CONSULTANT REPORT

EVALUATION OF THE ENERGY EFFICIENT STATE PROPERTY REVOLVING LOAN FUND PROGRAM

Prepared for: California Energy Commission

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JUNE 2014

CEC-400-2014-012

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ABSTRACT

This report presents the results of the evaluation of the California Energy Commission's Energy Efficient State Property Revolving Loan Fund Program, administered by California's Department of General Services and funded by the American Recovery and Reinvestment Act of 2009 (ARRA). The program funded energy efficiency projects in state-owned and operated buildings. The evaluation assessed the effectiveness of the program implementation and verified energy savings realized from loans issued during 2009-2010. It also estimated greenhouse gas emission reductions and assessed job creation and market transformation.

The evaluation methodology was based on a stratified sample of projects representing the ease or difficulty of predicting energy savings. Evaluators calculated energy savings based on observations of project installation, and collection of operating conditions. These were usually collected during site visits.

Overall, the program realized about 30 gigawatt-hours (GWh) and 1.4 million therms compared to existing conditions before project implementation. Electric savings were primarily split between heating, ventilating, and air-conditioning (HVAC) (51 percent) and lighting measures (49 percent), and HVAC measures comprised the bulk of natural gas savings (80 percent). Life-cycle savings total more than 400 GWh and nearly 23 million therms. Roughly 17,000 metric tons annually of greenhouse gas emissions are avoided as a result of this program.

Due to the nature of the ARRA funding, it was important that projects be "shovel-ready." The evaluation team found that projects with the most initial project development, including rigorous engineering analyses, consistently saw the highest realized savings. Participants reported high satisfaction with the program. Due to ongoing budget and funding constraints for state-owned buildings, this program funded energy efficiency projects that were long overdue or may not have otherwise happened.

Keywords: Retrofits, American Recovery and Reinvestment Act, ARRA, Department of General Services, loan program, evaluation, measurement and verification; energy savings, energy retrofits, HVAC, lighting, domestic hot water, state buildings, energy efficiency, revolving loan funds

Please use the following citation for this report:

Gaffney, Kathleen, Julia Vetromile, and Stephanie Yang. (DNV KEMA Energy & Sustainability). 2014. ***Evaluation of the Energy Efficient State Property Revolving Loan Fund Program.*** California Energy Commission. Publication Number: CEC-400-2014-012.

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EXECUTIVE SUMMARY

California's Department of General Services (DGS) established the Energy Efficient State Property Revolving Loan Fund Program to fund energy efficiency projects in state-owned and state-operated buildings. The Loan Fund Program is part of the California Energy Commission's State Energy Program, funded by the American Recovery and Reinvestment Act of 2009 (ARRA).

The initial pool of ARRA funds allocated to the DGS revolving loan program totaled $25 million. During the 2009 and 2010 fiscal years, DGS lent out these funds in order to fund projects. Loan payments are paid back into the program's loan fund and allocated to the next project in the queue. This process is intended to be self-sustaining, as long as loans are paid back and there are cost-effective energy efficiency measures to be installed at state-owned facilities. Since DGS identified many such opportunities, in September 2011 the California Legislature authorized the Energy Commission to transfer additional funds to allow for additional retrofit projects. The Energy Commission transferred about $2.7 million in 2012.

The Energy Efficient State Property Revolving Loan Fund Program's four major elements consist of the small building element, the large building element, California Department of Corrections and Rehabilitation (CDCR) projects, and the Office of the Chief Information Officer (OCIO) project. The small building loans focused on buildings of less than 50,000 square feet, targeting about 20 different agencies. The large building loans addressed state office buildings greater than 50,000 square feet, primarily located in Sacramento. The mix of projects implemented during 2009-2010 was extremely diverse, ranging from simple lighting retrofits at small buildings to complicated equipment upgrade and operation optimization projects at very large campuses.

As of August 2012, 64 projects had been implemented, and about $23 million in funds had been distributed. The first annual repayments, nearly $4 million, were collected beginning in September 2012. This initial set of projects saved about 30 gigawatt-hours (GWh) and 1.4 million therms each year and resulted in energy cost savings totaling about $4 million per year.

Evaluation Results

The Energy Commission retained DNV KEMA Energy & Sustainability (DNV KEMA) as evaluators to assess the effectiveness of the Energy Efficient State Property Revolving Loan Fund Program implementation and verify the energy savings realized from loans issued during 2009-2010. Additional goals included determining the proportion of energy savings that would have occurred without the Loan Fund Program, estimating greenhouse gas emission reductions and program cost-effectiveness, assessing job creation and market transformation, and informing the Energy Commission of any waste, fraud, or abuse of loan funds. DNV KEMA completed an evaluation plan in April 2011, and collected and analyzed the data starting in May 2011 and ending in July 2012.

Summary of Results

- **The program design concept was successful.** In general, results from the evaluation demonstrate that California effectively used ARRA funding to initiate energy efficiency projects in state buildings which may not have otherwise had the resources to participate in this type of program. The program effectively targeted recognized opportunities in California correctional facilities, office buildings, and operating facilities. Program-funded projects resulted in better operations and long-term savings for the state.
- **Leveraging existing studies and planned energy efficiency actions was key to program success.** The evaluation team found that the types of projects completed were appropriate for ARRA funding. The program provided loans for needed projects that improved operating efficiency, often where existing contracts and feasibility studies could be leveraged. In particular, the funding of projects at CDCR facilities that had been developed but not funded provided reliable savings expeditiously.
- **The program solved financial budgeting constraints, allowing projects to move forward quickly**. The availability of loan funds that were outside of the normal budgeting process allowed identified cost-effective, energy-efficient upgrade opportunities to be installed.
- **The program set a strong foundation for the future.** The administrative framework of the program developed procedures and approaches for the ongoing effective use of the revolving loan funds. The availability of loan funds outside of the normal budgeting process will continue to facilitate energy efficiency improvements in state buildings for as long as loans are repaid into the fund. In fact, in February 2012, DGS received the first repayment of loans and has selected several new projects to implement.

Gross Energy Impacts

The evaluation results indicate that the program realized about 30 GWh and 1.4 million therms, very close to the expected savings of 31 GWh and nearly 1.2 million therms per year. The expected savings estimates (also called ex ante savings) are derived from the estimated project savings used as the basis for the loan. Tables 1 and 2 below compare the expected electric savings estimates (ex ante) with the verified calculated savings (ex post) from the evaluation.

