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Sustainable Office Lighting Control Pilot Program: Project Results

Volume II

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ALCS – 001

Building Type: Refrigerated Warehouse
Participant Industry: Shipping and Distribution
Building Size: 155,220 sq ft
Project Area: 120,000 sq ft
Completion Date: December 2015
Lease/Own: Unknown
Number of Employees: Unknown
Contractor Group: CALCTP Certified[1]

Project Specifications

Project number 001 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the ALCS that serves the functions shown in Table 1. The facility retrofitted T-5 fixtures with LED fixtures and integrated these new fixtures into the ALCS. The retrofit covered 77% of the building area. The facility operates 24 hours a day, 365 days of the year.

Table 1. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Not Feasible, Not Implemented
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Feasible, Not Implemented
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, occupancy controls, and zoning. Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response; however, the system is capable of both. Daylight harvesting was not feasible because the building lacks windows. Scheduling is always feasible; however, because the building operates 24 hours a day, the additional energy savings of implementing scheduling may be small.

Quality Assurance

An SCE third-party technical reviewer completed a pre-retrofit inspection of the facility, gathering fixture data and operating hours that RHA reviewed and used in project calculations. RHA completed a post-inspection in April 2016 that included seven days of power metering, fixture verification, and functional testing of the ALCS.

Upon final inspection, RHA found several issues with the project:

[1] CALCTP requires CALCTP-certified projects to be conducted by CALCTP-certified contractors using a CACLTP-certified project manager and CALCTP-certified installers. This study did not determine whether projects performed by CALCTP -certified contractors met these requirements or if the persons installing the ALCS had CALCTP training or certifications.

- During data logging, RHA found that a system power outage can cause up to a four-hour delay for the fixture to recommunicate with the ALCS.
- Several fixtures did not store consumption data due to a communication error between the fixtures and the controller.
- Approximately 85 fixtures stopped communicating with the central ALCS and went to default settings, staying on 100% of the time. The system manufacturer resolved this issue at the customers' expense since the warranty was valid at the time.
- During system commissioning, the occupancy delay on all fixtures was changed from the planned three- and five-minute time delays to 20 minutes; this reduced the savings possible from the occupancy controls. The installing contractor resolved this issue by changing the setting back to the original schedules.

RHA accounted for these issues upon calculating verified savings for the project. Power monitoring results were within 3% of the reported energy consumption of the ALCS, verifying the system was correctly accounting for energy usage. However, the system was not achieving its full potential due to the above-documented issues.

Energy Impacts

The installing contractor estimated the energy savings achieved by the project, which Cadmus compared to energy savings verified by RHA to determine the project realization rate. RHA verified energy savings representing the condition found on site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors, and updated fixture wattages to verified fixture wattages.[2] Table 2 details project energy savings and demand reduction.

Table 2. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	461,748	413,216	648,749	92%	8%
Realization Rate	-	89%	157%	-	-
Demand Reduction (kW)	45.0	44.8	31.0	97%	3%
Realization Rate	-	99%	69%	-	-

The project achieved 648,749 kWh of energy savings and 31.0 kW of demand reduction. These energy savings account for an 80% reduction in lighting energy usage. The project contractor overestimated energy savings for this project by 11%, achieving an 89% realization rate. The LED upgrade accounted for 92% of project energy savings with the remaining 8% due to the ALCS.

[2] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

The project achieved a relative energy savings of 5.4 kWh per square foot of project area. Considering the project costs, energy savings, and utility rate for this project, the customer would expect a simple payback of 2.9 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the above-code savings for this project. The methods they applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods led to an estimated 335,593 kWh of energy savings for this project above Title 24 code. Cadmus evaluated above code savings for this projects to be 526,881 kWh and 31.0kW of demand reduction.

Pilot Awareness, Decision Making, and Challenges

Cadmus was unable to speak with a project decision maker at the site, and the key decision maker did not return our messages from six separate attempts at contact by phone and email. Cadmus also called the publicly listed business line and spoke with other staff, who indicated that they were very busy and we would likely not hear from the key decision maker. Cadmus made two additional but unsuccessful attempts to reach the decision maker a few months later, during a less busy time.

Willingness to Pay and Project Costs

The lighting project cost $214,738.00, and the decision maker received an incentive of $50,000.00 (Table 3). Without key decision maker feedback, Cadmus was unable to determine their willingness to complete the same project for a different incentive amount.

Table 3. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$214,738.00	$50,000.00	N/A

The project invoice included costs of the fixture upgrade and the ALCS system broken out separately. Of the total project cost Cadmus estimates that 90% of these costs funded the fixture upgrade while the remaining 10% or approximately $18,000 were the costs of the ALCS.

Contractor Details

Contractor 2 was the lead contractor for this project. The contracting company offers commissioning; electrical and lighting; controls (mechanical, electrical, lighting, and energy management); energy assessments, diagnostics, or ratings; HVAC equipment; mechanical systems; insulation and building envelope measures; and renewable energy; as well as training and consulting.

For this project, the decision maker received an incentive check from SCE.

Contractor Training

The contracting company's installers are designated as having received California Advanced Lighting Control Training Program training. However, the lead contractor (interviewed) was not CALCTP-certified. The only project-related training received by the lead contractor was through the California Civilian Conservation Corp.

The contractor learned about the pilot through contact with an SCE representative. They expressed a preference for staying informed about the pilot through the SCE website as well as in emails from SCE representatives. The contractor chose to recommend the pilot to customers because of the cost savings.

Contractor Experience with Pilot

The contractor did not experience acceptance testing for the project.

On a scale of 0 to 10, where 0 means *not at all influential* and 10 means *very influential*, the contractor rated the pilot as a 7 in influencing their decision to recommend that the company install the advanced lighting control system.

Participating in the pilot did not change the contractor's sales for advanced lighting control systems. The contractor reported that before participating in the pilot, they recommended advanced lighting control systems 90% of the time; after participating, they still recommend these systems 90% of the time.

Table 4 shows the importance ratings provided by the contractor.

Table 4. Contractor Attribution Ratings

H6. Using a 0 to 10 rating scale, how important in your recommendation was…:	
Factors	**Score**
Information provided on SCE's website	9
Training and seminars provided by SCE	7
Your company's past participation in a rebate program sponsored by SCE	8
Training outside the pilot (if rating of 5 or greater, which trainings)	6

The contractor noted that being able to spend more time with customers and work with them on pricing and rebate project options was the greatest benefit of promoting the pilot. The contractor also said that 90% of the time they discuss the pilot and project goals to achieve "deep energy savings."

Satisfaction

Contractor

Overall, the contractor expressed high satisfaction with their pilot experience. Table 5 shows the respondent's satisfaction ratings for various pilot elements.

Table 5. Contractor Satisfaction Ratings

Project Element	Response
SCE communications about the pilot and offerings	Very satisfied
Pre-installation process	Somewhat satisfied
Post-installation process with verification contractor	Somewhat satisfied
SCE making the paperwork easy	Somewhat satisfied
Time for paperwork to be processed	Not very satisfied
Response time to questions or inquiries	Somewhat satisfied
Providing the right amount of support for contractors to confidently sell and install energy efficiency equipment	Very satisfied
The final incentives provided	Somewhat satisfied
Pilot overall	Very satisfied

The contractor said the pilot ran smoothly and that he had no additional suggestions for what SCE could do to improve his pilot experience.

ALCS – 002

Building Type: Office
Participant Industry: Finance
Building Size: 16,000 sq ft
Project Area: 16,000 sq ft
Completion Date: May 2015
Lease/Own: Unknown
Number of Employees: Unknown
Contractor Group: Manufacturer Trained

Project Specifications

Project number 002 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 6. The facility retrofitted T-8 fixtures with LED fixtures and integrated these new fixtures into the ALCS. The retrofit covered approximately 100% of the building area. The retrofit covered 100% of the building area. The office hours of the building are from 8:00 a.m. to 5:00 p.m., five days a week.

Table 6. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Yes
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, daylight harvesting, occupancy controls, scheduling, and zoning. Cadmus was unable to determine if the ALCS used lumen maintenance or automatic demand response; however, the system is capable of both.

Quality Assurance

A pre-inspection site verification was not completed at the facility: although this is required for participation, the project received an exception. The installation contractor gathered fixture data and operating hours, which RHA reviewed. RHA completed a post-inspection in April 2016 that included seven days of light logging, fixture verification, and functional testing of the ALCS.

Upon final inspection, RHA found three issues with the project:

- The ALCS updates data at a minimum of 12-minute intervals, resulting in lower accuracy of savings and usage calculations. RHA confirmed with the system manufacturer that this behavior is not normal and that the system can provide real-time usage. The speculated cause of the error was a programming error.

- The ALCS was not capable of calculating savings from tuning and displaying those to the system operator. This issue was known to the manufacturer, who said it would be corrected in a future software update.
- RHA noted the daylight harvesting controls provided insignificant energy savings due to proximity of the fixtures to the windows and the aggressive task tuning employed by the controls. While this is not an installation error, but due to the circumstances of the system and controls employed daylight harvesting provides minimal additional savings.

RHA accounted for these issues upon calculating verified savings for the project. The light logging results showed the lighting control system reported usage varied between 2% and 24% of the observed usage, indicating the system was not accurately reporting consumption. Due to this large error from the ALCS, RHA used the light logging results when calculating project savings.

Energy Impacts

The installing contractor estimated the energy savings achieved by the project, Cadmus compared these to the energy savings verified by RHA to determine the project realization rate. RHA verified energy savings represent the condition found onsite during the post inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[3] Table 7 details project energy savings and demand reduction.

Table 7. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	47,836	45,515	47,987	83%	17%
Realization Rate	-	95%	105%	-	-
Demand Reduction (kW)	13.4	15.3	12.8	79%	21%
Realization Rate	-	114%	84%	-	-

The project achieved 47,987 kWh of energy savings and 12.8 kW of demand reduction. These energy savings account for a 72% reduction in lighting energy usage. The project contractor overestimated energy savings for this project by 5%, achieving a 95% realization rate. The LED upgrade accounted for 83% of project energy savings with the remaining 17% due to the ALCS.

The project achieved a relative energy savings of 3.0 kWh saved per square foot of project area. Considering the project costs, energy savings, and utility rate for this project, the customer would expect a simple payback of 5.2 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the above-code savings for this project. The methods they applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting,

[3] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

occupancy controls, and associated minimum settings. These methods led to an estimated 16,406 kWh of energy savings for this project above Title 24 code. Cadmus evaluated above code savings for this project to be 14,856 kWh and 10.0 kW of demand reduction.

Pilot Awareness, Decision Making, and Challenges

The project decision makers declined to respond to the survey regarding their experience with the pilot. Cadmus sent four emails, made four telephone calls, and left one voicemail to request an interview, but was unable to connect with the decision maker.

Willingness to Pay and Project Costs

The lighting project cost $59,746.00, and the decision maker received an incentive of $21,847.00 (Table 8). Without key decision maker feedback, Cadmus was unable to determine their willingness to complete the same project for a different incentive amount.

Table 8. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$59,746.00	$21,847.00	N/A

Cadmus examined project documentation and was unable to determine which portions of the project costs funded each aspect of the new lighting system.

Contractor Interactions

The contractor declined to respond to the survey regarding their experience with the pilot. Cadmus attempted to reach the contractor six times to request an interview but was unable to connect with the contractor.

Final Comments

Because none of the key stakeholders responded to our requests for an interview, we do not have information regarding pilot satisfaction, contractor trainings, or other information.

ALCS – 003

Building Type: University
Participant Industry: Education/School/University
Building Size: 22,000 sq ft
Project Area: 17,226 sq ft
Completion Date: May 2016
Lease/Own: Own
Number of Students: 14,000
Contractor Group: General Electrical Contractor

Project Specifications

Project number 003 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 9. The facility retrofitted T-8 fixtures with LED fixtures in two adjacent buildings and integrated these new fixtures into the ALCS. The retrofit covered 78% of the building area. The facility operates Monday through Saturday from 7:00 a.m. to 10:00 p.m.

Table 9. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Feasible, Not Implemented
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, occupancy controls, scheduling, and zoning. Cadmus was unable to determine if the ALCS used lumen maintenance or automatic demand response; however, the system is capable of both. The ALCS is capable of daylight harvesting; however, the contractor did not activate the feature for unexplained reasons.

Quality Assurance

A member of the SCE third-party technical review team completed a pre-retrofit inspection of the facility, gathering fixture data and operating hours that RHA reviewed and used in project calculations. RHA completed a post inspection in May of 2016; this inspection included 7 days of light loggers, power metering, fixture verification and functional testing of the ALCS.

Upon final inspection, RHA found two issues with the project:

- The ALCS-generated reports contained duplicate and erroneous data, limiting their usefulness in analysis.

- The contractor did not replace fixtures in building 2 classrooms and hallways; due to this error, the contractor overestimated energy consumption energy consumption was by 4%.

RHA accounted for these issues upon calculating verified savings for the project. Power monitoring results showed ALCS system accurately accounted for energy usage of the lighting system with less than 1% variance in reported energy consumption. One of the monitored zones indicated a 17% error between monitored and ALCS reported results, however RHA identified this error was due to the low load of the monitored zone and limitations of RHA's deployed monitoring system.

Energy Impacts

The installing contractor estimated the energy savings achieved by the project, which Cadmus compared to the energy savings verified by RHA to determine the project realization rate. RHA verified energy savings representing the condition found on the site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[4] Table 10 details project energy savings and demand reduction.

Table 10. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	83,816	60,249	65,297	59%	41%
Realization Rate	-	72%	108%	-	-
Demand Reduction (kW)	13.6	19.1	18.3	67%	33%
Realization Rate	-	140%	96%	-	-

The project achieved 65,297 kWh of energy savings and 18.3 kW of demand reduction. These energy savings account for a 79% reduction in lighting energy usage. The project contractor overestimated energy savings for this project by 28%, achieving a 72% realization rate. The LED upgrade accounted for 59% of project energy savings with the remaining 41% due to the ALCS.

The project achieved a relative energy savings of 3.8 kWh per square foot of project area. Considering the project costs, energy savings, and utility rate for this project, the customer would expect a simple payback of 8.7 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the above-code savings for this project. The methods they applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods led to an estimated 16,983 kWh of energy savings for this project above Title 24 code. Cadmus evaluated above code savings for this project to be 15,563 kWh and 10.5 kW of demand reduction.

[4] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

Pilot Awareness, Decision Making, and Challenges

The project decision maker learned about the pilot from their SCE account manager. The project decision maker initiated the lighting project at the facility.

The decision maker noted the following factors as being important in their decision to make the lighting system upgrades through the pilot:

- Most important: To save money on energy bills
- To reduce energy consumption or energy demand
- To be a leader in the market or field

The decision maker cited high initial costs as the biggest challenge they faced in making energy-efficient improvements.

The decision maker said they experienced no barriers when deciding whether to participate in the pilot.

The decision maker said their organization has benefited from participating in the pilot because the university it is using less energy, has reduced their energy consumption or energy demand, is saving money on utility bills, and is experiencing better aesthetics.

Willingness to Pay and Project Costs

The lighting project cost $102,028.00, and the decision maker received an incentive of $28,919.00 (Table 11). According to the decision maker, they would have installed the project if they received 50% of the incentive.

Table 11. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$102,028.00	$28,919.00	$14,459.50

Cadmus examined project documentation and was unable to determine which portions of the project costs funded each aspect of the new lighting system.

Contractor Interactions

The university staff worked on this project internally. The decision maker reported that they chose to do this work internally because it was the only affordable way. Instead of hiring for the project at the prevailing wage, the university hired an emergency temporary electrician who helped the project move efficiently.

For this project, the decision maker received an incentive check from SCE.

Contractor Training

The university staff who worked in a contractor role for the project did not have any specific trainings or certificates relevant to the project.

Contractor Experience with Pilot

The university staff did not experience acceptance testing for the project.

On a scale of 0 to 10, where 0 means *not at all influential* and 10 means *very influential*, the university staff rated the pilot as a 5 in influencing their decision to install the advanced lighting control system.

Participating in the pilot did not change the university staff's decision-making process regarding advanced lighting control systems. The university staff reported that before participating in the pilot, they chose advanced lighting control systems 100% of the time; After participating, they continued to pursue these systems 100% of the time.

Table 12 shows the importance ratings provided by university staff.

Table 12. University Staff Attribution Ratings

H6. Using a 0 to 10 rating scale, how important in your recommendation was…:	
Factors	**Score**
Information provided on SCE's website	0
Training and seminars provided by SCE	0
Your company's past participation in a rebated program sponsored by SCE	10
Training outside the pilot (if rating of 5 or greater, which trainings)	8

University staff noted that a shorter return on investment was the greatest benefit of promoting the pilot. University staff also said that very frequently deep energy savings was an explicit goal.

Counterfactual Baseline and Project Net-to-Gross

The decision maker answered several questions about the likely path they would have taken if the pilot and incentives had not existed, and about the pilot influence on their decision to install the ALCS.

The decision maker said they would have done a basic lighting retrofit following code had the pilot not existed. If the pilot did not exist, the decision maker would have installed the project later but within the same year. Prior to learning about the pilot, they had not budgeted for the purchase of the lighting control system. Additionally, they had considered the energy savings in relation to the project cost in their decision to proceed with installing the lighting control system.

To determine the benefit/cost analysis, the university focused on smaller projects that can be accomplished in partnership with SCE pilot pricing and for which they obtain rebates through vendors. This project was partially funded through the Chancellor's office, which helped fund the project through an awards system. University staff also indicated that without the pilot incentive, the return on their investment would have been high enough to install the same control system.

The decision maker answered several questions using Program Attribution Index scoring regarding the level of pilot influence on their decision to install the lighting control system. First, the decision maker rated the pilot and non-pilot influences shown in Table 13 (known as Program Attribution Index 1).

Table 13. Program Attribution Index 1 Ratings

E4. Using a 0 to 10 rating scale, please rate the importance of each of the following in your decision to implement the advanced lighting controls with a graphical user interface.		
Type	**Factors**	**Score**
Pilot Influences	1. The availability of the pilot incentive	4
	2. Recommendations or suggestions from SCE pilot staff	5
	3. Recommendations or suggestions from SCE account representative	8
	4. Recommendations or suggestions from contractor or vendor	9
Non-Pilot Influences	5. Internal policy or requirements inside company or organization	9
	6. Concerns about environmental effects or global warming	8
	7. Desire to install a control system to improve employee morale	7
	8. Desire to save money on monthly energy bills	7
	9. Interest in the lighting control technology	9
	10. Desire to install a control system to reduce operation and maintenance costs	7
	11. Desire to install a control system to automate lighting decisions	10

Next, the decision maker answered questions about the timing of their decision, and rated the relative importance of the pilot influences compared to the non-pilot influences: these are known as the Program Attribution Index 2, shown in Table 14.

Table 14. Program Attribution Index 2 Ratings

Question	Response	
Did you learn about the pilot before or after you decided to adopt or install the advanced lighting control system?	Before	
Rate the importance of the pilot on your decision as opposed to other factors that may have influenced your decision. Using a 0 to 10 rating scale where 0 means *not at all important* and 10 means *very important*, please rate the overall importance of the pilot versus the most important of the other factors we just discussed in your decision to adopt or install the specific measure. This time the two importance ratings—the pilot importance and the non-pilot importance—should total 10.	**Pilot Score**	**Non-Pilot Score**
	8	2

Lastly, the decision maker rated the likelihood they would have installed each aspect of the lighting control system had the pilot incentives not been available: these are known as Program Attribution Index 3 and shown in Table 15.

Table 15. Program Attribution Index 3 Ratings

Think about the action you would have taken with regard to installing this equipment if the pilot had not been available. Using a 0 to 10 scale, please rate the likelihood that you would have integrated each of the following features into your lighting control system:	
ALCS Feature	**Rating**
Graphical user interface	8
Fixtures using task tuning, where each lighting fixture can be optimized to the space	9
Daylight harvesting system that dims lighting fixtures in response to sunlight	6
Occupancy or vacancy controls that turn off lighting in rooms that are not occupied	9
Lighting automation system that turns lighting on and off depending on the time of day	5
Control system allowing for automatic demand response that allows utility to dim lights	9

Upon calculating the Pilot Attribution Indexes 1, 2, and 3, Cadmus estimated the project's NTG ratio as 50%. In the absence of the program they were likely to have completed a lighting retrofit to code.

Satisfaction

Key Decision Maker

Overall, the decision maker expressed satisfaction with their pilot experience. Table 16 shows the respondent's satisfaction rating for various pilot elements.

Table 16. Decision Maker Satisfaction Ratings

Project Element	Response
Performance of new system	Very satisfied
Pilot overall	Very satisfied

In addition, the decision maker rated the application paperwork as *somewhat challenging*.

The decision maker said there was nothing specific that SCE could have done to improve their pilot experience, but said it was a pain to come up with data; otherwise, the decision maker had no major complaints.

Overall, the university staff expressed satisfaction with their pilot experience. Table 17 shows the respondent's satisfaction ratings for various pilot elements that a contractor would have fulfilled in a more traditional project.

Table 17. University Staff Satisfaction Ratings

Project Element	Response
SCE communications about the pilot and offerings	Very satisfied
Pre-installation process	Very satisfied
Post-installation process with verification contractor	Very satisfied
SCE making the paperwork easy	Somewhat satisfied
Time for paperwork to be processed	Somewhat satisfied
Response time to questions or inquiries	Very satisfied
Providing the right amount of support for contractors to confidently sell and install energy efficiency equipment	N/A
The final incentives provided	Very satisfied
Pilot overall	Very satisfied

The contractor said that SCE could have improved their pilot experience by creating something better than the current SCE log-in page, such as a Dropbox account to store and share all the documents.

Final Comments

The key decision maker is pleased that SCE is working to "push things forward" with energy-efficiency incentives.

End User Survey

The decision maker sent an online survey by email (provided by Cadmus) to the building occupants interacting with the new control system, and one person responded to the survey. This respondent had received training on how to use the system from the key decision maker, said that the training was very effective, and said they are somewhat effectively able to operate the system, as shown in Table 18.

Table 18. End User Survey Response

Project Element	Number of Responses	
Received training on the lighting control system	1	
Can effectively operate lighting controls	Very or somewhat effectively	Not too or not at all effectively
	1	0
Satisfaction with controls	Very or somewhat satisfied	Not very or not at all satisfied
	1	0

The respondent does not have administrator access and has not updated any of the control programming since the new controls were installed.

The respondent strongly agreed that the new systems have made the space more comfortable, improved the quality of their work, and reduced utility bills for the university. The respondent somewhat agreed that the system has made the space safer and improved the aesthetics. Overall, the respondent was very satisfied with the new lighting and control system.

ALCS – 004

Building Type: Mechanical Tunnel
Participant Industry: Education/School/University
Building Size: 20,174 sq ft
Project Area: 20,174 sq ft
Completion Date: April 2016
Lease/Own: Own
Number of Students: 14,000
Contractor Group: General Electrical Contractor

Project Specifications

Project number 004 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 19. The project was to retrofit T-8 fixtures with LED fixtures in a mechanical tunnel serving the campus and integrated these new fixtures into the ALCS. The retrofit covered 100% of the tunnel, which operates continuously (24 hours a day, 365 days of the year).

Table 19. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Not Feasible
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, occupancy controls, scheduling, and zoning. Cadmus was unable to determine if the ALCS used lumen maintenance or automatic demand response; however, the system is capable of both. Daylight harvesting was not feasible because the tunnel has no natural light.

Quality Assurance

A member of SCE's third-party review team completed a pre-retrofit inspection of the facility, gathering fixture data and operating hours that RHA reviewed and used in project calculations. RHA completed a post-inspection in June 2016 that included seven days of power metering, fixture verification, and functional testing of the ALCS.

Upon final inspection, RHA found no issues with the project or installed ALCS. During data logging RHA found the ALCS reported accurate energy consumption finding a variance of less than 1% of observed usage. Due to very low energy usage of the installed lighting fixtures during unoccupied periods the installed data loggers were unable to sense this very low load. Consequently RHA used the reported EMS consumption to determine energy savings for ALCS.

Energy Impacts

The installing contractor estimated the energy savings achieved by the project, which Cadmus compared to the energy savings verified by RHA to determine the project realization rate. RHA verified energy savings representing the condition found on the site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[5] Table 20 details project energy savings and demand reduction.

Table 20. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	77,564	86,731	83,805	17%	83%
Realization Rate	-	112%	97%	-	-
Demand Reduction (kW)	2.1	6.1	2.6	28%	72%
Realization Rate	-	296%	42%	-	-

The project achieved 83,731 kWh of energy savings and 2.6 kW of demand reduction. These energy savings account for a 96% reduction in lighting energy usage. The project contractor underestimated energy savings for this project by 12%, achieving a 112% realization rate. The LED upgrade accounted for 17% of project energy savings with the remaining 83% due to the ALCS.

The project achieved a relative energy savings of 4.2 kWh per square foot of project area. Considering the project costs, energy savings, and utility rate for this project, the customer would expect a simple payback of 2.2 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the above-code savings for this project. The methods they applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods led to an estimated 84,392 kWh of energy savings for this project above Title 24 code. Cadmus evaluated above code savings for this project to be 81,466 kWh and 2.6 kW of demand reduction.

Pilot Awareness, Decision Making, and Challenges

The project decision maker learned about the pilot from their SCE account manager and initiated the lighting project at the facility.

The decision maker noted the following factors as being important in their decision to make the lighting system upgrades through the pilot:

[5] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

- Most important: To save money on energy bills
- To reduce energy consumption or energy demand
- To be a leader in the market or field

The decision maker cited high initial costs as the biggest challenge they face in making energy-efficient improvements.

The decision maker said they experienced no barriers when deciding whether to participate in the pilot.

The decision maker said their organization has benefited from participating in the pilot because the building is using less energy and the university has reduced its energy consumption or energy demand and is saving money on utility bills.

Willingness to Pay and Project Costs

The lighting project cost $54,008.00, and the decision maker received an incentive of $27,004.00 (Table 21). According to the decision maker, they would have installed the project if they received 50% of the incentive, but not if they received 25%.

Table 21. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$54,008.00	$27,004.00	$13,502.00

The project invoice included costs of the fixture upgrade and the ALCS system broken out separately. Of the total project cost Cadmus estimates that 53% of these costs funded the fixture upgrade while the remaining 47% or approximately $25,000 were the costs of the ALCS.

Contractor Interactions

The university staff worked on this project internally. The decision maker reported that they chose to do the project work internally because it was the only affordable way. Instead of hiring for the project at the prevailing wage, the university hired an emergency temporary electrician who helped the project move efficiently.

For this project, the customer received an incentive check from SCE.

Contractor Training

The university staff who worked in a contractor role for the project did not have any specific trainings or certificates relevant to the project.

Contractor Experience with Pilot

The university staff did not experience acceptance testing for the project.

On a scale of 0 to 10, where 0 means *not at all influential* and 10 means *very influential*, the university staff rated the pilot as a 5 in influencing their decision to install the advanced lighting control system.

Participating in the pilot did not change the university staff's decision-making process regarding advanced lighting control systems. The university staff reported that before participating in the pilot, they chose advanced lighting control systems 100% of the time; After participating, they continued to pursue these systems 100% of the time.

Table 22 shows the importance ratings provided by university staff.

Table 22. University Staff Attribution Ratings

H6. Using a 0 to 10 rating scale, how important in your recommendation was…:	
Factors	**Score**
Information provided on SCE's website	0
Training and seminars provided by SCE	0
Your company's past participation in a rebate program sponsored by SCE	10
Training outside the pilot (if rating of 5 or greater, which trainings)	8

University staff noted that a shorter return on investment was the greatest benefit of promoting the pilot. University staff also said that very frequently deep energy savings was an explicit project goal.

Counterfactual Baseline and Project Net-to-Gross

The decision maker answered several questions about the path the university would likely have taken had the pilot and incentives not existed, and about the pilot influence on their decision to install the ALCS.

