The primary factor affecting RETIRE savings were the M&V approach and Part-use adjustment as outlined in Section A.15.1.3, with a total negative impact of 2,673,955.

Figure A-28 RETIRE Factors Affecting Ex-Post Gross Savings



A.15.3 Process Evaluation

The following sections detail the process evaluation findings for RETIRE.

A.15.3.1 Process Evaluation Approach and Methodology

For FY 22/23, the Evaluator performed a summary process evaluation of the RETIRE 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

Additionally, the Evaluator summarized findings on key metrics developed from the surveys of program participants in FY 21/22 and FY 22/23. The results presented are based on responses from 212 FY 21/22 participants and 96 FY 22/23 participants.

The Evaluator performed a full process evaluation of the RETIRE program in FY 21/22. The main findings of the full process evaluation were:

- **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.

- **Postcard 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% though that the pickup crews were professional.
- **RETIRE and EPM are cross-promoted and a sizable share of RETIRE participants also participated in EPM during FY 21/22.** 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 the pick-up crew did not check that the unit was working.
- **Program data capture 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 recommendations made in the full process evaluation were:

- **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 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 FY 15/16, 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.15.3.2 Process Evaluation Findings

Overall, program staff reported that RETIRE has continued to provide replacement refrigerators without significant changes to the program design, marketing approach, or delivery since FY 21/22. As discussed in Section A.14.3.2, a change in ownership of ARCA also impacted the program operations. On March 9, 2023, ARCA announced that the company's COO and CFO would purchase the company from its parent corporation, JanOne, Inc.[25] The change in ownership led to changes in contracting, such as with the third-party ARCA contract, pertaining to the pickup of the old refrigerators, which resulted in some disruption of program operations. However, a potential benefit is that with the change in ownership, ARCA has begun to develop its own crews to complete the delivery and pickup. LADWP staff are optimistic that this will increase ARCA's capacity to provide the service to their customers.

A.15.3.2.1 Program Marketing

LADWP staff noted that they had considered a postcard marketing campaign for RETIRE in lieu of a campaign for REP, which faced challenges in procuring a sufficient number of refrigerators. Ultimately, this campaign was not run because they anticipated that the supply disruptions would end, but they are considering it for FY 23/24. The program

[25] https://arcarecyclinginc.com/news/announcing-new-ownership-of-arca-recycling/ (Retrieved 7/27/2023)

continued to be marketed by the LADWP marketing group through social media and LADWP eNewsletters.

Cross promotion with refrigerator discounts through the Efficient Product Marketplace program continued and staff noted that this expanded to include the room air conditioner discounts available through the Cool LA program.

A.15.3.2.2 Previous Evaluation Recommendations

Table A-144 summarizes the program response to previously made recommendations.

Table A-144 Previous RETIRE Recommendations and Program Response

Summary of Past Recommendations	Program Response
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.	Program staff indicated that they are considering this and will review the evaluation results to inform their decision.
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.	During FY 22/23, ARCA began training its own contractors to provide pick up services as part of the program change in ownership.
Monitor savings over longer term but consider customer satisfaction benefits when assessing the viability of RETIRE. The age of appliance manufacture has increased since FY 15/16, 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	The program staff is aware of savings changes overtime and continue to monitor the issue.

Summary of Past Recommendations	Program Response
customers can participate without any cash-outlay, the program is accessible to a large number of customers.	

A.15.3.2.3 Participant Survey Findings

Participants were satisfied with the program. Most respondents (98% and 99%) 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-29).

Figure A-29 Participant Satisfaction with RETIRE (Percent Satisfied)

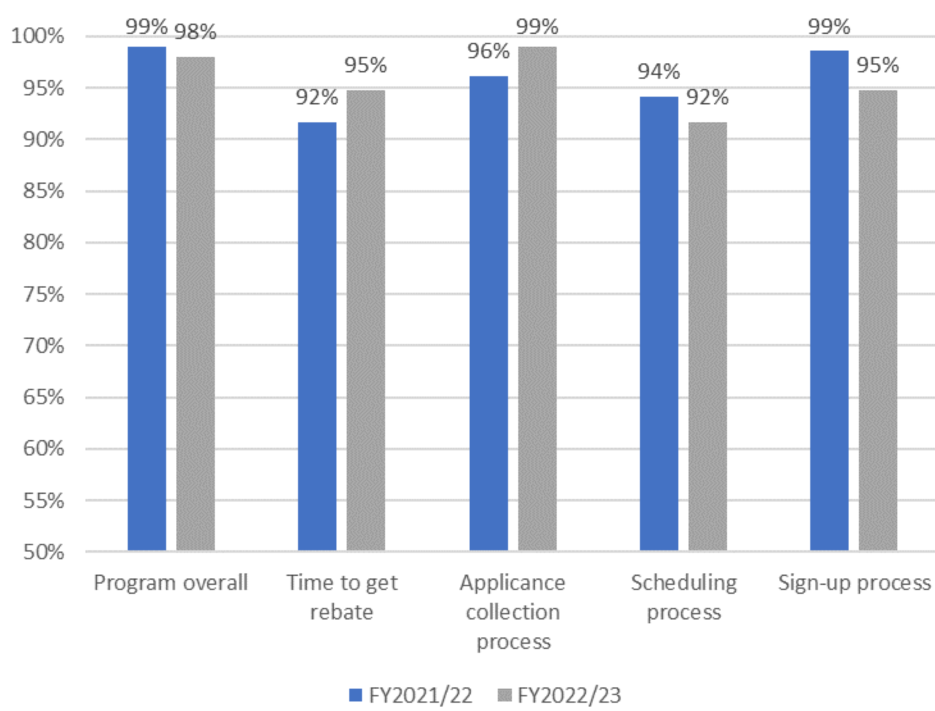


Table A-145 summarizes the customer service metrics across the two fiscal years. The results are positive and consistent across the two years.

Table A-145 RETIRE – Customer Service Metrics

Online Sign Up	Percent of Respondents (FY 21/22)	Percent of Respondents (FY 22/23)
Easy to find sign-up screen (n= 155 / n=75)	96%	96%

Online Sign Up	Percent of Respondents (FY 21/22)	Percent of Respondents (FY 22/23)
Website answered all of the participants questions (n=156 / n=76)	94%	93%
Telephone Sign Up	**Percent of FY 21/22 Respondents**	**Percent of FY 22/23 Respondents**
Representative was courteous (n=36 / n=16)	100%	94%
Representative answered all their questions (n=36 / n=16)	100%	88%
Appliance Pickup	**Percent of FY 21/22 Respondents**	**Percent of FY 22/23 Respondents**
Pickup crew was professional (n= 144 / n=70)	99%	99%

Rebate Wait Times

Wait times for rebates varied but participants typically received it within 6 weeks or less (see Table A-146).

Table A-146 RETIRE - Rebate Wait Times

Response	Percent of Respondents (FY 21/22 n = 205)	Percent of Respondents (FY 22/23 n = 93)
Less than 2 weeks	15%	20%
2 – 4 weeks	46%	45%
4 – 6 weeks	30%	22%
6 – 8 weeks	5%	10%
More than 8 weeks	4%	3%

Participant Demographics

The following tables summarize the demographic characteristics of program participants.

Table A-147 RETIRE - Home Ownership and Fuel Type

Home Ownership	Percent of FY 21/22 Respondents (n = 205)	Percent of FY 22/23 Respondents (n= 91)
Own	66%	64%
Rent	32%	34%

Home Ownership	Percent of FY 21/22 Respondents (n = 205)	Percent of FY 22/23 Respondents (n= 91)
Own and rent to someone else	2%	2%

Table A-148 RETIRE - Language Spoken in Home and Preferences for Communication

Language Spoken at Home	Percent of FY 21/22 Respondents (n = 200)	Percent of FY 22/23 Respondents (n = 88)
Only English is spoken	57%	65%
Spanish	22%	15%
Mandarin	2%	1%
Vietnamese	1%	2%
Tagalog	3%	1%
Armenian	3%	2%
Korean	5%	2%
Russian	2%	0%
Persian (including Farsi, Dari)	3%	2%
Other	6%	7%
Prefer not to answer	3%	5%
Preferred Communication Language	**Percent of FY 21/22 Respondents (n = 71)**	**Percent of FY 22/23 Respondents (n = 23)**
English	83%	74%
Spanish	9%	22%
Mandarin	1%	0%
Vietnamese	0%	4%
Tagalog	0%	0%
Armenian	0%	0%
Korean	6%	0%
Russian	0%	0%
Persian (including Farsi, Dari)	1%	0%
Other	0%	0%

Table A-149 RETIRE - Number of People Residing in the Home

Response	Percent of FY 21/22 Respondents (n = 201)	Percent of FY 22/23 Respondents (n = 89)
1 person	18%	16%

Response	Percent of FY 21/22 Respondents (n = 201)	Percent of FY 22/23 Respondents (n = 89)
2 people	30%	30%
3 people	16%	13%
4 people	19%	15%
5 people	7%	7%
6 people	2%	3%
7 people	2%	2%
8 or more people	0%	0%
Prefer not to state	6%	13%

Response	Percent of FY 21/22 Respondents (n = 201)	Percent of FY 22/23 Respondents (n =88)
18 - 24	2%	1%
25 – 34	13%	14%
35 – 44	22%	24%
45 – 54	19%	17%
55 – 64	18%	20%
65 – 74	11%	7%
75 +	7%	7%
Prefer not to answer	9%	10%

Table A-150 RETIRE - Race/Ethnicity of Survey Respondents

Response	Percent of FY 21/22 Respondents (n = 201)	Percent of FY 22/23 Respondents (n = 88)
American Indian or Alaska Native	1%	2%
East Asian	14%	15%
South Asian	2%	1%
Black or African American	10%	6%
Hispanic, Latino, or Spanish	26%	20%
Native Hawaiian or Other Pacific Islander	0%	0%
Middle Eastern or North African	3%	1%
White or Caucasian	36%	38%
Other	0%	2%
Prefer not to answer	13%	19%

Table A-151 RETIRE - Household Income Level

Response	Percent of FY 21/22 Respondents (n = 201)	Percent of FY 22/23 Respondents (n = 88)
Under $15,000	7%	7%
$15,000 to less than $25,000	8%	6%
$25,000 to less than $35,000	9%	5%
$35,000 to less than $50,000	14%	8%
$50,000 to less than $75,000	6%	9%
$75,000 to less than $100,000	10%	9%
$100,000 to less than $150,000	12%	9%
$150,000 or over	11%	12%
Prefer not to answer	24%	34%

A.16 Residential Lighting Efficiency Program

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-152 RLEP Program Evaluation Data Collection

Source	Data Types
Program tracking data	Distribution channel and quantity
ADM 2023 LED bulb metering, EPM, HEIP participants	Lighting hours of use
General population survey	Survey from Retrospective period leveraged for FY 21/22
2019 RASS Study	LADWP service territory response data for existing lamps
LA Assessor Data	Housing types – single family, multifamily by climate zone
LED Manufacturer Specification Sheet	Wattages, lumens, lifetime hours
CA MAEDbs, Modern Appliance Efficiency Database	GSL lamp wattage (1000-1350 lumens)
NREL, Uniform Methods Project, Chapter 6	Incremental ISR increase for stocked lamps

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 first year ISR. 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-153.

Table A-153 RLEP Tracking Data Document List

File Name	LED Kits Distributed
Energy Savings Portfolio data export	2,055
RLEP 22-23.xlsx	2,055

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 metered annual hours of use for LED bulbs were leveraged from the ADM 2023 LED lamp metering site visits for the EPM and HEIP programs. The participants from both programs received LED A-19 general service lamps, similar to the RLEP program lamps.

The number of residences, lamps metered by program are listed in Table A-154

Table A-154 ADM 2023 LED GSL Metering Site Visits

Strata	Number of Residences	Usage Areas Metered	Lamps Metered	Days Metered
EPM LED GSL LED	7	13	53	194
HEIP LED GSL LED	12	18	61	503
Total	**19**	**31**	**114**	**697**

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, then applied the mix of lamp technology to determine a lumen equivalent baseline lamp wattage. The remaining life of the baseline lamps was estimated as one-third of the EUL of the weighted lamp mix and their respective lamp life. After the midlife shift, the energy savings are reduced significantly, as the baseline wattage drops to 18 watts from 30 watts.

Table A-155 RLEP Baseline Developed from RASS Survey

Variable	CFL	Incandescent	LED
Proportion	32%	23%	44%
Equivalent Watts to RLEP efficient lamp	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-49 and Equation A-50 below, respectively:

$$kWh = \#LED\ kits\ x\ 2\frac{lamps}{kit}\ x\ \frac{(Watts_{base} - Watts_{LED})}{1000W/kW}\ x\ HOU\ xISR \qquad \text{Equation A-49}$$

$$kW = kWh_{savings}\ x\ CDF \qquad \text{Equation A-50}$$

A description of the savings inputs is presented in Table A-156 below.

Table A-156 RLEP Ex-Ante Energy Savings Algorithm Inputs/Outputs

Factor	Description
kWh	Annual energy savings
kW	Peak demand savings
#LED kits	Kit quantity
$Watts_{Base}$	Base lamps, 36 Watts
$Watts_{LED}$	LED lamp, 12 Watts
HOU	Annual hours of use, 1095 hours
RR	Realization Rate, 0.66
CDF	Coincident demand factor; 0.000117

Table A-157 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 and channels were listed. The tracking data included 100% of the savings in the ESP reports. Peak demand reduction was not listed in the tracking data.