The evaluation team calculated ex post energy savings results relative to two baselines—the conditions found before the energy efficiency measures implementation (Baseline 1), and either minimally code-compliant conditions or standard practice when no code is applicable (Baseline 2). Baseline 1 reflects the savings expected on the utility bill due to the energy efficiency measure. Baseline 2 provides a useful indication of savings for equipment that is replaced under current conditions, showing the value of selecting equipment that is more efficient than standard practice or minimum code requirements.

Table 1: Evaluation Results – Gross Annual Program-Level Electricity Savings

Loan Group	Annual Ex Ante Electricity Savings (kWh*)	Baseline 1		Baseline 2	
		Annual Ex Post Electricity Savings (kWh*)	Realization Rate	Annual Ex Post Electricity Savings (kWh*)	Realization Rate
Small Buildings	9,027,543	8,418,032	93%	8,327,706	92%
Large Buildings	6,788,621	5,591,422	82%	5,711,301	84%
CDCR	12,206,388	13,131,148	108%	13,032,242	107%
OCIO	3,092,234	2,572,269	83%	2,572,269	83%
Total	31,114,786	29,712,871	95%	29,643,518	95%

* kWh=kilowatt-hours
Source: DNV KEMA analysis

Table 2: Evaluation Results – Gross Annual Program-Level Natural Gas Savings

Loan Group	Annual Ex Ante Natural Gas (therms)	Baseline 1		Baseline 2	
		Annual Ex Post Natural Gas (therms)	Realization Rate	Annual Ex Post Natural Gas (therms)	Realization Rate
Small Buildings	130,245	178,494	137%	149,194	115%
Large Buildings	60,893	37,929	62%	28,361	47%
CDCR	1,001,738	1,210,118	121%	884,249	88%
OCIO	0	0	NA	0	NA
Total	1,192,876	1,426,541	120%	1,061,804	89%

Source: DNV KEMA analysis

To develop a representative sample, the projects were stratified into three groups (low, medium, and high), representing the ease or difficulty of predicting energy savings. Generally, the more complex projects were expected to have higher levels of variation while simpler projects, such as those involving relatively straightforward lighting measures, were expected to have less variation. The remaining projects were assigned to a "Medium" group and generally involved heating, ventilating, and air-conditioning (HVAC) measures. The "High" variability group projects were sampled at a higher frequency to improve the accuracy of the evaluation. Model-based statistical sampling methods were used to select the sample, with the goal of achieving relative precision of the overall program ex post savings estimates within ± 10 percent at the 90 percent confidence level.

As shown, overall, based on applying the realization rates from sampled projects, the 64 projects implemented through the Energy Efficient State Property Revolving Loan Fund

Program should realize 95 percent of the expected annual electricity savings – or about 30 GWh – relative to either Baseline 1 or Baseline 2. Similarly, annual natural gas savings should be either 1.4 million therms (120 percent relative to Baseline 1) or 1.1 million therms (89 percent relative to Baseline 2). The overall precision of these estimates, which indicates the reliability of the results, is 9 percent for Baseline 1 and 12 percent for Baseline 2, at the 90 percent confidence interval.

The six projects implemented at CDCR facilities accounted for 44 percent of the total ex post annual electricity savings, whereas the 45 projects implemented through the small buildings component and the 12 projects implemented through the large buildings component accounted for 28 percent and 19 percent of the total ex post annual electricity savings, respectively. The one OCIO project accounted for 9 percent of the total ex post annual electricity savings. In terms of total ex post annual electricity savings from different types of measures, the results were primarily split between lighting measures at 49 percent of the savings and HVAC measures at 51 percent. Less than 1 percent of electric savings accrued from domestic hot water projects. The six projects implemented at CDCR facilities accounted for 85 percent of the total ex post annual natural gas savings primarily due to the implementation of HVAC measures.

Net Energy Impacts

Using self-reported responses to a participant telephone survey, the evaluation team assessed the extent to which the gross energy savings could be attributed to the program. All 11 of the surveyed participants indicated that the projects would not have moved forward without the program. Most of these projects were previously identified by DGS and were determined to have cost-effective, energy-efficient upgrade opportunities. The results of the interviews indicate that, without the financial support provided through the program, none of the projects would have been implemented during this same time frame, if at all.

Therefore, the net energy savings attributable to the Energy Efficient State Property Revolving Loan Fund Program was determined to be equal to 100 percent of the gross energy savings.

Life-Cycle Impacts

Savings continue to accrue beyond the first year a facility implements an energy-efficient measure. As shown in Table 3, life-cycle savings for the measures implemented through the Energy Efficient State Property Revolving Loan Fund Program total more than 400 GWh and nearly 23 million therms. The projects implemented at CDCR facilities account for more than 95 percent of the life-cycle natural gas savings and more than 40 percent of the life-cycle electricity savings. These projects consisted primarily of HVAC retrofits in prisons and other correctional facilities.

Table 3: Evaluation Results – Net Annual and Life-Cycle Program-Level Savings

	Baseline 1		Baseline 2	
	Net Ex Post Electricity Savings (kWh*)	Net Ex Post Natural Gas (therms)	Net Ex Post Electricity Savings (kWh*)	Net Annual Ex Post Natural Gas (therms)
Annual	29,712,871	1,426,541	29,643,518	1,061,804
Life-Cycle	429,574,170	22,944,438	427,230,546	18,973,546

* kWh=kilowatt-hours
Source: DNV KEMA analysis

Greenhouse Gas Emissions Reductions

Greenhouse gas (GHG) emissions reductions accrue when energy is saved or renewable energy replaces fossil generation. As shown in Table 4, evaluators estimate that nearly 17,000 metric tons of GHG emissions are avoided annually, and more than 250,000 metric tons will be avoided over the lifetime of the measures, as a result of this program under Baseline 1 calculation methods.

Table 4: Evaluation Results – Avoided Greenhouse Gas Emissions

	Avoided Greenhouse Gas Emissions (metric tons)	
	Baseline 1	Baseline 2
Annual	16,864	14,909
Life-Cycle	256,113	234,323

Source: DNV KEMA analysis

Participant Satisfaction and Suggestions for Improvement

Interviews with participants revealed very high levels of satisfaction with the program – including the equipment installed and amount of the loans received. Participants were somewhat less satisfied with the loan structure and amortization schedule, and some reported dissatisfaction with the program compliance requirements, such as the Buy American Act and the Davis Bacon Act provisions.