The decision maker said they would have installed a less ambitious lighting controls project had the pilot not existed. If the pilot did not exist, the decision maker would have installed the project more than one year later but within two years. Prior to learning about the pilot, they had not budgeted for the purchase of the lighting control system. Additionally, they had considered the energy savings in relation to the project cost in their decision to proceed with installing the lighting control system.

To determine the benefit/cost analysis, the university focused on smaller projects that can be accomplished in partnership with SCE pilot pricing and for which they obtain rebates through vendors. Project 004 was partially funded through the Chancellor's office, which helped fund the project through an awards system. University staff also indicated that without the pilot incentive, the return on their investment would have been high enough to install the same control system.

The decision maker answered several questions using Program Attribution Index scoring regarding the level of pilot influence on the customer's decision to install the lighting control system. First, the decision maker rated the pilot and non-pilot influences shown in Table 23 (known as Program Attribution Index 1).

Table 23. Program Attribution Index 1 Ratings

E4. Using a 0 to 10 rating scale, please rate the importance of each of the following in your decision to implement the advanced lighting controls with a graphical user interface.		
Type	**Factors**	**Score**
Pilot Influences	1. The availability of the pilot incentive	8
	2. Recommendations or suggestions from SCE pilot staff	0
	3. Recommendations or suggestions from SCE account representative	0
	4. Recommendations or suggestions from contractor or vendor	0
Non-Pilot Influences	5. Internal policy or requirements inside company or organization	3
	6. Concerns about environmental effects or global warming	6
	7. Desire to install a control system to improve employee morale	5
	8. Desire to save money on monthly energy bills	10
	9. Interest in the lighting control technology	10
	10. Desire to install a control system to reduce operation and maintenance costs	7
	11. Desire to install a control system to automate lighting decisions	8

Next, decision makers answered questions about the timing of their decision, and rated the relative importance of the pilot influences compared to the non-pilot influences: these are known as the Program Attribution Index 2, shown in Table 24.

Table 24. Program Attribution Index 2 Ratings

Question	Response	
Did you learn about the pilot before or after you decided to adopt or install the advanced lighting control system?	After	
Rate the importance of the pilot on your decision as opposed to other factors that may have influenced your decision. Using a 0 to 10 rating scale where 0 means *not at all important* and 10 means *very important*, please rate the overall importance of the pilot versus the most important of the other factors we just discussed in your decision to adopt or install the specific measure. This time the two importance ratings—the pilot importance and the non-pilot importance—should total 10.	**Pilot Score**	**Non-Pilot Score**
	4	6

The decision maker did not rate the likelihood they would have installed each aspect of the lighting control system had the pilot incentives not been available, because they would have either installed the full controls system or none of it but could not separate the separate features of the system.

As the decision maker was unable to provide specific data regarding control strategies they would have employed we calculated NTG using scores 1 and 2 only and estimated the project's NTG ratio as 32%. As it is difficult to determine the decisions maker's likely scenario without PAI3 scores we determined it is likely the absence of the program they were likely to have completed a lighting retrofit as least to code.

Satisfaction

Key Decision Maker

Overall, the decision maker expressed satisfaction with their pilot experience. Table 25 shows the respondent's satisfaction rating for various pilot elements.

Table 25. Decision Maker Satisfaction Ratings

Project Element	Response
Performance of new system	Very satisfied
Pilot overall	Very satisfied

In addition, the decision maker rated the application paperwork as *somewhat challenging*.

The decision maker said there was nothing specific that SCE could have done to improve their pilot experience, but said it was a pain to come up with data; otherwise, the decision maker had no major complaints.

Overall, the university staff expressed satisfaction with their pilot experience. Table 26 shows the respondent's satisfaction ratings for various pilot elements that a contractor would have fulfilled in a more traditional project.

Table 26. University Staff Satisfaction Ratings

Project Element	Response
SCE communications about the pilot and offerings	Very satisfied
Pre-installation process	Very satisfied
Post-installation process with verification contractor	Very satisfied
SCE making the paperwork easy	Somewhat satisfied
Time for paperwork to be processed	Somewhat satisfied
Response time to questions or inquiries	Very satisfied
Providing the right amount of support for contractors to confidently sell and install energy efficiency equipment	N/A
The final incentives provided	Very satisfied
Pilot overall	Very satisfied

The contractor said that SCE could have improved their pilot experience by creating something better than the current SCE log-in page, such as a Dropbox account to store and share all the documents.

Final Comments

The key decision maker is pleased that SCE is working to "push things forward" with energy-efficiency incentives.

End User Survey

Cadmus sent an online survey by email to the building occupants interacting with the new control system, and one person responded to the survey. We sent a follow-up request to the decision maker to send the survey a second time but received no additional responses. The one respondent had received training on how to use the system from the key decision maker, said that the training was very effective, and said they are somewhat effectively able to operate the system, as shown in Table 27.

Table 27. End User Survey Response

Project Element	Number of Responses	
Received training on the lighting control system	1	
Can effectively operate lighting controls	Very or somewhat effectively	Not too or not at all effectively
	1	0
Satisfaction with controls	Very or somewhat satisfied	Not very or not at all satisfied
	1	0

The respondent does not have administrator access and has not updated any of the control programming since the new controls were installed.

The respondent strongly agreed that the new systems have made the space more comfortable, improved the quality of their work, and reduced utility bills for the university. The respondent somewhat agreed that the system has made the space safer and improved the aesthetics. Overall, the respondent was very satisfied with the new lighting and control system.

ALCS – 005

Building Type: Industrial
Participant Industry: Manufacturing
Building Size: 98,880 sq ft
Project Area: 98,880 sq ft
Completion Date: November 2016
Lease/Own: Unknown
Number of Employees: Unknown
Contractor Group: CALCTP Trained[6]

Project Specifications

Project number 005 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 28. The facility retrofitted T-5, T-8, and T-12 fixtures with LED fixtures and integrated these new fixtures into the ALCS. The retrofit covered 100% of the building area. The facility operates seven days a week except for federal holidays.

Table 28. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Feasible; Not implemented
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, occupancy controls, scheduling, and zoning. Cadmus was unable to determine if the ALCS used lumen maintenance or automatic demand response; however, the system is capable of both. Daylight harvesting was a feasible control strategy; however, the contractor did not use daylight harvesting for unknown reasons.

Quality Assurance

RHA completed a pre-retrofit inspection of the facility, gathering fixture data and operating hours and completed light logging. RHA completed a post-inspection in February 2017 that included seven days of lighting logging, fixture verification, and functional testing of the ALCS. RHA conducted light logging in place of power monitoring due to safety concerns at the facility.

[6] CALCTP requires CALCTP-certified projects to be conducted by CALCTP-certified contractors using a CACLTP-certified project manager and CALCTP-certified installers. This study did not determine whether projects performed by CALCTP -certified contractors met these requirements or if the persons installing the ALCS had CALCTP training or certifications.

Upon final inspection, RHA found two issues with the project:

- The contractor did not provide a complete set of usage data from the ALCS for RHA's comparison. Six and a half days were provided were provided instead of the requested 7 days.
- Daylight harvesting was not employed in the primary daylighting zones as required by Title 24.

RHA accounted for these issues upon calculating verified savings for the project. Lighting logger results showed the ALCS system accurately accounted for operating hours of the lighting system with less than 2% variance in reported lighting hours. Cadmus reviewed savings documentation and found no issues with calculated savings for the lighting and ALCS system.

Energy Impacts

The installing contractor estimated the energy savings achieved by the project, which Cadmus compared to the energy savings verified by RHA to determine the project realization rate. RHA verified energy savings representing the condition found on the site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[7] Table 29 details project energy savings and demand reduction.

Table 29. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	399,354	466,615	504,683	32%	68%
Realization Rate	-	117%	108%	-	-
Demand Reduction (kW)	16.4	54.1	37.0	40%	60%
Realization Rate	-	331%	68%	-	-

The project achieved 504,683 kWh of energy savings and 37.0 kW of demand reduction. These energy savings account for a 77% reduction in lighting energy usage. The project contractor underestimated energy savings for this project by 17%, achieving a 117% realization rate. The LED upgrade accounted for 32% of project energy savings with the remaining 68% due to the ALCS.

The project achieved a relative energy savings of 5.1 kWh per square foot of project area. Considering the project costs, energy savings, and utility rate for this project, the customer would expect a simple payback of 2.6 years.

RHA did not provide above-code energy savings for this project.

[7] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

Pilot Awareness, Decision Making, and Challenges

The project decision maker declined to respond to the survey regarding their experiences with the pilot. Cadmus attempted to contact them six times on the phone and one email to request an interview but was not able to connect with the decision maker.

Willingness to Pay and Project Costs

The lighting project cost $234,631.00, and the decision maker received an incentive of $50,000.00 (Table 30). Without key decision maker feedback, Cadmus was unable to determine their willingness to complete the same project for a different incentive amount.

Table 30. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$234,631.00	$50,000.00	N/A

The project invoice included costs of the fixture upgrade and the ALCS system broken out separately. Of the total project cost Cadmus estimates that 83% of these costs funded the fixture upgrade while the remaining 17% or approximately $40,000 were the costs of the ALCS.

Contractor Interactions

The contractor declined to respond to the survey regarding their experience with the pilot. Cadmus attempted to contact them four times on the phone and left one voicemail to request an interview but was not able to connect with the contractor.

Final Comments

Because none of the key stakeholders responded to our requests for an interview, we do not have information regarding pilot satisfaction, contractor trainings, or other information.

ALCS – 006

Building Type: Industrial
Participant Industry: Manufacturing
Building Size: 25,000 sq ft
Project Area: 25,000 sq ft
Completion Date: November 2016
Lease/Own: Unknown
Number of Employees: Unknown
Contractor Group: CALCTP Trained[8]

Project Specifications

Project number 006 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 31. The facility retrofitted T-8 fixtures with LED fixtures and integrated these new fixtures into the ALCS. The retrofit covered 100% of the building area. The facility operates 24 hours a day, six days a week, and is closed on federal holidays.

Table 31. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Feasible; Not implemented
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, occupancy controls, scheduling, and zoning. Cadmus was unable to determine if the ALCS used lumen maintenance or automatic demand response; however, the system is capable of both. The contractor installed daylight harvesting sensors and controls with the ALCS but failed to activate the sensors at the time of site inspection.

Quality Assurance

RHA completed a pre-retrofit inspection of the facility, gathering fixture data and operating hours and completing power monitoring. RHA also completed a post-inspection in February 2017 that included seven days of power metering, fixture verification, and functional testing of the ALCS.

Upon final inspection, RHA found several issues with the project:

[8] CALCTP requires CALCTP-certified projects to be conducted by CALCTP-certified contractors using a CACLTP-certified project manager and CALCTP-certified installers. This study did not determine whether projects performed by CALCTP -certified contractors met these requirements or if the persons installing the ALCS had CALCTP training or certifications.

- Fixture were not communicating correctly with the ALCS and reported erroneous data to the central computer; this was likely due to a wiring error.
- Daylight harvesting features and sensors were present but not used by the control system.
- Occupancy sensor time delays could be reduced to 10 minutes for the observed setting of 15 minutes to realize additional energy savings.

RHA accounted for these issues upon calculating verified savings for the project.

Energy Impacts

The installing contractor estimated the energy savings achieved by the project, which Cadmus compared to the energy savings verified by RHA to determine the project realization rate. RHA verified energy savings representing the condition found on the site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[9] Table 32 details project energy savings and demand reduction.

Table 32. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	177,457	162,224	154,276	73%	27%
Realization Rate	-	91%	95%	-	-
Demand Reduction (kW)	27.8	24.5	14.5	76%	24%
Realization Rate	-	88%	59%	-	-

The project achieved 154,276 kWh of energy savings and 14.5 kW of demand reduction. These energy savings account for an 80% reduction in lighting energy usage. The project contractor overestimated energy savings for this project by 9%, achieving a 91% realization rate. The LED upgrade accounted for 73% of project energy savings with the remaining 27% due to the ALCS.

The project achieved a relative energy savings of 6.2 kWh per square foot of project area. Considering the project costs, energy savings, and utility rate for this project, the customer would expect a simple payback of 2.1 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the above-code savings for this project. The methods they applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods led to an estimated 34,074 kWh of energy savings for this project above Title 24 code. Cadmus evaluated above code savings for this project to be 12,785 kWh and 12.2 kW of demand reduction.

[9] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

Pilot Awareness, Decision Making, and Challenges

The project decision maker declined to respond to the survey regarding their experiences with the pilot. Cadmus attempted to contact them seven on the phone, including six voicemails to request an interview, but was not able to connect with the decision maker.

Willingness to Pay and Project Costs

The lighting project cost $114,201.00, and the decision maker received an incentive of $50,000.00 (Table 33). Without key decision maker feedback, Cadmus was unable to determine their willingness to complete the same project for a different incentive amount.

Table 33. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$114,201.00	$50,000.00	N/A

The project invoice included costs of the fixture upgrade and the ALCS system broken out separately. Of the total project cost Cadmus estimates that 71% of these costs funded the fixture upgrade while the remaining 29% or approximately $33,000 were the costs of the ALCS.

Contractor Interactions

The contractor had an incomplete phone number and an undeliverable email address. The same company, but a different contractor, was listed for a different project. Had we been able to reach that contractor we would have attempted to obtain better contact information for this project.

Final Comments

Because none of the key stakeholders responded to our requests for an interview, we do not have information regarding pilot satisfaction, contractor trainings, or other information.

ALCS – 007

Building Type: Warehouse and Office (only warehouse was affected by ALCS updates)
Participant Industry: Manufacturing
Building Size: 80,000 sq ft
Project Area: 65,000 sq ft
Completion Date: April 2016
Lease/Own: Unknown
Number of Employees: Unknown
Contractor Group: CALCTP Trained[10]

Project Specifications

Project number 007 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 34. The facility retrofitted metal halide and high-pressure sodium fixtures with LED fixtures in the building and integrated these new fixtures into the ALCS. The retrofit covered 81% of the building area. The facility operates Monday through Friday from 7:00 a.m. to 5:00 p.m.

Table 34. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Feasible; Not implemented
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, occupancy controls, scheduling, and zoning. Cadmus was unable to determine if the ALCS used lumen maintenance or automatic demand response; however, the system is capable of both. Daylight harvesting was feasible but not employed in the ACLS because the contractor failed to install daylight harvesting sensors due to their misunderstanding of the capabilities of the installed sensors.

Quality Assurance

A member of the SCE third party review team completed a pre-retrofit inspection of the facility, gathering fixture data and operating hours and completed light logging. RHA completed a post-inspection in June 2016 that included seven days of power monitoring, fixture verification, and functional testing of the ALCS.

[10] CALCTP requires CALCTP-certified projects to be conducted by CALCTP-certified contractors using a CACLTP-certified project manager and CALCTP-certified installers. This study did not determine whether projects performed by CALCTP -certified contractors met these requirements or if the persons installing the ALCS had CALCTP training or certifications.

Upon final inspection, RHA found two issues with the project:

- Daylight harvesting was not employed in the primary daylighting zone as required by Title 24. The installing contractor had misunderstood the capabilities of the sensors they installed assuming those sensors were equipped with a daylight sensor.
- The customer mentioned the lighting levels were too low in some areas of the facility and noticed that some of the fixtures equipped with occupancy sensors did not appear to be turning off fixtures during unoccupied periods.
- The installing contractor had conducted their own light logging before installing the new lighting system, however the contractor had analyzed the data incorrectly.
- The daytime tuning strategy was set to 100% increasing the energy consumption of the lighting system during the daytime, RHA recommends this setting should be reconsidered by the customer as the nighttime setting is only 80%. However due to the customers perception the lighting is insufficient this is unlikely.
- The original lighting energy consumption and fixture wattages were incorrectly entered into the ALCS by the contractor resulting in the system incorrectly reporting energy savings.

RHA accounted for these issues upon calculating verified savings for the project. While the system was not reporting correct energy consumption due to a data entry issue, the power metering results showed the ALCS system accurately accounted for energy consumption of the lighting system with less than 1% variance in reported energy usage.

Energy Impacts

The installing contractor estimated the energy savings achieved by the project, which Cadmus compared to the energy savings verified by RHA to determine the project realization rate. RHA verified energy savings representing the condition found on the site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[11] Table 35 details project energy savings and demand reduction.

Table 35. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	375,994	268,904	296,897	84%	16%
Realization Rate	-	72%	110%	-	-
Demand Reduction (kW)	43.4	12.8	9.0	100%	0%
Realization Rate	-	30%	70%	-	-

The project achieved 296,897 kWh of energy savings and 9.0 kW of demand reduction. These energy savings account for an 88% reduction in lighting energy usage. The project contractor overestimated

[11] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

savings for this project by 28%, achieving a 72% realization rate. The LED upgrade accounted for 84% of project energy savings with the remaining 16% due to the ALCS.

The project achieved a relative energy savings of 4.6 kWh per square foot of project area. Considering the project costs, energy savings, and utility rate for this project, the customer would expect a simple payback of 1.6 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the above-code savings for this project. The methods they applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods led to an estimated 197,160 kWh of energy savings for this project above Title 24 code. Cadmus evaluated above code savings for this project to be 217,684 kWh and 9.0 kW of demand reduction.

Pilot Awareness, Decision Making, and Challenges

Cadmus was unable to speak with a project decision maker at the site, and none of our five telephone calls (with voicemail) and emails were returned.

Willingness to Pay and Project Costs

The lighting project cost $132,299.00, and the decision maker received an incentive of $50,000.00 (Table 36). Without key decision maker feedback, Cadmus was unable to determine their willingness to complete the same project for a different incentive amount.

Table 36. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$132,299.00	$50,000.00	N/A

The project invoice included costs of the fixture upgrade and the ALCS system broken out separately. Of the total project cost Cadmus estimates that 80% of these costs funded the fixture upgrade while the remaining 20% or approximately $27,000 were the costs of the ALCS.

Contractor Interactions

Contractor 2 was the contractor for this project from start to finish, design through install. The contractor offers commissioning; electrical and lighting; controls (mechanical, electrical, lighting, and energy management); energy assessments, diagnostics, or ratings; HVAC equipment; mechanical systems; insulation and building envelope measures; and renewable energy; as well as training and consulting.

For this project, the decision maker received an incentive check from SCE.

Contractor Training

The contractor firm is designated as having received California Advanced Lighting Control Training Program training. However, the lead contractor (interviewed) was not CALCTP-certified. The only

project-related training received by the lead contractor was through the California Civilian Conservation Corp.

The contractor learned about the pilot through contact with an SCE representative. They expressed a preference for staying informed about the pilot through the SCE website as well as in emails from SCE representatives. The contractor chose to recommend the pilot to customers because of the cost savings.

Contractor Experience with Pilot

The contractor did not experience acceptance testing for the project.

On a scale of 0 to 10, where 0 means *not at all influential* and 10 means *very influential*, the contractor rated the pilot as a 7 in influencing their decision to recommend that the company install the advanced lighting control system.

Participating in the pilot did not change the contractor's sales for advanced lighting control systems. The contractor reported that before participating in the pilot, they recommended advanced lighting control systems 90% of the time; After participating, they still recommend these systems 90% of the time.

Table 37 shows the importance ratings provided by the contractor.

Table 37. Contractor Attribution Ratings

H6. Using a 0 to 10 rating scale, how important in your recommendation was…:	
Factors	**Score**
Information provided on SCE's website	9
Training and seminars provided by SCE	7
Your company's past participation in a rebate program sponsored by SCE	8
Training outside the pilot (if rating of 5 or greater, which trainings)	6

The contractor noted that being able to spend more time with customers and work with them on pricing and rebate project options was the greatest benefit of promoting the pilot. The contractor also said that 90% of the time they discuss the pilot and project goals to achieve "deep energy savings."

Satisfaction

Contractor

Overall, the contractor expressed high satisfaction with their pilot experience. Table 38 shows the respondent's satisfaction rating for various pilot elements.

Table 38. Contractor Satisfaction Ratings

Project Element	Response
SCE communications about the pilot and offerings	Very satisfied
Pre-installation process	Somewhat satisfied
Post-installation process with verification contractor	Somewhat satisfied
SCE making the paperwork easy	Somewhat satisfied
Time for paperwork to be processed	Not very satisfied
Response time to questions or inquiries	Somewhat satisfied
Providing the right amount of support for contractors to confidently sell and install energy efficiency equipment	Very satisfied
The final incentives provided	Somewhat satisfied
Pilot overall	Very satisfied

The contractor said the pilot ran smoothly and that he had no additional suggestions for what SCE could do to improve his pilot experience.

Final Comments

The contractor had no final comments about this project. Cadmus was not able to administer an end user feedback survey for this project since we were unable to contact any key decision makers at the business.

ALCS – 008

Building Type: Warehouse
Participant Industry: Manufacturing
Building Size: 279,696 sq ft
Project Area: 243,386 sq ft
Completion Date: August 2016
Lease/Own: Unknown
Number of Employees: Unknown
Contractor Group: Manufacturer Trained

Project Specifications

Project number 008 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 39. The facility retrofitted T-5, T-8, and Metal Halide fixtures with LED fixtures, and integrated these new fixtures into the ALCS. The retrofit covered 87% of the building area, focusing on the production and warehouse areas. The facility operates 24 hours a day, 365 days of the year.

Table 39. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Feasible; Not Implemented
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, occupancy controls, scheduling, and zoning. Though Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, the system is capable of both. Daylight harvesting was feasible in the building, given the building contained skylights and windows. Due to safely concerns, however, the daylight harvesting features were not activated.

Quality Assurance

A SCE account manager completed a pre-retrofit inspection of the facility, gathering fixture data and operating hours, which RHA reviewed and used in project calculations. In August 2016, RHA completed a post-inspection that included seven days of power metering, fixture verification, and functional testing of the ALCS.

Upon final inspection, RHA found several issues with the project:

- The control software could not accurately gauge the ALCS system's energy consumption due to a software compatibility issue and the timing of feedback that the ALCS receives. As the ALCS receives feedback from each fixture with a significant 5 to 15-minute delay, energy usage

reported by the ACLS falsely reports energy consumption if an event lasts less than the reporting time.

- The facility was the first site using a specific combination of controllers and software. As such, the system manufacturer cited the system's development as the primary cause for much ALCS system false reporting.
- The installing contractor did not provide a complete zoning diagram to the customer. Due to this oversight, the customer could not quickly identify zones when updating the ALCS settings.
- The ALCS does not measure energy usage of the installed lighting but calculates usage based on manually entered wattage and commands from the fixtures. The entered wattages were incorrect resulting in false reporting by the ALCS.

RHA accounted for these issues upon calculating verified savings for the project, including accounting for consumption and savings from observed ALCS conditions during monitoring. Power monitoring results were 65% higher than the reported energy consumption of the ALCS. This indicated the system did not accurately account for the ALCS' energy consumption and savings.

Energy Impacts

The installing contractor estimated energy savings achieved by the project, which Cadmus compared to RHA-verified energy savings to determine the project realization rate. RHA-verified energy savings represented conditions found on site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[12] Table 40 details project energy savings and demand reduction.

Table 40. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	258,417	179,441	198,121	51%	49%
Realization Rate	-	69%	110%	-	-
Demand Reduction (kW)	10.4	18.7	13.1	56%	44%
Realization Rate	-	180%	70%	-	-

The project achieved 198,121[13] kWh of energy savings and 13.1 kW of demand reduction. These energy savings accounted for a 30% reduction in lighting energy usage. The project contractor overestimated this project's savings by 31%, achieving a 69% realization rate. The LED upgrade accounted for 51% of the project's energy savings with the remaining 49% due to the ALCS.

[12] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

[13] The fixtures installed by the contractor could not be identified by Cadmus in DLC QPL.

The project achieved a relative energy savings of 0.8 kWh per square foot of project area. Considering the project costs, energy savings, and utility rate for this project, the customer could expect a simple payback of 6.6 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the above-code savings for this project. The methods applied allowed them to consider the maximum lighting power density and the required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods led to an estimated 36,890 kWh of energy savings for this project above the Title 24 code. Cadmus evaluated above code savings for this project to be 40,730 kWh and 13.1 kW of demand reduction.

Pilot Awareness, Decision Making, and Challenges

The project decision maker declined to respond to the survey regarding their experiences with the pilot. Cadmus attempted to contact them four times on the phone and left three voicemails to request an interview but was not able to connect with the decision maker.

Willingness to Pay and Project Costs

The lighting project cost $214,600.00, and the decision maker received an incentive of $50,000.00 (Table 41).

Table 41. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$214,600.00	$50,000.00	N/A

The project invoice included fixture upgrade and ALCS system costs broken out separately. Of the total project cost, Cadmus estimates 87% funded the fixture upgrade while the remaining 13% (approximately $28,000) were ALCS costs.

Contractor Interactions

The contractor declined to respond to the survey regarding their experience with the pilot. Cadmus attempted to contact them four times on the phone, left three voicemails and two emails to request an interview, but was not able to connect with the contractor.

Final Comments

Because none of the key stakeholders responded to our requests for an interview, we do not have information regarding pilot satisfaction, contractor trainings, or other information.

ALCS – 009

Building Type: Refrigerated Warehouse
Participant Industry: Food Processing
Building Size: 247,529
Project Area: 247,529
Completion Date: April 2015
Lease/Own: Unknown
Number of Employees: Unknown
Contractor Group: Manufacturer Trained

Project Specifications

Project number 009 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 42. The facility retrofitted T-8 and metal halide fixtures with LED fixtures and integrated these new fixtures into the ALCS. The retrofit covered the entire building area. The facility operates six days a week, 20 hours a day, including all holidays.

Table 42. Project Functions Implemented

Function	Implemented?
Task Tuning	Feasible, Not Implemented
Daylighting Harvesting	Yes
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Feasible, Not Implemented
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed daylight harvesting, occupancy controls, and zoning. Though Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, the system is capable of both. Task tuning was not employed for unknown reasons, with all fixtures set to a maximum output of 100%. Scheduling always remains feasible; as the building operates nearly continuously, however, but a small amount of additional energy savings may be achieved through programming a schedule during unoccupied times.

Quality Assurance

An SCE representative completed a pre-retrofit inspection of the facility, gathering fixture data and operating hours reviewed by RHA. The review found documented operating hours did not accurately represent the building's true operating hours and updated hours based on facility staff interviews. In June 2016, RHA completed a post-inspection that included seven days of power metering, fixture verification, and functional testing of the ALCS.

Upon final inspection, RHA found several issues with the project:

- The installing contractor did not complete system commissioning upon scheduling a post-inspection with RHA. Due to this oversight, RHA could only document system energy savings achieved during the inspection and monitoring period.
- During occupied periods, the fixtures were set to 100% output. RHA identified this as unnecessary and recommended tuning the fixtures to less than 100% to realize task tuning energy savings.
- The control system was not configured for daylight harvesting during the inspection; consequently, monitoring energy savings for daylight harvesting could not be quantified. The contractor later activated the daylight harvesting feature after completion of post-inspection.

RHA accounted for these issues upon calculating the project's verified savings. During power monitoring, results fell within 3% of reported ALCS energy consumption, verifying the system correctly accounted for energy usage. The system, however, did not achieve its full potential due to the above-documented issues.

Energy Impacts

The installing contractor estimated energy savings achieved by the project, which Cadmus compared to energy savings verified by RHA to determine the project realization rate. RHA verified energy savings representing conditions found on site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[14] Table 43 details project energy savings and demand reduction.

Table 43. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	434,786	753,109	1,049,454	64%	36%
Realization Rate	-	173%	139%	-	-
Demand Reduction (kW)	66.9	68.4	38.9	100%	0%
Realization Rate	-	102%	57%	-	-

The project achieved 1,049,454 kWh of energy savings and 38.9 kW of demand reduction. These energy savings accounted for an 82% reduction in lighting energy usage. The project contractor underestimated project savings by 73%, achieving a 173% realization rate. The LED upgrade accounted for 64% of project energy savings with the remaining 36% due to the ALCS.