Table A-157 RLEP ESP and Program Tracking Savings Comparison

Measure	ESP Data Ex-Ante kWh	Program Data Ex-Ante kWh	ESP Ex-Ante Peak kW	Program Tracking Ex-Ante Peak kW
LED Lamps	71,287	71,287	8.35	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-51*

$$kW = \frac{kWh}{HOU}\ x\ CF$$ *Equation A-52*

Table A-158 RLEP ENERGY STAR Lighting Savings Algorithm Inputs

Variable Name	Input	Source	Value Range
$Kits_{ver}$	Quantity verified in tracking data	RLEP tracking data	Variable
$Lamps/kits$	LED lamps per kit	RLEP tracking data	2
HOU	2023 ADM GSL lamp measure metering study	HEIP, EPM site visits and metering	779 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: GSL & Modern Appliance Database listed lamps	18 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%
$ISR_{3\ year\ average}$	In Service Rate, first three year average	NREL Uniform Methods Project Chapter 6 applied to ISR first year	81%
CF	Coincident Factor	2023 ADM LED GSL lamp measure metering	0.0796
RUL	Remaining Useful life	1/3 x Weighted lamp mix life/HOU	3.4 years

Variable Name	Input	Source	Value Range
EUL	Effective Useful Life	DEER Resources,max lifetime	15 years

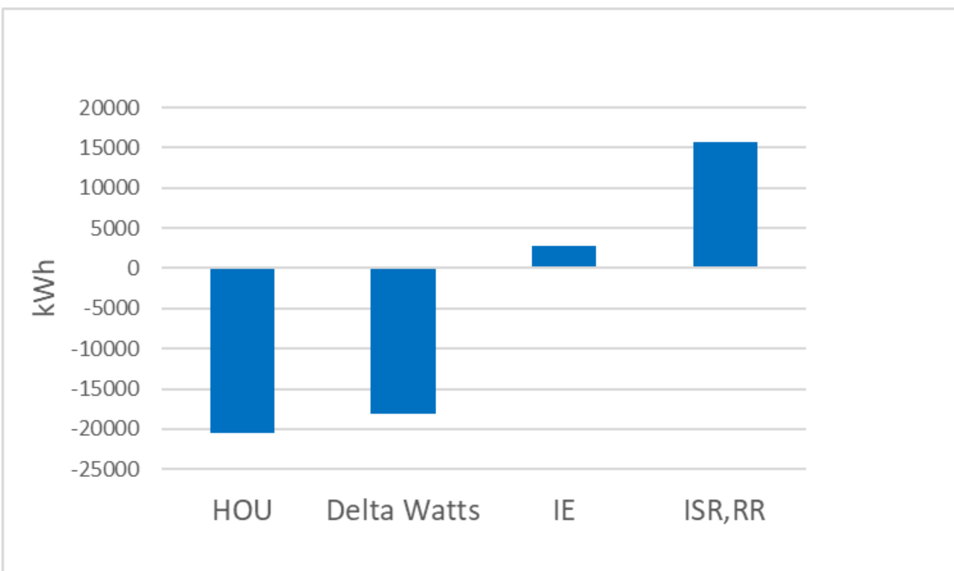
A.16.2 Impact Evaluation

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. The peak demand reduction calculation utilized the CF factor determined by the 2023 ADM LED GSL lamp measure metering study for the percentage of lamps on during the peak period hours, Monday to Friday.

A.16.2.1 Description of Factors Affecting Gross Realized Savings

Figure A-30 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 45 lumens per watt, or 89 lumens for LED GSL lamps. The 2019 RASS survey data for LADWP responses estimated a weighted mix of lamp technology for LED/CFL/Incandescent at 44%/32%/23%. This method resulted in a baseline at 30W, for a delta-watts 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-30 RLEP Realized Savings Factors



A.16.3 Process Evaluation

A process evaluation was not completed for FY 22/23 because the door-to-door delivery of LEDs remained suspended. The findings from the summary process evaluation completed in FY 21/22 were:

- Door to door distribution has been on hold since 2020.
- 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.

RLEP has continued to distribute LEDs at events and through the REP.

- 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. Events during February 2023 handed out 100 kits (for 200 lamps and an estimated 2,161 kWh savings).
- 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 2022 through June 2023, REP handed out 1,955 kits (for 3,910 lamps and an estimated 42,244 kWh in savings).

A.17 Air Conditioning Optimization Program

This section presents details about the evaluation methodology and impact evaluation for the ACOP.

A.17.1 Evaluation Methodology

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

A.17.1.1 Tracking Data Review

LADWP provided the Evaluator the available program tracking data for measures installed between August 9, 2016, through June 17, 2020. LADWP provided the following datasets:

- Quarterly billable amounts by measure.
- Measure-level tracking data including customer accounts, premise address, measures installed, quantity of measures installed, contractor name, measure cost, and install date; and,
- Monthly measure count summaries with associated measure-level Ex-Ante kWh savings.

The Evaluator reviewed available program data and counted the total number of unique measures completed in FY 21/22. 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-159 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-159 below.

Table A-159 ACOP Ex-Ante Savings Summary

Measure	ESP Data Ex-Ante kWh	Program Data Ex-Ante kWh	ESP Ex-Ante kW	Program Tracking Ex-Ante kW
Commercial	308,662	308,662	61.97	302.55
Multifamily	9,728,201	9,728,201	4,345.09	11,715.08
Single Family	2,247,150	2,247,150	998.99	3,185.16
Mobile Home	52,794	52,794	23.58	71.56
Total	**12,336,807**	**12,336,807**	**5,429.64**	**15,274.35**

A.17.1.3 M&V Approach

Table A-160 summarizes the data sources used in the ACOP impact evaluation.

Table A-160 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:

- First, the Evaluator conducted an exploratory data analysis that made use of all provided participant billing data.
- Second, the Evaluator used regression models to make longitudinal and cross-sectional comparisons of energy consumption before and after installation of energy efficiency measures to determine how electricity use changed after a measure was installed at a household or business.
- Third, the Evaluator quantified whole home or building savings by extrapolating regression model outputs with weather and number of participants in each study period.

Ex-post savings were determined using the regression coefficients. Further details of the billing analysis approach are summarized in Section A.17.1.4 below.

A.17.1.4 Billing Analysis Approach

The Evaluator 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 the Evaluator generated estimates at the premise-level. A pooled billing data regression was used to evaluate Commercial premises. A billing data retrofit isolation was used to evaluate Residential premises.

A.17.1.4.1 Billing Data Regression

A pre/post pooled mixed effects billing data regression was selected to evaluate the Commercial measure. 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, 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.

For the FY 20/21, FY 21/22, and FY 22/23 program years, a total of 180, 446, and 247 Commercial premises participated in the program by the time of evaluation. However, only 157, 187, and 124 participants had sufficient data to be included in a regression analysis, respectively. Although a billing analysis was attempted for each program year independently, the Evaluator was not able to obtain a statistically significant impact due to the high variability in Commercial billing data. To compensate for this lack of significance, the Evaluator included data dating as far back as FY 17/18 to increase the number of available data points, thereby decreasing the standard error and increasing the likelihood of detecting statistically significant savings. Therefore, the analysis for FY 20/21 included data from FY 17/18 through FY 20/21; FY 21/22 included data from FY 17/18 through FY 21/22; and FY 22/23 included data from FY 17/18 through FY 22/23.

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-53.

$$Average\ Daily\ kWh = \frac{Total\ kWh}{Number\ of\ Days} \qquad \textit{Equation A-53}$$

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-161. 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-161 ACOP Commercial Participant Count

Fiscal Year	Measure	All Participants	Qualified Participants	Final Sample Size
20/21	ACOP Commercial	180	157	2,110
21/22	ACOP Commercial	446	187	2,241
22/23	ACOP Commercial	247	124	2,363

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-54 :

$$Average\ Daily\ kWh_i = \alpha + \beta_1 \cdot post + \beta_2 \cdot CDD_{i,n} + \beta_3 \cdot HDD_{i,n} + \beta_4 \cdot CDD_{i,n} \cdot post + \beta_5 \cdot HDD_{i,n} \cdot post + \varepsilon \qquad \text{Equation A-54}$$

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-55. The Evaluator used the LFE 2.8-6 package in R 3.6.3 to perform the mixed effects regression model.

$$Average\ Daily\ kWh_i = \alpha_i + \beta_1 \cdot post + \beta_2 \cdot CDD_i + \beta_3 \cdot HDD_i + \beta_4 \cdot CDD_i \cdot post + \beta_5 \cdot HDD_i \cdot post + \varepsilon \qquad \text{Equation A-55}$$

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*
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
ε	=	the error term

The regression coefficients of interest for estimating savings are β_1, β_4, and β_5. Table A-162 provides information regarding the regression coefficients for the model and the overall model fit.

Table A-162 ACOP Commercial Regression Coefficients

Fiscal Year	Term	Regression Coefficient	Standard Error	T-value	P-value	Adjusted R-squared
20/21	Post	-1.703	0.655	-2.6	0.009	0.939
	Post x HDD	-0.249	0.125	-1.996	0.046	0.939
	Post x CDD	-0.06	0.109	-0.547	0.584	0.939
21/22	Post	-1.693	0.37	-4.575	0	0.947
	Post x HDD	-0.416	0.071	-5.852	0	0.947
	Post x CDD	0.036	0.064	0.562	0.574	0.947
22/23	Post	-1.969	0.533	-3.692	0.000	0.935
	Post x HDD	-0.375	0.100	-3.757	0.000	0.935
	Post x CDD	0.048	0.094	0.513	0.608	0.935

The savings for each fiscal year were then calculated using the formula presented in Equation A-56.

$$\begin{aligned} Annual\ Savings &= [Post\ Coefficient \\ &+ (Post\ x\ CDD\ Coefficient\ \cdot \overline{CDD}) \\ &+\ (Post\ x\ HDD\ Coefficient\ \cdot \overline{HDD})] \cdot -1 \cdot 365.25 \end{aligned}$$

Equation A-56

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-163.

Table A-163 ACOP Commercial Weighted Average TMY3 HDD and CDD

Fiscal Year	Measure	Average Daily HDD	Average Daily CDD
20/21	ACOP Commercial	2.335	2.09
21/22	ACOP Commercial	2.471	2.011
22/23	ACOP Commercial	2.528	1.804

Savings per household, 90% confidence intervals, and relative precision at the 90% confidence level are presented in Table A-164.

Table A-164 ACOP Commercial Average Savings per Household

Fiscal Year	Measure	Annual kWh Savings	90% Confidence Interval		Relative Precision (90% CL)
			Lower Bound	Upper Bound	
20/21	ACOP Commercial	785	523	1,047	33%
21/22	ACOP Commercial	855	705	1,005	18%
22/23	ACOP Commercial	971	758	1,184	22%

A.17.1.4.2 Billing Data Retrofit Isolation

To evaluate Residential premises, the Evaluator used a billing data retrofit isolation approach. Several considerations were made prior to selecting the retrofit approach over a PSM regression analysis. First, results from the 2019 Residential Appliance Saturation Survey (RASS) suggest a volatile saturation of central HVAC equipment in LADWP service territory (only 10.2% to 37.8% of residential customers have electric space heating depending on building type; only 20.4% to 69.3% of residential customers have central space cooling depending on building type). This renders a PSM inappropriate as there is a high probability that comparison customers selected via PSM may not have comparable equipment installed despite being matched based on energy consumption.

Billing Data Preparation

LADWP provided participant bi-monthly billing data. As with the procedure described with the billing data regression analysis, customer billing data was first calendarized from billing periods to calendar years. After calendarization, customer billing data was filtered for the following criteria:

- The Evaluator reviewed the post-installation data for each measure to determine the optimal post-installation period for each measure. For FY 20/21, the optimal post-installation period was determined to be August 2021 to January 2022. In all cases, participants were filtered for those participants that had a full 6 months of post-installation data. For FY 21/22, 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 7 months of post-installation data. For FY 22/23, the optimal post-installation period was determined to be September 2022 to June 2023. In all cases, participants were filtered for those participants that had a full 10 months of post-installation data.

- During the FY 20/21 program year, an insufficient number of participants were available to perform independent analyses for Multi-Residential and Single Family homes. These two groups were therefore combined into a single stratum for evaluation. Similarly, an insufficient number of Mobile Homes were present in FY 21/22 and FY 22/23 and where therefore combined with Single Family Homes for evaluation.
- Pre-installation data was reviewed to determine the optimal pre-installation period for each measure. For FY 20/21, the optimal pre-installation period was determined to be January 2019 and August 2019 through December 2019. In all cases, participants were filtered for those participants that had a full 6 months of pre-installation data. For FY 21/22, 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 7 months of pre-installation data. For FY 22/23, the optimal pre-installation period was determined to be January 2019 through June 2019 and September 2019 through December 2019. In all cases, participants were filtered for those participants that had a full 10 months of pre-installation data.
- Participants must not have taken part in any other energy efficiency programs administered by LADWP during FY 20/21, FY 21/22, or FY 22/23.
- 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-165 below.

Table A-165 ACOP Residential Participant Count

Fiscal Year	Strata	Number of Participants	Final Sample Size
20/21	ACOP Residential	94	26
21/22	ACOP Multi-Residential	25,991	221
	ACOP Single Family & Mobile Homes	6,616	376
22/23	ACOP Multi-Residential	23,119	514
	ACOP Single Family & Mobile Homes	4,142	183

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-57.

$$Average\ Daily\ kWh_i = \alpha + \beta_1 \cdot post + \beta_2 \cdot CDD_{i,n} + \beta_3 \cdot HDD_{i,n} + \beta_4 \cdot CDD_{i,n} \cdot post + \beta_5 \cdot HDD_{i,n} \cdot post + \varepsilon$$

Equation A-57

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

The difference in pre and post weather-dependent load was treated as the savings for each customer, as represented in Equation A-58.

$$\Delta kWh_{HVAC} = kWh_{HVAC\ Pre} - kWh_{HVAC\ Post}$$ *Equation A-58*

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-166.

Table A-166 ACOP Residential Participant-Level Savings

Fiscal Year	Strata	Annual kWh Savings	90% Confidence Interval		Relative Precision (90% CL)
			Lower Bound	Upper Bound	
20/21	ACOP Residential	711.51	298.89	1124.13	58%
21/22	ACOP Multi-Residential	344.56	251.78	437.35	27%
	ACOP Single Family & Mobile Homes	479.8	311.98	647.61	35%
22/23	ACOP Multi-Residential	410.52	282.52	538.51	31%
	ACOP Single Family & Mobile Homes	601.30	283.78	918.82	53%

A.17.1.4.3 Adjustment for COVID-19

It is important to note that the savings calculated as part of the residential billing analysis may be impacted by the ongoing COVID-19 pandemic. Therefore, both the residential energy consumption observed in the billing data and the observed savings for FY 22/23 may inadvertently be impacted by changes due to the COVID-19 pandemic. To account for this impact, the Evaluator created a series of adjustment factors for each measure by leveraging the non-participant billing data received from LADWP.

The creation of these adjustment factors largely followed the logic of the billing data retrofit isolation analysis in the following manner:

- The nonparticipant data was separated into a typical period (January 2019 through December 2019) and COVID-19-impacted period. For FY 20/21, the COVID-19 period was estimated as October 2020 through September 2021 for program non-participants. For FY 21/22, the COVID-19 period was estimated as May 2021 through April 2022 for program non-participants. For FY 22/23, the COVID-19 period was estimated as June 2022 through May 2023 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.17.2 Process Evaluation

The following sections discuss the ACOP process evaluation methodology.

A.17.2.1 Process Evaluation Approach and Methodology

For FY 22/23, the Evaluator performed a summary process evaluation of ACOP. 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
- Barriers and opportunities going forward
- Other topics as relevant

The Evaluator performed a full process evaluation of ACOP in FY 21/22. The key findings of that process evaluation were as follows:

- **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.