Self-Reported Evidence of Job Creation

Although based on self-reported evidence, several participants reported that jobs were created in each of their facilities, with 31 jobs reported as added or retained. The participants were typically facilities managers or loan managers, not necessarily with hiring or job creation authority. Many participants speculated that jobs may have been created and/or retained within the energy efficiency contracting industry, mostly engineers, but some at management level. In 2014, the Energy Commission will release a comprehensive report on the employment effects of the full suite of programs funded through the ARRA.

Recommendations

The evaluation produced a set of recommendations for improving the program going forward:

- **Continue to identify, prioritize, and effectively target projects that will most cost-effectively contribute to meeting the state's energy and GHG reduction goals.**
  - DGS may want to identify and work with agencies and entities that need to further reduce energy consumption to meet government mandates requiring state agencies to reduce GHG emissions by 10 percent by 2015 and 15 percent by 2020[1]. By identifying where opportunities at state agencies exist, DGS can target them more effectively.
- **Improve the loan selection process**.
  - The federal timeline for spending ARRA funds reduced the opportunity to assess the loans and minimize risk. The ongoing program should incorporate a longer loan review stage to select projects that have reasonable certainty for achieving expected savings. DGS can adopt a more rigorous evaluation process of the project's feasibility to save energy before granting the loan.
  - DGS may want to compare the Loan Fund Program approval process with other state or municipal revolving funds to seek the best practices for the loan approval process.
- **Consider researching and then implementing organizational "best practices" for meeting energy efficiency and building performance goals.**
  - Organizations have successfully implemented many activities to help reduce energy and meet building performance goals, ranging from the advanced (such as tracking energy consumption and mining energy management data to identify energy efficiency opportunities) to the simplistic (such as "treasure hunt" competitions among facility managers to identify opportunities).
  - Another energy efficiency building management best practice is to formally incorporate energy efficiency into long-term plant operations and capital planning.
  - Other organizations have found that building occupant and tenant education is key to realizing the full potential of energy efficiency measures. This practice is especially important when introducing new technologies, such as lighting and temperature controls.
  - In addition, creating a forum for agencies and facility managers to share energy efficiency success stories (and failures) within DGS should be considered. This forum will encourage innovative thinking and knowledge transfer.
  - Revisit government procurement procedures to continually improve energy efficiency. This review will encourage agencies to keep energy innovation at the forefront.

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1 The Governor's Executive Order B-18-12 requires all state-owned buildings to reduce their grid-based energy purchases by 20 percent by 2018, and reduce GHG emissions by 20 percent by 2020.

- **Encourage project co-funding through other sources, such as utility programs and state budgets.**
  - Leveraging funding from utilities or internal state funding allows the completion of large comprehensive projects. The funding through ARRA, combined with the CDCR partnership program with the utilities, resulted in significant savings.
  - Access to funding from other sources allows agencies to implement a greater range of measures, such as demand response and advanced building automation technologies that enable further savings, in addition to effectively designed energy efficiency projects that improve performance of state buildings.
- **Adopt more rigorous project savings analysis and documentation requirements.**
  - In general, the evaluators found less variation in realization rates from projects that were subject to more rigorous savings documentation early on, such as when developed by energy service companies (ESCOs) or in partnership with utilities. During onsite verification, the evaluation team sometimes saw substantial deviations between what was reported and what had been observed as implemented. For example, operational hours observed for installed equipment may have been significantly different than what was reported in ex ante estimates.
  - Pre-retrofit and baseline conditions should be carefully documented.
  - In addition, it is important to consistently maintain tracking data at the measure level as the program evolves. Data on scope of work changes for a project were not always available to the evaluation team, though status updates were useful. To ease future evaluation efforts, it would helpful to have a regularly maintained tracking database to keep abreast of project changes.
  - Consider including electrical demand savings in program results. The program should provide a transparent method for determining demand, which is consistent with Energy Commission needs.
- **Consider changes to program design.**
  - Develop an approach that focuses on small buildings across the state, allowing remote and rural locations to be addressed. Consider contracting terms that incentivize projects across the portfolio, regardless of contractor travel time.
  - Analyze buildings and develop targeted approaches for different building segments.
  - Provide technical resources, such as available staff and a toolkit for small buildings.
  - Adapt loan payment due dates to allow projects to generate a year's worth of savings before payment is due.
  - Consider including cost-effective distributed generation projects.
  - Consider including long-term monitoring for savings persistence for the projects with the most savings.

Finally, the Energy Efficient State Property Revolving Loan Fund Program was designed to provide a continuous pool of funding for energy efficiency upgrades to state buildings. According to the program loan administrator, the loans funded the most energy efficiency projects since 2001. Before the loan fund under ARRA, many projects were identified, but the funding was not available to move forward. The ARRA funding allowed these projects to be

completed. The program achieved its goal of delivering long-term, self-sustained energy efficiency in state facilities through this effective revolving loan program.

CHAPTER 1: Introduction

This report provides the California Energy Commission with an independent evaluation of the Energy Efficient State Property Revolving Loan Fund Program (Loan Fund Program). The evaluation sought to assess the effectiveness of the Loan Fund Program implementation and to verify the energy savings realized from loans issued during 2009 and 2010.

The Energy Commission contracted with DNV KEMA Energy and Sustainability (DNV KEMA) to conduct the evaluation. DNV KEMA conducted the evaluation from May 2011 to July 2012. The primary objective was to determine the actual gross energy and peak demand savings from the Loan Fund Program's projects. DNV KEMA calculated gross energy savings and peak demand savings for the sample of sites included in this evaluation. However, peak demand information was not available in the program data for many sites, preventing the extrapolation of peak demand savings. Therefore, this report focuses on energy savings only, providing annual and life-cycle estimates. The report also explains the differences between ex ante and ex post savings results.