The project achieved relative energy savings of 4.2 kWh per square foot of project area. Considering the project costs, energy savings, and utility rate, the customer could expect a simple payback of 6.9 years.

[14] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the project's above-code savings. The methods applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods led to an estimated 505,838 kWh of energy savings for this project above Title 24 code. Cadmus evaluated above code savings for this project to be 656,911 kWh and 38.9 kW of demand reduction.

Pilot Awareness, Decision Making, and Challenges

The project decision maker declined to respond to the survey regarding their experience with the pilot. Cadmus sent three emails, called the decision maker three times and left a voicemail to request an interview but was not able to connect with the decision maker.

Willingness to Pay and Project Costs

The lighting project cost $328,453.00, and the decision maker received an incentive of $40,271.00 (Table 44).

Table 44. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$328,453.00	$40,271.00	N/A

Contractor Interactions

Contractor 17 was the contractor for this project. They were very involved in developing the project scope, and Cadmus interviewed the project manager in charge of the project design, development, and delivery. For this project, the contractor filled out the rebate application for the decision maker.

Contractor Training

The contractor learned about the pilot through contact with their SCE representative. They expressed a preference for staying informed about the pilot through emails from SCE. The contractor chose to recommend the pilot to customers because of cost savings and the incentive provided, and to gain a competitive advantage in the marketplace. They also chose to participate in the pilot because the work necessary to meet the pilot standards was not a massive undertaking: they just had to install light rules and a low voltage network, and when they crunched the numbers ahead of time they realized they could be better off through the pilot.

The contractor has worked in lighting and controls contracting for three years and has Digital Lumens training and Title 24 training. They had to subcontractor some of the project work regarding acceptance testing to a contractor with a license in California.

Contractor Experience with Pilot

The contractor did experience acceptance testing for the project and was not impressed because the energy efficiency engineering industry already performs so much disclosure that the contractor already compiles data that the acceptance testing required for pre- and post- light levels.

On a scale of 0 to 10, where 0 means *not at all influential* and 10 means *very influential*, the contractor rated the pilot as a 10 in influencing their decision to recommend that the company install the advanced lighting control system.

Participating in the pilot did change the contractor's sales for advanced lighting control systems. Before participating in the pilot, the contractor recommended advanced lighting control systems 30% of the time, but after participating, they recommend these systems 100% of the time.

Table 45 shows the importance ratings provided by the contractor.

Table 45. Contractor Attribution Ratings

H6. Using a 0 to 10 rating scale, how important in your recommendation was…:	
Factors	**Score**
Information provided on SCE's website	0
Training and seminars provided by SCE	0
Your company's past participation in a rebate program sponsored by SCE	7
Training outside the pilot (if rating of 5 or greater, which trainings)	0

The contractor noted that they were going to lose money on the project because of how much they had been shorted in the incentive amounts, so being able to recuperate the lost costs was the greatest benefit of promoting the pilot. The contractor noted that being able to make a customer happy for free was also good. The contractor also said that deep energy savings is almost never their explicit goal: the work is more about convincing a prospective client of the lighting system's value.

Satisfaction

Contractor

Overall, the contractor expressed satisfaction with their pilot experience. Table 46 shows the respondent's satisfaction ratings for various pilot elements.

Table 46. Contractor Satisfaction Ratings

Project Element	Response
SCE communications about the pilot and offerings	Somewhat satisfied
Pre-installation process	Somewhat satisfied
Post-installation process with verification contractor	Somewhat satisfied
SCE making the paperwork easy	Somewhat satisfied
Time for paperwork to be processed	Very satisfied
Response time to questions or inquiries	Very satisfied
Providing the right amount of support for contractors to confidently sell and install energy efficiency equipment	Somewhat satisfied
The final incentives provided	Somewhat satisfied
Pilot overall	Very satisfied

The contractor said that SCE could have made the requirements as plain as possible from the beginning to improve their pilot experience.

ALCS – 010

Building Type: Offices
Participant Industry: Public Services
Building Size: 41,050 sq. ft
Project Area: 41,050 sq. ft
Completion Date: November 2016
Lease/Own: Own
Number of Employees: 250–300
Contractor Group: CALCTP Trained[15]

Project Specifications

Project number 010 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 47. The facility retrofitted T-8 fixtures with LED fixtures and integrated these new fixtures into the ALCS. The retrofit covered 100% of the building's area. The facility operates Monday through Thursday, from 8:00 am to 8:00 pm and on Fridays from 8:00 am to 6:00 pm; it does not operate on holidays.

Table 47. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Feasible; Not Implemented
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Feasible; Not Implemented
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, occupancy controls, a schedule, and zoning. Though Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, the system is capable of both. The contractor did not install daylight harvesting sensors as required by code; consequently, a daylight harvesting control was not employed, nor was a schedule programmed into the ALCS. Programming a new schedule for the unoccupied period could achieve additional savings through more aggressing occupancy delays and tuning levels. The system included individual controls in offices, conference rooms, and classrooms, allowing manual adjustments to lighting levels. Common and storage areas did not include these manual controls.

[15] CALCTP requires CALCTP-certified projects to be conducted by CALCTP-certified contractors using a CACLTP-certified project manager and CALCTP-certified installers. This study did not determine whether projects performed by CALCTP -certified contractors met these requirements or if the persons installing the ALCS had CALCTP training or certifications.

Quality Assurance

RHA completed a pre-retrofit inspection of the facility, gathering fixture data and operating hours, and monitored lighting usage for seven days. In November 2016, RHA completed a post-inspection that included seven days of power metering, fixture verification, and functional testing of the ALCS.

Upon final inspection, RHA found one significant issue with the project:

- The building's perimeter fixtures were in the primary daylighting zone and were not configured for daylight harvesting. RHA recommends that the contractor install daylight harvesting sensors and configure the system to utilize the ALCS' daylight harvesting feature.

RHA accounted for this issue upon calculating the project's verified savings. This included calculating savings for the building's condition during post inspection. It remains unclear, however, if the contractor could reconcile the building's lack of daylight harvesting sensors. Power monitoring results indicated that ALCS-reported energy consumption fell within 1% of the monitored load, verifying that the system correctly accounted for energy usage. The system, however, did not achieve its full potential due to the above documented issue.

Energy Impacts

The installing contractor estimated the energy savings achieved by the project, which Cadmus compared to the energy savings verified by RHA to determine the project realization rate. RHA verified energy savings representing the condition found on the site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[16] Table 48 details project energy savings and demand reduction.

Table 48. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	112,516	109,782	121,323	66%	34%
Realization Rate	-	98%	111%	-	-
Demand Reduction (kW)	37.8	23.6	20.0	75%	25%
Realization Rate	-	62%	85%	-	-

The project achieved 121,323 kWh of energy savings and 20.0 kW demand reduction. The energy savings accounted for an 86% reduction in lighting energy usage. The project contractor overestimated savings for this project by 2%, resulting in a 98% realization rate. The LED upgrade accounted for 66% of project energy savings with the remaining 34% due to the ALCS.

[16] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

The project achieved a relative energy savings of 3.0 kWh per square foot of project area. Considering the project costs, energy savings, and utility rate for this project, the customer would expect a simple payback of 5.1 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the above-code savings for this project. The methods they applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods led to an estimated 57,926 kWh of energy savings above Title 24 code. Cadmus evaluated above code savings for this project to be 62,608 kWh and 20.0 kW of demand reduction.

Pilot Awareness, Decision Making, and Challenges

Cadmus was unable to speak with a key decision maker. The provided decision maker was no longer with the business and no remaining staff been involved with the project.

Willingness to Pay and Project Costs

The lighting project cost $156,143.00, and the decision maker received an incentive of $50,000.00 (Table 49).

Table 49. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$156,143.00	$50,000.00	N/A

Contractor Interactions

Contractor 2 was the prime contractor for this project from start to finish, audit to design through install. They offer commissioning; electrical and lighting; controls (mechanical, electrical, lighting, and energy management); energy assessments, diagnostics, or ratings; HVAC equipment; mechanical systems; insulation and building envelope measures; and renewable energy; as well as training and consulting.

The contractor was chosen because they had worked with the decision maker on previous projects. For this project, the decision maker filled out the rebate application and received an incentive check in the mail from SCE.

Contractor 2 worked with Day Tree, a lighting manufacturer, on this project. Another firm was involved that helped with post inspections (the contractor could not recall the company name).

Contractor Training

The contractor firm is designated as having received California Advanced Lighting Control Training Program training. However, the lead contractor (interviewed) was not CALCTP-certified. The only project-related training received by the lead contractor was through the California Civilian Conservation Corp.

The contractor learned about the pilot through contact with an SCE representative. They expressed a preference for staying informed about the pilot through the SCE website as well as in emails from SCE representatives. The contractor chose to recommend the pilot to customers because of the cost savings.

Contractor Experience with Pilot

The contractor did not experience acceptance testing for the project.

On a scale of 0 to 10, where 0 means *not at all influential* and 10 means *very influential*, the contractor rated the pilot as a 7 in influencing their decision to recommend that the company install the advanced lighting control system.

Participating in the pilot did not change the contractor's sales for advanced lighting control systems. The contractor reported that before participating in the pilot, they recommended advanced lighting control systems 90% of the time; After participating, they recommend these systems 90% of the time.

Table 50 shows the importance ratings provided by contractors.

Table 50. Contractor Attribution Ratings

H6. Using a 0 to 10 rating scale, how important in your recommendation was…:	
Factors	**Score**
Information provided on SCE's website	10
Training and seminars provided by SCE	7
Your company's past participation in a rebate program sponsored by SCE	7
Training outside the pilot (if rating of 5 or greater, which trainings)	5

The contractor noted that being able to spend more time with customers and work with them on pricing and rebate project options was the greatest benefit of promoting the pilot. The contractor also said that they discussed the pilot and project goals to achieve "deep energy savings" for this project.

Satisfaction

Contractor

Overall, the contractor expressed high satisfaction with their pilot experience. Table 51 shows the respondent's satisfaction rating for various pilot elements.

Table 51. Contractor Satisfaction Ratings

Project Element	Response
SCE communications about the pilot and offerings	Very satisfied
Pre-installation process	Somewhat satisfied
Post-installation process with verification contractor	Somewhat satisfied
SCE making the paperwork easy	Somewhat satisfied
Time for paperwork to be processed	Not very satisfied
Response time to questions or inquiries	Somewhat satisfied
Providing the right amount of support for contractors to confidently sell and install energy efficiency equipment	Very satisfied
The final incentives provided	Somewhat satisfied
Pilot overall	Very satisfied

The contractor said the pilot ran smoothly and they had no additional suggestions for ways SCE could improve their pilot experience.

ALCS – 011

Building Type: Office
Participant Industry: Education/School/University
Building Size: 30,012 sq ft
Project Area: 22,000 sq ft
Completion Date: March 2016
Lease/Own: Own
Number of Employees: 300 (In the building)
Contractor Group: CALCTP Trained[17]

Project Specifications

Project number 011 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 52. The facility retrofitted T-8 fixtures with LED fixtures and integrated these new fixtures into the ALCS. The retrofit covered approximately 73% of the building area. The building office hours are from 9:00 a.m. to 4:00 p.m., Monday, Tuesday, Thursday, and Friday; and 10:00 a.m. to 4:00 p.m. on Wednesdays. The building closes on federal holidays.

Table 52. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Yes
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, daylight harvesting, occupancy controls, scheduling, and zoning. Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, though the system is capable of both.

Quality Assurance

A member of SCE's third-party technical review team completed pre-inspection site verification, documenting the building's operating hours and lighting fixtures. RHA reviewed these data and determined that documented operating hours were underestimated. RHA updated the operating hours of the building based on observed occupancy patterns found during post-inspection and on an interview with the facility manager. In June 2016, RHA completed a post-inspection that included seven days of

[17] CALCTP requires CALCTP-certified projects to be conducted by CALCTP-certified contractors using a CACLTP-certified project manager and CALCTP-certified installers. This study did not determine whether projects performed by CALCTP -certified contractors met these requirements or if the persons installing the ALCS had CALCTP training or certifications.

light logging, spot measurements of lighting energy consumption, fixture verification, and functional testing of the ALCS.

Upon final inspection, RHA found several issues with the project:

- Consumption reported by the ALCS did not match data-logged values as 54 fixtures in private offices and emergency lights were not connected to the ALCS. Hence, the analysis scope excluded these fixtures.
- RHA noted that daylight harvesting controls provided insignificant energy savings due to the fixtures' proximity to windows and the aggressive task tuning employed by the controls. While this is not an installation error, but, due to system circumstances, controls employing daylight harvesting provided minimal additional savings.
- The installed ALCS accurately gauged energy consumption of new lighting; when calculating energy savings, however, it relied on the user to accurately input the original lighting system's fixtures and operating hours. The installed ALCS did not accurately report energy savings due to incorrect data entered by the installing contractor.

RHA accounted for these issues upon calculating the project's verified savings. Light logging results indicated that usage reported by the lighting control system fell within 3% of observed usage, indicating the system accurately reported consumption for controlled fixtures. RHA used the installed ALCS' reported energy usage and, upon calculating energy savings, calculations of baseline usage for the original lighting system.

Energy Impacts

The installing contractor estimated the energy savings achieved by the project, which Cadmus compared to the energy savings verified by RHA to determine the project realization rate. RHA verified energy savings representing the condition found on the site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[18] Table 53 details project energy savings and demand reduction.

Table 53. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	80,843	61,283	62,718	47%	53%
Realization Rate	-	76%	102%	-	-
Demand Reduction (kW)	14.3	14.4	11.6	50%	50%
Realization Rate	-	101%	81%	-	-

The project achieved 62,718 kWh of energy savings and 11.6 kW demand reduction. The energy savings accounted for an 82% reduction in lighting energy usage. The project contractor underestimated savings

[18] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

for this project by 24%, resulting in a 76% realization rate. The LED upgrade accounted for 47% of project energy savings with the remaining 53% due to the ALCS.

The project achieved a relative energy savings of 2.9 kWh per square foot of project area. Considering the project costs, energy savings, and utility rate for this project, the customer would expect a simple payback of 11.8 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the above-code savings for this project. The methods they applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods led to an estimated 32,192 kWh of energy savings above Title 24 code. Cadmus evaluated above code savings for this project to be 29,607 kWh and 11.6 kW of demand reduction.

Pilot Awareness, Decision Making, and Challenges

The project decision maker learned about the pilot from the SCE program manager and contractor. University staff initiated the lighting project at the facility.

The decision maker noted the following factors as being important in their decision to make the lighting system upgrades through the pilot:

- Most important: To obtain the incentive
- To save money

The decision maker cited lack of awareness about available incentives for energy-efficient equipment as the biggest challenge they face in making energy-efficient improvements:

The decision maker said that when deciding whether to participate in the pilot, they experienced a barrier in viewing the pilot as unorganized and poorly administered; they mentioned it was challenging to get accurate information from the program administrator.

The decision maker said their organization has benefited from participating in the pilot because of better aesthetics with the new lighting.

Willingness to Pay and Project Costs

The lighting project cost $100,823.00, and the decision maker received an incentive of $29,416.00 (Table 54). According to the decision maker, they would not have installed the same project if they received 75% of the pilot incentive.

Table 54. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$100,823.00	$29,416.00	$22,062.00

Contractor Interactions

Contractor 2 was the contractor for this project from start to finish, design through install. They offer commissioning; electrical and lighting; controls (mechanical, electrical, lighting, and energy management); energy assessments, diagnostics, or ratings; HVAC equipment; mechanical systems; insulation and building envelope measures; and renewable energy; as well as training and consulting. The contractor sought out the key decision maker and had the lowest bid, both of which were factors in the key decision maker choosing to work with Contractor 2.

For this project, the decision maker received an incentive check from SCE.

Contractor Training

A second firm provided labor as a subcontractor on this project, supervised by Contractor 2, the prime contractor.

The Contractor 2 is designated as having received California Advanced Lighting Control Training Program training. However, the lead contractor (interviewed) was not CALCTP-certified. The only project-related training received by the lead contractor was through the California Civilian Conservation Corp.

The contractor learned about the pilot through contact with an SCE representative. They expressed a preference for staying informed about the pilot through the SCE website as well as in emails from SCE representatives. The contractor chose to recommend the pilot to customers because of the cost savings.

Contractor Experience with Pilot

The contractor did not experience acceptance testing for the project.

On a scale of 0 to 10, where 0 means *not at all influential* and 10 means *very influential*, the contractor rated the pilot as a 7 in influencing their decision to recommend that the company install the advanced lighting control system.

Participating in the pilot did not change the contractor's sales for advanced lighting control systems. The contractor reported that before participating in the pilot, they recommended advanced lighting control systems 90% of the time; after participating, they recommend these systems 90% of the time.

Table 55 shows the importance ratings provided by the contractor.

Table 55. Contractor Attribution Ratings

H6. Using a 0 to 10 rating scale, how important in your recommendation was…:	
Factors	**Score**
Information provided on SCE's website	9
Training and seminars provided by SCE	7
Your company's past participation in a rebate program sponsored by SCE	8
Training outside the pilot (if rating of 5 or greater, which trainings)	6

The contractor noted that being able to spend more time with customers and work with them on pricing and rebate project options was the greatest benefit of promoting the pilot. The contractor also said that 90% of the time they discuss the pilot and project goals to achieve "deep energy savings."

Decision Maker Perceptions of the Contractor

The decision maker rated themselves as *somewhat satisfied* with their experience with the contractor, because the project took longer than expected and was a little disorganized at outset. However, the decision maker commented that workmanship and quality assurance were good.

The decision maker noted that the contractor did not have to correct issues during commissioning, code inspection, or SCE QA.

Counterfactual Baseline and Project Net-to-Gross

The decision maker answered several questions about the likely path they would have taken had the pilot and incentives not existed, and about the pilot influence on their decision to install the ALCS.

The decision maker would have not installed this project had the pilot not existed. Prior to learning about the pilot, they had not budgeted for the purchase of the lighting control system. Additionally, they had considered the energy savings in relation to the project cost in their decision to proceed with installing the lighting control system. There are approximately 130 buildings on the campus, and staff understand where energy-savings opportunities exist. The staff perform regular benchmarking and audits. The decision maker also indicated that without the pilot incentive, the return on their investment would not have been high enough to install the same control system.

The decision maker answered several questions using Program Attribution Index scoring regarding the level of pilot influence on their decision to install the lighting control system. First, the decision maker rated the pilot and non-pilot influences shown in Table 56 (known as Program Attribution Index 1).

Table 56. Program Attribution Index 1 Ratings

E4. Using a 0 to 10 rating scale, please rate the importance of each of the following in your decision to implement the advanced lighting controls with a graphical user interface.		
Type	**Factors**	**Score**
Pilot Influences	1. The availability of the pilot incentive	10
	2. Recommendations or suggestions from SCE pilot staff	7
	3. Recommendations or suggestions from SCE account representative	8
	4. Recommendations or suggestions from contractor or vendor	8
Non-Pilot Influences	5. Internal policy or requirements inside company or organization	5
	6. Concerns about environmental effects or global warming	3
	7. Desire to achieve energy independence	2
	8. Desire to save money on monthly energy bills	9
	9. Interest in the lighting control technology	6
	10. Desire to install a control system to reduce operation and maintenance costs	7
	11. Desire to install a control system to automate lighting decisions	6

Next, the decision maker answered questions about the timing of their decision and rated the relative importance of the pilot influences compared to the non-pilot influences: these are known as the Program Attribution Index 2, shown in Table 57.

Table 57. Program Attribution Index 2 Ratings

Question	Response	
Did you learn about the pilot before or after you decided to adopt or install the advanced lighting control system?	Before	
Rate the importance of the pilot on your decision as opposed to other factors that may have influenced your decision. Using a 0 to 10 rating scale where 0 means *not at all important* and 10 means *very important*, please rate the overall importance of the pilot versus the most important of the other factors we just discussed in your decision to adopt or install the specific measure. This time the two importance ratings—the pilot importance and the non-pilot importance—should total 10.	Pilot Score	Non-Pilot Score
	10	0

Lastly, the decision maker rated the likelihood they would have installed each aspect of the lighting control system had the pilot incentives not been available: these are known as Program Attribution Index 3 and shown in Table 58.

Table 58. Program Attribution Index 3 Ratings

Think about the action you would have taken with regard to installing this equipment if the pilot had not been available. Using a 0 to 10 scale, please rate the likelihood that you would have integrated each of the following features into your lighting control system:	
ALCS Feature	Rating
Graphical user interface	0
Fixtures using task tuning, where each lighting fixture can be optimized to the space	0
Daylight harvesting system that dims lighting fixtures in response to sunlight	0
Occupancy or vacancy controls that turn off lighting in rooms that are not occupied	0
Lighting automation system that turns lighting on and off depending on the time of day	0
Control system allowing for automatic demand response that allows utility to dim lights	0

Upon calculating the Pilot Attribution Indexes 1, 2, and 3, Cadmus estimated the project's NTG ratio as 84%. In the absence of the program they were likely to have not completed a project, the decision maker had considered the costs and benefits and without the pilot incentives the return on investment would not have been high enough.

Satisfaction

Key Decision Maker

Overall, the decision maker expressed satisfaction with their pilot experience. Table 59 shows the respondent's satisfaction rating for various pilot elements.

Table 59. Decision Maker Satisfaction Ratings

Project Element	Response
Performance of new system	Very satisfied
Pilot overall	Somewhat satisfied

In addition, the decision maker rated the application paperwork as *not at all challenging*.

The decision maker had the following comments about their pilot experience that show room for pilot improvement:

- Program administrator did not appear knowledgeable of pilot offering or technologies
- Paperwork and verification process was a headache because staff at SCE was disorganized
- Custom verifiers were silly and required duplicative effort
- The measurement and verification process was poorly administered overall

Contractor

Overall, the contractor expressed high satisfaction with their pilot experience. Table 60 shows the respondent's satisfaction rating for various pilot elements.

Table 60. Contractor Satisfaction Ratings

Project Element	Response
SCE communications about the pilot and offerings	Very satisfied
Pre-installation process	Somewhat satisfied
Post-installation process with Verification contractor	Somewhat satisfied
SCE making the paperwork easy	Somewhat satisfied
Time for paperwork to be processed	Not very satisfied
Response time to questions or inquiries	Somewhat satisfied
Providing the right amount of support for contractors to confidently sell and install energy efficiency equipment	Very satisfied
The final incentives provided	Somewhat satisfied
Pilot overall	Very satisfied

The contractor said the pilot ran smoothly and they had no additional suggestions for ways SCE could improve their pilot experience.

Final Comments

The key decision maker said that the pilot process was bumpy, but they are happy with the installed equipment.

The contractor had no final comments about this project.

End User Survey

Cadmus was not able to administer an end user survey for this site, as the decision maker had just administered a survey with staff and was sensitive to requiring additional attention of them in the evaluation timeframe. We followed up several months later with a request to send the survey, since some time had passed, but the decision maker was unresponsive.

ALCS – 012

Response from the key decision maker and contractor

Building Type: Warehouse
Participant Industry: Manufacturing
Building Size: 40,000 sq ft
Project Area: 36,500 sq ft
Completion Date: May 2016
Lease/Own: Lease
Number of Employees: 100
Contractor Group: CALCTP Trained[19]

Project Specifications

Project number 012 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 61. The facility retrofitted Metal Halide fixtures with LED fixtures in buildings and integrated these new fixtures into the ALCS. The retrofit covered approximately 91% of the building area. The facility operates Monday through Friday, from 3:00 a.m. to 6:00 p.m., and Saturdays from 3:00 a.m. to 3:00 p.m., including holidays.

Table 61. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Feasible; Not Implemented
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, occupancy controls, scheduling, and zoning. Though Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, the system is capable of both. As daylight harvesting sensors were not installed, this feature was not utilized by the building; the ALCS, however, can integrate with daylight harvesting sensors.

Quality Assurance

A member of SCE's third-party technical review team completed pre-inspection site verification, documenting the building's operating hours and lighting fixtures. RHA reviewed these data and determined that documented operating hours were underestimated for the facility. RHA updated the building's operating hours based on an interview with the facility manager. RHA completed a post-

[19] CALCTP requires CALCTP-certified projects to be conducted by CALCTP-certified contractors using a CACLTP-certified project manager and CALCTP-certified installers. This study did not determine whether projects performed by CALCTP -certified contractors met these requirements or if the persons installing the ALCS had CALCTP training or certifications.

inspection in May 2016 that included seven days of light logging, fixture verification, and functional testing of the ALCS.

Upon final inspection, RHA found several issues with the project:

- The installing contractor did not install daylight harvesting sensors due to a misunderstanding regarding the capabilities of existing sensors.
- The installed ALCS accurately gauged energy consumption of the new lighting, but, when it calculated energy savings, it relied on the user to accurately input the original lighting systems' fixtures and operating hours. The installed ALCS did not accurately report energy savings due to incorrect data entered by the installing contractor.
- The lighting zones defined in the ALCS were too broad, resulting in the occupancy sensors activating non-adjacent lighting fixtures when adjacent areas were occupied. This resulted in the lighting system's unnecessary energy consumption in adjacent but unoccupied zones.

RHA accounted for these issues upon calculating the project's verified savings. Initially, plans cited installing power monitoring instead of light logging; the lighting circuits' significant non-lighting loads, however, prevented power logging. The light logging results showed the lighting control system's reported usage without an error when compared to observed usage, indicating the system accurately reported consumption for controlled fixtures. Upon calculating energy savings, RHA used reported energy usage of installed ALCS and calculations of baseline usage for the original lighting system.

Energy Impacts

The installing contractor estimated the energy savings achieved by the project, which Cadmus compared to the energy savings verified by RHA to determine the project realization rate. RHA verified energy savings representing the condition found on the site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[20] Table 62 details project energy savings and demand reduction.

Table 62. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	92,030	91,075	100,556	97%	3%
Realization Rate	-	99%	110%	-	-
Demand Reduction (kW)	19.3	20.9	14.6	100%	0%
Realization Rate	-	108%	70%	-	-

The project achieved 100,556 kWh of energy savings and 14.6 kW demand reduction. The energy savings accounted for an 84% reduction in lighting energy usage. The project contractor overestimated

[20] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

savings for this project by 1%, resulting in a 99% realization rate. The LED upgrade accounted for 97% of project energy savings with the remaining 3% due to the ALCS.

The project achieved a relative energy savings of 2.8 kWh per square foot of project area. Considering the project costs, energy savings, and utility rate for this project, the customer would expect a simple payback of 3.4 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the above-code savings for this project. The methods they applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods led to an estimated 65,534 kWh of energy savings above Title 24 code. Cadmus evaluated above code savings for this project to be 72,356 kWh and 14.6 kW of demand reduction.

Pilot Awareness, Decision Making, and Challenges

The project decision maker learned about the pilot from the private equity company that owns their company. The private equity company was looking to save money.

The decision maker noted the following factors as being important in their decision to make the lighting system upgrades through the pilot:

- Most important: To save money
- To improve comfort
- To improve employee morale

The decision maker cited the high initial costs of technology as the biggest challenge they face in making energy-efficient improvements.

The decision maker said their organization has benefited from participating in the pilot because of:

- Energy savings: reduced energy consumption and energy demand
- Better aesthetics with new lighting

Willingness to Pay and Project Costs

The lighting project cost $101,810.00, and the decision maker received an incentive of $43,715.00 (Table 63). According to the decision maker, they would have installed the same project if they received 25% of the pilot incentive.

Table 63. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$101,810.00	$43,715.00	$10,929.00

Contractor Interactions

Contractor 2 was the contractor for this project from start to finish, design through install. They offer commissioning; electrical and lighting; controls (mechanical, electrical, lighting, and energy management); energy assessments, diagnostics, or ratings; HVAC equipment; mechanical systems; insulation and building envelope measures; and renewable energy; as well as training and consulting. The contractor was designated to the project by the private equity firm that owns their company.

Contractor Training

Contractor 2 was the only contractor on this project.