The recommendations made in FY 21/22 were:

- **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.17.2.2 Summary Process Evaluation Findings

The following presents the key findings from the summary process evaluation of the FY 22/23 program.

A.17.2.2.1 Staffing and Partnership

LADWP reported that the program continued to work with Proctor to implement ACOP. This relationship continues to be effective with regular communication occurring on a biweekly basis between LADWP and Proctor.

A.17.2.2.2 Program Performance

LADWP staff noted that program savings were down somewhat from FY 21/22 in FY 22/23. While it is difficult to discern the exact reason for the change in performance, LADWP staff suggested that the wet winter and spring period may have lessened participation in the program.

The program continued the heat pump electrification component and saw around 350 of these projects completed during the program year. While staff thought this component was performing "pretty well," they noted that changes in the efficiency standards (i.e., the transition to the SEER2 standards) had made it more difficult to procure efficient systems.

A.17.2.2.3 Program Marketing

The program continued with social media campaigns and promoting the program through its monthly newsletters during FY 22/23. Additionally, there was an effort to recruit additional multifamily properties by sending a mailing to property management companies.

A.17.2.2.4 Previous Evaluation Recommendations

Table A-167 summarizes staff's response to the recommendations made in the FY 21/22 Evaluation.

Table A-167 Previous ACOP Recommendations and Program Response

Summary of Past Recommendations	Program Response
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.	Staff has not acted on this recommendation.
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.	Staff has not acted on this recommendation.
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	Staff have not acted on the recommendation and note that it is difficult to oversee what technicians are communicating to customers.

Summary of Past Recommendations	Program Response
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.	Staff believe that the variances in thermostat installation across technicians was due to chance differences in customer eligibility or interest in smart thermostats and noted that technicians are required to indicate that a customer declined the thermostat.
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.	Have not acted on this recommendation but agree that it makes sense.
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 indicated that they looked in this but that the findings from the survey were inconsistent with data collected by the program on the technicians performance.
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.	Staff has not acted on this recommendation.
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.	Have not acted on this recommendation.

A.18 City Plants 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-168 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-168 CP Program Ex-Ante Savings Source Comparison

Fiscal Year	ESP Data Ex-Ante kWh Savings	Program Data Ex-Ante kWh Savings	ESP Data Ex-Ante Peak kW Savings	Program Data Ex-Ante Peak kW Savings
FY 20/21	6,617,573	6,617,573	3,018.61	-
FY 21/22	6,896,107	6,896,107	7,647.19	-
FY 22/23	7,243,165	7,243,165	3,236.96	-
Total	**20,756,845**	**20,756,845**	**13,902.77**	**-**

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. Electric savings from these models were within 4% for all 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-169 below.

Table A-169 CP - EcoLayers Parameter Defaults

	Pre-1950	1950-80	Post-1980
Glazing (m2)	22.7	22.5	30.2
Floor type	Crawl	Crawl	Slab
Wall RValue	7	7	11
Ceiling RValue	7	11	25
Cooling SEER	10	10	10
Heat Duct Location	Crawl	Crawl	Attic
Cool Duct Location	Crawl	Crawl	Attic
Duct Wall RValue	2.1	2.1	4.2
Leaf On Indirect (month)	4	4	4
Leaf Off Indirect (month)	11	11	11
Window Frame Type	Metal w/ Dividers	Metal w/ Dividers	Metal w/ Dividers
Window Operation Type	sliding	sliding	sliding
Thermal Break	No	No	No
Glazing Panes	1	1	2
Wall Construction Type	1in Wood 7 rvalue	1in Stucco 7 rvalue	1in Stucco 11 rvalue
Roof Construction Type	generic 7 rvalue	generic 7 rvalue	generic 11 rvalue

The building energy use model quantifies changes in annual heating and cooling energy consumption for the shading scenarios specified in the EcoLayers interface and quantified by the shadow model. Hourly heat gains or losses are computed using the resulting shading factors and data on building structure, insulation level, window configuration, installed heating/cooling equipment, and local weather based on standard ASHRAE formulations. The Radiant Time Series Method (RTSM) is used to convert heat gains to cooling loads.

Energy savings are calculated over each hour as the difference in energy required to cool the building with and without trees. Hourly data are aggregated monthly and annually.

The kWh savings for the next year begins by “growing” the tree for the next year using the tree growth model, passing the necessary parameters to the shadow model, and running the building heat run model for each hour of the year and aggregating the results.

A.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-170 shows CP Program Ex-Ante savings summary for FY 21/22.

Table A-170 CP Ex-Ante Savings Summary

Fiscal Year	Program Data Ex-Ante Direct Savings/Shade Only (kWh)	Program Data Ex-Ante Indirect Savings/Ambient Cooling (kWh)	Program Data Ex-Ante Total Savings (kWh)	Program Data Ex-Ante Total Reported Savings (kWh)*
FY 20/21	5,406,514	1,946,345	7,352,859	6,617,573

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
FY 22/23	5,917,618	2,130,343	8,047,961	7,243,165
Total	**16,958,208**	**6,104,955**	**23,063,161**	**20,756,845**

** 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, The Evaluator 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-171 presents the results of these on-site surveys. A total of 10 site were visited. The database provided by LADWP reported 36 trees planted at these sites. However, the survey found that a total of 33 trees (92%) were alive and well at 10 visited sites. The remaining three trees either died or there was no evidence of trees being planted.

Table A-171 CP Site Visit Summary

Site Visit Finding	Total Observations
Total Sites Visited	10
# of Trees reported in LADWP database	36
# of Trees found alive & well	33

Site Visit Finding	Total Observations
# of Trees missing or no evidence of being planted	3

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-172 below.

Table A-172 CP Details on In-Person Verified Shade Tree Projects

Project	Zip Code	# Of Trees	Orientation	Species	Height (ft.)	Spread (ft.)	Spread (ft.)
Project	Zip Code	# Of Trees	Orientation	Species	Height (ft.)	Spread (ft.)	Distance from House (feet)
Project 1	90025	1	West	Tristania conferta/Brisbane Box	30	12	15
Project 2	90016	1	West	Bauhinia purpurea/Purple Orchid	6	6	20
Project 3	90018	1	East	African Sumac	15	15	15
Project 4	90018	1	West	Brisbane Box	18	7	30
Project 5	90037	1	West	Chinese Elm	22	15	5
Project 6	90016	1	North	African Sumac	22	10	15
Project 7	90037	1	East	African Sumac	8	6	6
Project 8	90044	1	East	Chinese Elm	10	5	15
Project 9	90037	9	South	Brisbane Box	8 - 15	4 - 10	20
Project 10	90044	3	South	Chinese Elm	18	10	8

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. The Evaluator 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 10 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. portrays a picture of an American Sumac tree planted in front of the house, through the CP Program. The house is facing West.

Figure A-31 American Sumac Tree Planted through CP Program

Figure A-32 portrays the screen capture of i-Tree Design model of the same house shown from above. A green pin on front of the house marks the location of the American Sumac tree. The canopy spread of these trees were visually inspected, which were used as an input to the model.

Figure A-32 CP - Capture of i-Tree Design Model

Table A-173 presents energy savings for 10 modeled projects during the summer and winter seasons. The summer savings (kWh) are associated with the cooling energy and winter savings (Therms) with the heating energy. It is noticeable that winter savings 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 do not shed their leaves in winter and consequently provide shade to the house, resulting in higher heating load.

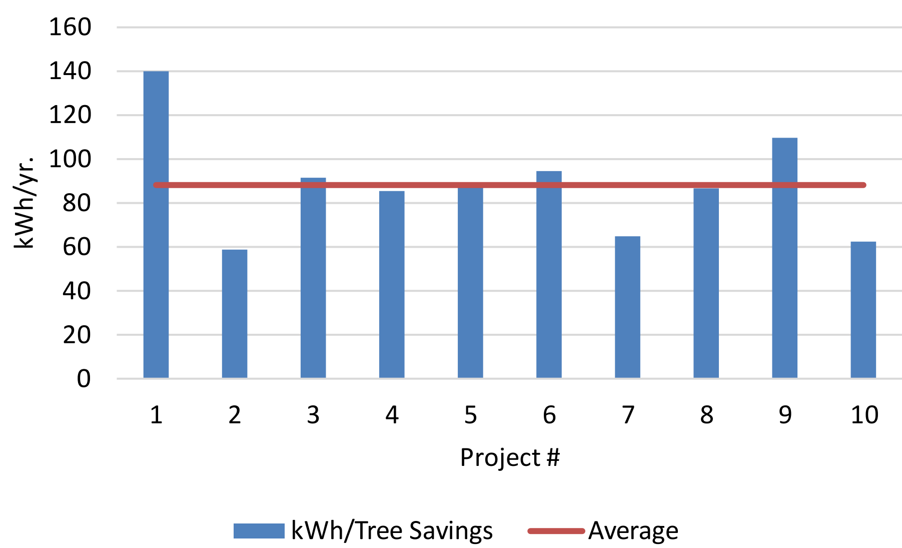
Table A-173 CP - Energy Savings during the Summer and Winter seasons

Project	Number of Trees	Summer Energy Savings (kWh)	Winter Energy Savings (Therms)
Project 1	1	140	-1.1
Project 2	1	59	1.2

Project	Number of Trees	Summer Energy Savings (kWh)	Winter Energy Savings (Therms)
Project 3	1	91	-1.3
Project 4	1	86	-1.1
Project 5	1	88	-1
Project 6	1	95	2.9
Project 7	1	65	-0.8
Project 8	1	87	2.8
Project 9	9	986	-13
Project 10	3	187	-5
Average	**2.0**	**188**	**-1.6**

Figure A-33 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 188 kWh. Note that a project may have more than one tree, but the savings presented in Figure A-33 are normalized on per tree basis for each project.

Figure A-33 CP i-Tree Design Per Tree Annual Summer Savings



Similarly, Figure A-34 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, over the entire population, the impact could be considerable. Especially, when trees become mature and cause more shade.

Figure A-34 CP i-Tree Design Per Tree Annual Winter Savings

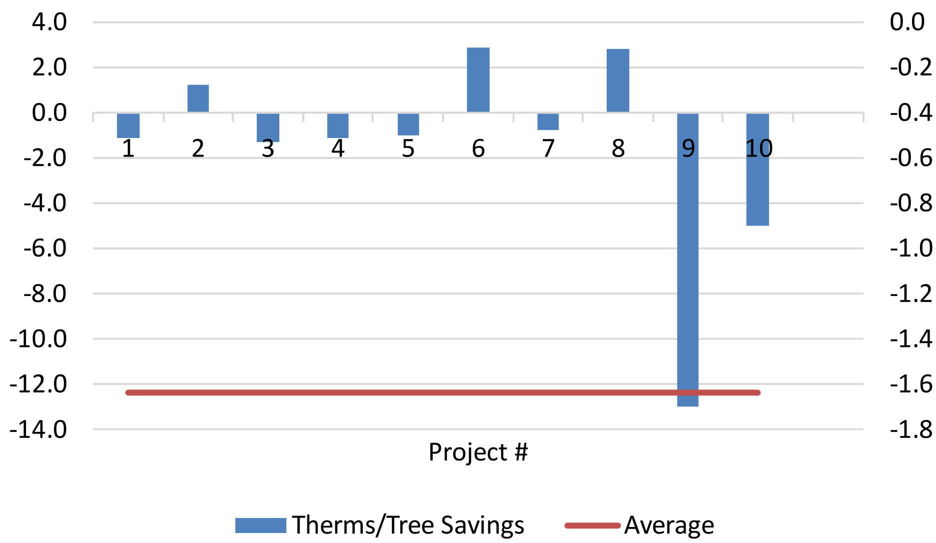


Figure A-35 shows the impact of orientation on the energy savings along with an average of savings for all trees. The average of annual energy savings for all trees is 62 kWh/yr. per-tree. As evident from this chart, West orientation is the best for planting shade trees, followed by south and Southwest orientations. North orientation is the least desired, among the simulated sample of trees.

Figure A-35 CP i-Tree Design Per Tree Energy Savings by Orientation

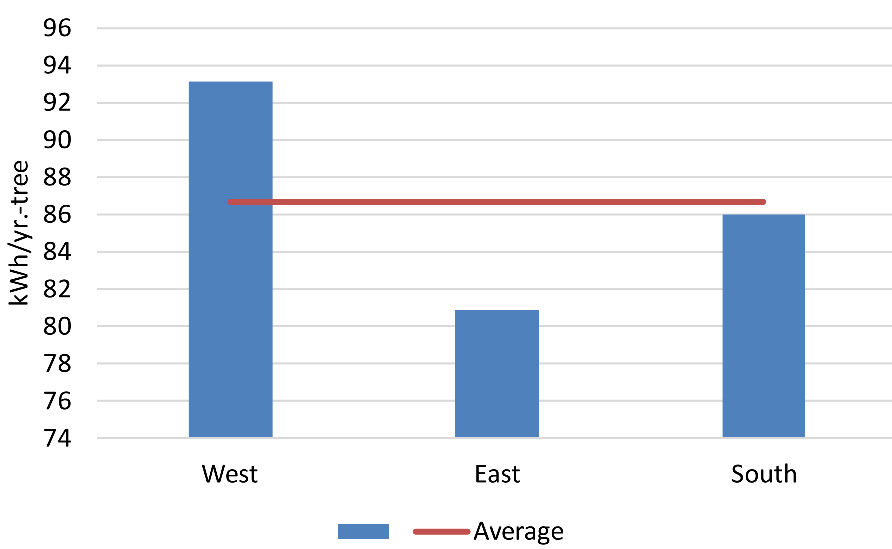
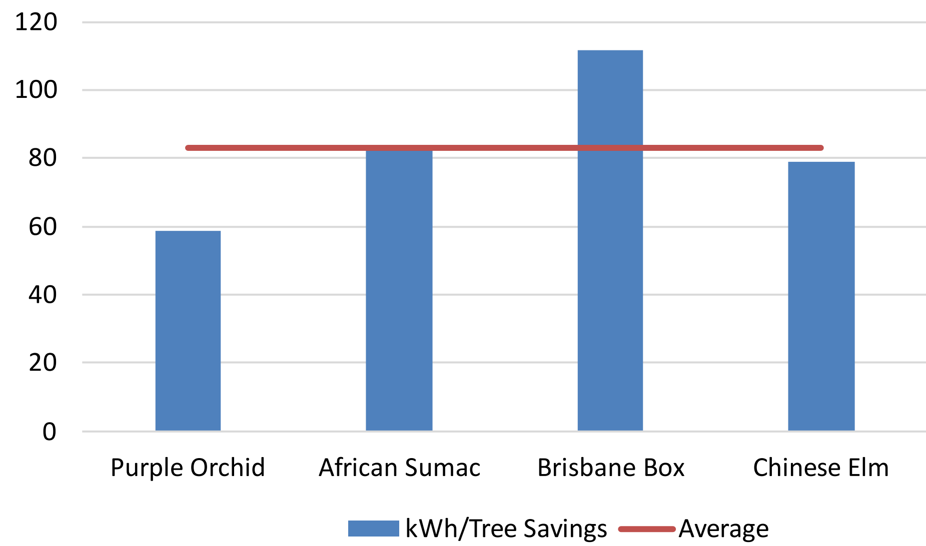


Figure A-36 shows the impact of different tree species on the energy savings. The average of annual energy savings for all trees is 65 kWh/yr., per tree.