Through in-depth interviews with Loan Fund Program participants, the evaluation team also assessed:

- Free ridership, or the proportion of energy savings that would have occurred without the Loan Fund Program.
- Participant decision-making process and criteria, including how projects were identified, reasons for implementing projects, use of financial or other decision-making criteria (for example, payback period), and consideration of life-cycle benefits and costs.
- Participant spillover effects (that is, implementation of energy efficiency measures outside the Loan Fund Program project scope).
- Participant satisfaction with equipment installed, loans received, the loan structure and amortization schedule, compliance requirements (for example, the National Historic Preservation Act, the Buy American Act, the Davis Bacon Act), and interactions with Energy Commission staff.
- Participant self-reporting of employment effects attributable to the Loan Fund Program.

In addition, the evaluation team explored the extent to which the Loan Fund Program succeeded in generating market transformation effects, such as contributing to developing long-term, sustainable infrastructure to support energy efficiency in state facilities.

Finally, the evaluation also included a comprehensive assessment of the Loan Fund Program's overall cost-effectiveness, greenhouse gas (GHG) emission reductions, and direct and indirect employment effects. These components of the evaluation are ongoing, and the results will be reported under separate cover.

Subsequent sections of this report are organized as follows:

- **Chapter 2: Program Overview.** Describes the Loan Fund Program, its objectives, and expected results.
- **Chapter 3: Evaluation Approach**. Provides an overview of the evaluation methodology, including sample design, description of the final sample, data collection elements, and calculation methods.
- **Chapter 4: Results.** Presents evaluation results, including program-level gross and net energy impacts, breakdown of savings results by loan group and by measure type, and calculation of life-cycle savings. Results from in-depth interviews with Loan Fund Program participants are also presented.
- **Chapter 5: Summary and Recommendations.** Summarizes the evaluation results and provides recommendations for the program going forward.
- **Chapter 6: Glossary.** Provides a list and describes the meaning of acronyms used in this report.

Appendices to this report include:

- **Appendix A: Detailed Evaluation Methodology.** Provides a more detailed description of the evaluation methods.
- **Appendix B: Participant In-depth Interview Guide.** Provides the in-depth interview guide used to interview Loan Fund Program participants.
- **Appendix C: Population Level Program Tracking Data.** Summarizes program tracking information, including ex ante savings estimates, for all of the Loan Fund Program projects included in the scope of this evaluation.
- **Appendix D: Evaluation Results for Sampled Sites.** Presents ex post evaluation results for the sites included in the evaluation sample.
- **Appendix E: Evaluation Site Reports.** Provides the final evaluation site reports for projects included in the evaluation sample.

CHAPTER 2: Program Overview

With an allocation to the Energy Commission from the American Recovery and Reinvestment Act of 2009 (ARRA), California established the Loan Fund Program to fund energy-efficient upgrade projects in state-owned and state-operated buildings.[2] This program was designed such that the participating agencies will be able to repay the loans through energy cost avoidance alone and is administered by California's Department of General Services (DGS).

Program Design Summary

The Energy Commission was awarded $226 million in ARRA funds, through the U.S. Department of Energy's (DOE) State Energy Program (SEP). Under this award, the Energy Commission had the authority to disseminate funds, direct program design, and oversee reporting for program accomplishments for all ARRA-funded SEP activities. The Energy Commission allocated a total of $25 million in ARRA-SEP funding to DGS to administer the Loan Fund Program during the fiscal years of 2009 and 2010.[3]

DGS developed and implemented an action plan for the Loan Fund Program that identified, benchmarked, categorized, and prioritized state-owned and state-operated buildings that would most benefit from energy efficiency retrofits. In the 2009 and 2010 fiscal year, project retrofits were selected at 64 sites from the identified opportunities. Most of the projects identified for the Loan Fund Program had previously been determined to have cost-effective, energy-efficient upgrade opportunities. However, a lack of funding prohibited these projects from moving forward.

During fiscal years 2009 and 2010, 12 loans were awarded, comprising a total of 64 projects. These projects were implemented through four program elements, or "loan groups": the small building program element (less than 50,000 square feet), large building program element, California Department of Corrections and Rehabilitation (CDCR) projects, and Office of the Chief Information Officer (OCIO) projects.

The Loan Fund Program covered purchasing materials and installing any commercially available energy efficiency equipment with proven energy and/or capacity savings. According to the loan administrator, the projects should return 110 percent of the cost of the measure over its lifetime. Examples of qualifying energy efficiency measures include:

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2 California Public Resources Code Sections 25470 through 25474.

3 In September 2011, the California Legislature passed Assembly Bill 1392 (Bradford, Chapter 488, Statutes of 2011) permitting transfers from the Energy Commission of up to $50 million to fund the program in future years. About $2.7 million was transferred in June and July of 2012.

- Lighting
  - Interior lighting, lighting controls, delamping.[4]
  - Exterior lighting.
- Heating, ventilation, and air-conditioning (HVAC) systems, including:
  - Automated energy management systems (EMSs) and controls.
  - Replacing boilers or chillers and associated piping.
  - Variable-frequency drives (VFDs).
- Domestic hot water (DHW) equipment replacement.

Modeled largely after another Energy Commission program—the low-interest revolving loan programs enabled through the Energy Conservation Assistance Act (ECAA)—DGS designed the Loan Fund Program to improve the long-term energy efficiency performance in state-owned and operated facilities. Loans were designed to cover the full cost of energy efficiency projects such that no other sources of upfront capital were needed; the lengths of the loans were based on savings calculations. Repayment plans were developed on a case-by-case basis, incorporating each project's anticipated energy cost savings such that out-of-pocket expenses would be minimized. That is, an agency's repayment would begin after a project's completion and was based on the assumption that the savings in energy bills would be equal to or greater than the loan payments. Project payback periods were always considered in the selection process to keep the loan replenishment time as short as possible. The loan interest rate was 2.5 percent, established to account for inflation and to cover program administration costs. Loan payments are paid back into the Loan Fund Program and are reallocated to the next project in the queue. This process is intended to be self-sustaining as long as loans are repaid and there are cost-effective energy efficiency measures to be installed at additional state-owned facilities.

Loan terms were calculated using a simple amortization spreadsheet. Loan repayment was set in the loan agreement. Annual repayment date for all loans was set for September 15 of the year after the loans were initiated. This date was later adjusted in some cases to account for the time required for internal state financial transfers. In some cases, the loan terms were shortened after the fact due to higher than expected savings.