The contractor firm is designated as having received California Advanced Lighting Control Training Program training. However, the lead contractor (interviewed) was not CALCTP-certified. The only project-related training received by the lead contractor was through the California Civilian Conservation Corp.

The contractor learned about the pilot through contact with an SCE representative. They expressed a preference for staying informed about the pilot through the SCE website as well as in emails from SCE representatives. The contractor chose to recommend the pilot to customers because of the cost savings.

Contractor Experience with Pilot

The contractor did not experience acceptance testing for the project.

On a scale of 0 to 10, where 0 means *not at all influential* and 10 means *very influential*, the contractor rated the pilot as a 7 in influencing their decision to recommend that the company install the advanced lighting control system.

Participating in the pilot did not change the contractor's sales for advanced lighting control systems. The contractor reported that before participating in the pilot, they recommended advanced lighting control systems 90% of the time; after participating, they recommend these systems 90% of the time.

Table 64 shows the importance ratings provided by the contractor.

Table 64. Contractor Attribution Ratings

H6. Using a 0 to 10 rating scale, how important in your recommendation was:	
Factors	**Score**
Information provided on SCE's website	9
Training and seminars provided by SCE	7
Your company's past participation in a rebate program sponsored by SCE	8
Training outside the pilot (if rating of 5 or greater, which trainings)	6

The contractor noted that being able to spend more time with customers and work with them on pricing and rebate project options was the greatest benefit of promoting the pilot. The contractor also said that 90% of the time they discuss the pilot and project goals to achieve "deep energy savings."

Decision Maker Perceptions of the Contractor

The decision maker rated themselves as *not at all satisfied* with their experience with the contractor because the project was off schedule from the start, as the contractor began late and ran behind schedule.

The decision maker noted that the contractor did not have to correct issues during commissioning, code inspection, or SCE QA.

Counterfactual Baseline and Project Net-to-Gross

The decision maker answered several questions about the likely path they would have taken had the pilot and incentives not existed, and about the pilot influence on their decision to install the ALCS.

The decision maker would have installed a less ambitious lighting controls project had the pilot not existed. They likely would have installed new lighting in the same timeframe. Prior to learning about the pilot, they had budgeted for the purchase of the lighting control system. Additionally, they had considered the energy savings in relation to the project cost in their decision to proceed with installing the lighting control system. They had received bids from three or four other companies. They also indicated that without the pilot incentive, the return on their investment would have been high enough to install the same control system.

The decision maker answered several questions using Program Attribution Index scoring regarding the level of pilot influence on their decision to install the lighting control system. First, the decision maker rated the pilot and non-pilot influences shown in Table 65 (known as Program Attribution Index 1).

Table 65. Program Attribution Index 1 Ratings

E4. Using a 0 to 10 rating scale, please rate the importance of each of the following in your decision to implement the advanced lighting controls with a graphical user interface.		
Type	**Factors**	**Score**
Pilot Influences	1. The availability of the pilot incentive	8
	2. Recommendations or suggestions from SCE pilot staff	8
	3. Recommendations or suggestions from SCE account representative	7
	4. Recommendations or suggestions from contractor or vendor	6
Non-Pilot Influences	5. Internal policy or requirements inside company or organization	10
	6. Concerns about environmental effects or global warming	10
	7. Desire to achieve energy independence	10
	8. Desire to save money on monthly energy bills	10
	9. Interest in the lighting control technology	10
	10. Desire to install a control system to reduce operation and maintenance costs	10
	11. Desire to install a control system to automate lighting decisions	8

Next, the decision maker answered questions about the timing of their decision and rated the relative importance of the pilot influences compared to the non-pilot influences: these are known as the Program Attribution Index 2, shown in Table 66.

Table 66. Program Attribution Index 2 Ratings

Question	Response	
Did you learn about the pilot before or after you decided to adopt or install the advanced lighting control system?	After	
Rate the importance of the pilot on your decision as opposed to other factors that may have influenced your decision. Using a 0 to 10 rating scale where 0 means *not at all important* and 10 means *very important*, please rate the overall importance of the pilot versus the most important of the other factors we just discussed in your decision to adopt or install the specific measure. This time the two importance ratings—the pilot importance and the non-pilot importance—should total 10.	Pilot Score	Non-Pilot Score
	4	6

Lastly, the decision maker rated the likelihood they would have installed each aspect of the lighting control system had the pilot incentives not been available: these are known as Program Attribution Index 3 and shown in Table 67.

Table 67. Program Attribution Index 3 Ratings

Think about the action you would have taken with regard to installing this equipment if the pilot had not been available. Using a 0 to 10 scale, please rate the likelihood that you would have integrated each of the following features into your lighting control system:	
ALCS Feature	**Rating**
Graphical user interface	0
Fixtures using task tuning, where each lighting fixture can be optimized to the space	0
Daylight harvesting system that dims lighting fixtures in response to sunlight	N/A
Occupancy or vacancy controls that turn off lighting in rooms that are not occupied	0
Lighting automation system that turns lighting on and off depending on the time of day	0
Control system allowing for automatic demand response that allows utility to dim lights	0

Upon calculating the Pilot Attribution Indexes 1, 2, and 3, Cadmus estimated the project's NTG ratio as 55%. In the absence of the program they were likely to have completed a lighting retrofit to code. While they had considered the cost effectiveness of the system and had received multiple bids for a controls system they indicated in PAI-3 they were unlikely to utilize the features provided by an ALCS system.

Satisfaction

Key Decision Maker

Overall, the decision maker rated themselves as *very satisfied* with their pilot experience. Table 68 shows the respondent's satisfaction rating for various pilot elements.

Table 68. Decision Maker Satisfaction Ratings

Project Element	Response
Performance of new system	Very satisfied
Pilot overall	Very satisfied

In addition, the decision maker rated the application paperwork as *very challenging*.

The decision maker said that SCE could provide a larger incentive to improve their pilot experience.

Contractor

Overall, the contractor expressed high satisfaction with their pilot experience. Table 69 shows the respondent's satisfaction rating for various pilot elements.

Table 69. Contractor Satisfaction Ratings

Project Element	Response
SCE communications about the pilot and offerings	Very satisfied
Pre-installation process	Somewhat satisfied
Post-installation process with verification contractor	Somewhat satisfied
SCE making the paperwork easy	Somewhat satisfied
Time for paperwork to be processed	Not very satisfied
Response time to questions or inquiries	Somewhat satisfied
Providing the right amount of support for contractors to confidently sell and install energy efficiency equipment	Very satisfied
The final incentives provided	Somewhat satisfied
Pilot overall	Very satisfied

The contractor said the pilot ran smoothly and they had no additional suggestions for ways SCE could improve their pilot experience.

Final Comments

The key decision maker said that the pilot was great and made them start the process for retrofitting lighting at their other facilities across the country.

The contractor had no final comments about this project.

End User Survey

Cadmus did not receive any responses to an end user survey we sent.

ALCS – 013

Building Type: Offices
Participant Industry: Education/School/University
Building Size: 45,000 sq ft
Project Area: 45,000 sq ft
Completion Date: October 2016
Lease/Own: Own
Number of Employees: 250–300
Contractor Group: CALCTP Trained[21]

Project Specifications

Project number 013 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 70. The facility retrofitted T-5, T-8, and halogen fixtures with LED fixtures in the building, integrating these new fixtures into the ALCS. The retrofit covered approximately 91% of the building area. The facility operates Monday through Friday, from 3:00 a.m. to 6:00 p.m., and Saturdays from 3:00 a.m. to 3:00 p.m., including holidays.

Table 70. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Yes
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	No
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, daylight harvesting, occupancy controls, scheduling, and zoning. Though Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, the system is capable of both.

Quality Assurance

A member of SCE's third-party technical review team completed pre-inspection site verification, documenting the buildings operating hours and lighting fixtures. The installing contractor completed light logging in the building. RHA reviewed these data and determined that the contractor provided hours of operation for each space in the facility, based on lighting logging and additional analysis, accurately represented the building's original conditions. In October 2016, RHA completed a post-

[21] CALCTP requires CALCTP-certified projects to be conducted by CALCTP-certified contractors using a CACLTP-certified project manager and CALCTP-certified installers. This study did not determine whether projects performed by CALCTP -certified contractors met these requirements or if the persons installing the ALCS had CALCTP training or certifications.

inspection included seven days of light logging, power monitoring, fixture verification, and functional testing of the ALCS.

Upon final inspection, RHA found several issues with the project:

- The ALCS installed was not configured to provide the customer with energy consumption and savings, and the contractor did know of this ALCS feature. RHA provided instruction to the contractor on how to configure the feature and delayed verification while the contractor updated the system.
- Due to a communication error between the ALCS and fixtures, the system failed to report energy consumption for one monitored zone.
- The installed ALCS system recorded events with a 27-minute delay. This caused error in the energy consumption reports as the long delay led the system to not record system changes if events fell between recording intervals.
- The ALCS cannot accurately report energy savings from task tuning.
- Several zones were not tuned to lower the lighting's energy consumption. RHA recommended that the contractor tune those zones to reduce energy consumption.

RHA accounted for these issues upon calculating the project's verified savings. The light logging and power monitoring results revealed the lighting control system reported usage 29% lower than observed, indicating the system did not accurately report consumption for controlled fixtures. Given this significant difference in reported energy consumption, RHA—upon calculating energy savings—used its data-logged energy usage of the installed ALCS and its calculations of baseline usage from the original lighting system.

Energy Impacts

The installing contractor estimated the energy savings achieved by the project, which Cadmus compared to the energy savings verified by RHA to determine the project realization rate. RHA verified energy savings representing the condition found on the site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[22] Table 62 details project energy savings and demand reduction.

[22] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

Table 71. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	91,395	118,356	134,712	51%	49%
Realization Rate	-	129%	114%	-	-
Demand Reduction (kW)	37.3	22.3	20.1	85%	15%
Realization Rate	-	60%	90%	-	-

The project achieved 134,712 kWh of energy savings and 20.1 kW demand reduction. The energy savings accounted for an 83% reduction in lighting energy usage. The project contractor underestimated savings for this project by 29%, resulting in a 129% realization rate. The LED upgrade accounted for 51% of project energy savings with the remaining 49% due to the ALCS.

The project achieved a relative energy savings of 3.0 kWh per square foot of project area. Considering the project costs, energy savings, and utility rate for this project, the customer would expect a simple payback of 6.8 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the above-code savings for this project. The methods they applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods led to an estimated 44,082 kWh of energy savings above Title 24 code. Cadmus evaluated above code savings for this project to be 50,174 kWh and 12.8 kW of demand reduction.

Pilot Awareness, Decision Making, and Challenges

The project decision maker learned about the pilot from the primary contractor, who initiated the lighting project at the facility.

The decision maker noted the following factors as being important in their decision to make the lighting system upgrades through the pilot:

- Most important: To replace broken (non-functioning) equipment
- To save money on energy bills

The decision maker cited retrofitting the facility's custom fixtures as the biggest challenge they face in making energy-efficient improvements.

The decision maker said they experienced two barriers when deciding whether to participate in the pilot:

- Retrofitting custom fixtures was challenging
- They had communication gaps with the contractor

The decision maker said their organization has benefited from participating in the pilot because the lights now work, where many had failed before the project.

Willingness to Pay and Project Costs

The lighting project cost $185,000.00, and the decision maker received an incentive of $50,000.00 (Table 72). According to the decision maker, they would have installed the advanced lighting control system if they received only 25% of the incentive, because they had failing equipment that needed to be replaced.

Table 72. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$185,000.00	$50,000.00	$12,500.00

Contractor Interactions

Contractor 2 was the contractor for this project from start to finish, design through install. They offer commissioning; electrical and lighting; controls (mechanical, electrical, lighting, and energy management); energy assessments, diagnostics, or ratings; HVAC equipment; mechanical systems; insulation and building envelope measures; and renewable energy; as well as training and consulting.

For this project, the decision maker received an incentive check from SCE.

Contractor Training

Contractor2 was the only contractor on this project.

The contractor firm is designated as having received California Advanced Lighting Control Training Program training. However, the lead contractor (interviewed) was not CALCTP-certified. The only project-related training received by the lead contractor was through the California Civilian Conservation Corp.

The contractor learned about the pilot through contact with an SCE representative. They expressed a preference for staying informed about the pilot through the SCE website as well as in emails from SCE representatives. The contractor chose to recommend the pilot to customers because of the cost savings.

Contractor Experience with Pilot

The contractor did not experience acceptance testing for the project.

On a scale of 0 to 10, where 0 means *not at all influential* and 10 means *very influential*, the contractor rated the pilot as a 7 in influencing their decision to recommend that the company install the advanced lighting control system.

Participating in the pilot did not change the contractor's sales for advanced lighting control systems. The contractor reported that before participating in the pilot, they recommended advanced lighting control systems 90% of the time; After participating, they recommend these systems 90% of the time.

Table 73 shows the importance ratings provided by the contractor.

Table 73. Contractor Attribution Ratings

H6. Using a 0 to 10 rating scale, how important in your recommendation was…:	
Factors	**Score**
Information provided on SCE's website	9
Training and seminars provided by SCE	7
Your company's past participation in a rebate program sponsored by SCE	8
Training outside the pilot (if rating of 5 or greater, which trainings)	6

The contractor noted that being able to spend more time with customers and work with them on pricing and rebate project options was the greatest benefit of promoting the pilot. The contractor also said that 90% of the time they discuss the pilot and project goals to achieve "deep energy savings."

Decision Maker Perceptions of the Contractor

The decision maker rated themselves as *very satisfied* with their experience with the contractor, because had no major problems with the contractor; however, the decision maker still mentioned some communications gaps in the beginning of the project, which improved, as well as that the contractor had some trouble with custom fixture retrofits and, as such, the design and actual equipment installed differed.

The decision maker noted that the contractor did not have to correct issues during commissioning, code inspection, or SCE QA.

Counterfactual Baseline and Project Net-to-Gross

The decision maker answered several questions about the likely path they would have taken had the pilot and incentives not existed, and about the pilot influence on their decision to install the ALCS.

The decision maker would have would have installed a less ambitious lighting controls project had the pilot not existed. Prior to learning about the pilot, they had not budgeted for the purchase of the lighting control system. They also indicated that without the pilot incentive, the return on their investment would not have been high enough to install the same control system.

The decision maker answered several questions using Program Attribution Index scoring regarding the level of pilot influence on their decision to install the lighting control system. First, the decision maker rated the pilot and non-pilot influences shown in Table 74 (known as Program Attribution Index 1).

Table 74. Program Attribution Index 1 Ratings

E4. Using a 0 to 10 rating scale, please rate the importance of each of the following in your decision to implement the advanced lighting controls with a graphical user interface.		
Type	**Factors**	**Score**
Pilot Influences	1. The availability of the pilot incentive	8
	2. Recommendations or suggestions from SCE pilot staff	0
	3. Recommendations or suggestions from SCE account representative	0
	4. Recommendations or suggestions from contractor or vendor	8
Non-Pilot Influences	5. Internal policy or requirements inside company or organization	0
	6. Concerns about environmental effects or global warming	9
	7. Desire to achieve energy independence	10
	8. Desire to save money on monthly energy bills	9
	9. Interest in the lighting control technology	7
	10. Desire to install a control system to reduce operation and maintenance costs	9
	11. Desire to install a control system to automate lighting decisions	8

Next, the decision maker answered questions about the timing of their decision and rated the relative importance of the pilot influences compared to the non-pilot influences: these are known as the Program Attribution Index 2, shown in Table 75.

Table 75. Program Attribution Index 2 Ratings

Question	Response	
Did you learn about the pilot before or after you decided to adopt or install the advanced lighting control system?	Don't know	
Rate the importance of the pilot on your decision as opposed to other factors that may have influenced your decision. Using a 0 to 10 rating scale where 0 means *not at all important* and 10 means *very important*, please rate the overall importance of the pilot versus the most important of the other factors we just discussed in your decision to adopt or install the specific measure. This time the two importance ratings—the pilot importance and the non-pilot importance—should total 10.	**Pilot Score**	**Non-Pilot Score**
	7	4

Lastly, the decision maker rated the likelihood they would have installed each aspect of the lighting control system had the pilot incentives not been available: these are known as Program Attribution Index 3 and shown in Table 76.

Table 76. Program Attribution Index 3 Ratings

Think about the action you would have taken with regard to installing this equipment if the pilot had not been available. Using a 0 to 10 scale, where 0 is *not at all likely* and 10 is *extremely likely*, please rate the likelihood that you would have integrated each of the following features into your lighting control system:	
ALCS Features	**Rating**
Graphical user interface	9
Fixtures using task tuning, where each lighting fixture can be optimized to the space	7
Daylight harvesting system that dims lighting fixtures in response to sunlight	8
Occupancy or vacancy controls that turn off lighting in rooms that are not occupied	9
Lighting automation system that turns lighting on and off depending on the time of day	8
Control system allowing for automatic demand response that allows utility to dim lights	2

Upon calculating the Pilot Attribution Indexes 1, 2, and 3, Cadmus estimated the project's NTG ratio as 45%. In the absence of the program they were likely to have completed a lighting retrofit to code. The decision maker stated they would have pursued a less ambitious lighting control system and they were likely to implement several aspects of the lighting control system however, they would have been unlikely to fund the costs of the installed ALCS.

Satisfaction

Key Decision Maker

Overall, the decision maker expressed satisfaction with their pilot experience. Table 77 shows the respondent's satisfaction rating for various pilot elements.

Table 77. Decision Maker Satisfaction Ratings

Project Element	Response
Performance of new system	Very satisfied
Pilot overall	Somewhat satisfied

The decision maker did not complete the application paperwork.

The decision maker had nothing to recommend for ways SCE could improve their pilot experience.

Contractor

Overall, the contractor expressed high satisfaction with their pilot experience. Table 78 shows the respondent's satisfaction rating for various pilot elements.

Table 78. Contractor Satisfaction Ratings

Project Element	Response
SCE communications about the pilot and offerings	Very satisfied
Pre-installation process	Somewhat satisfied
Post-installation process with verification contractor	Somewhat satisfied
SCE making the paperwork easy	Somewhat satisfied
Time for paperwork to be processed	Not very satisfied
Response time to questions or inquiries	Somewhat satisfied
Providing the right amount of support for contractors to confidently sell and install energy efficiency equipment	Very satisfied
The final incentives provided	Somewhat satisfied
Pilot overall	Very satisfied

The contractor said the pilot ran smoothly and they had no additional suggestions for ways SCE could improve their pilot experience.

End User Survey

Cadmus sent an online survey by email to the building occupants interacting with the new control system, and no one responded to the survey. We made a follow up and received no response.

ALCS – 016

Building Type: Retail
Participant Industry: Retail/Wholesale
Building Size: 10,900 sq. ft
Building Area: 10,900 sq. ft
Completion Date: July 2015
Lease/Own: Unknown
Number of Employees: Unknown
Contractor Group: Manufacturer Trained

Project Specifications

Project number 016 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 79. The facility retrofitted T-8 fixtures in the building with LED fixtures and integrated these new fixtures into the ALCS. The retrofit covered approximately 100% of the building area. The facility operates seven days a week, from 10:00 a.m. to 8:00 p.m., including holidays.

Table 79. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Yes
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, daylight harvesting, occupancy controls, scheduling, and zoning. Though Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, the system is capable of both.

Quality Assurance

A pre-inspection site verification was not completed at the facility: although required for participation, the project received an exception. The installation contractor gathered fixture data and operating hours, which RHA reviewed and used in its analysis. RHA completed a post-inspection in April 2016 that included seven days of power metering, fixture verification, and functional testing of the ALCS.

Upon final inspection, RHA found several issues with the project:

- The installed ACLS did not measure energy consumption directly, but relied on correct fixture wattage to calculate accurate energy consumption of the lighting system. RHA observed fixture wattages incorrectly entered into the system, resulting in false ALCS reporting.

- The occupancy sensor sensitivity settings were set too high and were not properly calibrated, resulting in the ALCE turning on lighting for erroneous reasons.

During data logging, RHA found the ALCS reported inaccurate energy consumption, finding variances of up to 30% from observed usage. Inaccurate energy consumption reported by the ALCS could be corrected by updating the fixture wattages. RHA applied this correction to ALCS-supplied data when calculating final project savings.

Energy Impacts

The installing contractor estimated the energy savings achieved by the project, which Cadmus compared to the energy savings verified by RHA to determine the project realization rate. RHA verified energy savings representing the condition found on the site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[23] Table 62 details project energy savings and demand reduction.

Table 80. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	55,468	66,329	74,736	71%	29%
Realization Rate	-	120%	113%	-	-
Demand Reduction (kW)	9.6	12.4	10.2	75%	25%
Realization Rate	-	129%	82%	-	-

The project achieved 74,736 kWh of energy savings and 10.2 kW demand reduction. The energy savings accounted for an 85% reduction in lighting energy usage. The project contractor underestimated savings for this project by 20%, resulting in a 120% realization rate. The LED upgrade accounted for 71% of project energy savings with the remaining 29% due to the ALCS.

The project achieved a relative energy savings of 6.9 kWh per square foot of project area. Considering the project costs, energy savings, and utility rate for this project, the customer would expect a simple payback of 1.4 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the above-code savings for this project. The methods they applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods led to an estimated 64,185 kWh of energy savings above Title 24 code. Cadmus evaluated above code savings for this project to be 38,995 kWh and 8.3 kW of demand reduction.

[23] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

Pilot Awareness, Decision Making, and Challenges

The project decision maker declined to respond to the survey regarding their experiences with the pilot. Cadmus attempted them five on the phone, leaving one two voicemails and two messages with an office manager with a request for an interview, but were not able to connect with the decision maker.

Willingness to Pay and Project Costs

The lighting project cost $34,011.00, and the decision maker received an incentive of $17,005.00 (Table 81).

Table 81. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$34,011.00	$17,005.00	N/A

Contractor Interactions

The contractor, Contractor 15, declined to respond to the survey regarding their experience with the pilot. Cadmus attempted the contractor three times on the phone and left two voicemails with a request for an interview, but we were not able to connect with them.

Final Comments

Because none of the key stakeholders responded to our requests for an interview, we do not have information regarding pilot satisfaction, contractor trainings, or other information.

ALCS – 017

Building Type: Warehouse
Participant Industry: Manufacturing
Building Size: 38,500 sq ft
Project Area: 38,500 sq ft
Completion Date: September 2015
Lease/Own: Lease
Number of Employees: Unknown
Contractor Group: CALCTP Trained[24]

Project Specifications

Project number 017 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 82. The facility retrofitted metal halides with LEDs and integrated them into the ALCS. The retrofit covered the entire building area.

Table 82. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Feasible; Not Implemented
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, controls, scheduling and zoning. Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, though the system is capable of both.

Quality Assurance

A member of the SCE third party inspection team completed a pre-inspection site where they gathered fixture data and operating hours, which RHA reviewed and used in their analysis. RHA completed a post-inspection in September 2015 that included seven days of power metering, fixture verification, and functional testing of the ALCS.

Based on post-inspection, RHA found two issues with the project:

- Consumption data for the initial power data logging did not include the first two months of logging because the system's wireless access controller erased old data when offline.

[24] CALCTP requires CALCTP-certified projects to be conducted by CALCTP-certified contractors using a CACLTP-certified project manager and CALCTP-certified installers. This study did not determine whether projects performed by CALCTP -certified contractors met these requirements or if the persons installing the ALCS had CALCTP training or certifications.

- The project took more than six months to get an incentive approval from the ALCS pilot program and the contractor faced scheduling issues, thus stretching out the project timeline.

Upon calculating verified savings for the project, RHA accounted for these issues.

Energy Impacts

The installation contractor estimated energy savings achieved by the project, which Cadmus compared to energy savings verified by RHA to determine the project's realization rate. RHA verified energy savings representing conditions found on site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[25] Table 87 details project energy savings and demand reduction.

Table 83. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	139,300	222,602	245,775	89%	11%
Realization Rate	-	160%	110%	-	-
Demand Reduction (kW)	0.0	45.9	32.1	100%	0%
Realization Rate	-	N/A	70%	-	-

The project achieved 245,775 kWh of energy savings and 32.1 kW of demand reduction. These energy savings accounted for an 89% reduction in lighting energy usage. The project contractor underestimated savings for this project by 60%, resulting in a 160% realization rate. The LED upgrade accounted for 89% of project energy savings, with the remaining 11% due to the ALCS.

The project achieved relative energy savings of 6.4 kWh per square foot of the project area. Considering the project costs, energy savings, and utility rate for this project, customers could expect a simple payback of 1.8 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated above-code savings for the project. The methods applied allowed it to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods estimated that the project achieved 98,642 kWh energy savings above Title 24 code. Cadmus evaluated above code savings for this project to be 108,911 kWh and 18.4 kW of demand reduction.

[25] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

Pilot Awareness, Decision Making, and Challenges

Cadmus spoke with staff at the site but was unable to speak with a project decision maker, as all staff who were involved with the project no longer work at the company. The staff we spoke with forwarded our end user survey to those who were on the site and working in the area with lighting improvements.

Willingness to Pay and Project Costs

The lighting project cost $106,452.00, and the decision maker received an incentive of $50,000.00 (Table 84).

Table 84. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$106,452.00	$50,000.00	N/A

Contractor Interactions

Contractor 2 was the contractor for this project from start to finish, design through install. They offer commissioning; electrical and lighting; controls (mechanical, electrical, lighting, and energy management); energy assessments, diagnostics, or ratings; HVAC equipment; mechanical systems; insulation and building envelope measures; and renewable energy; as well as training and consulting.

For this project, the decision maker received an incentive check from SCE.

Contractor Training

Contractor 2 was the only contractor on this project.

The contractor firm is designated as having received California Advanced Lighting Control Training Program training. However, the lead contractor (interviewed) was not CALCTP-certified. The only project-related training received by the lead contractor was through the California Civilian Conservation Corp.

The contractor learned about the pilot through contact with an SCE representative. They expressed a preference for staying informed about the pilot through the SCE website as well as in emails from SCE representatives. The contractor chose to recommend the pilot to customers because of the cost savings.

Contractor Experience with Pilot

The contractor did not experience acceptance testing for the project.

On a scale of 0 to 10, where 0 means *not at all influential* and 10 means *very influential*, the contractor rated the pilot as a 7 in influencing their decision to recommend that the company install the advanced lighting control system.

Participating in the pilot did not change the contractor's sales for advanced lighting control systems. The contractor reported that before participating in the pilot, they recommended advanced lighting control systems 90% of the time; after participating, they recommend these systems 90% of the time.

Table 85 shows the importance ratings provided by the contractor.

Table 85. Contractor Attribution Ratings

H6. Using a 0 to 10 rating scale, how important in your recommendation was…:	
Factors	**Score**
Information provided on SCE's website	9
Training and seminars provided by SCE	7
Your company's past participation in a rebate program sponsored by SCE	8
Training outside the pilot (if rating of 5 or greater, which trainings)	6

The contractor noted that being able to spend more time with customers and work with them on pricing and rebate project options was the greatest benefit of promoting the pilot. The contractor also said that 90% of the time they discuss the pilot and project goals to achieve "deep energy savings."

Satisfaction

Contractor

Overall, the contractor expressed high satisfaction with their pilot experience. Table 86 shows the respondent's satisfaction rating for various pilot elements.

Table 86. Contractor Satisfaction Ratings

Project Element	Response
SCE communications about the pilot and offerings	Very satisfied
Pre-installation process	Somewhat satisfied
Post-installation process with verification contractor	Somewhat satisfied
SCE making the paperwork easy	Somewhat satisfied
Time for paperwork to be processed	Not very satisfied
Response time to questions or inquiries	Somewhat satisfied
Providing the right amount of support for contractors to confidently sell and install energy efficiency equipment	Very satisfied
The final incentives provided	Somewhat satisfied
Pilot overall	Very satisfied

The contractor said the pilot ran smoothly and they had no additional suggestions for ways SCE could improve their pilot experience.