Figure A-36 CP 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 to accommodate “leaves on” and “leaves off” schedules during different seasons (i.e., Leaf-on: April, Leaf-off: October), similar to that 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 Table A-169 above. In the current eQuest model, the parameters belonging to 1950-1980 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-174 shows eQuest results on per-tree energy savings by orientation, under the two different weather zones.

Table A-174 CP - eQuest Results on Per Tree Energy Savings (kWh/yr.-tree) by Orientation Under Two Weather Zones

Weather/ Orientation	South	East	West	North	Average
South Coast	48.3	38.7	65.0	14.3	50.7
South Valleys	40.8	79.7	120.0	36.9	80.2
Average	**44.5**	**59.2**	**92.5**	**25.6**	**55.5**

A.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.[26] conducted a 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[27]).

Akbari et al[28]. monitored peak-power and cooling-energy savings from shade trees in two houses in Sacramento, California. The collected data included air-conditioning electricity use, indoor and outdoor dry-bulb temperature and humidity, roof, and ceiling surface temperatures, inside and outside wall temperatures, insulation, and wind speed and direction. The shading and microclimate effects of the trees at the two monitored houses yielded seasonal cooling energy savings of 30%, corresponding to average savings of 3.6 and 4.8 kWh/day. Peak demand savings for the same houses were 0.6 and 0.8 kW (about 27% savings in one house and 42% in the other).

Taha et al[29]. 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

26 https://www.tandfonline.com/doi/abs/10.3846/13923730.2015.1111934

27 https://www.researchgate.net/publication/280755913_Technical_Advances_in_the_EU_Cool_Roof_Project

28 https://www.osti.gov/servlets/purl/860475

29 https://www.osti.gov/servlets/purl/860475

smaller than the direct effects of shading, and, moreover, required that the entire city be planted.

Yekang Ko et al[30]. 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)[31] 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-175.

Table A-175 CP - Secondary Research Results on Per Tree Energy Savings (kWh/yr.-tree) by Orientation under Two Weather Zones

Weather/ Orientation	South	East	West	North	Average	Climate Only
South Coast	18.0	15.0	23.0	-	18.7	16
South Valleys	32.0	36.0	60.0	-	42.7	25
Average	**25.0**	**25.5**	**41.5**	**-**	**30.7**	**20.5**

A.18.2.2.4 Comparisons of Energy Savings Results

Table A-176 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.

30 https://www.sciencedirect.com/science/article/abs/pii/S0169204615001553

31 https://www.sciencedirect.com/science/article/abs/pii/S1618866704700254

Table A-176 CP - Comparisons of Energy Savings due to Shade Trees by Source

Source/ Orientation	South	East (kWh/yr.-tree)	West (kWh/yr.-tree)	North	Average (Shade Only) (kWh/yr.-tree)	Climate Only (kWh/yr.-tree)
EcoLayers	Not Calculated	Not Calculated	Not Calculated	Not Calculated	41.5	14.94
i-Tree Design	86.0	80.87	93.1	N/A	86.6	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)	**51.8**	**55.2**	**75.7**	**25.6**	**57.6**	**20.5**

** EcoLayers' results include 10% reduction based on street tree mortality rates found in Fall 2018 sampling*

A.18.3 Process Evaluation

The following sections detail the process evaluation performed for the CP Program.

A.18.3.1 Process Evaluation Approach and Methodology

For FY 22/23, the Evaluator performed a summary process evaluation of the CP 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
- Barriers and opportunities going forward
- Other topics as relevant

The Evaluator performed a full process evaluation of the CP Program in FY 21/22. The key findings from the FY 21/22 process evaluation were as follows:

- **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 personal benefits of shade trees, such as shade and the availability of fruit, is a more influential argument 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.**

The recommendations made in the FY 21/22 process evaluation were as follows:

- **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 personal benefits of shade trees, such as shade and the availability of fruit, is a more influential argument 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 Process Evaluation Findings

The City Plants (CP) Program design and operations in FY 22/23 were largely consistent with the FY 21/22 program. The following sections discuss program developments and changes.

A.18.3.2.1 Staffing and Partnerships

No program staffing changes were made at LADWP during FY 22/23. The LADWP program manager reported that there were some staff changes at City Plants, the non-profit that provides overall oversight and delivery of the program, among interns and part-time employees. Moreover, the City Plants executive director left at the start of FY 23/24 (July) and had not been replaced at the time of the interview (August 2023). The program is continuing to provide trees to LADWP customers, but operations may become more difficult as time progresses if the executive director position is not filled.

A couple of additions to the partner group during the fiscal year. One group that works with the LADWP Community Partnership Grants program began hosting tree adoptions and has now fully joined as a Planting Partner. The group provides services in South Los Angeles. This group can now offer adoption events without program support.

Another group, which oversees and coordinates community gardens in the city. This group provides tree adoptions and also hosts workshops for the program.

A.18.3.2.2 Program Design

No significant changes were made to the program design during FY 22/23.

The program continued its enhanced services pilot (discussed in the FY 21/22 report) that provides additional assistance with tree selection, location, and planting to would-be adopters. The service is offered to customers that fall into equity zone areas identified by the Urban Forest Equity Collective. The program hopes to offer this service more frequently in the near future.

Additionally, the program also continued its Tree Ambassador initiative with its second cohort of ambassadors. This initiative works with community members who get paid to speak with members of their communities about the program and the benefits of trees. The community members that participate are trained through the process and a cohort has included 10 to 12 individuals who can speak with the members of their community and primarily work in low canopy areas of the city.

A.18.3.2.3 Previous Evaluation Recommendations

Table A-177 Previous CP Recommendations and Program Response

Summary of Past Recommendations	Program Response
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,	The program manager noted that improving the tracking system comes at the trade-off of doing something else and seemed uncertain that additional improvements would be worth the benefit achieved. He also noted that EM&V as well as their own internal quality control processes (site inspections

Summary of Past Recommendations	Program Response
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.	and customer feedback), and academic partners that have provided research and feedback on the program, help maintain the quality of the program.
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.	Staff has not acted on this recommendation.
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 continues to be marketed on the City Plants website (https://www.cityplants.org). .
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.	While this specific recommendation has not been implemented, the program is continuing to improve education of tree adopters through enhanced services and workshops that the new planting partner will offer.
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.	The program manager noted that they continue to try to improve communications such as by providing status update emails on when trees will be received.
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	The cap remains in place.

Summary of Past Recommendations	Program Response
customers stated they would not plant more trees if the cap was increased.	

A.18.3.2.4 Commonwealth Nursery Partnership

The program manager noted that they are continuing to grow their partnership with Commonwealth Nursery, located in Griffith Park, to grow trees for the program. This collaboration aims to cultivate trees specifically for the program, focusing on those native to the region or those that offer enhanced biodiversity benefits. The objective is to diversify the selection of tree sizes, thereby accommodating a broader spectrum of spaces.

A.19 Program Outreach & Community Partnerships

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. The program was initially funded using formula-based Energy Efficiency and Conservation Block Grant (ARRA) funding from U.S. Department of Energy. It was considered successful and was extended using rate-payer funding. The program has completed nine major rounds of funding and three sub-rounds of awards including 251 grants totaling more than $14 million. At the time of this evaluation, the program was in Phase 1 of its 2023 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[32] 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

For FY 22/23, the Evaluator performed a summary process evaluation of POCP. This included an in-depth interview with LADWP program staff to understand and explore the following:

- How program interventions drive customer participation in resource programs?
- What metrics are in place to measure program effectiveness and systems to inform program progress against those metrics?
- What additional data sources should be tracked to evaluate this program moving forward?

[32] LADWP partners with the Southern California Gas Company to deliver natural gas efficiency programs.

- How are non-profit organizations using the grants and what has been most effective?
- What segments of customers are effectively engaged through the program and which ones are not?

The Evaluators performed a full process evaluation of PCOP in FY 20/21. Key findings from that evaluation included:

- Services grantees' organizations provide have broad benefits for the region including creating a more resilient future for all communities, reducing electricity and water usage, and supporting the LA100 initiative optimizing the efficiency of how customers use electricity.
- Grantees had very good experiences with the overall grant process. They described good working relationships with LADWP based on flexibility, reasonable reporting requirements, clear rules, trust, and helpfulness of the peer facilitator (grantee funded to assist the other grantees).
- Grantees were very satisfied with the program and LADWP.
- Grantees employed outreach strategies to overcome known barriers such as customers' limited access to technology, cultural relevance, and trust, and limited English-speaking communication skills.
- The equity metrics audit included findings related to the program's definition of hard-to-reach customers, process for ensuring the program serves those customers, and suggestions for overcoming barriers to collecting customer information that could inform progress toward equity goals.

A.19.2 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-178 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-178).

Table A-178 POCP – Program Theory Logic Model and Metrics

Outcomes	Activities	Outputs	Metric(s)
Increase customer engagement with LADWP programs	▪ Grantees facilitate customer engagement with LADWP programs	▪ Number of grantees that provide support to customers in applying for LADWP programs ▪ Number of customers who like, share, repost, or comment on grantee outreach through online media platforms ▪ Number of customers who participate in outreach events (i.e., received a flyer or came to a workshop)	▪ Percentage of grantees that provide LADWP program application support ▪ Rate at which grantees met their set targets for customer engagement outlined in their Memorandums of Understanding
Increase customer awareness about LADWP programs	▪ Grantees conduct outreach activities to their client base to raise awareness about LADWP programs	▪ Number of social media posts ▪ Number of blog posts ▪ Number of webpage posts ▪ Number of flyer distributions ▪ Number of newsletters distributed ▪ Number of press releases ▪ Number of mass mailings / emails ▪ Number of presentations	▪ Rate at which grantees met their set targets for customer outreach outlined in their Memorandums of Understanding
Barriers to measurement	These activities, outputs, and metrics are well embedded into the current program design. However, the Evaluator recognizes that the best metrics for increasing customer engagement and awareness are rates of actual engagement and rates of actual change in awareness. These two metrics can be difficult to assess given grantees' limited ability to gather quality information about individual customers. The outcomes of increased customer engagement with and awareness of LADWP programs may be better framed as metrics that help measure progress toward a broader outcome – Increased reach to HTR customer groups.		
Potential measurement solutions	Consider developing proxy measures for customer engagement with and awareness of LADWP programs. Refer to recommendations in the Recommendations section (A.19.4).		

Outcomes	Activities	Outputs	Metric(s)
	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	▪ 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	▪ Rates of grantee satisfaction ▪ Rate of grantee knowledge/skill attainment

Outcomes	Activities	Outputs	Metric(s)
	utility bills, and awareness of LADWP program offerings	▪ Feedback from grantees about their pre-participation knowledge and experience with energy and water conservation Feedback from grantees about their post-participation knowledge gain and skill development	
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.19.3 Results and Findings

The following sections include a summary of findings informed by the LADWP program staff interview conducted in July 2023.

A.19.3.1 Process Evaluation Findings

A.19.3.1.1 Program Design and Delivery

LADWP staff note that POCP's program design and delivery is largely the same as the previous two fiscal years (i.e., FY 20/21 and FY 21/22). Program goals are unchanged, and the focus remains on customer engagement and behavior change, by educating customers. Grant offerings vary each round, and target needs outside of efficiency, such as water quality, solar, and electric vehicles. In a recent round they emphasized hiring community members to help with enrollments and financial assistance programs.

The program strives to measure success in the following ways:

- **Energy and water saving estimates**. In the impact form included in final reports, each grantee documents the extent to which they were able to achieve predicted savings based on activities undertaken, the level of reach and engagement. The program does not require strict savings quotas from grantees. This flexibility is intended to foster diversity in the grantee pool and project types. Results from all grantees are compiled and summarized to determine the overall impact of each round.
- **Community engagement and behavior change.** Staff target non-profits that are engaging the community in some way or that have shown they are already changing behavior on other fronts. The program will keep working with the cross section of non-profits, hard-to-reach communities, and customers to have a healthy level of engagement and behavior change.

Program staff also note that internal operations are going well. They got through the pandemic and are back to normal in terms of grantees being able to execute projects and engage in more in-person activities. In fact, the program has increased grant funding available each cycle. One remaining effect from the pandemic is a substantial turnover in staff within non-profits which can affect progress rates on projects.

A.19.3.1.2 Barriers and Opportunities

Program staff highlighted the following barriers:

- **Need for additional staff.** The POCP is currently run by two staff members and has been unable to fill a third open position for the past three years. The staff feel they could provide a much better service to grantees if they had one to two additional team members. Additional help would allow for more thorough review of grantee final reports to absorb lessons learned - for this and other programs - and closer examination of reported metrics. An additional staff person would also enable them to monitor grantees better and provide assistance during instances of staff turnover, helping to bring new people up to speed on the projects, and avoiding delays and extensions. Finally, additional staff would allow them to further develop their mailing list of non-profits to bring in a wider pool of applicants.

- **Need to attract enough quality applications.** This has been a challenge since round one of the program. While the program awards projects competitively, it also strives to distribute awards in each of the council districts, target hard to reach communities, and address other specific focus project categories. A larger group of qualified applicants would enable them to pay more attention to these secondary target areas.
- **Staff turnover in the non-profit community.** Non-profits continue to see frequent staff turnover which can affect progress on grant-funded projects, hinder grantee's ability to meet project deadlines, and necessitate filing for extensions. This in turn creates additional work for program staff.

Program staff see additional opportunities in the following areas:

- **Save staff time through electronic payments.** Currently, grant checks are sent by mail taking up scarce staff time. This sometimes leads to the time-consuming task of tracking down missing checks. Shifting to electronic payments will reduce staff time needed for this and eliminate the search for missing checks.
- **Enable online applications.** Allowing grant applicants to file their applications online would make it easier for some. Staff suggest maintaining the current option (email submission of PDFs of documents) as well as well as the option to apply online.