As of August 2012,[5] the Loan Fund Program collected the first annual repayment totaling $3,947,409. This amount includes all but one loan recipient, the Department of Mental Health, for which repayment was pushed back due to project delays. A total of $6 million to $7 million, composed of loan repayments, transfers from the Energy Commission, and unspent funds from

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4 Delamping refers to removing light bulbs or fixtures in areas where illumination is greater than required.

5 DGS Status Report 8/25/12.

the original $25 million, was available for lending in late 2012. Table 5 shows the maximum loans for each project, the total funds distributed by loan group, and the payback period.

Table 5: Summary of Loan Fund Program Accomplishments

Loan Group	Maximum Single Loan in Each Group	Loan Amount Distributed	Average Payback (years)
Small Buildings	$4,559,004	$9,630,788	6.8
Large Buildings	$5,155,325	$5,788,744	9.2
CDCR	$4,084,982	$5,419,591	2.8
OCIO	$2,278,049	$2,278,049	14.4
Administration		$335,963	
Total Loan Fund Program		$23,453,135	5.6

Source: DGS Energy Efficient State Revolving Fund, Annual Legislative Report. January 1, 2013.

Program Delivery

The Loan Fund Program has been continually administered by one individual who works on capital outlays for the Energy Unit of the Special Program Section in the Real Estate Division of DGS. Within the Real Estate Division of DGS, there is separation of administration and implementation of the loans; the Energy and Sustainability Unit administers loans, including disbursement of funds, and the Special Programs Section implements the projects.

At the onset of the Loan Fund Program, the issuance of loans quickly was a priority. The federal schedule reduced the time frame for both contracting and review of planned projects. The Loan Fund Program administration worked with state agencies to finalize loan terms as quickly as possible. Loans could follow two models: departments with their own building management teams with signature authority could apply for the loans and implement the projects themselves once the loan was granted or agencies could apply for the loans and pay DGS to implement and manage the projects.

Due to the urgency of the program, DGS sought out existing contract vehicles where possible to minimize the expected time to bid and award a government contract. The process also favored "shovel-ready" projects. Projects were implemented through three contracting channels:

- **Existing retrocommissioning contracts.** DGS had previously executed contracts for retrocommissioning[6] services for investigation and calibration with several contractors.

6 Retrocommissioning is the process of optimizing the existing building systems and operations to improve energy performance.

As part of this process, retrocommissioning agents identified energy efficiency measures. Many of these measures had not been implemented. At the start of the Loan Fund Program, these existing contracts were still open, and DGS was able to extend them to cover the energy efficiency projects under the Loan Fund Program. Because a typical contract can take up to one year to finalize, DGS welcomed this opportunity to expedite the loan process.

- **Energy service company (ESCO) contracts.** Under the authority of Public Utilities Code Section 388, DGS established a pool of qualified ESCOs and issued contracts for energy retrofits at state-owned facilities. ESCOs are firms that typically offer services in developing and implementing energy efficiency projects. The ESCOs played an important role in identifying and installing measures, as well as working with utilities to identify incentives.
- **Special repair contracts.** DGS's Building and Property Management Branch examined its five-year plans for building maintenance and repair objectives and identified energy-related projects that were potential candidates to participate in the Loan Fund Program.

Program Structure

A total of 64 loans were awarded to the four program elements.

Small Buildings Program Element

The small building program element typically focused on various state agencies' department field offices smaller than 50,000 square feet in size. Together, these smaller buildings comprise more than half the square footage in the entire portfolio of California's state-owned facilities. About 20 departments—such as the Department of Motor Vehicles (DMV), the California Highway Patrol (CHP), and the Department of Developmental Services (DDS)—were targeted for the small building element of the Loan Fund Program. The bulk of the loan group measures were installed at large campuses and complexes. Contractors were discouraged to schedule sites separated by long distances due to travel time costs.

Agencies in this loan group did not have the signature authority to implement their own projects. Four ESCOs bid on the contract, and the successful ESCO was awarded the small building contract. The awardee developed energy efficiency measures based on data collected during preliminary site visits to selected small buildings.

Large Buildings Program Element

The large buildings program element consisted of buildings greater than 50,000 square feet. These agencies also did not have the signature authority to implement their own projects and relied on contracts executed by DGS, including the retrocommissioning contracts.

This loan group also included several buildings near the state capital in downtown Sacramento, including the Energy Commission, Jesse Unruh, Secretary of State, and Board of Equalization

buildings. These buildings had undergone retrocommissioning studies under the Green Buildings Initiative,[7] and the contract remained open. The consultants hired to perform the studies were retained, but these projects were considered by DGS to have high uncertainty. Time had elapsed since the retrocommissioning studies on these buildings were initiated in 2005, and the studies were not revisited again before the Loan Fund Program began implementation, according to the loan fund administrator.

California Department of Corrections and Rehabilitation

The CDCR projects were implemented primarily at prisons. This agency had the signature authority to apply and manage projects directly. Some of the CDCR group buildings belonged in investor-owned utility (IOU) service territory and had long been engaged in an ongoing partnership with the IOU. Before the start of the ARRA funding cycle, audits had already identified and the partnership vetted several projects within the CDCR system. This vetting, coupled with enhanced incentive money from public-use funds that the IOUs were under pressure to use, provided the perfect platform for these "shovel-ready" CDCR projects. Participants were able to leverage both sources of funding to quickly implement energy efficiency projects that, having already gone through detailed review by the partnership, reliably returned savings.

Office of the Chief Information Officer Program

The OCIO was the smallest loan group with only one project site at the Gold Camp Data Center in Rancho Cordova. The OCIO also had the signature authority to issue contracts and manage its own projects. The OCIO identified energy efficiency opportunities.

Program Goals and Accomplishments

As described above, the Loan Fund Program was designed to be a self-sustaining financing vehicle for upgrading state-owned and operated buildings throughout California. Its underlying goals were to reduce annual energy usage and expenditures in state buildings, stimulate the short-term economy by creating new or retaining existing jobs, and reduce GHG emissions and the state's dependence on fossil fuels.

Loan Fund Program projects were implemented at a variety of state buildings throughout California, from prisons in Salinas to state buildings in Sacramento. Table 6 and Figure 1 present summary information for the Loan Fund Program. As shown, about $25 million in ARRA funding was awarded through 12 loans covering costs associated with 64 total projects, most of which were implemented via the small building program element. Total annual energy savings from all 64 projects was expected to be about 31 gigawatt-hours (GWh) and nearly 1.2 million therms, with associated annual energy cost savings of $4 million.