End User Survey

Though no staff on site was a key decision maker for the project, others were willing to forward the end user survey to those on site and working in the area with lighting improvements. Cadmus emailed the online survey to the building occupants interacting with the new control system, then followed up once.

One person responded to the survey, a maintenance staff person who was aware of the lighting upgrades and sometimes works in the area that received the upgrades. This respondent had received training on how to use the system and said they are somewhat satisfied with the controls, as shown in Table 87.

Table 87. End User Survey Response

Project Element	Number of Responses	
Received training on the lighting control system	1	
Can effectively operate lighting controls	Very or somewhat effectively	Not too or not at all effectively
	N/A	N/A
Satisfaction with controls	Very or somewhat satisfied	Not very or not at all satisfied
	1 (somewhat satisfied)	N/A

Because of the change in staff, the survey respondent was unaware of the exact equipment installed or with the technology specifications available.

ALCS – 018

Building Type: Refrigerated Warehouse
Participant Industry: Distribution
Building Size: 214,000 sq. feet
Project Area: 214,000 sq. feet
Completion Date: September 2016
Lease/Own: Lease
Number of Employees: 300
Contractor Group: Manufacturer Trained

Project Specifications

Project number 018 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 88. The facility is a new construction that installed LEDs and integrated them into the ALCS. The retrofit covered the entire building area.

Table 88. Project Functions Implemented

Function	Implemented?
Task Tuning	Feasible; Not implemented
Daylighting Harvesting	Yes
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed daylight harvesting, controls, scheduling and zoning. Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, though the system is capable of both.

Quality Assurance

A pre-retrofit inspection was not conducted because the facility was a new construction. Instead, a DOE2 Model was used to estimate baseline conditions. In September of 2015, RHA completed a post-inspection, which included seven days of power monitoring.

Based on post-inspection, RHA found one issue with the project:

- Due to existing circumstances related to the project, RHA developed a methodology for the energy analysis to establish a realistic baseline. The modeling software, did not include occupancy sensor savings in establishing the baseline.

Upon calculating the project's verified savings, RHA accounted for these issues. Power monitoring results fell within 0.40% of the ALCS' reported energy consumption.

Energy Impacts

The installation contractor estimated the project's energy savings, which Cadmus compared to energy savings verified by RHA to determine the project realization rate. RHA verified energy savings that represented conditions found on site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[26]

Table 89 details project energy savings and demand reduction.

Table 89. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	N/A	636,036	947,503	56%	44%
Realization Rate	-	N/A	149%	-	-
Demand Reduction (kW)	N/A	60.6	41.6	100%	0%
Realization Rate	-	N/A	69%	-	-

The project achieved 947,503 kWh of energy savings and 41.6 kW of demand reduction. The LED upgrade accounted for 56% of project energy savings, with the remaining 44% due to the ALCS.

The project achieved relative energy savings of 4.4 kWh per square foot of project area. Considering the project costs, energy savings, and utility rates for this project, customers could expect a simple payback of 2.3 years.

RHA calculated above-code savings for this project using a detailed method for estimating energy savings above 2016 Title 24 code requirements. The applied methods allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods estimated that project achieved 636,036 kWh energy savings above Title 24 code. As the project was new construction and all saving were calculated above code, Cadmus verified savings are equivalent to above code savings.

Pilot Awareness, Decision Making, and Challenges

The project decision maker learned about the pilot after reaching out to an SCE account manager and hearing about better lighting options. The key decision maker initiated the lighting project at the facility but had to get approval from other managers.

The decision maker noted the purchase cost as being the most important factor in their decision to make the lighting system upgrades through the pilot.

The decision maker cited the following as the biggest challenges they faced in making energy-efficient improvements:

[26] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

- High initial costs
- Need to replace equipment without affecting operations
- Lack of adequate savings from past energy efficiency projects

The decision maker said that when deciding whether to participate in the pilot, they experienced the barrier of the SCE representative recommending either unfeasible or unnecessary equipment when they visited.

The decision maker said their organization has benefited from participating in the pilot because the lights are actually using less energy and reducing energy consumption, and they are actually seeing substantial savings that exceed expectations.

Willingness to Pay and Project Costs

The lighting project cost $283,612.00, and the decision maker received an incentive of $50,000.00 (Table 90). According to the decision maker, they would have installed the same equipment if they received 25% of the incentive.

Table 90. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$283,612.00	$50,000.00	$12,500.00

The project invoice included costs of the fixture upgrade and the ALCS system broken out separately. Of the total project cost Cadmus estimates that 94% of these costs funded the fixture upgrade while the remaining 6% or approximately $18,000 were the costs of the ALCS. However, the installed fixtures include integrated occupancy and daylight harvesting sensors, increasing their cost over standard LED fixtures.

Contractor Interactions

Contractor 5 was the contractor for this project. The decision maker reported that they chose to work with the contractor on this project because they were the most knowledgeable and word of mouth was positive.

For this project, the decision maker received an incentive check from SCE.

Decision Maker Perceptions of the Contractor

The decision maker rated themselves as *very satisfied* with their experience with the contractor.

The decision maker noted that the contractor did not have to correct issues during commissioning, code inspection, or SCE QA.

Counterfactual Baseline and Project Net-to-Gross

The decision maker answered several questions about the likely path they would have taken had the pilot and incentives not existed, and about the pilot influence on their decision to install the ALCS.

The decision maker would have only installed a basic lighting project following Title 24 code requirements had the pilot not existed. Prior to learning about the pilot, they had not budgeted for the purchase of the lighting control system. Additionally, they had not considered the energy savings in relation to the project cost in their decision to proceed with installing the lighting control system. Since this was a new building, they needed to comply with Title 24 regulations, and they typically assess the building needs before making lighting decisions. They also indicated that without the pilot incentive, the return on their investment would not have been high enough to install the same control system.

The decision maker answered several questions using Program Attribution Index scoring regarding the level of pilot influence on their decision to install the lighting control system. First, the decision maker rated the pilot and non-pilot influences shown in Table 91 (known as Program Attribution Index 1).

Table 91. Program Attribution Index 1 Ratings

E4. Using a 0 to 10 rating scale, please rate the importance of each of the following in your decision to implement the advanced lighting controls with a graphical user interface.		
Type	**Factors**	**Score**
Pilot Influences	1. The availability of the pilot incentive	8
	2. Recommendations or suggestions from SCE pilot staff	5
	3. Recommendations or suggestions from SCE account representative	0
	4. Recommendations or suggestions from contractor or vendor	9
Non-Pilot Influences	5. Internal policy or requirements inside company or organization	5
	6. Concerns about environmental effects or global warming	5
	7. Desire to achieve energy independence	5
	8. Desire to save money on monthly energy bills	9
	9. Interest in the lighting control technology	7
	10. Desire to install a control system to reduce operation and maintenance costs	9
	11. Desire to install a control system to automate lighting decisions	7

Next, the decision maker answered questions about the timing of their decision and rated the relative importance of the pilot influences compared to the non-pilot influences: these are known as the Program Attribution Index 2, shown in Table 92.

Table 92. Program Attribution Index 2 Ratings

Question	Response	
Did you learn about the pilot before or after you decided to adopt or install the advanced lighting control system?	Before	
Rate the importance of the pilot on your decision as opposed to other factors that may have influenced your decision. Using a 0 to 10 rating scale where 0 means *not at all important* and 10 means *very important*, please rate the overall importance of the pilot versus the most important of the other factors we just discussed in your decision to adopt or install the specific measure. This time the two importance ratings—the pilot importance and the non-pilot importance—should total 10.	**Pilot Score**	**Non-Pilot Score**
	5	5

Lastly, the decision maker was unable to rate the likelihood they would have installed each aspect of the lighting control system had the pilot incentives not been available.

As the decision maker was unable to provide specific data regarding control strategies they would have employed, Cadmus calculated NTG using scores 1 and 2 only and estimated the project's NTG ratio as 50%. Without influence from the program they were likely to have installed a lighting system following code as they indicated.

Satisfaction

Key Decision Maker

Overall, the decision maker expressed satisfaction with their pilot experience. Table 93 shows the respondent's satisfaction ratings for various pilot elements.

Table 93. Decision Maker Satisfaction Ratings

Project Element	Response
Performance of new system	Very satisfied
Pilot overall	Somewhat satisfied

In addition, the decision maker rated the application paperwork as *very easy*.

When asked what SCE could have done to improve their pilot experience, the decision maker said, "We may not be a really large account, but having a point person at SCE to be there with us would have been helpful. When we reach out to them, we didn't get any of the assistance that was listed in this survey."

End User Survey

Cadmus sent an online survey by email to the building occupants interacting with the new control system; however, no one responded to the survey.

ALCS – 020

Building Type: Warehouse and Office
Participant Industry: Manufacturing
Building Size: 75,000 sq. ft
Project Area: 75,000 sq. ft
Completion Date: September 2016
Lease/Own: Lease
Number of Employees: Unknown
Contractor Group: CALCTP Trained[27]

Project Specifications

Project number 020 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 94. The facility retrofitted T-5s and metal halides with LEDs and integrated them into the ALCS, with the retrofit covering the entire building area.

Table 94. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Feasible; Not Implemented
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Feasible; Not Implemented
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, controls, and zoning. Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, though the system is capable of both.

Quality Assurance

RHA conducted a pre-inspection of this facility including 7 days of monitoring. In December 2016, RHA completed a post-inspection, which included seven days of power monitoring.

Based on post-inspection, RHA found several issues with the project:

- During the final inspection, the dimming study was not able to be completed because fixtures did not respond to inputs.
- The pre-inspection data was not reflective of actual daytime energy demand.

[27] CALCTP requires CALCTP-certified projects to be conducted by CALCTP-certified contractors using a CACLTP-certified project manager and CALCTP-certified installers. This study did not determine whether projects performed by CALCTP -certified contractors met these requirements or if the persons installing the ALCS had CALCTP training or certifications.

- The facility has twenty skylights, which the contractor should have considered in fixture configuration.
- The customer could have employed more aggressive control strategies to achieve energy savings, such as shutting the lights off when an area is not occupied as opposed to dimming.

RHA accounted for these issues upon calculating the project's verified savings. Power monitoring results fell within 12.8% of the ALCS' reported energy consumption, indicating the ALCS was not correctly reporting energy consumption. Due this discrepancy with the reported ALCS energy consumption RHA relied on monitored energy consumption upon calculation final project savings

Energy Impacts

The installation contractor estimated energy savings achieved by the project, which Cadmus compared to energy savings verified by RHA to determine the project's realization rate. RHA verified energy savings representing conditions found on site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[28] Table 95 details project energy savings and demand reduction.

Table 95. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	244,598	162,005	179,852	91%	9%
Realization Rate	-	66%	111%	-	-
Demand Reduction (kW)	20.8	27.1	19.1	77%	23%
Realization Rate	-	130%	71%	-	-

The project achieved 179,852 kWh of energy savings and 19.1 kW of demand reduction. These energy savings accounted for a 44% reduction in lighting energy usage. The project contractor overestimated energy savings for this project by 34%, which achieved a 66% realization rate. The LED upgrade accounted for 91% of project energy savings, with the remaining 9% due to the ALCS.

The project achieved relative energy savings of 2.4 kWh per square foot of project area. Considering the project costs, energy savings, and utility rates for this project, customers could expect a simple payback of 1.9 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the project's above-code savings. Methods applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods estimated that the project achieved 76,183 kWh

[28] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

energy savings above Title 24 code. Cadmus evaluated above code savings for this project to be 85,095 kWh and 19.1 kW of demand reduction.

Pilot Awareness, Decision Making, and Challenges

Cadmus was unable to speak with the project decision maker at site, who is no longer with the company. No other staff were familiar with the project.

Willingness to Pay and Project Costs

The lighting project cost $194,664.00, and the decision maker received an incentive of $50,000.00 (Table 96).

Table 96. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$194,664.00	$50,000.00	N/A

Contractor Interactions

Contractor 2 was the contractor for this project from start to finish, design through install. They offer commissioning; electrical and lighting; controls (mechanical, electrical, lighting, and energy management); energy assessments, diagnostics, or ratings; HVAC equipment; mechanical systems; insulation and building envelope measures; and renewable energy; as well as training and consulting.

For this project, the decision maker received an incentive check from SCE.

Contractor Training

Contractor 2 was the only contractor on this project.

The contractor firm is designated as having received California Advanced Lighting Control Training Program training. However, the lead contractor (interviewed) was not CALCTP-certified. The only project-related training received by the lead contractor was through the California Civilian Conservation Corp.

The contractor learned about the pilot through contact with an SCE representative. They expressed a preference for staying informed about the pilot through the SCE website as well as in emails from SCE representatives. The contractor chose to recommend the pilot to customers because of the cost savings.

Contractor Experience with Pilot

The contractor did not experience acceptance testing for the project.

On a scale of 0 to 10, where 0 means *not at all influential* and 10 means *very influential*, the contractor rated the pilot as a 7 in influencing their decision to recommend that the company install the advanced lighting control system.

Participating in the pilot did not change the contractor's sales for advanced lighting control systems. The contractor reported that before participating in the pilot, they recommended advanced lighting control systems 90% of the time; After participating, they recommend these systems 90% of the time.

Table 97 shows the importance ratings provided by the contractor.

Table 97. Contractor Attribution Ratings

H6. Using a 0 to 10 rating scale, how important in your recommendation was…:	
Factors	**Score**
Information provided on SCE's website	9
Training and seminars provided by SCE	7
Your company's past participation in a rebate program sponsored by SCE	8
Training outside the pilot (if rating of 5 or greater, which trainings)	6

The contractor noted that being able to spend more time with customers and work with them on pricing and rebate project options was the greatest benefit of promoting the pilot. The contractor also said that 90% of the time they discuss the pilot and project goals to achieve "deep energy savings."

Satisfaction

Contractor

Overall, the contractor expressed high satisfaction with their pilot experience. Table 98 shows the respondent's satisfaction rating for various pilot elements.

Table 98. Contractor Satisfaction Ratings

Project Element	Response
SCE communications about the pilot and offerings	Very satisfied
Pre-installation process	Somewhat satisfied
Post-installation process with verification contractor	Somewhat satisfied
SCE making the paperwork easy	Somewhat satisfied
Time for paperwork to be processed	Not very satisfied
Response time to questions or inquiries	Somewhat satisfied
Providing the right amount of support for contractors to confidently sell and install energy efficiency equipment	Very satisfied
The final incentives provided	Somewhat satisfied
Pilot overall	Very satisfied

The contractor said the pilot ran smoothly and they had no additional suggestions for ways SCE could improve their pilot experience.

ALCS – 021

Building Type: Warehouse and Office
Participant Industry: Aerospace Industry
Building Size: 135,880 sq. ft
Project Area: 80,000 sq. ft
Completion Date: August 2016
Lease/Own: Lease
Number of Employees: Approximately 1,000
Contractor Group: CALCTP Trained[29]

Project Specifications

Project number 021 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 99. The facility retrofitted T-8s with LEDs and integrated them into the ALCS, with the retrofit covering the entire building area.

Table 99. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Feasible; Not implemented
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, controls, scheduling, and zoning. Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, though the system is capable of both.

Quality Assurance

RHA conducted a pre-inspection of this facility including 7 days of monitoring. In August 2016, RHA completed a post-inspection, which included seven days of power monitoring.

Based on post-inspection, RHA found several issues with the project:

- Six light loggers provided false readings during the data logging period, hence the results were discarded. The remaining two data loggers experienced a 9% variation from project data.
- Fixtures in the primary daylight zone were not activated for daylight harvesting.

[29] CALCTP requires CALCTP-certified projects to be conducted by CALCTP-certified contractors using a CACLTP-certified project manager and CALCTP-certified installers. This study did not determine whether projects performed by CALCTP -certified contractors met these requirements or if the persons installing the ALCS had CALCTP training or certifications.

- The old lighting system data had to be manually entered by the contractor for the system to accurately calculate energy and cost savings, and entered data were higher than the actual baseline.

RHA accounted for these issues upon calculating the project's verified savings. Power monitoring results fell within 9% of the ALCS' reported energy consumption, indicating the system was not accurately account for energy consumption. RHA mitigated this discrepancy by relying on their monitored results to calculate energy consumption.

Energy Impacts

The installation contractor estimated energy savings achieved by the project, which Cadmus compared to energy savings verified by RHA to determine the project's realization rate. RHA verified energy savings representing conditions found on site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[30] Table 100 details project energy savings and demand reduction.

Table 100. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	268,487	270,841	299,468	77%	23%
Realization Rate	-	101%	111%	-	-
Demand Reduction (kW)	27.1	31.5	22.1	83%	17%
Realization Rate	-	116%	70%	-	-

The project achieved 299,468 kWh of energy savings and 22.1 kW of demand reduction. These energy savings accounted for a 64% reduction in lighting energy usage. The project contractor underestimated energy savings for this project by 1%, which achieved a 101% realization rate. The LED upgrade accounted for 77% of project energy savings, with the remaining 23% due to the ALCS.

The project achieved relative energy savings of 3.7 kWh per square foot of project area. Considering the project costs, energy savings, and utility rates for this project, customers could expect a simple payback of 5.6 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the project's above-code savings. Methods applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods estimated that the project achieved 168,038 kWh energy savings above Title 24 code. Cadmus evaluated above code savings for this project to be 185,964 kWh and 22.1 kW of demand reduction.

[30] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

Pilot Awareness, Decision Making, and Challenges

The project decision maker learned about the pilot from the previous building manager, who always kept up on new program opportunities similar to this pilot. The decision maker initiated the lighting project at the facility.

The decision maker noted that the most important factor in their decision to make the lighting system upgrades through the pilot was to save money on energy bills.

The decision maker cited high initial costs as the biggest challenge they faced in making energy-efficient improvements. The decision maker could not think of any barriers when deciding whether to participate in the pilot.

The decision maker said their organization has benefited from participating in the pilot because of the return on investment.

Willingness to Pay and Project Costs

The lighting project cost $261,541.00, and the decision maker received an incentive of $50,000.00 (Table 101). According to the decision maker, they might have installed the same lighting system and completed the same project if they received 25% of the incentive.

Table 101. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$261,541.00	$50,000.00	$12,500.00

Contractor Interactions

Contractor 1 was the contractor for this project. The decision maker reported that they chose to work with this contractor because they had worked with them on previous projects.

For this project, the decision maker was unsure who got the incentive check, which would have been handled by the company's accounting team.

Decision Maker Perceptions of the Contractor

The decision maker rated themselves as *very satisfied* with their experience with the contractor, because the contractor was very involved, very accommodating, and very accessible.

The decision maker noted that the contractor did not have to correct issues during commissioning, code inspection, or SCE QA.

Counterfactual Baseline and Project Net-to-Gross

The decision maker answered several questions about the likely path they would have taken had the pilot and incentives not existed, and about the pilot influence on their decision to install the ALCS.

The decision maker indicated they would have installed the same lighting control system had the pilot not existed. Prior to learning about the pilot, they had budgeted for the purchase of the lighting control

system. Additionally, they had considered the energy savings in relation to the project cost in their decision to proceed with installing the lighting control system. They also indicated that without the pilot incentive, the return on their investment would have been high enough to install the same control system.

The decision maker answered several questions using Program Attribution Index scoring regarding the level of pilot influence on their decision to install the lighting control system. First, the decision maker rated the pilot and non-pilot influences shown in Table 102 (known as Program Attribution Index 1).

Table 102. Program Attribution Index 1 Ratings

E4. Using a0 to 10 rating scale, please rate the importance of each of the following in your decision to implement the advanced lighting controls with a graphical user interface.		
Type	**Factors**	**Score**
Pilot Influences	1. The availability of the pilot incentive	8
	2. Recommendations or suggestions from SCE pilot staff	DK
	3. Recommendations or suggestions from SCE account representative	DK
	4. Recommendations or suggestions from contractor or vendor	8
Non-Pilot Influences	5. Internal policy or requirements inside company or organization	9
	6. Concerns about environmental effects or global warming	5
	7. Desire to achieve energy independence	RF
	8. Desire to save money on monthly energy bills	10
	9. Interest in the lighting control technology	10
	10. Desire to install a control system to reduce operation and maintenance costs	9
	11. Desire to install a control system to automate lighting decisions	9

Next, the decision maker answered questions about the timing of their decision and rated the relative important of the pilot influences compared to the non-pilot influences: these are known as the Program Attribution Index 2, shown in Table 103.

Table 103. Program Attribution Index 2 Ratings

Question	Response	
Did you learn about the pilot before or after you decided to adopt or install the advanced lighting control system?	Before	
Rate the importance of the pilot on your decision as opposed to other factors that may have influenced your decision. Using a 0 to 10 rating scale where 0 means *not at all important* and 10 means *very important*, please rate the overall importance of the pilot versus the most important of the other factors we just discussed in your decision to adopt or install the specific measure. This time the two importance ratings—the pilot importance and the non-pilot importance—should total 10.	**Pilot Score**	**Non-Pilot Score**
	5	5

Lastly, the decision maker rated the likelihood they would have installed each aspect of the lighting control system had the pilot incentives not been available: these are known as Program Attribution Index 3 and shown in Table 104.

Table 104. Program Attribution Index 3 Ratings

Think about the action you would have taken with regard to installing this equipment if the pilot had not been available. Using a 0 to 10 scale, where 0 is *not at all likely* and 10 is *extremely likely*, please rate the likelihood that you would have integrated each of the following features into your lighting control system:	
ALCS Features	**Rating**
Graphical user interface	10
Fixtures using task tuning, where each lighting fixture can be optimized to the space	10
Daylight harvesting system that dims lighting fixtures in response to sunlight	10
Occupancy or vacancy controls that turn off lighting in rooms that are not occupied	10
Lighting automation system that turns lighting on and off depending on the time of day	10
Control system allowing for automatic demand response that allows utility to dim lights	10

Upon calculating the Pilot Attribution Indexes 1, 2, and 3, Cadmus estimated the project's NTG ratio as 31%. In the absence of the program they were likely to install the same ALCS system they installed as they had already budgeted for the system they installed.

Satisfaction

Key Decision Maker

Overall, the decision maker expressed satisfaction with their pilot experience. Table 105 shows the respondent's satisfaction rating for various pilot elements.

Table 105. Decision Maker Satisfaction Ratings

Project Element	Response
Performance of new system	Very satisfied
Pilot overall	Somewhat satisfied

The decision maker did not complete the application paperwork.

The decision maker said that to improve their pilot experience, SCE could have extended the incentives through 2018, as there are still more lighting projects they would like to complete.

End User Survey

Cadmus sent an online survey by email to the building occupants interacting with the new control system; however, no one responded to the survey.

ALCS – 023

Building Type: Warehouse
Participant Industry: Distribution
Building Size: 41,652 sq. feet
Project Area: 41,652 sq. feet
Completion Date: July 2016
Lease/Own: Unknown
Number of Employees: Unknown
Contractor Group: CALCTP Trained[31]

Project Specifications

Project number 023 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 106. The facility retrofitted T-5s with LEDs and integrated these into the ALCS. The retrofit covered the entire building area.

Table 106. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Yes
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, daylight harvesting, controls, scheduling, and zoning. Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, though the system is capable of both.

Quality Assurance

A member of the SCE third party inspection team conducted a pre-retrofit inspection, gathering fixture data and operating hours that RHA reviewed and used in project calculations. RHA completed a post-inspection in July of 2016 that included seven days of power metering, fixture verification, and functional testing of the ALCS.

Based on post-inspection, RHA found one issue with the project:

- The facility's actual operating hours were slighting higher than the inputs used to conduct the analysis.

[31] CALCTP requires CALCTP-certified projects to be conducted by CALCTP-certified contractors using a CACLTP-certified project manager and CALCTP-certified installers. This study did not determine whether projects performed by CALCTP -certified contractors met these requirements or if the persons installing the ALCS had CALCTP training or certifications.

Upon calculating verified savings for the project, RHA accounted for this issue. Power monitoring results fell within 1% of the ALCS' reported energy consumption, verifying the system correctly accounted for energy usage. Cadmus' review of savings documentation did not find issues with RHA-calculated savings for the lighting and ALCS system.

Energy Impacts

The installation contractor estimated energy savings achieved by the project, which Cadmus compared to energy savings verified by RHA to determine the project's realization rate. RHA verified energy savings representing conditions found on site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages. Table 107 details project energy savings and demand reduction.

Table 107. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	31,941	55,647	58,174	56%	44%
Realization Rate	-	174%	105%	-	-
Demand Reduction (kW)	0.0	12.7	8.5	72%	28%
Realization Rate	-	N/A	67%	-	-

The project achieved 58,174 kWh of energy savings and 8.5 kW of demand reduction. These energy savings accounted for an 83% reduction in lighting energy usage. The project contractor underestimated energy savings for this project by 74%, which achieved a 174% realization rate. The LED upgrade accounted for 56% of project energy savings, with the remaining 44% due to the ALCS.

The project achieved relative energy savings of 1.4 kWh per square foot of project area. Considering the project's costs, energy savings, and utility rate, customers could expect a simple payback of 7.1 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the project's above-code savings. Methods applied allowed RHA to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods estimated that the project achieved 33,805 kWh energy savings above Title 24 code. Cadmus evaluated above code savings for this project to be 35,340 kWh and 8.5 kW of demand reduction.

Pilot Awareness, Decision Making, and Challenges

The project decision maker declined to respond to the survey regarding their experience with the pilot. Cadmus called four times and attempted to send emails, but the key decision maker's phone number did not have a voicemail machine, and the email address associated with the contact was not active.

Willingness to Pay and Project Costs

The lighting project cost $89,536.00, and the decision maker received an incentive of $26,710.00 (Table 108).

Table 108. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$89,536.00	$26,710.00	N/A

Contractor Interactions

Contractor 10 was the contractor for this project and was very involved in determining the scope of work for the project. In addition, they designed the lighting plan, designed the controls plan, proposed the solution, and managed the project installation and incentive process. They also managed commissioning of the project, in which they confirmed and commissioned the system to ensure it met decision maker expectations and conducted a follow-up process to ensure that the decision maker was satisfied.

Contractor Training

The contractor has three years of experience in lighting and controls and has completed trainings including CEU (continuing education units) credits and certification from Lighting Control Association.

The contractor learned about the pilot through an SCE briefing. They expressed a preference for staying informed about the pilot through the SCE website. The contractor chose to recommend the pilot to customers because of the savings value of energy controls.

Contractor Experience with Pilot

The contractor did experience acceptance testing for the project. The contractor indicated that the acceptance testing is part of their process and something they do regardless of the pilot.

On a scale of 0 to 10, where 0 means *not at all influential* and 10 means *very influential*, the contractor rated the pilot as a 9 in influencing their decision to recommend that the company install the advanced lighting control system.

Participating in the pilot did not change the contractor's sales for advanced lighting control systems. The contractor reported that before participating in the pilot, they recommended advanced lighting control systems 50% of the time; After participating, they recommend these systems 50% of the time.

Table 109 shows the importance ratings provided by the contractor.

Table 109. Contractor Attribution Ratings

H6. Using a 0 to 10 rating scale, how important in your recommendation was…:	
Factors	**Score**
Information provided on SCE's website	7
Training and seminars provided by SCE	5
Your company's past participation in a rebate program sponsored by SCE	10
Training outside the pilot (if rating of 5 or greater, which trainings)	5

The contractor noted that the rebates for their customers is the greatest benefit of promoting the pilot. The contractor also said that they stated deep energy savings as an explicit goal 100% of the time.

Satisfaction

Contractor

Overall, the contractor expressed moderate satisfaction with their pilot experience. Table 110 shows the respondent's satisfaction rating for various pilot elements.