A.19.3.2 Previous Recommendations

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

Table A-179 Previous POCP Recommendations and Program Response

Summary of Past Recommendations	Program Response
Consider incorporating more in-depth customized guidance to grantees looking for effective and sustainable strategies for data collection and impacts measurement.	Program staff are discussing ways they might do this. They have made refinements to the final report and impact form and have worked to clarify what is expected in progress reports, milestones, and grant installment requests. They are making ongoing improvements as opportunities come up.
Optimize grantees' time during interactions with LADWP (marketing approval process, process for getting status updates on applications to other programs, time they or their customers spend navigating the LADWP website).	Staff offer preliminary guidance on documents for which grantees want marketing approval to speed up the review process. Staff warns grantees about the timeframe needed for approvals. Marketing staff have also supplied marketing documents proactively in anticipation of grantee needs.
Consider creating a new proxy measure for the program's impact on customer engagement in other LADWP program (e.g., cross-program	No changes at this time.

Summary of Past Recommendations	Program Response
participant questionnaire regarding their recollection of POCP efforts, or systematically capture how participants learned about programs when they start).	
Consider building on this approach to create proxy measures for the program's impact on customer awareness of other LADWP programs.	No changes at this time.
Consider optimizing market engagement with the Marketing, Education and Outreach program and program marketing and outreach strategies based on insights from grantees.	No changes at this time.
Select the most relevant CalEnviroScreen indicators when leveraging CalEnviroScreen indicator scores to determine geographic areas where DACs are located.	This program does not follow CalEnviroScreen.
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.).	Grantees tend to be very equity oriented and know their communities.
Consider incorporating the newly proposed administrative metric to demonstrate how well the program delivers services equitably.	No changes at this time.
Upon availability of individual customer data from grantees, consider implementation-based equity metrics to demonstrate how well the program delivers services equitably.	The program does not get individual customer data from grantees.

A.19.4 Recommendations

Address staffing resource issues. The Evaluators recommend that LADWP explore options to hire additional PCOP staff or make resources available to current staff to enable them to provide deeper services to grant applicants and better utilize program data to improve the program over time.

A.20 Codes, Standards & Ordinances Program

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

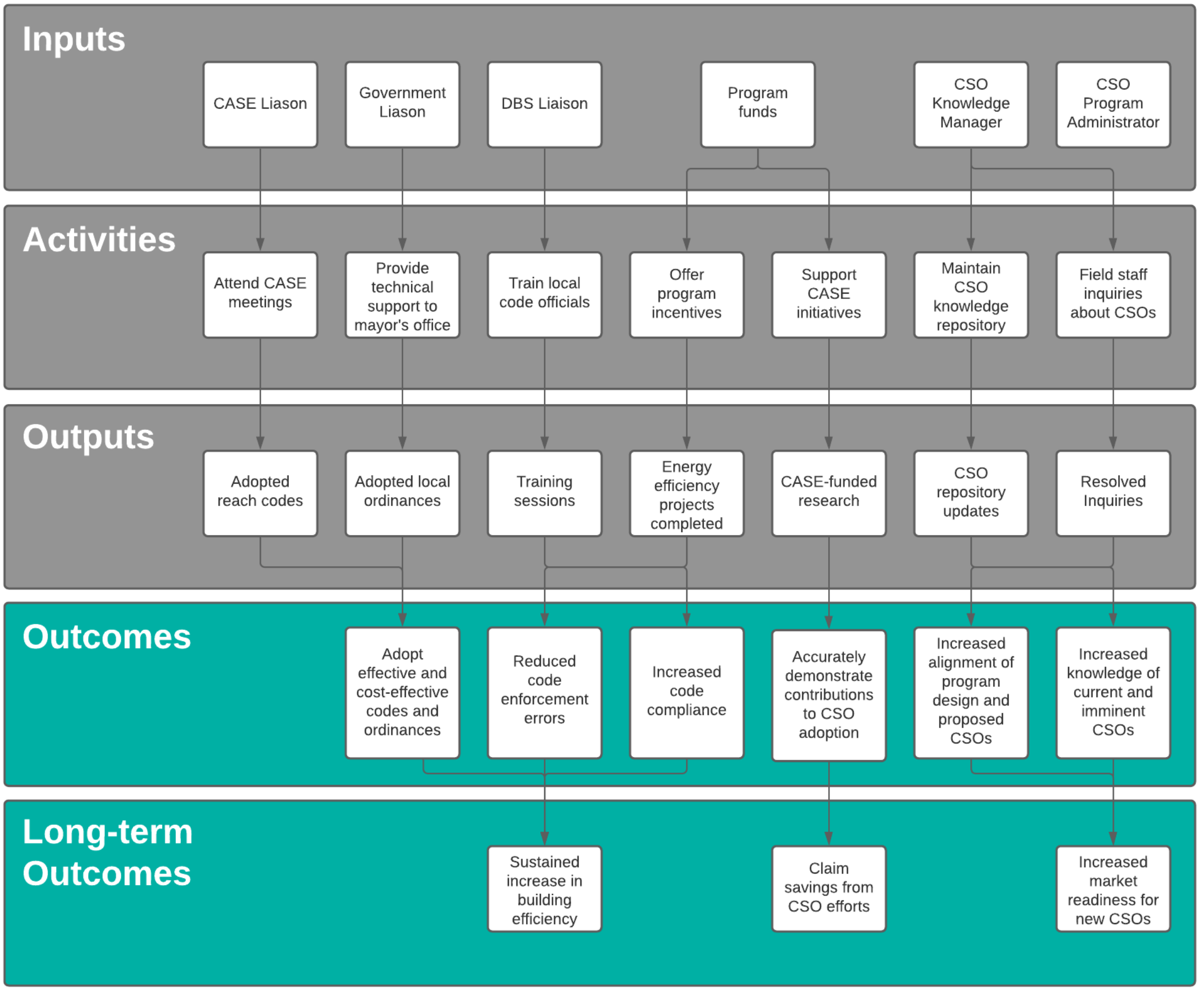
For FY 22/23, the Evaluator performed a summary process evaluation of the CSO program. This included an in-depth interview with LADWP program staff to understand and explore the following:

- 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 Evaluator performed a full process evaluation of the CSO program in FY 20/21, and a summary process evaluation in FY 21/22.

A primary work product of the FY 20/21 process evaluation was to develop a logic model for the program. Figure A-37 presents the logic model.

Figure A-37 CSO Base Program Logic Model



Other key findings of the full process evaluation were:

- **Interviews with resource program staff identified an opportunity for the CSO program to lead staff training and to participate more directly in program design and redesign conversations.** Training would ideally occur twice per year. Some program staff said that training would help program staff prepare for the impacts of new codes and standards on their program processes and the savings they can claim.
- **CSO program staff have unique visibility into proposed codes and standards.** By participating in program design and redesign, CSO program staff could identify ideas for new programs or changes to existing programs that could help prepare the market for proposed code changes.
- **Staff interviews identified an opportunity for the CSO program to track and monitor some of its outputs.** Tracking CSO program outputs would provide useful information to the CASE program about the CSO-related activities being conducted by LADWP, which could help with attributing and allocating C&S savings to

LADWP's activities and could be useful for other utilities. Tracking these outputs could also help the CSO program to improve over time, as this documentation will increase the evaluability of the program, leading to additional insights about program improvements.

Key findings of the FY 21/22 summary process evaluation were:

- **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.**
- **Program staff highlighted that they were focusing on the development of customer guidance documents on code and standard design information to inform implementation and developing a stronger link between CSO and resource program measure offers that are ready to become a code, standard, or ordinance.**

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 noted that there were no major changes in the program's objectives and approach from previous years. They did say that they are trying to be more proactive in their codes, standards, and ordinances work. One way they are doing this is by monitoring the proposed 2025 code measures to identify expected changes and anticipate what impacts they will have on the program.

Staffing is an ongoing challenge for the program. Although the program added two new people in the past year, both were still splitting time between CSO, Program Development, and compliance with DWP's facilities ordinance. CSO staff noted the program remained understaffed, and existing staff get regularly diverted from their CSO tasks when other people in the company have questions. Further, because of being short-staffed, it is difficult to delve very deeply into changes in codes and benefits to the city.

Staff suggested that in addition to increasing their overall staff, it would be beneficial if there were a single person allocated fully to CSO, to avoid getting pulled into assisting other departments. Having a dedicated resource would help them make more progress on goals.

One option they use to supplant staffing is to leverage electrical engineering staff who can be involved part-time for electric-specific items. Still, staff note that CSO would benefit from having more access to subject matter experts (SME) when needed, either within the utility or from outside. They are hopeful that their restructuring and placement within the Power Systems department will give them more access to SMEs so they can better evaluate proposed code changes and how they will affect the city.

When asked about future goals, CSO staff noted wanting to be more engaged with industry contacts. For example, they have an MOU with the International Association of Plumbing and Mechanical Officials (IAPMO), the code-writing body for plumbing and mechanical code that is adopted in California. The IAPMO helps the department run their plumbing demonstration lab and supports their emerging tech research. Staff also expect to do more pilot projects with them geared toward water conservation.

A.20.2.2 Current Focus Area

Program staff highlighted the following focus areas currently being explored:

- Looking beyond efficiency. Staff feel their new department, Power Systems, is more receptive to their ideas on things like demand response and smart metering. They note that is where the state is focusing their attention, with load flexibility, battery storage and photovoltaics being used together.
- Developing customer guidance information. Program staff have compiled documents on measures such as electrification to help customers navigate installation challenges and barriers. They described gathering “a lot of information” to help customers avoid pitfalls including things like permitting and feasibility of placement. In addition to including this information in marketing materials, they are exploring options to publish the information more broadly.
- Upgrading buildings to meet LADWP facilities standard. LADWP developed a performance standard for utility-owned facilities that mandates design teams to have minimum efficiency that is higher than what code requires. Staff note that insuring compliance with this voluntary standard is a good use of staff time and shows that the utility “walks the talk.”
- Assisting staff regarding local all-electric buildings ordinance. With the adoption of the local All-Electric Buildings Ordinance No. 187714 (requiring new buildings and residences be all electric), CSO staff are dedicating resources to ensure they understand the requirements. They will then distribute the information to the program managers for future program planning, recognizing that these kinds of ordinances are established with the expectation that DWP will have some incentives available to offset any financial burden. Correspondingly, DWP is planning to launch a large set of offerings for building electrification, especially for commercial, in January 2024 as a way to support the local ordinance.

A.20.2.3 Previous Evaluation Recommendations

Table A-180 below includes a summary of previous recommendations and the program’s response to date.

Table A-180 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 staff produced several trainings over the past year and plan to continue doing this going forward.
Develop and maintain additional program documentation, detailing CSO program processes and program roles	Staff created a tracking program resembling a large spreadsheet that is used to track meetings, where they were, what was done, and identifying activities

Summary of Past Recommendations	Program Response
	that take time away from CSO efforts. These competing priorities include codes meetings, activities, and trainings.
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

- **Because CSO expertise is in regular demand within LADWP, and existing staff are having challenges finding time to devote to program objectives, adding personnel to the CSO program could enable more effective work on objectives, while also making personnel with codes expertise available to other departments who need it.** Designating whether staff act as a liaison to other departments or as a staff member dedicated exclusively to program objectives and activities would be beneficial.

A.21 Emerging Technology Program

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 FY 22/23, 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 FY 20/21 and a summary process evaluation in FY 21/22. The key findings form the full process evaluation were:

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

Key findings from the FY 21/22 summary process evaluation were as follows:

- Staff continued to test and refine the project intake and evaluation workflow process developed with NREL.
- The program continued partnering with Los Angeles Clean Tech Incubator (LACI) to identify areas for collaboration.
- The program identified primary focus areas including decarbonization, equity and extreme heat, flexible loads, and addressing data access for developers.

A.21.2 Results and Findings

The following sections include a summary of findings informed by the LADWP program staff interview conducted in August 2023.

A.21.2.1 Program Operations and Approach

Program staff report that since the last program year, they have continued to develop and refine their project intake and evaluation workflow process that was originally developed with NREL. They are looking to leverage NREL's process and break it out into something even wider and more expansive with the hope of considering more technology, being able to evaluate it more flexibly, and having more staff and other resources. Staff note that they are still building the system, but they have come a long way and are excited about it. They have implemented two technologies in the current process, but none to the pilot stage yet.

Staff state that the objectives of ETP continue to be conducting inquiries on technologies and pilots. Their focus, however, is shifting, giving greater importance to addressing greenhouse gas emissions, with heightened conversation on end use electrification and whole building electrification.

Also, it is worth noting that the Emerging Technology Program moved to the Power group. As such, the program efforts have become more aligned with power generation.

Some other areas of increasing attention include use of low GWP refrigerants in space and water heating applications, and use of hydrogen blended with natural gas for generation. To this end, DWP has contracted with Mitsubishi, in a collaborative effort involving several other municipal utilities, to study the use of blended natural gas and green hydrogen to re-power an old formerly coal-fired power plant. The green hydrogen will be produced from renewable generation-powered electrolysis using systems that would otherwise be curtailed.

The program named a new lead in June 2022, and has since had greater interaction with the Los Angeles Clean Tech Incubator (LACI), and Emerging Technologies Coordinating Council (ETCC). They also interact with the Rocket Fund out of CalTech. The fund picks worthy technologies and helps them build a prototype and connects them with venture capitalists.

A.21.2.2 Current Focus Areas

Program staff highlighted some focus areas currently being explored:

- **Decarbonization of space and water heating.** Decarbonization continues to be a priority area for the program. They see continued strong focus on electrification for space and water heating paired with greater use of low global warming potential refrigerants.
- **Decarbonization of fossil fuel generation.** They are exploring several technical issues with blending green hydrogen (H) with natural gas at existing fossil-fueled generation plants. These include H generation using renewable generation and electrolysis during times when generation would normally be curtailed, H long-term storage in modified nearby salt deposits, and improving knowledge regarding use of increasing blends of H in rotating generation equipment.
- **Transportation.** They are exploring battery technologies and electrochemistry as well as fuel cells, greater EV penetration through EVSE equipment chargers and charger maintenance programs.
- **Program staff note that at this time, no formal program metrics have been established to measure the program's progress.** Once they have completed the full cycle of their project intake and evaluation workflow process, they will be in a better position to explore performance metrics.

A.21.2.3 Barriers and Opportunities

Staff identified the following barriers:

- **Challenges related to a new program process.** The program has two technologies currently going through the program cycle but they have not yet reached pilot stage with a technology. Several steps of program development such as process refinement and development of performance metrics will proceed more easily once they have experience with the full process.
- **Restrictions on data and information gathering.** Staff point out that getting access to certain information such as interval data is not easy. The company is discussing deployment of smart meters which would be extremely helpful to innovators working on efficiency technologies.
- **Limited resources.** The program staff noted that they could accomplish much more in a more-timely manner with additional staff or resources.