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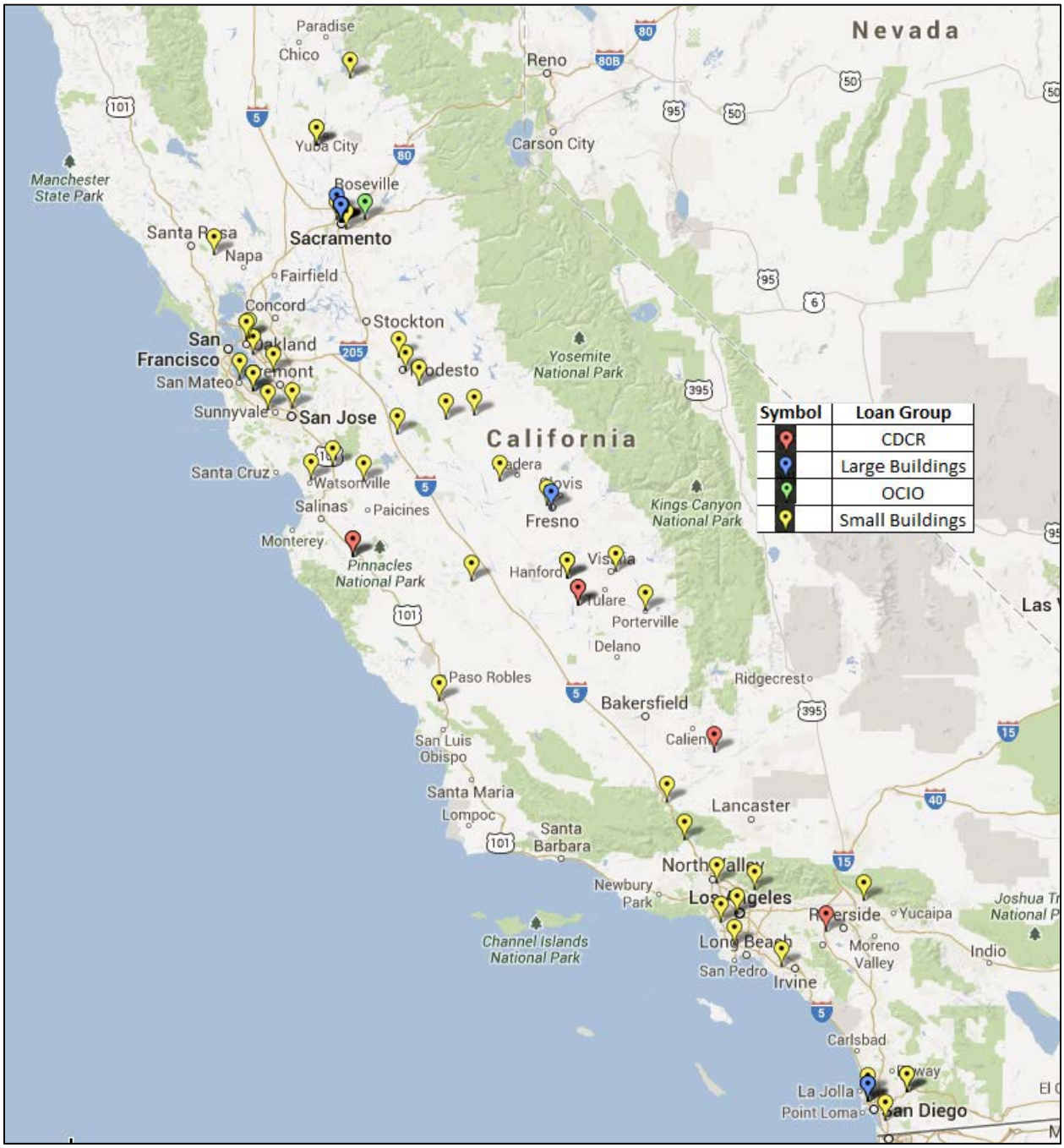
7 Executive Order S-20-04.

Table 6: Summary of Loan Fund Program Projects – Loan Amounts, Annual Ex Ante Energy Savings

Loan Group	Number of Loans	Number of Projects	ARRA Loan Funding (million)	Ex Ante Annual Energy Savings		Energy Costs (million)
				Electricity (GWh)	Natural Gas (million Therms)	
Small Buildings	6	45	$10.2	9.03	0.13	$1.4
Large Buildings	3	12	$6.6	6.79	0.06	$0.6
CDCR	2	6	$5.6	12.21	1.00	$1.7
OCIO	1	1	$2.3	3.09	0.00	$0.4
Total Loan Fund Program	12	64	$24.7	31.12	1.19	$4.1

Source: DGS Program in Progress Summary, August 25, 2012

Figure 1: Loan Fund Program Projects − Statewide Distribution



Source: Energy Commission provided information on Loan Fund Program loans.

These 64 projects involved a variety of end-use technologies and energy efficiency measures. In each project, specific project activities designed to save energy were grouped together and tracked by measure category or in ways that were consistent with the project documentation. For example, some projects included only one grouping, such as a lighting retrofit, regardless of how many fixtures were replaced. These tracked measure groupings were compiled into a

database, and the evaluation reported savings results by these groupings. A total of 151 tracked measure groupings are included in the 64 projects evaluated.

As shown in Table 7, similar tracked measure groupings were combined together to create measure-type categories (for example, boiler, HVAC equipment, lighting, and so forth.). About two-thirds of the projects included some type of lighting retrofit, while about one-third of the projects implemented HVAC measures. The table shows the total number of loans implemented for each measure type.

Table 7: Loan Fund Program Measure Description Summary

Measure Group	Measure Type	Measure Descriptions	Total Number of Projects with These Measures
HVAC	Boiler	Boiler replacement and retrofit measures	4
	HVAC Equipment	Efficient air conditioning, heat pumps, packaged units, chillers, economizers	17
	HVAC Controls	Energy management systems, cooling room upgrades, VFDs, HVAC maintenance, and retrocommissioning	11
Lighting	Lighting	Exterior and interior lighting	55
	Lighting controls	Occupancy sensors, lighting control systems	43
Water Heating	DHW	Water heaters and water heater pump controls	3

Source: DGS Program in Progress Summary, August 25, 2012

A summary of the projects implemented through the Loan Fund Program is shown in Table 8. In cases where only electricity savings are expected, the natural gas savings are not applicable (NA). A full listing with project-specific details is provided in Appendix C.