Table 110. Contractor Satisfaction Ratings

Project Element	Response
SCE communications about the pilot and offerings	Somewhat satisfied
Pre-installation process	Not very satisfied
Post-installation process with verification contractor	Somewhat satisfied
SCE making the paperwork easy	Not very satisfied
Time for paperwork to be processed	Not at all satisfied
Response time to questions or inquiries	Somewhat satisfied
Providing the right amount of support for contractors to confidently sell and install energy efficiency equipment	Refused
The final incentives provided	Very satisfied
Pilot overall	Somewhat satisfied

The contractor said that SCE could have addressed the following items to improve their pilot experience:

- The clarity of the pilot was not very good.
- The requirements changed during the process.
- The timeline for pre- and post-inspection took very long (more than six months).
- SCE's representatives' general understanding of the goals of the system and operations and value of the system were not good.
- The verification contractor's process for the post-inspection was cumbersome and the clients were not happy with the way the process intruding into their business.

ALCS – 024

Building Type: Warehouse and Office
Participant Industry: Manufacturing
Building Size: 175,000 sq. feet
Project Area: 140,000 sq. feet
Completion Date: August 2016
Lease/Own: Lease
Number of Employees: 350
Contractor Group: Manufacturer Trained

Project Specifications

Project number 024 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 111. The facility retrofitted T-8s with LEDs and integrated these into the ALCS. The retrofit covered 80% of the building area.

Table 111. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Not feasible
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, controls, scheduling, and zoning. Though Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, the system is capable of both.

Quality Assurance

SCE's engineering team conducted a pre-retrofit inspection, gathering fixture data and monitored operating hours, which RHA reviewed and used in project calculations. RHA completed a post-inspection in July 2016 that included seven days of power metering, fixture verification, and functional testing of the ALCS.

Based on post-inspection, RHA found two issues with the project:

- Due to employee feedback, lights in the manufacturing area were kept at 100% during working shifts. This reduces energy savings for task tuning.
- A data logger slipped off the conductor during data monitoring; so no data were collected during a five-day period.
- Some areas did not allow power data logging due to panel configurations.

Upon calculating verified savings for the project, RHA accounted for these issues. Power monitoring results fell within 1% of the ALCS' reported energy consumption, verifying that the system correctly accounted for energy usage.

Energy Impacts

The installation contractor estimated energy savings achieved by the project, which Cadmus compared to energy savings verified by RHA to determine the project's realization rate. RHA verified energy savings representing conditions found on site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[32] Table 112 details project energy savings and demand reduction.

Table 112. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	745,439	483,568	500,827	80%	20%
Realization Rate	-	65%	104%	-	-
Demand Reduction (kW)	87.3	87.3	57.7	86%	14%
Realization Rate	-	100%	66%	-	-

The project achieved 500,827 kWh of energy savings and 57.7 kW of demand reduction. These energy savings accounted for a 67% reduction in lighting energy usage. The project contractor overestimated energy savings for this project by 35%, which achieved a 65% realization rate. The LED upgrade accounted for 80% of project energy savings, with the remaining 20% due to the ALCS.

The project achieved relative energy savings of 3.6 kWh per square foot of project area. Considering the project costs, energy savings, and utility rates for this project, customers could expect a simple payback of 2.4 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the project's above-code savings. Methods applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods estimated that the project achieved 164,798 kWh energy savings above Title 24 code. Cadmus evaluated above code savings for this project to be 167,585 kWh and 22.1 kW of demand reduction.

Pilot Awareness, Decision Making, and Challenges

The project decision maker learned about the pilot when looking through rebates and working to find out more about what belongs in a cost analysis report. They found about the pilot and started working with Dario. The key decision maker initiated the lighting project at the facility.

[32] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

The decision maker noted the following factors as being important in their decision to make the lighting system upgrades through the pilot:

- Most important: To lower operations and maintenance costs
- To save money on energy bills

The decision maker cited the long payback period as the biggest challenge they face in making energy-efficient improvements.

The decision maker said they experienced a barrier when deciding whether to participate in the pilot: A year prior to this project, the decision maker installed an air compressor unit and was told by an SCE representative that there were no rebates. Then, right after the installation, they were told there was a rebate. The decision maker was cautious to begin the pilot because the verification continues for a long time, and said it would be easier if SCE said, "this is what you're going to get, let us know when you're done."

The decision maker said their organization has benefited from participating in the pilot because of increased occupant comfort, better aesthetics, the ability to set up lighting on schedules, the occupancy sensors, and being able to take advantage of daylight.

Willingness to Pay and Project Costs

The lighting project cost $274,713.00, and the decision maker received an incentive of $50,000.00 (Table 113). According to the decision maker, they might have completed the same projects if they received 75% of the incentive.

Table 113. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$274,713.00	$50,000.00	$37,500.00

Contractor Interactions

CLS Facility Services was the contractor for this project. The decision maker reported that they chose to work with this contractor because they had worked with them on previous projects.

CLS Facility Services declined to respond to the survey regarding their experience with the pilot. Cadmus attempted to reach the contractor five times but was not able to connect with the contractor.

Decision Maker Perceptions of the Contractor

The decision maker rated themselves as *somewhat satisfied* with their experience with the contractor, because the contractor could have improved their ability to work around operational schedules.

The decision maker noted that the contractor did not have to correct issues during commissioning, code inspection, or SCE QA.

Counterfactual Baseline and Project Net-to-Gross

The decision maker answered several questions about the likely path they would have taken had the pilot and incentives not existed, and about the pilot influence on their decision to install the control system.

The decision maker would have only installed a basic lighting retrofit project following Title 24 code requirements had the pilot not existed more than two years later. Prior to learning about the pilot, they had not budgeted for the purchase of the lighting control system. Additionally, they had considered the energy savings in relation to the project cost in their decision to proceed with installing the lighting control system. They also indicated that without the pilot incentive, the return on their investment would not have been high enough to install the same control system.

The company has an energy and sustainability team that conducts energy reviews at locations and gives some guidance on best practices. The decision maker said that they would have preferred that SCE give more credence to the concerns of the energy and sustainability team in developing the project recommendations.

The decision maker answered several questions using Program Attribution Index scoring regarding the level of pilot influence on their decision to install the lighting control system. First, the decision maker rated the pilot and non-pilot influences shown in Table 114 (known as Program Attribution Index 1).

Table 114. Program Attribution Index 1 Ratings

E4. Using a 0 to 10 rating scale, please rate the importance of each of the following in your decision to implement the advanced lighting controls with a graphical user interface.		
Type	**Factors**	**Score**
Pilot Influences	1. The availability of the pilot incentive	7
	2. Recommendations or suggestions from SCE pilot staff	4
	3. Recommendations or suggestions from SCE account representative	2
	4. Recommendations or suggestions from contractor or vendor	0
Non-Pilot Influences	5. Internal policy or requirements inside company or organization	10
	6. Concerns about environmental effects or global warming	10
	7. Desire to install a control system to improve employee morale	7
	8. Desire to save money on monthly energy bills	8
	9. Interest in the lighting control technology	6
	10. Desire to install a control system to reduce operation and maintenance costs	8
	11. Desire to install a control system to automate lighting decisions	6

Next, the decision maker answered questions about the timing of their decision and rated the relative importance of the pilot influences compared to the non-pilot influences: these are known as the Program Attribution Index 2, shown in Table 115.

Table 115. Program Attribution Index 2 Ratings

Question	Response	
Did you learn about the pilot before or after you decided to adopt or install the advanced lighting control system?	Before	
Rate the importance of the pilot on your decision as opposed to other factors that may have influenced your decision. Using a 0 to 10 rating scale, where 0 means *not at all important* and 10 means *very important*, please rate the overall importance of the pilot versus the most important of the other factors we just discussed in your decision to adopt or install the specific measure. This time the two importance ratings—the pilot importance and the non-pilot importance—should total 10.	Pilot Score	Non-Pilot Score
	4	6

Lastly, the decision maker rated the likelihood they would have installed each aspect of the lighting control system had the pilot incentives not been available: these are known as Program Attribution Index 3 and shown in Table 116.

Table 116. Program Attribution Index 3 Ratings

Think about the action you would have taken with regard to installing this equipment if the pilot had not been available. Using a 0 to 10 scale, where 0 is *not at all likely* and 10 is *extremely likely*, please rate the likelihood that you would have integrated each of the following features into your lighting control system:	
ALCS Features	**Rating**
Graphical user interface	10
Fixtures using task tuning, where each lighting fixture can be optimized to the space	10
Daylight harvesting system that dims lighting fixtures in response to sunlight	10
Occupancy or vacancy controls that turn off lighting in rooms that are not occupied	10
Lighting automation system that turns lighting on and off depending on the time of day	10
Control system allowing for automatic demand response that allows utility to dim lights	4
Control system installed into the entire area of the building that was part of the final project	10

Upon calculating the Pilot Attribution Indexes 1, 2, and 3, Cadmus estimated the project's NTG ratio as 27%. In the absence of the program they were likely to have completed a lighting retrofit to code more than 2 years later. The key decision maker indicated they were very likely to have incorporated all ALCS features into their lighting system in the absence of the program however they would have been unable fund the costs of a system incorporating these features making their implementation unlikely without the pilot.

Satisfaction

Key Decision Maker

Overall, the decision maker expressed satisfaction with their pilot experience. Table 117 shows the respondent's satisfaction rating for various pilot elements.

Table 117. Decision Maker Satisfaction Ratings

Project Element	Response
Performance of new system	Very satisfied
Pilot overall	Somewhat satisfied

In addition, the decision maker rated the application paperwork as *somewhat challenging*.

The decision maker said that to improve their pilot experience, SCE could have increased the simplicity. They said that when SCE offers an incentive to a customer, they should make it easy for the customer to obtain the incentive without having to jump through many hoops. The decision maker said that in third-party verification, SCE should work with a new party, and take more proactive steps before and after the project. They also said that increased communication with the customer would be useful. When Dario from SCE was out for a week, the decision maker said there was no one was backing him up, so suggested that SCE needs some support for him.

Final Comments

Overall, the decision maker rated themselves as *somewhat satisfied* with the pilot and *very satisfied* with the installed lighting controls.

End User Survey

Cadmus sent an online survey by email to the building occupants interacting with the new control system. Three individuals responded to the survey, but only one completed all of the questions. One respondent has received training on how to use the system form Digital Lumens technical staff while the other two had not, as shown in Table 118.

Table 118. End User Survey Responses

Project Element	Number of Responses	
Received training on the lighting control system	1	
Can effectively operate lighting controls	Very or somewhat effectively	Not too or not at all effectively
	1	0
Satisfaction with controls	Very or somewhat satisfied	Not very or not at all satisfied
	1	0

The respondent who has received training on how to use the system reported that they have administrator access and update the control programming less than every month to allow for additional hours of operation on days that require a longer shift. On those days, the staff are in the building beyond normal business hours and lighting needs to be adjusted to accommodate their work.

Originally the respondent noted that they had a couple fixtures fail after being installed, but since then everything has worked perfectly. They strongly agreed that the lighting system has made the space more comfortable and safer, has improved the quality of their work, has saved the company money, and has improved the aesthetics of the space. They are overall very satisfied with the new system.

ALCS – 025

Building Type: Offices
Participant Industry: Aeronautics Industry
Building Size: 48,800 sq. ft
Project Area: 48,800 sq. ft
Completion Date: April 2016
Lease/Own: Lease
Number of Employees: 2,500
Contractor Group: CALCTP Trained[33]

Project Specifications

Project number ALCS-025 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 119. The facility retrofitted T-8s with LEDs and integrated them into the ALCS. The retrofit covered the entire building area.

Table 119. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Not Feasible, Not Implemented
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, controls, and zoning. Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, though the system is capable of both. The ALCS did not utilize daylight harvesting as none of the retrofitted lighting fell within the primary daylighting zone.

Quality Assurance

No third-party, pre-retrofit inspection was completed at this facility; the contractor gathered fixture data and operating hours that RHA reviewed and used in project calculations. The contractor conducted light logging prior to the retrofit to establish baseline conditions, RHA conducted analysis on the monitored data. A post-inspection was completed by RHA including 7 days of power monitoring.

RHA found several issues with the project:

- The provided EMS reports were not ideal for analysis, and nine zones did not have critical information for analysis. Ultimately, the contractor could provide more complete reports.

[33] CALCTP requires CALCTP-certified projects to be conducted by CALCTP-certified contractors using a CACLTP-certified project manager and CALCTP-certified installers. This study did not determine whether projects performed by CALCTP -certified contractors met these requirements or if the persons installing the ALCS had CALCTP training or certifications.

- Wireless access controller devices stopped working and did not report consumption data for two zones.
- No baseline wattage or operation hours were entered into the ACLS control system, due to this error the ALCS was unable to display energy savings of the control system to the customer.

Upon calculating verified savings for the project, RHA accounted for these issues. Power monitoring results fell within 1% of the ALCS' reported energy consumption, verifying the system correctly accounted for energy usage.

Energy Impacts

The installation contractor estimated energy savings achieved by the project, which Cadmus compared to energy savings verified by RHA to determine the project realization rate. RHA verified energy savings representing the condition found on site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[34] Table 120 details project energy savings and demand reduction.

Table 120. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	109,468	159,499	171,497	51%	49%
Realization Rate	-	146%	108%	-	-
Demand Reduction (kW)	20.2	22.0	18.3	67%	33%
Realization Rate	-	109%	83%	-	-

The project achieved 171,497 kWh of energy savings and 18.3 kW of demand reduction. These energy savings accounted for a 65% reduction in lighting energy usage. The project contractor underestimated energy savings for this project by 46%, which achieved a 146% realization rate. The LED upgrade accounted for 51% of project energy savings, with the remaining 49% due to the ALCS.

The project achieved relative energy savings of 3.5 kWh per square foot of project area. Considering the project costs, energy savings, and utility rate for this project, customers should expect a simple payback of 3.0 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated above-code savings for this project. Methods applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods estimated that the project achieved 39,129 kWh energy savings above Title 24 code. Cadmus evaluated above code savings for this project to be 34,492 kWh and 13.8 kW of demand reduction.

[34] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

Pilot Awareness, Decision Making, and Challenges

The project decision maker learned about the pilot from their contractor. Someone no longer with the company initiated the lighting project at the facility.

The decision maker noted the following factors as being important in their decision to make the lighting system upgrades through the pilot:

- Most important: To reduce energy consumption or energy demand
- To lower operation and maintenance costs

The decision maker cited the following as the biggest challenges they face in making energy-efficient improvements:

- Completing the pilot application process, namely the financial process
- Committing to go through with the entire project
- Improving specific areas of the building as compared to which equipment is eligible for an incentive

The decision maker said they did not recall experiencing any barriers when deciding whether to participate in the pilot and said their organization has benefited from participation through lowering energy bills and saving money on maintenance costs.

Willingness to Pay and Project Costs

The lighting project cost $129,405.00, and the decision maker received an incentive of $50,000.00 (Table 121). According to the decision maker, they would not have installed the same ALCS if they received 50% of the incentive but might have installed the system if they received 75%. They said the incentive amount would depend on how it affected the return on investment (ROI).

Table 121. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$129,405.00	$50,000.00	$37,500.00

Contractor Interactions

A lighting designer and Contractor 9 were the contractors for this project. The lighting designer planned the project, and the second contractor installed the system. The decision maker reported that they chose the installation contractor based on the recommendation of the first contractor.

For this project, the decision maker received an incentive check from the contractor that provided an instant discount.

Contractor Training

Cadmus reached out to both contractors and learned that the contractors are no longer with the company, and other staff were not familiar enough with the project to answer questions.

Decision Maker Perceptions of the Contractor

The decision maker rated themselves as *somewhat satisfied* with their experience with the contractor because the contractor did not complete the installation process without issues—it was not a 100% smooth process.

The decision maker noted that the installation contractor did not have to correct issues during commissioning, code inspection, or SCE QA.

Counterfactual Baseline and Project Net-to-Gross

The decision maker answered several questions about the likely path they would have taken had the pilot and incentives not existed, and about the pilot influence on their decision to install the control system.

The decision maker indicated they would have completed a less ambitious lighting controls project had the pilot not existed and noted they would have installed the system sooner, without the red tape of the pilot. Prior to learning about the pilot, the decision maker had budgeted for the purchase of the lighting control system. Additionally, they had considered the energy savings in relation to the project cost in their decision to proceed with the installation. In short, they said the company always looks to make the most energy-efficient decisions when installing new equipment, but they also review the ROI of the equipment as well. Typically, they try to receive an ROI of one year. They also said that without the pilot incentive, the ROI would have been high enough to install a smaller control system.

The decision maker answered several questions using Program Attribution Index scoring regarding the level of pilot influence on the decision to install the lighting control system. First, the decision maker rated the pilot and non-pilot influences shown in Table 122 (known as Program Attribution Index 1).

Table 122. Program Attribution Index 1 Ratings

E4. Using a 0 to 10 rating scale, please rate the importance of each of the following in your decision to implement the advanced lighting controls with a graphical user interface.		
Type	**Factors**	**Score**
Pilot Influences	1. The availability of the pilot incentive	8
	2. Recommendations or suggestions from SCE pilot staff	N/A
	3. Recommendations or suggestions from SCE account representative	N/A
	4. Recommendations or suggestions from contractor or vendor	9
Non-Pilot Influences	5. Internal policy or requirements inside company or organization	10
	6. Concerns about environmental effects or global warming	10
	7. Desire to achieve energy independence	10
	8. Desire to save money on monthly energy bills	10
	9. Interest in the lighting control technology	8
	10. Desire to install a control system to reduce operation and maintenance costs	10
	11. Desire to install a control system to automate lighting decisions	5

Next, the decision maker answered questions about the timing of their decision and rated the relative importance of the pilot influences compared to the non-pilot influences: these are known as the Program Attribution Index 2, shown in Table 123.

Table 123. Program Attribution Index 2 Ratings

Question	Response	
Did you learn about the pilot before or after you decided to adopt or install the advanced lighting control system?	Did not remember	
Rate the importance of the pilot on your decision as opposed to other factors that may have influenced your decision. Using a 0 to 10 rating scale, where 0 means *not at all important* and 10 means *very important*, please rate the overall importance of the pilot versus the most important of the other factors we just discussed in your decision to adopt or install the specific measure. This time the two importance ratings—the pilot importance and the non-pilot importance—should total 10.	Pilot Score	Non-Pilot Score
	5	5

Lastly, the decision maker rated the likelihood they would have installed each aspect of the lighting control system had the pilot incentives not been available: these are known as Program Attribution Index 3 and shown in Table 124.

Table 124. Program Attribution Index 3 Ratings

Think about the action you would have taken with regard to installing this equipment if the pilot had not been available. Using a 0 to 10 scale, where 0 is *not at all likely* and 10 is *extremely likely*, please rate the likelihood that you would have integrated each of the following features into your lighting control system:	
ALCS Features	**Rating**
Graphical user interface	10
Fixtures using task tuning, where each lighting fixture can be optimized to the space	10
Daylight harvesting system that dims lighting fixtures in response to sunlight	N/A
Occupancy or vacancy controls that turn off lighting in rooms that are not occupied	10
Lighting automation system that turns lighting on and off depending on the time of day	2
Control system allowing for automatic demand response that allows utility to dim lights	10

Upon calculating the Pilot Attribution Indexes 1, 2, and 3, Cadmus estimated the project's NTG ratio as 34%. In the absence of the program they were likely to have completed a lighting retrofit to code.

Satisfaction

Key Decision Maker

Overall, the decision maker expressed satisfaction with their pilot experience. Table 125 shows the respondent's satisfaction rating for various pilot elements.

Table 125. Decision Maker Satisfaction Ratings

Project Element	Response
Performance of new system	Somewhat satisfied
Pilot overall	Somewhat satisfied*

* The decision maker also answered "don't know" since they want to see how it goes over the long term.

In addition, the decision maker rated the application paperwork as *somewhat challenging*.

End User Survey

The decision maker refused to forward the end user survey to current employees of the facility, calling it inappropriate to have them take a survey about their satisfaction with the building.

ALCS – 028

Building Type: Manufacturing
Participant Industry: Food Processing
Building Size: 82,896 sq. ft
Project Area: 71,711 sq. ft
Completion Date: January 2017
Lease/Own: Unknown
Number of Employees: Unknown
Contractor Group: Manufacturer Trained

Project Specifications

Project number 028 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 130. The facility retrofitted T-8s and T-5s with LEDs and integrated them into the ALCS. The retrofit covered 87% of the building area, which operates 24 hours a day, 365 days a year.

Table 126. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Yes
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, daylight harvesting, controls, and zoning. Though Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, the system was capable of both.

Quality Assurance

RHA completed a pre-retrofit inspection of the facility, gathering fixture data and monitored operating hours, which RHA reviewed and used in project calculations. In April 2017, RHA completed a post-inspection that included four days of power metering, fixture verification, and functional ALCS testing.

Upon final inspection, RHA found several issues with the project:

- The contractor entered fixture wattages lower than actual installed wattages due to a change in the project's scope, which increased wattages to meet customer desired light levels.
- Contractor did not complete wiring to fixtures in the filling room and hallway zones, which limited the consumption data measurement.
- The contractor's estimated hours of operation were lower than monitored hours.

RHA accounted for these issues upon calculating the project's verified savings. Power monitoring results were consistent with no error reported from the ALCS energy consumption, verifying the system correctly accounted for energy usage.

Energy Impacts

The installation contractor estimated energy savings achieved by the project, which Cadmus compared to energy savings verified by RHA to determine the project's realization rate. RHA verified energy savings representing the condition found on site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[35] Table 127 details project energy savings and demand reduction.

Table 127. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	151,209	145,490	159,939	81%	19%
Realization Rate	-	96%	110%	-	-
Demand Reduction (kW)	22.5	14.5	10.1	92%	8%
Realization Rate	-	65%	70%	-	-

The project achieved 159,939 kWh of energy savings and 10.1 kW of demand reduction. These energy savings accounted for a 58% reduction in lighting energy usage. The project contractor overestimated the project's energy savings by 4%, achieving a 96% realization rate. The LED upgrade accounted for 81% of project energy savings with the remaining 19% due to the ALCS.

The project achieved relative energy savings of 2.2 kWh per square foot of project area. Considering the project costs, energy savings, and utility rate for the project, the customer could expect a simple payback of 3.7 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the project's above-code savings. The methods applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods estimated this project achieved 131,025 kWh in energy savings above Title 24 code. Cadmus evaluated above code savings for this project to be 143,968 kWh and 10.1 kW of demand reduction.

Pilot Awareness, Decision Making, and Challenges

The project decision maker declined to respond to the survey regarding their experiences with the pilot. Cadmus attempted to contact them six times on the phone and left one voicemail to request an interview but was not able to connect with the decision maker.

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[35] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

Willingness to Pay and Project Costs

The lighting project cost $131,781.00, and the decision maker received an incentive of $50,000.00 (Table 128).

Table 128. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$131,781.00	$50,000.00	N/A

Contractor Interactions

The contractor declined to respond to the survey regarding their experience with the pilot. Cadmus attempted to contact them several times on the phone and left one voicemail to request an interview but was not able to connect with the contractor.

Final Comments

Because none of the key stakeholders responded to our requests for an interview, we do not have information regarding pilot satisfaction, contractor trainings, or other information.

ALCS – 029

Building Type: Offices
Participant Industry: Medical
Building Size: 6,000 sq. ft
Project Area: 6,000 sq. ft
Completion Date: November 2016
Lease/Own: Unknown
Number of Employees: Unknown
Contractor Group: Manufacturer Trained

Project Specifications

Project number 029 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 129. The facility retrofitted T-8s with LEDs and integrated them into the ALCS. The retrofit covered 95% of the building area, which operates seven days a week from 5:30 am to 8:30 pm.

Table 129. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Feasible; Not implemented
Occupancy or Vacancy Control	Feasible; Not implemented
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, scheduling and zoning. Though Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, the system is capable of both.

Quality Assurance

RHA completed a pre-retrofit inspection of the facility, gathering fixture data and operating hours, which RHA reviewed and used in project calculations. RHA completed a post-inspection in March 2017 that included nine days of power metering, fixture verification, and functional ALCS testing.

Upon final inspection, RHA found one issue with the project:

- Fixtures in the primary daylight zone were required to use daylight harvesting, but this project did not employ this method.
- Occupancy sensors were not installed due to reliability concerns.
- The contractor could not provide system consumption data due to connectivity issues, limiting the post-inspection assessment.

RHA accounted for these issues upon calculating the project's verified savings; however, RHA could not determine accurate calculations from the system as the contractor could not provide data. As the

contractor was unable to provide comparison data for savings calculation RHA relied on their monitored consumption upon calculating final project savings

Energy Impacts

The installation contractor estimated energy savings achieved by the project, which Cadmus compared to energy savings verified by RHA to determine the project's realization rate. RHA verified energy savings representing conditions found on the site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[36] Table 130 details project energy savings and demand reduction.

Table 130. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	27,899	27,288	30,820	85%	15%
Realization Rate	-	98%	113%	-	-
Demand Reduction (kW)	9.8	8.5	7.6	87%	13%
Realization Rate	-	87%	89%	-	-

The project achieved 30,820 kWh of energy savings and 7.6 kW of demand reduction. These energy savings accounted for a 72% reduction in lighting energy usage. The project contractor overestimated energy savings for this project by 2%, achieving a 98% realization rate. The LED upgrade accounted for 85% of project energy savings, with the remaining 15% due to the ALCS.

The project achieved relative energy savings of 5.1 kWh per square foot of project area. Considering the project costs, energy savings, and utility rate for this project, the customer could expect a simple payback of 13.3 years.

Pilot Awareness, Decision Making, and Challenges

The project decision maker declined to respond to the survey regarding their experiences with the pilot. Cadmus attempted to contact them five times on the phone and was unable to leave a voicemail to request an interview. We also left a message with an operator at the building but were not able to connect with the decision maker.

Willingness to Pay and Project Costs

The lighting project cost $49,147.00, and the decision maker received an incentive of $13,098.00 (Table 131).

[36] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

Table 131. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$49,147.00	$13,098.00	N/A

Contractor Interactions

The contractor declined to respond to the survey regarding their experience with the pilot. Cadmus attempted to contact them four times on the phone and left three voicemails to request an interview but was not able to connect with the contractor.

Final Comments

Because none of the key stakeholders responded to our requests for an interview, we do not have information regarding pilot satisfaction, contractor trainings, or other information.

ALCS – 030

Building Type: Manufacturing
Participant Industry: Manufacturing
Building Size: 244,825 sq. ft
Project Area: 232,584 sq. ft
Completion Date: December 2016
Lease/Own: Unknown
Number of Employees: Unknown
Contractor Group: Manufacturer Trained

Project Specifications

Project number 030 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 132. The facility retrofitted T-8s with LEDs and integrated these into the ALCS. The retrofit covered 95% of the building area, which operates 24 hours a day, 365 days a year.

Table 132. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Yes
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, daylight harvesting, occupancy controls, and zoning. Though Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, the system was capable of both.

Quality Assurance

RHA completed a pre-retrofit inspection of the facility, gathering fixture data and monitored operating hours, which RHA reviewed and used in project calculations. In January 2017, RHA completed a post-inspection that included seven days of power metering, fixture verification, and ALCS functional testing.

Upon final inspection, RHA found one issue with the project:

- As an exact fixture to zoning diagram was unavailable, reported system consumption did not match monitored results.

Though RHA accounted for these issues upon calculating verified savings for the project, it could not determine accurate calculations from the system as layouts of fixtures and zones were unavailable. As a result, RHA relied on their monitored energy consumption upon calculating final project savings.

Energy Impacts

The installation contractor estimated energy savings achieved by the project, which Cadmus compared to energy savings verified by RHA to determine the project's realization rate. RHA verified energy savings representing conditions found on site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[37] Table 133 details project energy savings and demand reduction.

Table 133. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	385,801	392,940	408,795	18%	82%
Realization Rate	-	102%	104%	-	-
Demand Reduction (kW)	40.2	15.2	8.9	60%	40%
Realization Rate	-	38%	58%	-	-

The project achieved 408,795 kWh of energy savings and 8.9 kW of demand reduction. These energy savings accounted for a 67% reduction in lighting energy usage. The project contractor underestimated this project's energy savings by 2%, achieving a 102% realization rate. The LED upgrade accounted for 18% of project energy savings with the remaining 82% due to the ALCS.