Staff identified the following opportunities:

- **Contracting with laboratories.** Staff noted that they were drafting an RFP to get additional contract testing help from laboratories. This additional help could ease some of the pressure on their time and resources.
- **Expanding program visibility.** As the program becomes better known in the technology development community, more people are coming to it with ideas, and interactions with partner organizations grow increasingly productive.
- **Improving process.** Their processes become more efficient and effective as they gain experience with their new technology screening and review process and modify their processes based on that experience. Seeing technologies through the pilot stage will create more opportunities to improve the process. They note that the flow chart of this process is a very important tool they use so that they do not have to start from scratch each time a new technology is started.

A.21.2.4 Previous Evaluation Recommendations

Table A-181 below includes a summary of previous recommendations and the program's response to date.

Table A-181 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. Processes are still in progress to be completed. They need to finish the process and then establish the goals.
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. Current partnering organizations curate startups that are tailored to fit with the ET ideals.

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. They are seeing improved quality. They do not do RFPs.
Create regimented time periods for key program processes, specifically idea solicitation and selection	They have put some thought into this idea but are still considering options.

A.21.3 Recommendations

The Evaluator does not have any recommendations for ETP at this time.

A.22 Marketing, Education and Outreach

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.

This program is offered in addition to other LADWP programs and program-specific efforts. Each energy efficiency program conducts outreach to customers. LADWP also conducts outreach to historically underserved communities with 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

For FY 22/23, the Evaluator performed a summary process evaluation of MEO. This included an in-depth interview with LADWP program staff to understand and explore the following:

- Program changes to design, delivery, or focus
- 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 MEO in FY 20/21. Key findings from that evaluation included:

- Marketing efforts are largely distributed outside of the Efficiency Solutions portfolio. There did not appear to be a consolidated effort across the portfolio to streamline or consolidate marketing to customers or to leverage participants in one program when marketing to other programs.
- MEO did not provide coordination or crossover support between programs.

- The current structure appeared to enable participation in the Efficiency Solutions portfolio.
- The current program activities are not cohesive enough for the Evaluator to recommend specific metrics to be tracked.
- The customer pathway included challenges at the Program Awareness, Program Entry/Application, and Rebate/Program Closeout stages.

A.22.2 Results and Findings

The following sections include a summary of findings informed by the LADWP program staff interview conducted in August 2023.

A.22.2.1 Program Design and Delivery

This section describes activities separately for marketing, education, and outreach.

A.22.2.1.1 Marketing

LADWP staff note that the marketing efforts within MEO live within each program but feel they are doing much better with joint opportunities and sharing information across programs. Although marketing needs are identified within individual efficiency programs, MEO staff share developed products with all supervisors to see if others can use them. Some marketing efforts, such as those including email blasts and social media, involve working with the communications group outside LADWP.

A.22.2.1.2 Education

Educational activities are accomplished on several fronts including through a partnership with Los Angeles Unified School District (LAUSD) and the Program Outreach and Community Partnership (POCP) program. Through the LAUSD partnership, MEO reaches out to students and their families regarding program offerings and topics relating to energy and water conservation. Through the POCP grant program, grantees usually include educational components as part of their funded activities often aimed at disadvantaged communities or hard to reach populations. In addition, MEO also participates in the L.A. Better Buildings Challenge and produces webinars and other educational content to support commercial efficiency programs (e.g., informing participants what to expect from programs in terms of requirements and timing). Finally, MEO staff provide educational pieces to customers in partnership with the key accounts section.

A.22.2.1.3 Outreach

Outreach channels include partnership with initiatives like the LA Better Buildings Challenge for commercial customers and Gateway to Green for multi-family rental property owners. Both organizations promote LADWP efficiency programs to customers. The POCP program also funds grantees who reach a very diverse audience including hard to reach customers by various means.

MEO staff described renewed emphasis on equity following the LA100 study publication. LADWP launched an equity strategy study (LA100 Equity Strategies) to explore options for improving equity in the transition to 100 percent renewable energy. On the commercial side MEO works with contractors who use efficiency program incentives as part of their business model to do outreach with their customers.

MEO does not measure program progress toward goal. Goals are generally set and tracked at a program level for efficiency programs. Further, while they feel the program is effective, they do not necessarily have the data to measure that effectiveness. As an example, they believe that their outreach and marketing strategies are reaching the targeted groups but add that they really do not get the data to identify if there are gaps or if some customers are getting too frequent communications or the wrong medium.

MEO staff noted that they do not have enough staff to perform their duties the way they would like. They point out that everyone needs to divide up their tasks and do the best they can with the resources available.

A.22.2.2 Barriers and Opportunities

Program staff highlighted the following barriers:

- **Insufficient access to customer or market data**. MEO staff say they would benefit from more robust customer or market data so they can better understand the potential participant pool for each program and the history of program contact with them. This would help programs find gaps, avoid contacting customers too many times, choose media consistent with customer preferences, and better estimate what participation potential exists.
- **Inadequate tracking data.** Staff suggest that getting better feedback on results from current or past MEO actions would be helpful in improving the effectiveness of their efforts. Without this feedback, they do not know what adjustments would be best to help close gaps and maximize participation in the various efficiency programs. Paired with customer and market data, the tracking data would enable them to develop metrics to measure progress against goals for MEO and other programs.
- **Understaffing.** Not having enough staff forces existing staff to triage their tasks which can cause some potentially beneficial tasks, like reviewing data to inform program or process improvements, to be postponed. They just do their best with the resources they have. They are limited to putting things out and hoping people respond and ultimately participate. A key benefit of adding staff would be the ability to develop and analyze data enabling them to start making better business decisions on where to focus their efforts. They think this could both improve customer satisfaction and participation.

Program staff see additional opportunities in the following areas:

- **Coordinate and promote cross-program participation.** Institutionalizing cross-program promotion so that recent participants in an efficiency program are routinely referred to other relevant programs that would benefit them would improve participation rates and provide greater benefits to customers. Currently there are points where this happens, but it is more haphazard and could be done much more consistently.

- **Continue to prioritize equity and focus on disadvantaged communities**. Program staff note that most of their orientation is around equity and serving state-defined disadvantaged communities first. In residential this means focusing on low income lifeline discount customers and in commercial on small business. These groups are put first in any marketing or outreach effort they have.
- **Better coordinate efforts of Central Communications Office and MEO.** Staff suggested that there may be opportunities to improve efficiency of efforts by enhancing communication and coordination between staff at the Central Communications Office and MEO. This could help them avoid both gaps in coverage and areas of oversaturation and could also reduce duplication of effort.

A.22.2.3 Previous Evaluation Recommendations

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

Table A-182 Previous MEO 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.22.3 Recommendations

- **Expand MEO staff access to market, customer, and tracking data.** This will enable them to enhance the effectiveness of their actions and make more informed, data-driven decisions.
- **Continue to seek ways to coordinate efforts with the Central Communications Office.** Coordinated communications may reduce duplication of effort, gaps in coverage, and areas of oversaturation.
- **Establish and institutionalize cross-program promotion so that recent participants in efficiency programs are routinely referred to other relevant**

programs that would benefit them. This would improve participation rates and provide greater benefits to customers.

A.23 Program Analysis and Development Program

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[33]. 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.

A.23.1 Process Evaluation Approach and Methodology

For FY 22/23 the Evaluator completed a summary process evaluation of the PADP. An interview in August 2023 with LADWP program staff informed the summary process evaluation.

The Evaluator conducted a Full Process Evaluation of the PADP over the course of FY 20/21 and FY 21/22. A key work product of that effort was the development of a new program development process flow chart. This chart is reproduced below in Section A.23.2. Additionally, at the request of LADWP, the Evaluator identified metrics that would allow LADWP to classify PADP as a Market Support program. The FY 21/22 evaluation report 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.

Based on the evaluation research, the Evaluator had the following findings and recommendations for the PADP.

- **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 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

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

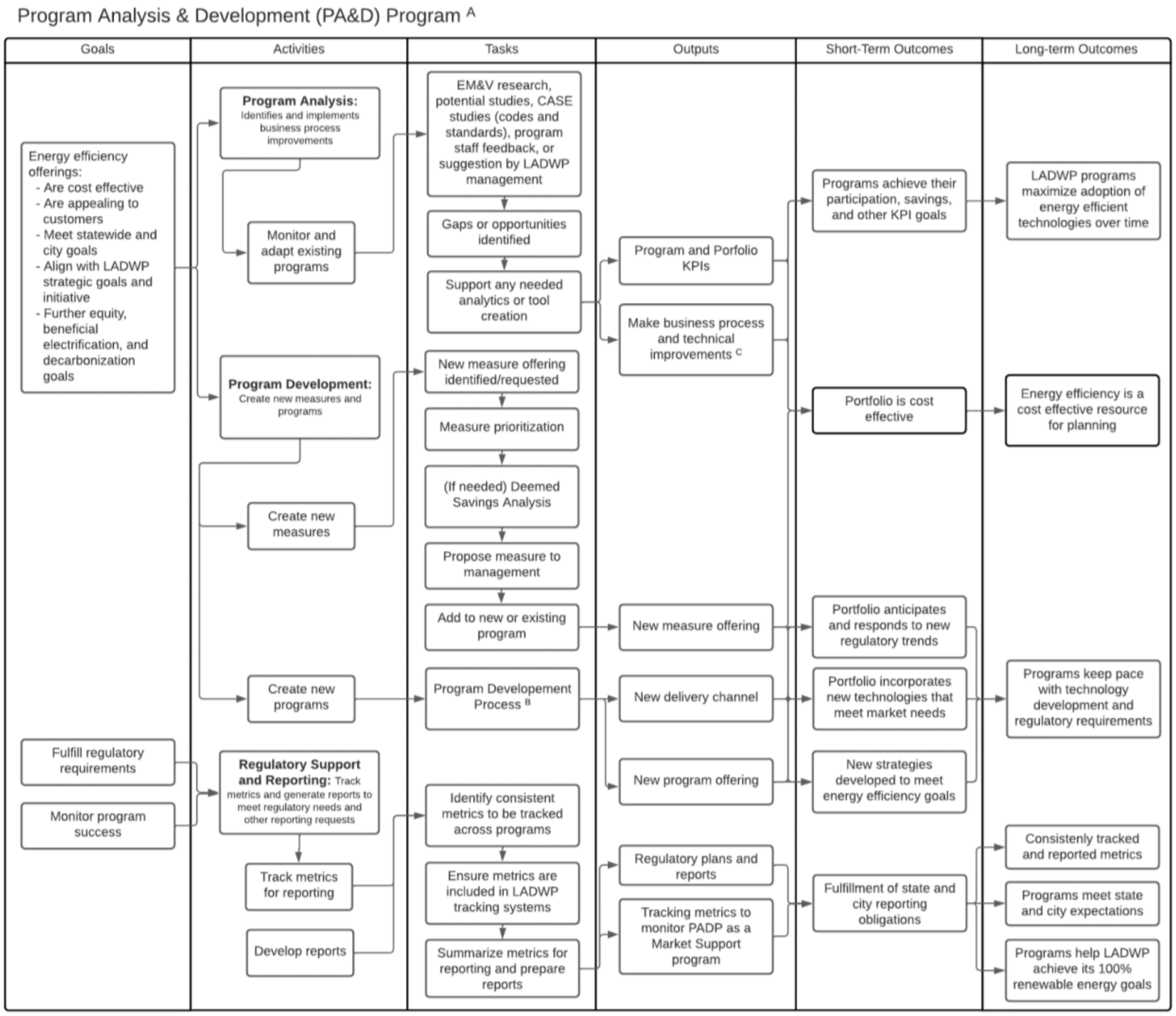
outcomes. This will help PADP remain responsive to LADWP strategic and regulatory objectives in an everchanging environment. This will also ensure that PADP staff have the resources and support to conduct activities that will help them achieve program goals.

- **Establish metrics that track PADP progress towards short and long-term outcomes, such as those recommended in the FY 21/22 evaluation.** 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.

A.23.2 New Program Development Process Flow Chart

Figure A-38 presents the PADP baseline logic model developed as part of the FY 21/22 process evaluation.

Figure A-38 PADP - Baseline Logic Model



[A] The program analysis and development team also manages attendance and contributions to academia, industry working groups, conferences, government agencies, and other industry dialogues and provides support for other internal and external research, compliance, outreach and training efforts, including supporting the Power Systems and Communications groups. These activities are not included in the logic model above, as they are secondary responsibilities of the PA&D program.

[B] Greater deail on the program development process can be found in the Program Development Process Flow Chart.

[C] Technical improvements include savings quantification, cost effectiveness updates, reprioritization of measure marketing and incentive rate updates for maximizing resource acquisition, and new metrics to reflect secondary goals such as equity or air quality improvements

A.23.2.1 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.23.2.2 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.23.2.3 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.23.3 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.23.4 Metrics to Track PADP as a Market Support Program

As part of the 2021 evaluation, LADWP requested that the Evaluator identify metrics that would allow LADWP to classify PADP as a Market Support program. Due to its status as a publicly owned utility (POU), LADWP is not required to adopt the guidelines put forward by the CPUC, which segment energy efficiency portfolios into the areas of resource acquisition, market support, or equity. However, LADWP typically follows this guidance as industry best practice.

On October 6, 2021, the CAEECC-Hosted Market Support Metrics Working Group (MSMWG) put forward guidance on the most important objectives and associated key metrics for utilities to track for the new market support portfolio segment. The MSMWG specified that the metrics should measure the performance of the overall segment, as opposed to individual programs. They also noted that program administrators (PAs) may propose additional or refined sub-objectives and associated metrics if they have a program that they believe fits into the Market Support segment but does not meet one of the existing sub-objectives. PAs are also encouraged, but not required, to have programs that support all five sub-objectives within the Market Support segment.

The Evaluator reviewed this guidance and identified those objectives and metrics most related to PADP. While this provides a snapshot of sub-objectives and metrics that PADP could support, LADWP should also consider whether the sub-objectives of the Market Support segment are met at the portfolio level. This information can be used to assess whether additional programs or adjustments to existing programs are needed to fully meet the Market Support sub-objectives.