There were 45 projects implemented through the small buildings program element, with expected annual savings totaling 9.03 GWh and 0.13 million therms. These projects were expected to contribute 29 percent of the total annual electricity savings for the overall Loan Fund Program and 11 percent of the total annual natural gas savings. These 45 projects were implemented at facilities occupied by the Department of Mental Health, the CHP, the DMV, the Department of Water Resources (DWR), and the DDS. Projects included mostly lighting retrofits and control measures, as well as relatively fewer HVAC, HVAC controls, and DHW measures.

There were 12 projects implemented through the large buildings program element, with expected annual savings totaling 6.79 GWh and 0.06 million therms (or 22 percent and 5 percent of the total annual electricity and natural gas savings, respectively). These 12 projects were implemented at facilities occupied by the Board of Equalization, the California Department of Transportation (Caltrans), the Energy Commission, CHP, DGS, as well as the Secretary of State

Building, and the Office of Fleet Management. These projects involved HVAC equipment and HVAC control measures, lighting retrofits and lighting control measures, boiler replacements, and DHW measures. The HVAC equipment measures involved replacement of boilers, chillers, air conditioners, and other HVAC equipment, while the HVAC controls measures addressed controls and upgrades on the associated systems, such as variable-frequency drives and air conditioner coil cleaning.

About 12.21 GWh and 1.00 million therms in annual savings were expected to come through six projects implemented at CDCR facilities. These projects were expected to contribute 39 percent of the total annual electricity savings and 84 percent of the total annual natural gas savings. These projects involved lighting retrofits and lighting control measures, HVAC control measures, boiler replacements, and a DHW measure.

Finally, the project implemented at the OCIO facility was expected to contribute 3.09 GWh in annual electricity savings, or 10 percent of the total annual electricity savings expected for the overall Loan Fund Program. This project involved HVAC, HVAC controls, and lighting retrofit measures.

Table 8: Loan Fund Projects – Annual Ex Ante Energy Savings

Loan Group	Loan Number	Organization and Sites	Measure Type	Annual Ex Ante Electricity Savings (kWh)	Annual Ex Ante Natural Gas Savings (Therms)
Small Buildings Program	108	Department of Mental Health (1 Site)	1 Lighting Retrofit	572,066	NA
	110	Department of Mental Health (1 Site)	1 Lighting Retrofit, 1 Lighting Controls	405,692	NA
	114	CHP (19 Sites)	7 HVAC, 18 Lighting Retrofits, 18 Lighting Controls	1,493,176	2,258
	116	DMV (19 Sites)	3 HVAC, 18 Lighting Retrofit, 17 Lighting Controls	721,028	1,742
	118	DWR (4 Sites)	4 HVAC, 4 Lighting Controls	503,021	10,571
	120	DDS (3 Sites)	3 HVAC Controls, 2 Lighting Retrofits, 1 Lighting Control	5,332,560	115,674
Large Buildings Program	101	Board of Equalization (1 Site)	1 Boiler Replacement, 2 DHW, 2 HVAC Controls, 1 Lighting Retrofit, 1 Lighting Controls	2,444,207	28,523
		Caltrans (2 Sites)	1 HVAC, 1 Lighting Controls	531,006	29,507
		Energy Commission Building (1 Site)	1 DHW, 4 HVAC Controls, 1 Lighting Controls, 1 Lighting Retrofit	171,200	NA
		DGS (4 Sites)	1 HVAC, 5 HVAC Controls, 1 Lighting Retrofit, 2 Lighting Controls	1,653,355	2,863
		Secretary of State Building (1 Site)	4 HVAC Controls, 1 Lighting Controls	1,015,995	NA
	104	Office of Fleet Management (1 Site)	1 Lighting Retrofit	761,436	NA
	106	CHP (1 Site)	1 Lighting Retrofit	211,422	NA
CDCR	102	CDCR (4 Sites)	2 Boiler Replacement, 1 DHW, 4 HVAC Controls, 6 Lighting Retrofits	6,747,138	731,048
	124	CDCR (2 Sites)	1 Boiler Replacement, 1 HVAC Controls, 1 Lighting Control,	5,459,250	270,690
OCIO	112	OCIO (1 Site)	1 HVAC, 2 HVAC Controls, 1 Lighting Retrofit	3,092,234	NA
Total Loan Fund Program				31,114,786	1,192,876

Source: DGS Program in Progress Summary, August 25, 2012

CHAPTER 3:
Evaluation Approach

This evaluation sought to assess the effectiveness of the Loan Fund Program implementation and verify the energy savings realized from loans issued during 2009 and 2010. Following the finalization of an evaluation plan in April 2011, the evaluation was completed from May 2011 through July 2012.

The evaluation relied on a number of data sources:

- Interviews and ongoing discussions with the Energy Commission and DGS staff, including the Energy Commission contract program manager, Energy Commission engineers and technical support staff, and the DGS program administrator. Initial interviews covered topics related to developing an understanding of the program's overall goals and design and identifying elements of uncertainty and risk associated with program delivery and execution. Ongoing discussions touched on how well the program was organized and managed, as well as kept track of any changes in project-specific scope and implementation.
- Program-specific documents, including program plans and progress reports,[8] as well as a range of project-specific documents and summary data (such as feasibility studies, preliminary savings estimates, and so forth). The evaluation team developed a Microsoft® Excel database to store project-specific details. The team periodically reviewed and updated this database based on DGS status reports and review of project documentation throughout the evaluation period.
- Site visits conducted at a sample of 18 projects to support the estimation of program savings. Site-specific engineering data collection, analyses and measurement and verification (M&V) activities were completed for the sampled projects, and the results were extrapolated to the full population of projects implemented through the Loan Fund Program. Where available and appropriate, billing data was collected as an additional cross-check of savings achieved.
- In-depth interviews completed by telephone with decision-makers at sampled sites. A total of 11 interviews representing 16 sites were conducted. The primary purpose of the interviews was to gather information about program effectiveness and attribution.