The project achieved relative energy savings of 1.8 kWh per square foot of project area. Considering the project costs, energy savings, and utility rate for this project, the customer could expect a simple payback of 4.2 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated above-code savings for this project. The methods applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods estimated the project achieved 227,150 kWh energy savings above Title 24 code. Cadmus evaluated above code savings for this project to be 225,746 kWh and 8.9 kW of demand reduction.

Pilot Awareness, Decision Making, and Challenges

The project decision maker declined to respond to the survey regarding their experiences with the pilot. Cadmus attempted to contact them seven times on the phone, leaving five voicemails and one email to request an interview, but was not able to connect with the decision maker.

Willingness to Pay and Project Costs

The lighting project cost $259,288.00, and the decision maker received an incentive of $50,000.00 (Table 134).

[37] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

Table 134. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$259,288.00	$50,000.00	N/A

Contractor Interactions

The contractor declined to respond to the survey regarding their experience with the pilot. Cadmus attempted to contact them five times on the phone and left four voicemails to request an interview but was not able to connect with the decision maker.

Final Comments

Because none of the key stakeholders responded to our requests for an interview, we do not have information regarding pilot satisfaction, contractor trainings, or other information.

ALCS – 034

Building Type: Convention Center
Participant Industry: Hospitality
Building Size: 245,000 sq. ft
Project Area: 52,924 sq. ft
Completion Date: January 2017
Lease/Own: Own
Number of Employees: 50
Contractor Group: Manufacturer Trained

Project Specifications

Project number 034 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 135. The facility retrofitted incandescents and metal halides with LEDs and integrated these into the ALCS. The retrofit covered 22% of the building area, which operates for 200 events per year.

Table 135. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Not feasible, Not Implemented
Occupancy or Vacancy Control	Unknown
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, occupancy controls, and zoning. Though Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, the system is capable of both.

Quality Assurance

RHA completed a pre-retrofit inspection of the facility, gathering fixture data and monitored operating hours, which RHA reviewed and used in project calculations. In February 2017, RHA completed a post-inspection that included 13 days of power metering, fixture verification, and functional testing of the ALCS.

Upon final inspection, RHA found a few issues with the project:

- The control system reported incorrect lighting consumption, potentially caused by noise on conductors feeding the fixtures. The customer replaced the drive, and the issue was resolved.
- It was not possible to accurately determine facility operating hours, due to variations in the number and type of events held at the facility.

- The control system generated relative analog numbers based on a given input rather than measuring consumption, and the software system could not be upgraded as the manufacturer was out of business.

RHA accounted for these issues upon calculating verified savings for the project, though RHA could not determine accurate calculations from the system. As a result of the system not setup to provide trending data RHA relied on their monitored energy consumption when calculating final project savings.

Energy Impacts

The installation contractor estimated energy savings achieved by the project, which Cadmus compared to energy savings verified by RHA to determine the project's realization rate. RHA-verified energy savings representing conditions found on site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages. Table 136 details project energy savings and demand reduction.

Table 136. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	317,852	151,215	168,441	83%	17%
Realization Rate	-	48%	111%	-	-
Demand Reduction (kW)	0.0	70.5	42.1	100%	0%
Realization Rate	-	N/A	60%	-	-

The project achieved 168,441 kWh of energy savings and 42.1 kW of demand reduction. These energy savings accounted for a 74% reduction in lighting energy usage. The project contractor overestimated the project's energy savings by 52%, achieving a 48% realization rate. The LED upgrade accounted for 83% of project energy savings, with the remaining 17% due to the ALCS.

The project achieved relative energy savings of 3.2 kWh per square foot of project area. Considering the project's costs, energy savings, and utility rate, the customer could expect a simple payback of 7.6 years.

Pilot Awareness, Decision Making, and Challenges

The project decision maker learned about the pilot from their contractor, who initiated the project.

The decision maker noted the following factors as being important in their decision to make the lighting system upgrades through the pilot:

- Most important: To use LED lighting fixtures purchased years prior and currently in storage. These fixtures did not function properly with the legacy lighting control system, and they installed the control system, so they could install and operate the lighting fixtures.
- To save money on energy bills
- To replace old but functional lighting

The decision maker cited the following as the biggest challenges they face in making energy-efficient improvements:

- Finding time to install the new lighting system since it required shutting down affected areas for installation events
- Scheduling contractors to work around a tight timeline

The decision maker said they did not experienced any barriers when deciding whether to participate in the pilot and that their organization benefited from participating in the pilot by lowering energy bills and savings money on maintenance costs.

Willingness to Pay

The lighting project cost $221,604.00 and the decision maker received an incentive of $50,000.00 (Table 137). According to the decision maker, and they would have installed the lighting control system even if they received less than 25% of the incentive.

Table 137. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$221,604.00	$50,000.00	<$12,500.00

Contractor Interactions

A primary contractor and an installation contractor completed this project. The primary contractor performed the design and layout of the control system and programmed the control system to allow the decision maker to schedule the lighting system operation and set lighting level on demand with a web-enabled app on a tablet. The installation contractor installed the lighting fixtures and made all the hardwired connections. The decision maker reported that they chose to work with the primary contractor on this project because they had worked with the contractor on previous projects.

For this project, the decision maker received the incentive directly from SCE.

Contractor Training

The primary contractor's representative had more than 30 years of experience with lighting controls and installation contractor had more than for more than 50 years in lighting controls. The primary contractor's representative said the contractor had two lighting control certifications: Certified Lighting Efficiency Professional and Certified Lighting Management Consultant, and said they had pursued those certification because of their professional focus on lighting retrofits and because these certifications were best suited to professionals who specialize in lighting retrofits. When asked why they have not pursued California Advanced Lighting Control Training Program certification, the representative said the pilot focuses on new construction and their business focuses on retrofit projects.

The primary contractor learned about the pilot through a lighting vendor. They expressed a preference for staying informed about the pilot through SCE's website. They recommended the pilot to the decision maker because SCE's incentives helped them make the sale.

Contractor Experience with Pilot

The primary contractor did experience acceptance testing for the project. They did not think the acceptance testing was worthwhile because it focuses on standalone control systems such as occupancy sensors or switches, which were unnecessary for this project.

On a scale of 0 to 10, where 0 means *not at all influential* and 10 means *very influential*, the primary contractor rated the pilot as a 0 in influencing their decision to recommend that the company install the advanced lighting control system. This was because a networked control system was necessary for the decision maker to operate the LED lighting fixtures previously purchased.

Participating in the pilot did not change the primary contractor's sales for advanced lighting control systems. The primary contractor reported that before participating in the pilot, they recommended advanced lighting control systems 5% of the time, which did not change after participating in the pilot.

Table 138 shows the importance ratings provided by the primary contractor.

Table 138. Contractor Attribution Ratings

H6. Using a 0 to 10 rating scale, how important in your recommendation was…	
Factors	**Score**
Information provided on SCE's website	0
Training and seminars provided by SCE	0
Your company's past participation in a rebate program sponsored by SCE	0
Training outside the pilot (if rating of 5 or greater, which trainings)	0

The primary contractor said that "the rebates for my customer" was the greatest benefit of promoting the pilot. The primary contractor also said that "people who are going to do controls are doing to do them anyways. The financial aspect is less promising due to the availability of LED lamps. LED lamps are already highly efficient. The savings for controls on top of LEDs makes the energy savings less attractive."

Decision Maker Perceptions of the Contractor

The decision maker rated themselves as *very satisfied* with their experience with the contractors. They selected this rating because the contractors completed the project within the window of time they had available.

The decision maker did not have issues with either the installation contractor or primary contractor. The project achieved higher savings than anticipated upon inspection by the verification contractor.

Counterfactual Baseline and Project Net-to-Gross

The decision maker answered several questions about the likely path they would have taken had the pilot and incentives not existed, and about the pilot's influence on their decision to install the control system.

The decision maker said they would have installed the same lighting control system they did, at the same time, had the pilot not existed. Prior to learning about the pilot, they had budgeted for the

purchase of the lighting control system. Additionally, the decision maker had not considered the energy savings in relation to the project cost in their decision to proceed with installing the system. They also said that the return on their investment would have been high enough to install the same control system without the incentive.

The decision maker answered several questions using Program Attribution Index scoring regarding the level of pilot influence on their decision to install the lighting control system. First, the decision maker rated the pilot and non-pilot influences shown in Table 139 (known as Program Attribution Index 1).

Table 139. Program Attribution Index 1 Ratings

E4. Using a 0 to 10 rating scale, please rate the importance of each of the following in your decision to implement the advanced lighting controls with a graphical user interface.		
Type	**Factors**	**Score**
Pilot Influences	1. The availability of the pilot incentive	6
	2. Recommendations or suggestions from SCE pilot staff	4
	3. Recommendations or suggestions from SCE account representative	4
	4. Recommendations or suggestions from contractor or vendor	8
Non-Pilot Influences	5. Internal policy or requirements inside company or organization	0
	6. Concerns about environmental effects or global warming	7
	7. Desire to achieve energy independence	0
	8. Desire to save money on monthly energy bills	10
	9. Interest in the lighting control technology	7
	10. Desire to install a control system to reduce operation and maintenance costs	10
	11. Desire to install a control system to automate lighting decisions	10

Next, the decision maker answered questions about the timing of their decision and rated the relative importance of the pilot influences compared to the non-pilot influences: these are known as the Program Attribution Index 2, shown in Table 140.

Table 140. Program Attribution Index 2 Ratings

Question	Response	
Did you learn about the pilot before or after you decided to adopt or install the advanced lighting control system?	Before	
Rate the importance of the pilot on your decision as opposed to other factors that may have influenced your decision. Using a 0 to 10 rating scale, where 0 means *not at all important* and 10 means *very important*, please rate the overall importance of the pilot versus the most important of the other factors we just discussed in your decision to adopt or install the specific measure. This time the two importance ratings—the pilot importance and the non-pilot importance—should total 10.	**Pilot Score**	**Non-Pilot Score**
	2	8

Lastly, the decision maker rated the likelihood they would have installed each aspect of the lighting control system had the pilot incentives not been available: these are known as Program Attribution Index 3 and shown in Table 141.

Table 141. Program Attribution Index 3 Ratings

Think about the action you would have taken with regard to installing this equipment if the pilot had not been available. Using a 0 to 10 scale, where 0 is *not at all likely* and 10 is *extremely likely*, please rate the likelihood that you would have integrated each of the following features into your lighting control system:	
ALCS Features	**Rating**
Graphical user interface	8
Fixtures using task tuning, where each lighting fixture can be optimized to the space	Not implemented
Daylight harvesting system that dims lighting fixtures in response to sunlight	Not implemented
Occupancy or vacancy controls that turn off lighting in rooms that are not occupied	Not implemented
Lighting automation system that turns lighting on and off depending on the time of day	0
Control system allowing for automatic demand response that allows utility to dim lights	Not implemented

Upon calculating the Pilot Attribution Indexes 1, 2, and 3, the estimated NTG ratio is 36%. This score is reinforced by the decision maker, who said that if the pilot did not exist they would have installed the same project at the same time.

Satisfaction

Key Decision Maker

Overall, the decision maker expressed satisfaction with their pilot experience. Table 142 shows the respondent's satisfaction rating for various pilot elements.

Table 142. Decision Maker Satisfaction Ratings

Project Element	Response
Performance of new system	Very satisfied
Pilot overall	Very satisfied

The decision maker did not have recommendations for SCE to improve the pilot, saying "[there were] no problems at all with the program. The staff was easy to work with."

Contractor

Overall, the contractor expressed satisfaction with their pilot experience. Table 143 shows the respondent's satisfaction rating for various pilot elements.

Table 143. Contractor Satisfaction Ratings

Project Element	Response
SCE communications about the pilot and offerings	Don't know
Pre-installation process	Somewhat satisfied
Post-installation process with verification contractor	Somewhat satisfied
SCE making the paperwork easy	Somewhat satisfied
Time for paperwork to be processed	Very satisfied
Response time to questions or inquiries	Very satisfied
Providing the right amount of support for contractors to confidently sell and install energy efficiency equipment	Don't know
The final incentives provided	satisfied
Pilot overall	satisfied

The contractor said that SCE could have made the currently available pilot offerings clearer and easier to identify on the SCE website to improve their pilot experience.

End User Survey

Cadmus sent an online survey by email to the building occupants interacting with the new control system, and nobody responded to the survey.

ALCS – 035

Response from the key decision maker and contractor

Building Type: Warehouse
Participant Industry: Manufacturing
Building Size: 114,000 sq. ft
Project Area: 90,000 sq. ft
Completion Date: December 2016
Lease/Own: Own
Number of Employees: 300
Contractor Group: CALCTP Trained[38]

Project Specifications

Project number 035 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 144. The facility retrofitted T-8 linear fluorescents with LEDs and integrated them into the ALCS. The retrofit covered 79% of the building area, which operates 24 hours a day, 365 days a year.

Table 144. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Not feasible; Not Implemented
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, occupancy controls, and zoning. Though Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, the system is capable of both.

Quality Assurance

A member of the SCE third party inspection team completed a pre-retrofit inspection of the facility, gathering fixture data and monitored operating hours, which RHA reviewed and used in project calculations. RHA completed a post-inspection in December 2016; this included 11 days of light logging, fixture verification, and functional testing of the ALCS.

[38] CALCTP requires CALCTP-certified projects to be conducted by CALCTP-certified contractors using a CACLTP-certified project manager and CALCTP-certified installers. This study did not determine whether projects performed by CALCTP -certified contractors met these requirements or if the persons installing the ALCS had CALCTP training or certifications.

Upon final inspection, RHA found two issues with the project:

- Due to the facility's heavy base load (more than 1,760 kW), RHA did not perform power monitoring because of safety and liability concerns.
- As one data logger provided false readings, readings were discarded in the analysis.

RHA accounted for these issues upon calculating the project's verified savings. Power monitoring results fell within 2.5% of the ALCS' reported energy consumption, demonstrating the system was correcting accounting for energy usage.

Energy Impacts

The installation contractor estimated energy savings achieved by the project, which Cadmus compared to energy savings verified by RHA to determine the project's realization rate. RHA verified energy savings representing conditions found on site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[39] Table 145 details project energy savings and demand reduction.

Table 145. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	407,609	319,155	328,199	58%	42%
Realization Rate	-	78%	103%	-	-
Demand Reduction (kW)	37.2	28.0	17.8	78%	22%
Realization Rate	-	75%	64%	-	-

The project achieved 328,199 kWh of energy savings and 17.8 kW of demand reduction. These energy savings accounted for a 72% reduction in lighting energy usage. The project contractor overestimated the project's energy savings by 22%, achieving a 78% realization rate. The LED upgrade accounted for 58% of project energy savings, with the remaining 22% due to the ALCS.

The project achieved relative energy savings of 3.6 kWh per square foot of project area. Considering project costs, energy savings, and utility rates for this project, the customer could expect a simple payback of 3.1 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the project's above-code savings. The methods applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods estimated the project achieved 252,885 kWh energy savings above Title 24 code. Cadmus evaluated above code savings for this project to be 255,031 kWh and 17.8 kW of demand reduction.

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[39] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

Pilot Awareness, Decision Making, and Challenges

The project decision maker learned about the pilot through a conversation with Lockheed Martin. U.S. Facilities Lighting initiated the lighting project at the facility.

The decision maker noted the following factors as being important in their decision to make the lighting system upgrades through the pilot:

- To reduce energy consumption or energy demand
- To obtain a pilot incentive

The decision maker cited high initial costs and the need to justifying the project as the biggest challenges they face in making energy-efficient improvements.

The decision maker said they did not experience any barriers when deciding whether to participate in the pilot. They received the amount of incentive they were told they could receive.

Willingness to Pay and Project Costs

The lighting project cost $201,128.00, and the decision maker received an incentive of $50,000.00 (Table 146). According to the decision maker, they might have completed the same projects if they had only received 25% of the incentive they received.

Table 146. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$201,128.00	$50,000.00	$12,500.00

Contractor Interactions

Contractor 1, Contractor 10, and a commissioning agent were the contractors for this project. Contractor 1 was the primary contractor for this project. While Contractor 10 installed the lighting and devices. The decision maker reported that they chose to work with the contractor on this project because the contractor already had an incentive lined up. Contractor 1 had already budgeted out the incentives and transferred an incentive allocated for another project to this projector.

For this project, the decision maker received an incentive check from SCE. The contractor was very involved in determining the scope of the work. They designed the lighting plan, designed the controls plan, proposed the solution, and managed the project installation and incentive process. They also confirmed and commissioned the system to ensure it met the decision maker's expectations, following up to ensure the decision maker's satisfaction.

Contractor Training

The Contractor 1 has three years of experience in lighting and controls and has completed trainings including continuing education unit credits and certification from the Lighting Control Association. The contractor learned about the pilot through an SCE briefing. They expressed a preference for staying informed about the pilot through the SCE website. The contractor recommended the pilot to the decision maker because of the savings value of energy controls.

Contractor Experience with Pilot

The contractor did experience acceptance testing for the project and said that acceptance testing is part of their process and performed regardless of the pilot.

On a scale of 0 to 10, where 0 means *not at all influential* and 10 means *very influential*, the contractor rated the pilot as a 9 in influencing their decision to recommend that the company install the advanced lighting control system.

Participating in the pilot did not change the contractor's sales for advanced lighting control systems. The contractor reported that before participating in the pilot, they recommended advanced lighting control systems 50% of the time; After participating, they recommend these systems 50% of the time.

Table 147 shows the importance ratings provided by the contractor.

Table 147. Contractor Attribution Ratings

H6. Using a 0 to 10 rating scale, how important in your recommendation was…	
Factors	**Score**
Information provided on SCE's website	7
Training and seminars provided by SCE	5
Your company's past participation in a rebate program sponsored by SCE	10
Training outside the pilot (if rating of 5 or greater, which trainings)	5

The contractor noted that the rebates for their customers were the greatest benefit of promoting the pilot. The contractor also said that they state deep energy savings as an explicit goal 100% of the time.

Decision Maker Perceptions of the Contractor

The decision maker rated themselves as *very satisfied* with their experience with the contractor. The decision maker is now working to get the contractor involved in other company facilities on the East Coast.

The decision maker noted that the contractor did have to correct issues during commissioning, code inspection, or SCE QA, which included a few controllers that did not work properly. The decision maker did not think that a lack of knowledge caused these issues.

Counterfactual Baseline and Project Net-to-Gross

The decision maker answered several questions about the likely path they would have taken had the pilot and incentives not existed, and about the pilot's influence on their decision to install the control system.

The decision maker would have installed a less ambitious lighting controls project had the pilot not existed. The decision maker indicated that the project would have occurred later than one year but within two years if the incentives had not been available. Prior to learning about the pilot, they had not budgeted for the purchase of the lighting control system. Additionally, if they can install something with a few years payback, the decision maker can get it through other decision makers even if it is not in an initial budget. They also want to be as green as possible— based on the industry. The decision maker

considered the energy savings in relation to the project cost in their decision to proceed with installing the lighting control system. They also indicated that without the pilot incentive, the return on their investment would have been high enough to install the same control system.

The decision maker answered several questions using Program Attribution Index scoring regarding the level of pilot influence on their decision to install the lighting control system. First, the decision maker rated the pilot and non-pilot influences shown in Table 148 (known as Program Attribution Index 1).

Table 148. Program Attribution Index 1 Ratings

E4. Using a 0 to 10 rating scale, please rate the importance of each of the following in your decision to implement the advanced lighting controls with a graphical user interface.		
Type	**Factors**	**Score**
Pilot Influences	1. The availability of the pilot incentive	10
	2. Recommendations or suggestions from SCE pilot staff	10
	3. Recommendations or suggestions from SCE account representative	10
	4. Recommendations or suggestions from contractor or vendor	8
Non-Pilot Influences	5. Internal policy or requirements inside company or organization	10
	6. Concerns about environmental effects or global warming	5
	7. Desire to install a control system improve to employee morale	3
	8. Desire to save money on monthly energy bills	10
	9. Interest in the lighting control technology	10
	10. Desire to install a control system to reduce operation and maintenance costs	10
	11. Desire to install a control system to automate lighting decisions	10

Next, the decision maker answered questions about the timing of their decision and rated the relative importance of the pilot influences compared to the non-pilot influences: these are known as the Program Attribution Index 2, shown in Table 149.

Table 149. Program Attribution Index 2 Ratings

Question	Response	
Did you learn about the pilot before or after you decided to adopt or install the advanced lighting control system?	Before	
Rate the importance of the pilot on your decision as opposed to other factors that may have influenced your decision. Using a 0 to 10 rating scale, where 0 means *not at all important* and 10 means *very important*, please rate the overall importance of the pilot versus the most important of the other factors we just discussed in your decision to adopt or install the specific measure. This time the two importance ratings—the pilot importance and the non-pilot importance—should total 10.	**Pilot Score**	**Non-Pilot Score**
	5	5

Lastly, the decision maker rated the likelihood they would have installed each aspect of the lighting control system had the pilot incentives not been available: these are known as Program Attribution Index 3 and shown in Table 150.

Table 150. Program Attribution Index 3 Ratings

Think about the action you would have taken with regard to installing this equipment if the pilot had not been available. Using a 0 to 10 scale, where 0 is *not at all likely* and 10 is *extremely likely*, please rate the likelihood that you would have integrated each of the following features into your lighting control system:	
ALCS Features	**Rating**
Graphical user interface	2
Fixtures using task tuning, where each lighting fixture can be optimized to the space	8
Daylight harvesting system that dims lighting fixtures in response to sunlight	N/A
Occupancy or vacancy controls that turn off lighting in rooms that are not occupied	8
Lighting automation system that turns lighting on and off depending on the time of day	8
Control system allowing for automatic demand response that allows utility to dim lights	N/A
Control system installed into the entire area of the building that was part of the final project	8

Upon calculating the Pilot Attribution Indexes 1, 2, and 3, the estimated NTG ratio is 44%.

Satisfaction

Key Decision Maker

Overall, the decision maker expressed satisfaction with their pilot experience. Table 151 shows the respondent's satisfaction rating for various pilot elements.

Table 151. Key Decision Maker Satisfaction Ratings

Project Element	Response
Performance of new system	Very satisfied
Pilot overall	Very satisfied

In addition, the decision maker rated the application paperwork as *very easy*.

The decision maker said that SCE could ensure that incentives are issued as fast as possible to improve their pilot experience. They received the payment in a fairly timely manner, but it is always nice to get the payment as soon as possible.

Contractor

Overall, the contractor expressed moderate satisfaction with their pilot experience. Table 152 shows the respondent's satisfaction rating for various pilot elements.

Table 152. Contractor Satisfaction Ratings

Project Element	Response
SCE communications about the pilot and offerings	Somewhat satisfied
Pre-installation process	Not very satisfied
Post-installation process with verification contractor	Somewhat satisfied
SCE making the paperwork easy	Not very satisfied
Time for paperwork to be processed	Not at all satisfied
Response time to questions or inquiries	Somewhat satisfied
Providing the right amount of support for contractors to confidently sell and install energy efficiency equipment	Refused
The final incentives provided	Very satisfied
Pilot overall	Somewhat satisfied

The contractor said that SCE could have addressed the following items to improve their pilot experience:

- The clarity of the pilot was not very good.
- The requirements changed during the process.
- The timeline for pre- and post-inspection took very long (in excess of six months).
- SCE's representatives' general understanding of the goals of the system and operations and value of the system were not good.
- The process of the post-inspection by the verification contractor was cumbersome and the clients were not happy with the way the process intruding into their business.

ALCS – 036

Building Type: Offices
Participant Industry: Government
Building Size: 645,419 sq. ft
Project Area: 601,475 sq. ft
Completion Date: November 2016
Lease/Own: Unknown
Number of Employees: Unknown
Contractor Type: CALCTP Trained[40]

Project Specifications

Project number 036 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 153. The facility retrofitted linear fluorescents with LED luminaires and integrated them into the ALCS. The retrofit covered 93% of the building area, which operates from 7 am to 5 pm, five days a week.

Table 153. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Yes
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, occupancy controls, and zoning. The first flow used daylight harvesting as an additional control strategy. Though Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, the system is capable of both.

Quality Assurance

A member of the SCE third party inspection team completed a pre-retrofit inspection of the facility, gathering fixture data and operating hours, which RHA reviewed and used in project calculations. In November 2016, RHA completed a post-inspection 2016 that included seven days of power metering, fixture verification, and functional testing of the ALCS.

Upon final inspection, RHA found several issues with the project:

[40] CALCTP requires CALCTP-certified projects to be conducted by CALCTP-certified contractors using a CACLTP-certified project manager and CALCTP-certified installers. This study did not determine whether projects performed by CALCTP -certified contractors met these requirements or if the persons installing the ALCS had CALCTP training or certifications.

- Fixture counts did not match the control system's entered fixture quantity, causing incorrect savings and consumption data.
- The quantity and wattages of emergency fixtures were not included in the system, causing incorrect savings and consumption data.
- Consumption was underrepresented for some of the 10 floors.

RHA accounted for these issues upon calculating the project's verified savings. Power monitoring results fell within 32% of the ALCS' reported energy consumption, indicating the ALCS system was not correctly accounting for energy savings. RHA mitigated this issue by relying on monitored energy consumption upon calculating final savings.

Energy Impacts

The installation contractor estimated the project's achieved energy savings, which Cadmus compared to energy savings verified by RHA to determine the project's realization rate. RHA-verified energy savings represented conditions found on site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[41] Table 154 details project energy savings and demand reduction.

Table 154. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	346,849	752,239	870,641	74%	26%
Realization Rate	-	217%	116%	-	-
Demand Reduction (kW)	119.6	204.5	197.9	70%	30%
Realization Rate	-	171%	97%	-	-

The project achieved 870,641 kWh of energy savings and 197.9 kW of demand reduction. These energy savings accounted for a 59% reduction in lighting energy usage. The project contractor underestimated the project's energy savings by 117%, achieving a 217% realization rate. The LED upgrade accounted for 74% of project energy savings with the remaining 26% due to the ALCS.

The project achieved relative energy savings of 1.4 kWh per square foot of project area. Considering the project costs, energy savings, and utility rate, the customer could expect a simple payback of 14.1 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the project's above-code savings. The methods applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods estimated the project achieved 345,106 kWh energy

[41] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

savings above Title 24 code. Cadmus evaluated above code savings for this project to be 399,426 kWh and 197.9 kW of demand reduction.

Pilot Awareness, Decision Making, and Challenges

Cadmus did not receive contact information for the project decision maker and was unable to request an interview regarding their experience with the pilot.

Willingness to Pay and Project Costs

The lighting project cost $1,563,649.00, and the decision maker received an incentive of $50,000.00 (Table 155).

Table 155. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$1,563,649.00	$50,000.00	N/A

Contractor Interactions

Contractor 13 was the contractor for this project, working as the project manager, and was heavily involved in construction, development, and determining the scope of the work. The contractor filled out the rebate application for the decision maker.

Contractor Training

The contractor has 19 years of experience in lighting and controls and has completed the California Advanced Lighting Control Training Program.

The contractor learned about the pilot through the SCE website and prefers to stay informed about the pilot through the website. The contractor recommended the pilot to customers because of the cost savings and pilot incentives.

Contractor Experience with Pilot

The contractor did experience acceptance testing for the project. The contractor noted that federal buildings are exempt from local jurisdiction requirements, but the key decision maker did hire their own engineering firm to do the acceptance test and Title 24 acceptance. These actions were a requirement of the contract with SCE.

On a scale of 0 to 10, where 0 means *not at all influential* and 10 means *very influential*, the contractor rated the pilot as a 10 in influencing their decision to recommend that the company install the advanced lighting control system.

Participating in the pilot did not change the contractor's sales for advanced lighting control systems. The contractor reported that before participating in the pilot, they recommended advanced lighting control systems 100% of the time; after participating, they recommend these systems 100% of the time.

Table 156 shows the importance ratings provided by the contractor.