Of the five sub-objectives identified by the MSMWG, Innovation and Accessibility and Access to Capital are most closely related to the current activities of the PADP program. These objectives are defined as follows:

- Innovation and Accessibility: Build, enable, and maintain innovation and accessibility in technology, approaches, and services development to increase value of, decrease costs of, increase energy efficiency of, and/or increase scale of and/or access to emerging or existing energy efficient products, and/or services. [Activity e.g., moving beneficial technologies towards greater cost-effectiveness]
- Access to Capital: Build, enable, and maintain greater, broader, and/or more equitable access to capital and program coordination to increase affordability of and investment in energy efficient projects, products, or services. [Activity e.g., access to capital]

The metrics for these two sub-objectives are identified Figure A-39 in below:

Figure A-39 PADP - MSMWG Recommended Metrics for Innovation and Accessibility and Access to Capital Sub-Objectives

Metric Type	Innovation and Accessibility	Access to Capital
Applicable Existing Metrics that will continue to be collected	▪ ETP Common Metrics (selection) ▪ ETP-T1: Prior year: % of new measures added to the portfolio that were previously ETP technologies ▪ ETP-T2: Prior Year: # of new measures added to the portfolio that were previously ETP technologies ▪ ETP-T3: Prior year: % of new codes or standards that were previously ETP technologies ▪ ETP-T4: Prior Year: # of new codes and standards that were previously ETP technologies ▪ ETP-T5: Savings of measures currently in the portfolio that were supported by ETP, added since 2009. Ex-ante with gross and net for all measures, with Ex-Post where available	▪ Participant data ▪ Credit score ▪ Census tract income ▪ CalEnviroScreen Scores of areas served ▪ 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).

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 Figure A-39 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). Figure A-40 below shows the Evaluator’s proposed breakdown of how these metrics could be captured across LADWP’s non-resource programs.

Figure A-40 PADP - Proposed Alignment of LADWP Non-Resource Programs with Innovation and Accessibility Metrics

Metric Type:	PADP	ETP	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	▪ Number of new, validated technologies recommended to CalTF	▪ None	▪ None

Metric Type:	PADP	ETP	CSO	MEO
	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)			
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. Figure A-41 below shows the Evaluator’s proposed breakdown of how these metrics could be captured across LADWP’s non-resource programs.

Figure A-41 PADP - 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.23.5 FY 22/23 Results and Findings

The following sections include a summary of findings informed by an additional LADWP program staff interview, completed in August 2023. This interview explored program design and objectives, performance indicators, current activities and processes, and future activities and processes.

A.23.5.1 Program Operations Findings

The program staff interview provided additional details on program operations including:

- **Collaborative prioritization and planning.** The Program Design and Liaison (PDL) team and the Engineering team work collaboratively to develop a list of activities for the program to focus on, scope them out, and assign responsibility for each. PADP research and support activities help determine what projects, pilots, or studies LADWP should invest in each year.
- **Program efforts supported by external partners.** Staff work with an external engineering service provider that assists with new measure development and emerging technology reviews. They also interact with the California Technical Forum on development of new measures.

PADP staff described the following activities conducted during FY 22/23:

- **Designed process flow.** Staff designed and implemented a process flow for the program, including a tracking system for activities, and a form to help keep track of requests for assistance from program teams. These requests are often about new measures or proposed incentive changes that fall under the Engineering team, but there are also process-related questions that are addressed by PDL. Staff report that while the process flow is still a work-in-progress, it thus far is working well and they have continued to refine it over time.
- **No performance metrics yet.** Staff noted that they had not established performance metrics but as the new process flow matures, they are making progress on establishing a performance baseline. They noted that the portfolio business plan document gave them a roadmap to make improvements and changes to the programs effectively, and that in future evaluations, evaluators could start measuring some performance indicators.
- **Expect to need a variety of metrics.** Staff pointed out that both a strength and a weakness of the program is that it is a group of functions pieced together. To evaluate these functions will require appropriate metrics for each. They offered some ideas on possible metrics such as number of tasks completed, improvements on realization rates for measures over time, and gap analysis for programs compared to estimated potential.

A.23.5.2 Program Barriers and Opportunities

Because this is an internal program, the primary barriers to implementation are balancing support efforts with other efficiency programs, as well as staffing and budget limitations.

An overall goal for PADP is to create a feedback loop with the other programs and use that to make continuous improvements. Staff see opportunities moving forward as they continue to refine program processes, optimize the services they provide to portfolio programs, and continue to support their success.

A.23.5.3 Previous Evaluation Recommendations

Summary of Past Recommendations	Program Response
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.	Program staff are more focused on delivering on the activity itself instead of assessing the activity. They have had no complaints about the process so far and have been delivering needed services when they are requested. They are now keeping better track of requests and actions than we had in the past. They feel now may be an opportune time to think about reassessing whether requests are accomplished in the view of those making the requests.
Establish metrics that track PADP progress towards short and long-term outcomes.	Established a program process that will help establish baselines enabling establishment of metrics. Staff are still working to establish the metrics
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	This has been done. Staff noted it would be good to interview the program management teams to get their view on how this is going.
▪ Clearly defining, delineating, and communicating roles and responsibilities, especially for tasks which involve multiple parties	They think this has been pretty well established when they scope out the projects.
▪ Giving resource program managers a point of contact for questions about new processes	This has been done.
▪ Giving resource program managers a way to provide feedback/suggestions related to new processes, such as regular check in points or internal surveys	Have not done this yet.
▪ 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.	This is well established with the program management teams.

A.23.6 Recommendations

The Evaluator does not have new recommendations for the program at this time.

A.24 Comprehensive Affordable Multifamily Retrofits Program

LADWP rolled out CAMR in July 2022 with no substantive changes since that time. It is run exclusively by LADWP, their contractor the Association for Energy Affordability (AEA), and AEA subcontractor California Housing Partnership, (CHP). The program has eight LADWP people when fully staffed. A previous lead within CAMR is now the supervisor and that lead position remains empty as of June 2023. The program includes another lead and four Utility Service Specialists (USS) with an additional USS position to eventually be filled.

The program runs on a fiscal year (a fiscal year, FY, is July 1 to June 30) basis with goals to save energy, reduce greenhouse gas emissions, and support jobs. In this fiscal year, three properties had onsite audits, but no customers completed an energy efficiency upgrade.

The program targets buildings with a high percent of low income tenants or buildings located in LADWP equity areas, defined as being in a Disadvantaged Communities (DACs).[34] CAMR provides multifamily 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 sixty-five or more units and for measures that reduce tenant-paid energy costs (Table A-183).

Table A-183 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*

[34] LADWP applies CalEnviroScreen V3.0 to determine and assign DAC census tracts.

A.24.1 Process Evaluation Approach and Methodology

This summary process evaluation of FY 22/23 included review of documents and staff interviews. The FY 21/22 process evaluation 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, 2022 program terms and conditions, 2023 Multifamily Solar Fact sheet, and information on the LADWP website.

A.24.1.2 Staff Interviews

Over a half-hour period in June 2023, the evaluation team interviewed three (3) CAMR staff. LADWP evaluation team members were also in attendance.

A.24.1.3 Participant Survey

The Evaluator did not survey participants as this is a relatively new program and there were no customers that completed energy efficiency upgrades as of June 2023.[35]

A.24.1.4 Process Evaluation Findings

As indicated above, the Evaluator's analysis of CAMR focused on speaking with the LADWP project managers about the program.

A.24.1.4.1 CAMR 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 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 achieve more than 5% in electrical energy savings may also be eligible to receive incentives for the installation of solar photovoltaic systems. (See the CAMR Solar Pilot below.)

In addition, AEA and their subcontractors must meet prevailing wage, skilled and trained workforce, and licensing requirements, as applicable.

[35] In this fiscal year, three customers were in the audit phase of the program. However, the program allows three years for projects to occur.

LADWP also has 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.24.1.4.2 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.

According to the program manager, the early marketing and outreach is going well. Program staff participated in an Apartment Owners Association conference in April 2023 and met their targeted audience. They plan to go to another conference in late October 2023 and to attend a Southern California Association of Non-Profit Housing conference in November 2023.

A.24.1.4.3 Incentive Structure

The program 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 a reduction in greenhouse gas emissions estimated on the reduced energy use. The incentives are higher for sites with sixty-five or more units and for measures that reduce tenant-paid energy costs (Table A-184)

Table A-184 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*

The incentive structure presents a different way of thinking about energy efficiency than most programs. In the past, staff indicated that the incentives based on GHG reductions often took a little more time to describe during the webinars as potential customers were finding it confusing. However, now the program manager feels they have worked this out. He describes incentives to potential customers as incentives for the typical kWh savings that are turned into GHG and with different incentive rates based on the number of units in a building and whether the energy efficiency measures reduce the owner or tenant energy costs.

A.24.1.4.4 Participation

A customer begins the participation process by filling out an interest form found on the LADWP website (https://ladwpcamr.com/). The April outreach activities appear to have helped the program obtain interest forms as the program added 50% more interest forms from January to May 2023 (from 68 to 96 interest forms). The ninety-six interest forms represent 177 properties and slightly more than 9,000 tenant units.

Using information from the form, LADWP vets the customer and determines if they are qualified or not. This process is needed as about one-third of the properties do not meet CAMR's program requirements noted above (e.g., at least thirty-six of the 96 properties with an interest form are ineligible).

Once vetted, the customer receives 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.[36]

As of June 2023, three properties are furthest along with onsite audits. While the property owners have expressed interest in taking the next step and participating further with CAMR through installation of energy efficient products, none have yet to do so. It is possible that they are waiting to see when funds from the Federal Inflation Reduction Act (IRA) will be available. As part of IRA, building owners (i.e., the taxpayer or Real Estate Investment Trusts) "would be able to take a deduction for energy efficient lighting, HVAC and building envelope costs placed in service as part of a retrofit. The value of the deduction would be based on how much energy savings is achieved. A minimum 25% reduction would be required to realize a $0.50 per square foot gain in the base credit. The base credit would be increased by $0.02 per square foot for each additional percentage point in energy savings, up to $1 per square foot. Bonus amounts, as described above, are available for taxpayers meeting paying prevailing wages and meeting applicable apprenticeship requirements."[37]

Additionally, IRA provide grants or loans to affordable housing owners that implement:

- Energy or water efficiency;
- Indoor air quality or sustainability;
- Zero-emission electricity generation or low-emission building materials or processes;
- Energy storage;
- Building electrification; and
- Climate resilience.

The program manager does not expect any project completions by the end of this fiscal year (June 2023) but hopes that the program will have begun installations by the end of

[36] AEA provides all the onsite assessments and technical support.

[37] https://www.naahq.org/what-passing-inflation-reduction-act-means-rental-housing-providers

the calendar year. He noted that projects could occur over multiple years as a site has 2-3 years to complete a project.

Section A.24.1.4.8 presents the logic model developed for the FY 21/22 process evaluation.

A.24.1.4.5 CAMR Solar Pilot Program

CAMR began a solar pilot in FY 22/23 to expand benefits to multifamily property owners and tenants. The pilot leverages the LADWP Virtual Net Energy Metering (VNEM) pilot (i.e., CAMR supports the customer through the VNEM participation process while VNEM provides the incentives to the customer). VNEM fits well within the CAMR desire to support both owners and tenants as 60% of VNEM sales proceeds go to the property owners and 40% of the proceeds go to tenants of the buildings.

To be eligible for the CAMR Solar Pilot, a customer must meet the CAMR program requirements, have implemented energy-efficiency measures through CAMR, and received CAMR incentives. Additionally, the customer must meet all the VNEM Pilot requirements. As of June 2023, there are no CAMR customers eligible for the VNEM Pilot.

CAMR staff have been working through some challenges while incorporating the solar pilot. They learned that the VNEM Solar Pilot had a threshold of a 30kW system, which is a large system and a size that CAMR buildings could not always support. As such, the CAMR program has had difficulty leveraging VNEM as planned. However, CAMR staff are currently working with the VNEM pilot to see if they can get the threshold lowered and enable all CAMR participants to be eligible for VNEM.

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-42).

A.24.1.4.6 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.24.1.4.7 Measures

CAMR participants can earn GHG incentives based on a full suite of energy savings measures as shown in Table A-185.

*Table A-185 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

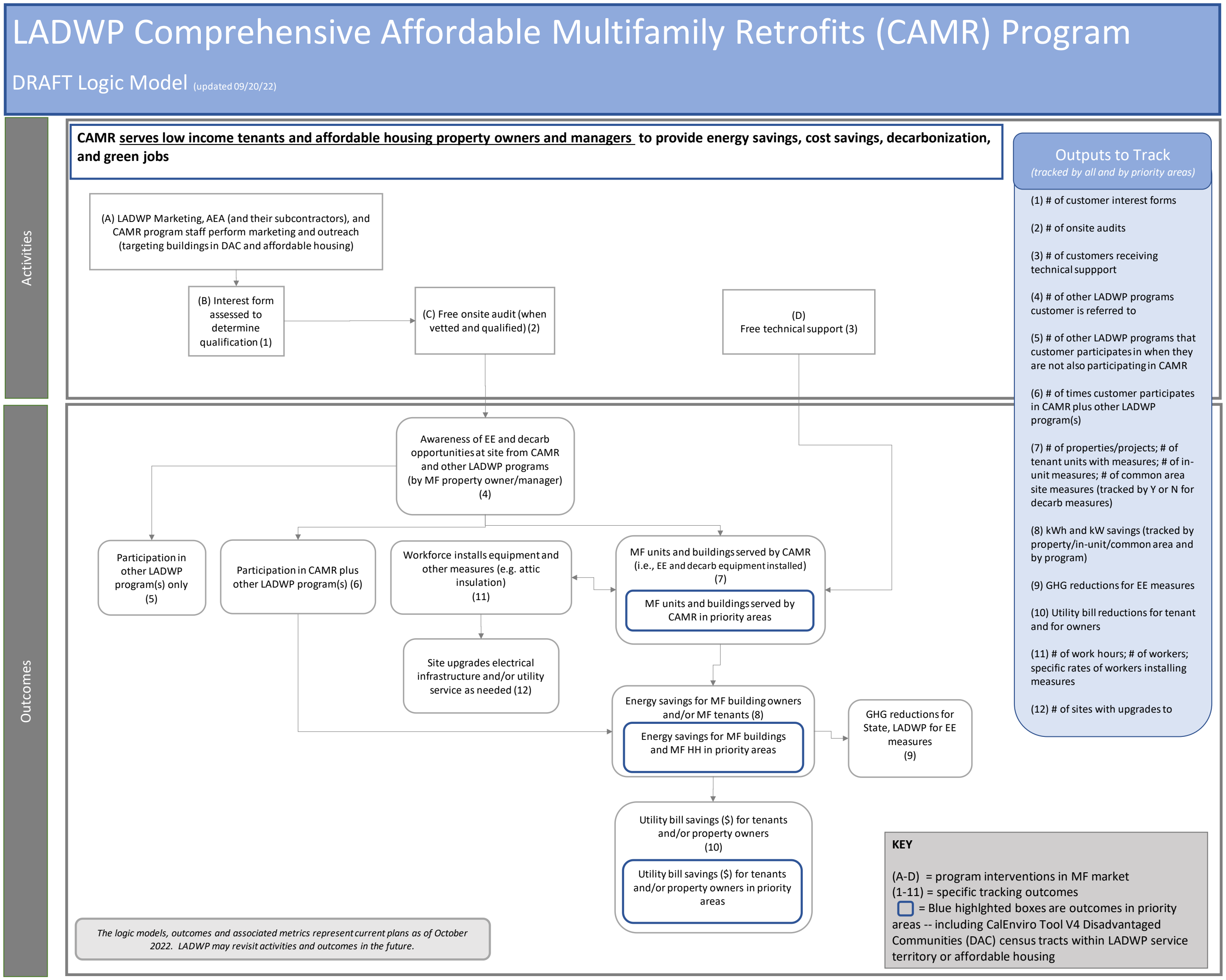
Water Measures	HVAC Measures	Appliance Measures	Weatherization Measures
Low-flow showerhead	Full HVAC system	Clothes dryers (common areas)	T24 window
Shower diverter valve	Electrification (Heat Pump)	Dishwashers (tenant)	Air conditioner cover
Showerhead adapter	Window/Room AC	Refrigerators (tenant)	Appliance 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
			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.24.1.4.8 Logic Model

The logic model is shown in Figure A-42. Besides documenting the main program activities, it also shows the outcomes from program activities and program outputs to demonstrate program success.