Table 156. Contractor Attribution Ratings

H6. Using a 0 to 10 rating scale, how important in your recommendation was…	
Factors	**Score**
Information provided on SCE's website	10
Training and seminars provided by SCE	5
Your company's past participation in a rebate program sponsored by SCE	5
Training outside the pilot (if rating of 5 or greater, which trainings)	5

The contractor noted that the rebates for their customers is the greatest benefit of promoting the pilot. The contractor also said that clients often cite deep energy savings as the goal of the project.

Satisfaction

Contractor

Overall, the contractor expressed great satisfaction with their pilot experience. Table 157 shows the respondent's satisfaction rating for various pilot elements.

Table 157. Contractor Satisfaction Ratings

Project Element	Response
SCE communications about the pilot and offerings	Very satisfied
Pre-installation process	Very satisfied
Post-installation process with the verification contractor	Very satisfied
SCE making the paperwork easy	Very satisfied
Time for paperwork to be processed	Very satisfied
Response time to questions or inquiries	Very satisfied
Providing the right amount of support for contractors to confidently sell and install energy efficiency equipment	Very satisfied
The final incentives provided	Very satisfied
Pilot overall	Very satisfied

ALCS – 037

Building Type: University
Participant Industry: Education/School/University
Building Size: 62,041 sq ft
Project Area: 62,041 sq ft
Completion Date: December 2016
Lease/Own: Own
Number of Students/Faculty: 125
Contractor Group: CALCTP Trained[42]

Project Specifications

Project number 037 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 158. The facility retrofitted T8 linear fluorescents with LED luminaires and integrated them into the ALCS. The retrofit covered the entire building area, which operates from 8 am to 10 pm, nearly 365 days a year.

Table 158. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Yes
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, daylight harvesting, occupancy controls, and zoning. Though Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, the system is capable of both.

Quality Assurance

RHA completed a pre-retrofit inspection of the facility, gathering fixture data and operating hours, which RHA reviewed and used in project calculations. In January 2017, RHA completed a post-inspection that included seven days of power metering, fixture verification, and functional testing of the ALCS.

Upon final inspection, RHA found one issue with the project:

- Inaccurate wattages entered into the ALCS system generated incorrect energy consumption data. The customer corrected the issue in February 2017.

[42] CALCTP requires CALCTP-certified projects to be conducted by CALCTP-certified contractors using a CACLTP-certified project manager and CALCTP-certified installers. This study did not determine whether projects performed by CALCTP -certified contractors met these requirements or if the persons installing the ALCS had CALCTP training or certifications.

RHA accounted for these issues upon calculating the project's verified savings. Power monitoring results fell within 56% of the ALCS' reported energy consumption, verifying the system was not correctly accounted for energy usage. Once corrected with accurate wattage data, the error was reduced to less than 3%.

Energy Impacts

The installation contractor estimated energy savings achieved by the project, which Cadmus compared to energy savings verified by RHA to determine the project's realization rate. RHA verified energy savings represented conditions found on site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and verified that project savings calculations accurately represented achieved energy savings. Table 159 details project energy savings and demand reduction.

Table 159. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	110,308	65,494	75,381	24%	76%
Realization Rate	-	59%	115%	-	-
Demand Reduction (kW)	0.0	13.5	14.0	47%	53%
Realization Rate	-	N/A	104%	-	-

The project achieved 75,381 kWh of energy savings and 14.0 kW of demand reduction. These energy savings accounted for a 62% reduction in lighting energy usage. The project contractor overestimated energy savings for this project by 41%, achieving a 59% realization rate. The LED upgrade accounted for 24% of project energy savings with the remaining 76% due to the ALCS.

The project achieved relative energy savings of 1.2 kWh per square foot of project area. Considering the project costs, energy savings, and utility rate for this project, the customer could expect a simple payback of 78 years.

Pilot Awareness, Decision Making, and Challenges

The project decision maker was unsure how they had first learned about the pilot. They started working at the company after project kick off and the previous project manager leaving for another position out of state. Since the decision maker was new to the project, Cadmus probed for their best understanding of the how the project came about. The decision maker said the university administrative staff pushes for energy-efficient projects and that it was interested in pursuing any energy-efficient project with a payback under seven years.

The decision maker cited the following as the biggest challenges they face in making energy-efficient improvements:

- Understanding potential areas for improvement
- Demonstrating the cost savings and other benefits of energy-efficient improvements to administrative staff

The decision maker said their organization benefited from participating in the pilot because the new lighting system offers energy and cost savings and provides better aesthetics in the room from the higher quality light.

Willingness to Pay and Project Costs

The lighting project cost $534,888.00 and the decision maker received an incentive of $31,437.00 (Table 160). According to the decision maker, they would have installed the same lighting project if they received 25% of the incentive.

Table 160. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$534,888.00	$31,437.00	$7,859.25

Contractor Interactions

Contractor 3 was the contractor for this project. The contractor provided all installation and logistics to install and network the controls. The decision maker reported that they chose the contractor through a formal bid process. For this project, the decision maker received the incentive check directly, but the contractor helped them fill out the rebate documentation.

Cadmus emailed, then attempted to contact this contractor three times by phone in November 2017 but received no reply.

The decision maker hired a contractor to perform the installation, but technical staff and students from the school designed the lighting system.

Contractor Training

The lighting contractor is certified through California Advanced Lighting Control Training Program.

Customer Perceptions of the Contractor

The decision maker rated themselves as *very satisfied* with their experience with the contractor, because their contractor was extremely proactive in helping them with issues as they arose. While the installation process did have problems during network testing, the installation contractor remedied these two issues:

- The proposed control system used an unnecessary number of control nodes; the installation contractor identified this during the design phase and proposed a solution reducing the amount of equipment needed that saved the project significant costs.
- One lecture hall contained three different types of legacy controls and fixtures; networking those systems to the new control system was a significant unforeseen effort.

The decision maker did not fault the installation contractor for these issues. As noted, the contractor provided solutions for the shortcomings of the initial design proposed by the school staff and other issues as they arose during the planning, installation, and commissioning phases.

Counterfactual Baseline and Project Net-to-Gross

The decision maker answered several questions about the likely path they would have taken had the pilot and incentives not existed, and about the pilot's influence on their decision to install the control system.

The decision maker said they would have done nothing to the lighting had the pilot not existed. Prior to learning about the pilot, the decision maker was unaware if the project was included their capital budget. Additionally, they had considered the energy savings in relation to the project cost in their decision to proceed with installing the lighting control system. They typically look for a seven-year payback on projects. The decision maker did not know if the payback for the project would have been high enough without the incentive.

The decision maker answered several questions using Program Attribution Index scoring regarding the level of pilot influence on their decision to install the lighting control system. First, the decision maker rated the pilot and non-pilot influences shown in Table 161 (known as Program Attribution Index 1).

Table 161. Program Attribution Index 1 Ratings

E4. Using a 0 to 10 rating scale, please rate the importance of each of the following in your decision to implement the advanced lighting controls with a graphical user interface.		
Type	**Factors**	**Score**
Pilot Influences	1. The availability of the pilot incentive	9
	2. Recommendations or suggestions from SCE pilot staff	0
	3. Recommendations or suggestions from SCE account representative	0
	4. Recommendations or suggestions from contractor or vendor	0
Non-Pilot Influences	5. Internal policy or requirements inside company or organization	9
	6. Concerns about environmental effects or global warming	8
	7. Desire to achieve energy independence	0
	8. Desire to save money on monthly energy bills	8
	9. Interest in the lighting control technology	0
	10. Desire to install a control system to reduce operation and maintenance costs	5
	11. Desire to install a control system to automate lighting decisions	9

Next, the decision maker answered questions about the timing of their decision and rated the relative importance of the pilot influences compared to the non-pilot influences: these are known as the Program Attribution Index 2, shown in Table 162.

Table 162. Program Attribution Index 2 Ratings

Question	Response	
Did you learn about the pilot before or after you decided to adopt or install the advanced lighting control system?	Before	
Rate the importance of the pilot on your decision as opposed to other factors that may have influenced your decision. Using a 0 to 10 rating scale, where 0 means *not at all important* and 10 means *very important*, please rate the overall importance of the pilot versus the most important of the other factors we just discussed in your decision to adopt or install the specific measure. This time the two importance ratings—the pilot importance and the non-pilot importance—should total 10.	**Pilot Score**	**Non-Pilot Score**
	3	7

Lastly, the decision maker rated the likelihood they would have installed each aspect of the lighting control system had the pilot incentives not been available: these are known as Program Attribution Index 3 and shown in Table 163.

Table 163. Program Attribution Index 3 Ratings

Think about the action you would have taken with regard to installing this equipment if the pilot had not been available. Using a 0 to 10 scale, where 0 is *not at all likely* and 10 is *extremely likely*, please rate the likelihood that you would have integrated each of the following features into your lighting control system:	
ALCS Features	**Rating**
Graphical user interface	10
Fixtures using task tuning, where each lighting fixture can be optimized to the space	5
Daylight harvesting system that dims lighting fixtures in response to sunlight	9
Occupancy or vacancy controls that turn off lighting in rooms that are not occupied	10
Lighting automation system that turns lighting on and off depending on the time of day	7
Control system allowing for automatic demand response that allows utility to dim lights	N/A

Upon calculating the Pilot Attribution Indexes 1, 2, and 3, Cadmus estimated the project's NTG ratio as 21%. The decision maker indicated that they would have done nothing to the lighting had the pilot not existed and they typically require a seven-year payback for energy projects to move forward. This project had significantly greater payback period of 78 years, but the key decision maker said that "the school is always looking for energy efficiency projects and will likely green light projects for other reasons than just the payback. They were very interested in these control systems and liked the opportunities they present."

Satisfaction

Key Decision Maker

Overall, the decision maker expressed satisfaction with their pilot experience. Table 164 shows the respondent's satisfaction rating for various pilot elements.

Table 164. Decision Maker Satisfaction Ratings

Project Element	Response
Performance of new system	Very satisfied
Pilot overall	Very satisfied

In addition, the decision maker rated the application paperwork as *very easy*.

The decision maker did not have recommendations for SCE to improve their pilot experience and said, "I did not have a lot of direct contact with SCE but the experience I had was very positive."

Final Comments

The decision maker had no final comments other than they were happy with how the project worked out for the university and they were happy with the controls.

End User Survey

Cadmus sent an online survey by email to the building occupants interacting with the new control system, and nobody responded to the survey.

ALCS – 038

Response from the key decision maker but not the contractor

Building Type: University
Participant Industry: Education/School/University
Building Size: 42, 972 sq. ft
Project Area: 42,972 sq. ft
Completion Date: December 2016
Lease/Own: Own
Number of Students/Faculty: 75
Contractor Group: CALCTP Trained[43]

Project Specifications

Project number 038 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 165. The facility replaced existing linear fluorescents fixtures, CLF's and Metal Halide with LED fixtures, and integrated them with an ALCS.

Table 165. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Yes
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, occupancy controls, and zoning. Though Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, the system is capable of both.

Quality Assurance

RHA completed a pre-retrofit inspection of the facility, gathering fixture data and monitored operating hours, which they reviewed and used in project calculations. In March 2017, RHA completed a post-inspection that included 14 days of power metering, fixture verification, and functional testing of the ALCS.

[43] CALCTP requires CALCTP-certified projects to be conducted by CALCTP-certified contractors using a CACLTP-certified project manager and CALCTP-certified installers. This study did not determine whether projects performed by CALCTP -certified contractors met these requirements or if the persons installing the ALCS had CALCTP training or certifications.

Upon final inspection, RHA found several issues with the project:

- After installation, one defective driver component caused fixtures to burn out, with 26 fixtures not operating. Additionally, some fixtures were not integrated into the control system. In March 2017, RHA revisited the facility and resolved all issues.
- The control system used incorrect wattages for the project's North Building area, thus underreporting consumption.
- As the daylight harvesting feature installed in the docking area was not exposed to sufficient ambient light, the daylight harvesting feature was not effective.
- The submitted diagram included room number errors, which caused interference in the verification analysis.

RHA accounted for these issues upon calculating the project's verified savings. Power monitoring results fell within 1% of the ALCS' reported energy consumption, verifying that the system correctly accounted for energy usage. The system, however, did not achieve its full potential due to the above documented issues.

Energy Impacts

The installing contractor estimated energy savings achieved by the project, which Cadmus compared to energy savings verified by RHA to determine the project's realization rate. RHA-verified energy savings representing conditions found on site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[44] Table 166 details the project's energy savings and demand reduction.

Table 166. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	126,386	136,948	165,201	73%	27%
Realization Rate	-	108%	121%	-	-
Demand Reduction (kW)	0.0	27.1	30.0	89%	11%
Realization Rate	-	N/A	111%	-	-

The project achieved 165,201 kWh of energy savings and 30.0 kW of demand reduction. These energy savings accounted for an 89% reduction in lighting energy usage. The project contractor underestimated the project's energy savings by 8%, achieving a 108% realization rate. The LED upgrade accounted for 73% of project energy savings with the remaining 27% due to the ALCS.

[44] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

The project achieved relative energy savings of 3.8 kWh per square foot of project area. Considering the project costs, energy savings, and utility rates for this project, the customer could expect a simple payback of 29.7 years.

Pilot Awareness, Decision Making, and Challenges

The project decision maker was unsure how they had first learned about the pilot. They started working at the company after project kick off and the previous project manager leaving for another position out of state. Since the decision maker was new to the project, Cadmus probed for their best understanding of the how the project came about. The decision maker said the university administrative staff pushes for energy-efficient projects and that it was interested in pursuing any energy-efficient project with a payback under seven years.

The decision maker cited the following as the biggest challenges they face in making energy-efficient improvements:

- Understanding potential areas for improvement
- Demonstrating the cost savings and other benefits of energy-efficient improvements to administrative staff

The decision maker said their organization benefited from participating in the pilot because the new lighting system offers energy and cost savings and provides better aesthetics in the room from the higher quality light.

Willingness to Pay and Project Costs

The lighting project cost $448,585.00 and the decision maker received an incentive of $50,000.00 (Table 167). According to the decision maker, they would have installed the same lighting project if they received 25% of the incentive.

Table 167. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$448,585.00	$50,000.00	$12,500.00

Contractor Interactions

The primary contractor provided all installation and logistics to install and network the controls. The decision maker reported that they chose the contractor through a formal bid process. For this project, the decision maker received the incentive check directly, but the contractor helped them fill out the rebate documentation.

Cadmus emailed, then attempted to contact this contractor three times by phone in November 2017 but received no reply.

The decision maker hired a contractor to perform the installation, but technical staff and students from the school designed the lighting system.

Decision Maker Perceptions of the Contractor

The decision maker rated themselves as *very satisfied* with their experience with the contractor, because their contractor was extremely proactive in helping them with issues as they arose. The decision maker could not remember the specifics of those issues but remembered they were minor issues that were corrected immediately.

Counterfactual Baseline and Project Net-to-Gross

The decision maker answered several questions about the likely path they would have taken had the pilot and incentives not existed, and about the pilot's influence on their decision to install the control system. The decision maker would have probably installed a less ambitious lighting controls project had the pilot not existed. Prior to learning about the pilot, the decision maker was unaware if the project was included their capital budget. Additionally, they had considered the energy savings in relation to the project cost in their decision to proceed with installing the lighting control system. They typically look for a seven-year payback on projects. The decision maker did not know if the payback for the project would have been high enough without the incentive.

The decision maker answered several questions using Program Attribution Index scoring regarding the level of pilot influence on their decision to install the lighting control system. First, the decision maker rated the pilot and non-pilot influences shown in Table 168 (known as Program Attribution Index 1).

Table 168. Program Attribution Index 1 Ratings

E4. Using a 0 to 10 rating scale, please rate the importance of each of the following in your decision to implement the advanced lighting controls with a graphical user interface.		
Type	**Factors**	**Score**
Pilot Influences	1. The availability of the pilot incentive	9
	2. Recommendations or suggestions from SCE pilot staff	0
	3. Recommendations or suggestions from SCE account representative	0
	4. Recommendations or suggestions from contractor or vendor	0
Non-Pilot Influences	5. Internal policy or requirements inside company or organization	9
	6. Concerns about environmental effects or global warming	8
	7. Desire to achieve energy independence	0
	8. Desire to save money on monthly energy bills	8
	9. Interest in the lighting control technology	0
	10. Desire to install a control system to reduce operation and maintenance costs	5
	11. Desire to install a control system to automate lighting decisions	9

Next, the decision maker answered questions about the timing of their decision and rated the relative importance of the pilot influences compared to the non-pilot influences: these are known as the Program Attribution Index 2, shown in Table 169.

Table 169. Program Attribution Index 2 Ratings

Question	Response	
Did you learn about the pilot before or after you decided to adopt or install the advanced lighting control system?	Before	
Rate the importance of the pilot on your decision as opposed to other factors that may have influenced your decision. Using a 0 to 10 rating scale, where 0 means *not at all important* and 10 means *very important*, please rate the overall importance of the pilot versus the most important of the other factors we just discussed in your decision to adopt or install the specific measure. This time the two importance ratings—the pilot importance and the non-pilot importance—should total 10.	Pilot Score	Non-Pilot Score
	3	7

Lastly, the decision maker rated the likelihood they would have installed each aspect of the lighting control system had the pilot incentives not been available: these are known as Program Attribution Index 3 and shown in Table 170.

Table 170. Program Attribution Index 3 Ratings

Think about the action you would have taken with regard to installing this equipment if the pilot had not been available. Using a 0 to 10 scale, where 0 is *not at all likely* and 10 is *extremely likely*, please rate the likelihood that you would have integrated each of the following features into your lighting control system:	
ALCS Features	**Rating**
Graphical user interface	10
Fixtures using task tuning, where each lighting fixture can be optimized to the space	5
Daylight harvesting system that dims lighting fixtures in response to sunlight	9
Occupancy or vacancy controls that turn off lighting in rooms that are not occupied	10
Lighting automation system that turns lighting on and off depending on the time of day	7
Control system allowing for automatic demand response that allows utility to dim lights	N/A

Upon calculating the Pilot Attribution Indexes 1, 2, and 3, Cadmus estimated the project's NTG ratio as 21%. The decision maker indicated that they would have installed a less ambitious lighting project had the pilot not existed and they typically require a seven-year payback for energy projects to move forward. This project had significantly greater payback period of 30 years, but the key decision maker said that "the school is always looking for energy efficiency projects and will likely green light projects for other reasons than just payback. They were very interested in these control systems and liked the opportunities they present."

Satisfaction

Key Decision Maker

Overall, the decision maker expressed satisfaction with their pilot experience. Table 171 shows the respondent's satisfaction rating for various pilot elements.

Table 171. Decision Maker Satisfaction Ratings

Project Element	Response
Performance of new system	Very satisfied
Pilot overall	Very satisfied

In addition, the decision maker rated the application paperwork as *very easy*.

The decision maker did not have recommendations for SCE to improve their pilot experience and said, "I did not have a lot of direct contact with SCE but the experience I had was very positive."

Final Comments

The decision maker had no final comments other than they were happy with how the project worked out for the university and they were happy with the controls.

End User Survey

Cadmus sent an online survey by email to the building occupants interacting with the new control system. One person responded to the survey: a teacher at the school who spent some of their time in the areas of the building with the new lighting control system (Table 172).

Table 172. End User Survey Response

Project Element	Number of Responses	
Received training on the lighting control system	1	
Can effectively operate lighting controls	Very or Somewhat Effectively	Not too or not at all Effectively
	1	0
Satisfaction with controls	Very or Somewhat Satisfied	Not very or not at all Satisfied
	1	0

This person did not have administrator-level access to the control system and had not made any changes to the control system since the system was installed. They were satisfied with the new lighting system and were "happy with the new sensors."

ALCS – 039

Building Type: Retail
Participant Industry: Retail Sales
Building Size: 6,000 sq. ft
Project Area: 6,000 sq. ft
Completion Date: February 2017
Lease/own: Unknown
Number of employees: Unknown
Contractor Group: Manufacturer Trained

Project Specifications

Project number 039 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 173. The store retrofitted T-8 fixtures and CFL lamps with LED fixtures, and integrated those fixtures into the ALCS. The store operates from 10:00 am to 8:00 pm seven days a week.

Table 173. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Yes
Occupancy or Vacancy Control	Yes
Lumen Maintenance	Unknown
Scheduling	Yes
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, daylight harvesting, occupancy sensors and zoning. Though Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, the system is capable of both.

Quality Assurance

RHA completed a pre-retrofit inspection of the facility, gathering fixture data and operating hours, including power metering. In April 2017, RHA also completed a post-inspection that included seven days of power metering, fixture verification, and functional testing of the ALCS.

Upon final inspection, RHA found one issues associated with M&V data gathering for the project:

- The installed LED fixtures energy consumption was not linear to tuning. The system calculates energy consumption using a linear tuning to energy consumption curve causing errors in the calculated energy consumption by the ALCS.

RHA accounted for these issues upon calculating verified savings for the project. Power monitoring results were within 3% of the reported energy consumption of the ALCS, verifying the system is correctly accounting for energy usage.

Energy Impacts

The installing contractor estimated energy savings achieved by the project, which Cadmus compared to energy savings verified by RHA to determine the project's realization rate. RHA-verified energy savings represented conditions found on site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[45] Table 174 details project energy savings and demand reduction.

Table 174. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	89,587	17,018	17,760	87%	13%
Realization Rate	-	19%	104%	-	-
Demand Reduction (kW)	0.0	4.8	3.7	82%	18%
Realization Rate	-	N/A	76%	-	-

The project achieved 17,760 kWh of energy savings and 3.7 kW of demand reduction. These energy savings accounted for a 79% reduction in lighting energy usage. The project contractor overestimated the project's energy savings by 81%, achieving a 19% realization rate. The LED upgrade accounted for 87% of project energy savings with the remaining 13% due to the ALCS.

The project achieved relative energy savings of 3.0 kWh per square foot of project area. Considering the project costs, energy savings, and utility rates for this project, the customer could expect a simple payback of 3 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the project's above-code savings. The methods applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods led to 14,635 kWh in estimated energy savings for this project above Title 24 code. Cadmus evaluated above code savings for this project to be 15,110 kWh and 3.7 kW of demand reduction.

Pilot Awareness, Decision Making, and Challenges

Initially, Cadmus did not receive contact information for the project decision maker and could not request an interview regarding their experience with the pilot. We received updated information in November 2017 and attempted to contact the decision maker three times but were unable to reach the decision maker for an interview.

[45] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

Willingness to Pay and Project Costs

The lighting project cost $17,972.00, and the decision maker received an incentive of $8,101.00 (Table 175).

Table 175. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$17,972.00	$8,181.00	N/A

Contractor Interactions

The contractor, declined to respond to the survey regarding their experience with the pilot.

Final Comments

Because none of the key stakeholders responded to our requests for an interview, we do not have information regarding pilot satisfaction, contractor trainings, or other information.

ALCS – 040

Building Type: Fast Food Restaurant
Participant Industry: Restaurant
Building Size: 4,000 sq. ft
Project Area: 4,000 sq. ft
Completion Date: November 2016
Lease/own: Unknown
Number of employees: Unknown
Contractor Group: Manufacturer Trained

Project Specifications

Project number 040 participated in the SCE Sustainable Office Lighting Control Pilot Program and installed the lighting control system that serves the functions shown in Table 176. The facility retrofitted T-8 fixtures and CFL lamps with LED fixtures, and integrated those fixtures into the ALCS.

Table 176. Project Functions Implemented

Function	Implemented?
Task Tuning	Yes
Daylighting Harvesting	Yes
Occupancy or Vacancy Control	Feasible; Not Implemented
Lumen Maintenance	Unknown
Scheduling	No
Auto Demand Response	Unknown
Zoning	Yes

The ALCS employed task tuning, daylight harvesting, and zoning, but occupancy controls were not installed due to integration issues with third-party occupancy sensors. The daylight harvesting feature was activated for the drive-through window fixtures. Though Cadmus could not determine if the ALCS used lumen maintenance or automatic demand response, the system is capable of both. Scheduling remains feasible, though, as the building operates 24 hours a day, additional energy savings from implementing scheduling may be small.

Quality Assurance

RHA completed a pre-retrofit inspection of the facility, gathering fixture data and operating hours, including power metering. In October 2016, RHA also completed a post-inspection that included seven days of power metering, fixture verification, and functional testing of the ALCS.

Upon final inspection, RHA found several issues associated with M&V data gathering for the project:

- Due to a technical failure, the system failed to report consumption data, but the issue was addressed the following week and data were generated for analysis.
- The facility planned on installing occupancy controls on the lighting system, but the ALCS proved incompatible with sensors available on the market. Consequently, occupancy controls could not

be used. The controls manufacturer stated occupancy controls would be installed in the future when they could manufacture compatible controls.

RHA accounted for these issues upon calculating the project's verified savings. As the contractor did not provide consumption data for the same time period as the monitoring, the energy monitoring results were not perfectly comparable across the two periods. The building, however, was occupied continuously during the monitoring period and contractor-provided period, as is typical for a 24-hour business. The comparison of two datasets indicated the system accurately accounted for energy usage, with less than a 4% variance between the two dissimilar datasets.

Energy Impacts

The installing contractor estimated energy savings achieved by the project, which Cadmus compared to energy savings verified by RHA to determine the project's realization rate. RHA-verified energy savings represented conditions found on site during the post-inspection and monitoring window. Cadmus reviewed the inspection documentation provided by RHA and applied DEER 2016 coincidence factors, interactive effects factors and updated fixture wattages to verified fixture wattages.[46] Table 177 details project energy savings and demand reduction.

Table 177. Project Energy Savings and Demand Reduction

Savings Type	Contractor Estimated Savings	RHA Verified Savings	Cadmus Verified Savings	Fixture % Savings	ALCS % Savings
Energy Savings (kWh)	15,419	14,448	14,881	90%	10%
Realization Rate	-	94%	103%	-	-
Demand Reduction (kW)	0.0	1.6	1.1	94%	6%
Realization Rate	-	N/A	71%	-	-

The project achieved 14,881 kWh of energy savings and 1.1 kW of demand reduction. These energy savings accounted for a 67% reduction in lighting energy usage. The project contractor overestimated the project's energy savings by 6%, achieving a 94% realization rate. The LED upgrade accounted for 90% of project energy savings with the remaining 10% due to the ALCS.

The project achieved relative energy savings of 3.7 kWh per square foot of project area. Considering the project costs, energy savings, and utility rates for this project, the customer could expect a simple payback of 9.1 years.

Using a detailed method for estimating energy savings above 2016 Title 24 code requirements, RHA calculated the project's above-code savings. The methods applied allowed them to consider maximum lighting power density and required control elements, including daylight harvesting, occupancy controls, and associated minimum settings. These methods led to 11,469 kWh in estimated energy savings for this

[46] 2013-2014 Table of Standard Fixture Wattages & for LED fixture upgrades Design Light Consortium QPL https://www.designlights.org/search/

project above Title 24 code. Cadmus evaluated above code savings for this project to be 11,625 kWh and 1.1 kW of demand reduction.

Pilot Awareness, Decision Making, and Challenges

Initially, Cadmus did not receive contact information for the project decision maker and could not request an interview regarding their experience with the pilot. We received updated information in November 2017 and attempted to contact the decision maker three times but were unable to reach the decision maker for an interview.

Willingness to Pay and Project Costs

The lighting project cost $31,679.00, and the decision maker received an incentive of $6,935.00 (Table 178).

Table 178. Project Costs and Incentive

Project Cost	Incentive Received	Incentive Needed to Install the Same Project
$31,679.00	$6,935.00	N/A

Contractor Interactions

The contractor, declined to respond to the survey regarding their experience with the pilot. Cadmus sent an email and made a follow-up call to the original contact, who had left the company and directed the team to two potential contacts. Those two contacts did not respond to the emails requesting an interview regarding their experience with the pilot.

Final Comments

Because none of the key stakeholders responded to our requests for an interview, we do not have information regarding pilot satisfaction, contractor trainings, or other information.