Figure A-42 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 The Concurrent Period.

B.1 Non-Residential Programs

Table B-1 CDI Measure Level Cost Effectiveness Results

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
20/21	Lighting	0.22	0.38	362.42	0.11	0.38
21/22	Lighting	0.47	0.47	3.00	0.19	0.47
22/23	Lighting	0.51	1.82	286.40	0.20	1.82

Table B-2 CLIP Measure Level Cost Effectiveness Results

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
20/21	Lighting	0.63	0.87	17.10	0.19	0.87
21/22	Lighting	1.19	1.96	24.18	0.24	1.96
22/23	Lighting	0.87	1.53	21.89	0.23	1.53

Table B-3 CPP Measure Level Cost Effectiveness Results

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
20/21	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
21/22	Custom HVAC, HVAC Controls, EMS, Window Film	2.38	2.32	14.91	0.35	2.32
	Commercial HVAC	1.79	1.87	13.27	0.31	1.87
	Custom Lighting	2.43	4.54	52.90	0.29	4.54
	Custom Motors	2.82	1.15	4.86	0.30	1.15

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
	Commercial Refrigeration	1.41	0.89	4.92	0.28	0.89
22/23	HVAC	3.29	0.54	1.04	0.52	0.54
	Lighting	2.33	0.28	0.94	0.30	0.28
	Refrigeration	3.30	2.10	8.64	0.35	2.10
	Food Service	2.01	0.14	0.42	0.31	0.14
	Process	2.42	0.25	0.60	0.40	0.25

Table B-4 FSP Comprehensive Measure Level Cost Effectiveness Results

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
20/21	Auto Closer - Cooler Doors	0.36	0.36	28.30	0.16	0.36
	Combination Oven	0.35	0.35	20.96	0.16	0.35
	Convection Oven	0.33	0.33	9.90	0.16	0.33
	Hot Food Holding Cabinet	0.28	0.28	4.85	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	9.79	0.16	0.33
21/22	Ice Machine	0.07	0.07	5.34	0.06	0.07
	Refrigerator/Freezer	0.06	0.06	2.96	0.05	0.06
22/23	Convection Oven	0.33	0.30	4.60	0.17	0.30
	Hot Food Holding Cabinet	0.24	0.15	0.97	0.15	0.15
	Ice Machine	0.34	0.33	9.43	0.17	0.33
	Electric Deck Oven	0.31	0.26	2.39	0.18	0.26
	Refrigerator/Freezer	0.32	0.27	3.51	0.16	0.27

Table B-5 FSP POS Measure Level Cost Effectiveness Results

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
20/21	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

FY	Measure	PAC Ratio	TRC Ratio	PCT Ratio	RIM Ratio	MTRC Ratio
	Refrigerator/Freezer	0.16	0.18	0.00	0.10	0.18
21/22	Ice Machine	0.04	0.04	1.98	0.04	0.04
	Convection Oven	0.06	0.05	0.91	0.05	0.05
	Combination Ovens	0.28	0.24	4.03	0.15	0.24
	Deck Ovens	0.37	0.28	2.52	0.17	0.28
	Hot Food Holding Cabinet	0.28	0.16	1.10	0.15	0.16
	Steamers	0.44	0.41	4.43	0.18	0.41
	Refrigerator/Freezer	0.15	0.13	2.40	0.10	0.13

Table B-6 LADWP Facilities Measure Level Cost Effectiveness Results

FY	Measure	PAC Ratio	TRC Ratio	PCT Ratio	RIM Ratio	MTRC Ratio
20/21	Lighting	0.26	0.25	29.66	0.15	0.25
21/22	Lighting	0.02	0.04	189.11	0.02	0.04
22/23	Lighting	0.11	12.18	146.29	0.08	12.18
	Streetlighting	0.21	8.98	78.06	0.12	8.98

Table B-7 LAUSD Direct Install Measure Level Cost Effectiveness Results

FY	Measure	PAC Ratio	TRC Ratio	PCT Ratio	RIM Ratio	MTRC Ratio
20/21	Lighting	0.33	1.93	76.96	0.16	1.93
21/22	Lighting	0.18	0.18	1.86	0.12	0.18
22/23	Lighting	0.29	0.87	71.98	0.17	0.87

Table B-8 SBD Measure Level Cost Effectiveness Results

FY	Measure	PAC Ratio	TRC Ratio	PCT Ratio	RIM Ratio	MTRC Ratio
20/21	New Construction	0.23	0.23	8.03	0.16	0.23
	Modernization	0.23	0.23	8.03	0.16	0.23
21/22	New Construction	1.85	2.35	13.28	0.39	2.35
	Modernization	0.07	0.07	12.85	0.06	0.07
22/23	New Construction	4.04	8.02	14.73	0.55	8.02
	Modernization	4.04	8.02	14.73	0.55	8.02

Table B-9 Upstream HVAC Measure Level Cost Effectiveness Results

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
20/21	AC	1.29	4.24	39.24	0.36	4.24
	HP	2.48	2.28	8.28	0.42	2.28
	VRF	2.55	4.33	33.92	0.44	4.33
21/22	AC	1.80	1.01	3.10	0.43	1.01
	HP	1.80	1.01	3.10	0.43	1.01
	VRF	1.80	1.01	3.10	0.43	1.01
22/23	AC	5.09	5.10	7.50	0.68	5.10
	HP	5.78	5.78	9.02	0.64	5.78
	VRF	5.15	5.15	8.96	0.58	5.15
	Chiller	7.29	7.29	13.42	0.55	7.29

Table B-10 LADWP ZBD Measure Level Cost Effectiveness Results

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
22/23	New Construction	0.12	0.12	14.80	0.10	0.12

B.2 Residential Programs

Table B-11 CRP Measure Level Cost Effectiveness Results

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
20/21	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 Windows & Skylights	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
21/22	Attic Insulation	0.44	0.28	1.31	0.22	0.28
	Central Air Conditioner	0.71	0.74	2.52	0.41	0.74
	Central Heat Pump	0.72	0.91	12.26	0.38	0.91

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
	Cool Roof	0.97	0.55	1.21	0.48	0.55
	Dual Pane Skylights	0.07	0.06	1.14	0.06	0.06
	Dual Pane Windows	1.21	0.52	1.01	0.51	0.52
	Pool Pump and Motor	0.54	0.90	6.87	0.22	0.90
	Whole House Fan	0.58	0.34	0.81	0.37	0.34
22/23	Attic Insulation	0.32	0.32	1.31	0.26	0.32
	Central Air Conditioner	0.58	0.67	2.89	0.36	0.67
	Central Heat Pump	0.76	1.19	0.00	0.40	1.19
	Cool Roof	0.52	0.52	1.63	0.38	0.52
	Dual Pane Windows	1.04	1.04	7.98	0.57	1.04
	Pool Pump and Motor	0.68	0.89	11.77	0.24	0.89
	Whole House Fan	0.99	1.19	0.00	0.36	1.19

Table B-12 EPM Measure Level Cost Effectiveness Results

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
20/21	Air Conditioner	1.10	1.32	13.55	0.56	1.32
	Light Bulb	1.43	1.46	382.29	0.25	1.46
	Power Strip	1.03	1.02	11.84	0.24	1.02
	Refrigerator	0.48	0.82	7.64	0.21	0.82
	Television	0.54	0.45	2.81	0.20	0.45
	Thermostat	1.08	0.90	2.61	0.55	0.90
21/22	Air Conditioner	1.33	1.81	11.40	0.51	1.81
	Light Bulb	0.82	1.15	0.00	0.17	1.15
	Power Strip	1.14	1.06	9.23	0.23	1.06
	Refrigerator	0.54	0.92	8.01	0.22	0.92
	Television	0.68	0.39	1.88	0.22	0.39
	Thermostat	1.73	2.06	17.21	0.56	2.06
22/23	Air Conditioner	0.91	1.43	9.30	0.44	1.43
	COOL LA Air Conditioner	0.19	1.06	13.48	0.16	1.06
	Light Bulb	1.60	1.94	368.45	0.28	1.94
	Power Strip	1.05	0.83	5.54	0.23	0.83
	Refrigerator	0.60	1.38	17.31	0.24	1.38

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
	Television	1.42	1.33	12.23	0.29	1.33
	Thermostat	1.52	1.89	65.55	0.55	1.89

Table B-13 ESAP Measure Level Cost Effectiveness Results

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
20/21	Whole House	0.26	0.26	2.06	0.13	0.26

Table B-14 HEIP Measure Level Cost Effectiveness Results

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
22/23	Window AC	0.29	0.29	3.64	0.22	0.29
	Aerator	0.31	0.31	10.06	0.17	0.31
	Air Sealing	0.27	0.34	566.33	0.22	0.34
	Attic Insulation	0.33	0.33	8.65	0.27	0.33
	Weather Stripping	0.33	0.33	28.56	0.26	0.33
	Duct Sealing	0.33	0.33	13.90	0.25	0.33
	LED	0.33	0.33	38.07	0.17	0.33
	Pipewrap	0.33	0.33	68.93	0.12	0.33
	Showerhead	0.32	0.32	21.58	0.18	0.32
	Toilet	0.19	0.19	1.90	0.13	0.19
	Toilet Gasket	0.00	0.00	0.00	0.00	0.00

Table B-15 REP Measure Level Cost Effectiveness Results

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
20/21	Refrigerator	0.20	0.23	115.34	0.14	0.23
21/22	Refrigerator	0.61	0.61	4.07	0.23	0.61
22/23	Refrigerator	0.84	2.35	156.28	0.27	2.35

Table B-16 RETIRE Measure Level Cost Effectiveness Results

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
20/21	Refrigerator	0.01	0.01	5.31	0.01	0.01
21/22	Air Conditioner	1.54	1.28	7.34	0.54	1.28
	Freezer	1.03	1.06	9.64	0.22	1.06

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
	Refrigerator	1.41	1.20	10.61	0.26	1.20
22/23	Air Conditioner	0.86	0.86	32.06	0.42	0.86
	Freezer	0.73	0.70	10.67	0.23	0.70
	Refrigerator	0.70	0.63	7.40	0.22	0.63

Table B-17 RLEP Measure Level Cost Effectiveness Results

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
20/21	LED Kit	8.23	8.23	73.40	0.29	8.23
21/22	LED Kit	0.71	0.71	5.95	0.17	0.71
22/23	LED Kit	7.47	50.31	0.00	0.33	50.31

B.3 Cross-Sector Programs

Table B-18 ACOP Measure Level Cost Effectiveness Results

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
20/21	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
	Mobile Home	0.00	0.00	0.00	0.00	0.00
21/22	Commercial	0.44	0.83	12.91	0.27	0.83
	Multifamily	0.29	0.29	1.83	0.18	0.29
	Single Family	0.33	0.55	3.42	0.23	0.55
	Mobile Home	0.66	0.49	1.51	0.37	0.49
22/23	Commercial	0.54	0.95	12.44	0.26	0.95
	Multifamily	0.46	1.02	16.30	0.28	1.02
	Single Family	0.50	1.04	16.21	0.31	1.04
	Mobile Home	0.64	1.04	13.21	0.36	1.04

Table B-19 CAHP Measure Level Cost Effectiveness Results

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
20/21	Appliances	0.89	0.89	5.36	0.24	0.89
	Heating & Cooling	0.77	0.77	1.92	0.46	0.77

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
	New Construction	0.45	0.45	2.43	0.20	0.45
21/22	Appliances	0.12	0.12	2.15	0.09	0.12
	HVAC Cooling	0.25	0.25	2.30	0.17	0.25
	HVAC Heating	0.02	0.02	1.99	0.02	0.02
	Water Irrigation	-0.01	-0.01	0.00	-0.01	-0.01
	Whole Building	0.32	0.32	2.36	0.17	0.32
22/23	Appliances	-0.06	-0.06	0.87	-0.07	-0.06
	Domestic Hot Water	0.09	0.24	3.81	0.06	0.24
	Indoor Fan	1.65	2.69	9.46	0.35	2.69
	Pump	2.03	2.03	6.90	0.34	2.03
	New Construction	1.52	1.52	5.69	0.29	1.52
	HVAC Cooling	1.04	1.04	2.29	0.47	1.04
	HVAC Heating	0.38	0.38	3.37	0.12	0.38
	Whole House Fan	1.61	2.71	8.30	0.40	2.71

Table B-20 CP Measure Level Cost Effectiveness Results

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
20/21	Shade Trees	4.84	4.84	13.41	0.98	4.84
21/22	Shade Trees	6.30	6.30	21.23	0.89	6.30
22/23	Shade Trees	11.62	16.62	17.06	0.98	16.62

Table B-21 CSO Measure Level Cost Effectiveness Results

FY	Measure	PAC	TRC	PCT	RIM	MTRC
		Ratio	Ratio	Ratio	Ratio	Ratio
20/21	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
21/22	Plumbing Ordinances	11.44	0.75	2.45	0.32	0.75
	Title 20/24	11.42	8.02	66.24	0.39	8.02
22/23	Plumbing Ordinances	149.28	149.28	0.00	0.34	149.28
	Title 20/24	149.28	149.28	0.00	0.43	149.28