The following sections provide short descriptions of key evaluation activities; Appendix A provides a more detailed description of the evaluation methodology.

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8 Sample progress reports can be viewed online at the Department of General Services website at http://www.dgs.ca.gov/resd/Programs/greenbuilding.aspx.

Sample Design

As discussed in Chapter 2, the Loan Fund Program targeted a wide variety of measures, ranging from simple lighting retrofits at small field offices operated by state agencies such as the DMV or CHP to more complex retrocommissioning projects at very large facilities or building campuses.

The evaluation team first reviewed the initial tracking data provided by DGS and developed a sample design. The goal of the sample design was to meet prescribed levels of statistical precision for the annual energy savings, expressed as source energy. Source energy converts energy savings from electricity in kWh and fuel savings in therms to source energy in million British thermal units (MMBtu). For electricity, the source energy includes a factor of three to account for the estimated fuel energy losses from generating electricity. About 3 Btu in fuel are needed to generate an equivalent 1 Btu in electricity at a power plant. Source energy was used for the sample design to allow equal weighting for projects saving natural gas or fuel saving and electricity.

To develop a representative sample of projects from the population of the 2009 and 2010 loan fund projects, DNV KEMA stratified the projects into three groups representing the ease or difficulty of predicting the energy savings. Where savings are more easily predicted, less difference is expected between the savings estimates developed by DGS (ex ante savings) and the evaluation (ex post savings). The DGS ex ante savings estimates were assessed by reviewing project documentation, and then each project was assigned to a group. Generally, the more complex projects were expected to have higher variation and therefore assigned to a "High" group. Simpler projects, such as those involving relatively straightforward lighting measures, were expected to have less variation and assigned to a "Low" group. The remaining projects were assigned to a "Medium" group and generally involved HVAC measures. The "High" variability group projects were sampled at a higher frequency, to improve the accuracy of the evaluation.

Model-based statistical sampling methods were used to select the sample, with the goal of achieving relative precision of the overall program ex post savings estimates within ± 10 percent at the 90 percent confidence level (90/10 precision). The sample selection was made based on the ex ante savings estimates converted to source energy. Overall, the error ratio for the population was estimated at 0.7, and the expected relative precision of the savings was estimated to be 8 percent, expressed as source energy.

Evaluation Sample

Out of the 64 total projects funded by the Loan Fund Program, a total of 52 tracked measure groupings at 18 project sites were evaluated for the Loan Fund Program, including:

- **Fourteen tracked measure groupings at six sites in the small buildings program.** These six sites included buildings occupied by the DMV, the CHP, and the DDS. The bulk of

the measures evaluated were lighting retrofits and lighting control measures, such as occupancy sensors. Lighting controls were typically occupancy sensors. Four HVAC tracked measure groupings in the small buildings program, including packaged HVAC units and HVAC control measures, were sampled.

- **Eighteen tracked measure groupings at five sites in the large building program.** The sample of large building program sites consisted of three office buildings and one fleet parking lot in Sacramento, and one Caltrans office building in San Diego. The evaluation team verified 1 interior lighting fixture retrofit and 3 occupancy sensors installations in office buildings, 1 exterior lighting fixture retrofit at a parking lot, a new chiller at Caltrans, 11 HVAC controls, and 1 DHW control.
- **Sixteen tracked measure groupings at six CDCR sites.** There were a total of six CDCR projects, and all six were included in the sample due to the relatively large savings expected from these projects. The evaluation team verified three boiler replacements, five HVAC controls, six lighting fixture retrofits plus one lighting control installation, and one DHW retrofit.
- **Four tracked measure groupings at one OCIO site.** There was only one OCIO project, and it was included in the sample. The OCIO project consisted of three HVAC controls installations and an interior lighting retrofit at the Gold Camp Data Center.

The table below lists the sampled projects by loan group, the types of measures, and the ex ante estimates of annual energy savings. Overall, about two-thirds (66 percent) of the total expected annual electricity savings were accounted for in the 18 sampled projects, and about 86 percent of the total expected annual natural gas savings were accounted in the sampled projects. Only 9 of the 18 sampled projects involved natural gas-saving measures.

Table 9: Sampled Loan Fund Program Projects – Measure Types and Annual Ex Ante Energy Savings

Loan Group	Loan Number	Organization and Sites	Measure Types	Annual Ex Ante Electricity Savings (kWh)	Annual Ex Ante Natural Gas Savings (Therms)
Small Buildings Program (6 sites)	114	CHP, Coalinga Area	Lighting Control, Lighting Retrofit, HVAC	45,403	0
		CHP, Oakland Area	Lighting Control, Lighting Retrofit	119,777	0
		CHP, South Los Angeles Area	Lighting Control, Lighting Retrofit	137,410	0
	116	DMV, Oakland Coliseum	Lighting Control, Lighting Retrofit	37,350	0
		DMV, Yuba City	HVAC, Lighting Retrofit	45,807	713
	120	DDS, Sonoma	HVAC Controls, Lighting Retrofit, Lighting Controls	2,160,715	36,114

Loan Group	Loan Number	Organization and Sites	Measure Types	Annual Ex Ante Electricity Savings (kWh)	Annual Ex Ante Natural Gas Savings (Therms)
Large Buildings Program (5 sites)	101	Caltrans District 11 Headquarters	HVAC, Lighting Controls	405,830	29,507
		Energy Commission Building	Lighting Retrofit, DHW, Lighting Controls	171,200	0
		DGS, Jesse Unruh Building	HVAC Controls, Lighting Retrofit	374,587	0
		Secretary of State Building	HVAC Controls, Lighting Retrofit	1,015,995	0
	104	Office of Fleet Management, Parking Lots	Lighting Retrofits	761,436	0
CDCR (6 sites)	102	Salinas Correctional Training Facility	Boiler Replacement, HVAC Controls, Lighting Retrofit	730,160	223,021
		Salinas Valley State Prison at Soledad	Lighting Retrofit, DHW	966,396	95,799
		Tehachapi	Boiler Replacement	430,116	345,322
		Corcoran State Prison	HVAC Controls, Lighting Retrofit	4,620,466	66,906
	124	Substance Abuse Treatment Facility	HVAC Control, Lighting Controls	5,413,745	49,944
		Norco Rehabilitation Center	Boiler Replacement	45,505	220,746
OCIO (1 site)	112	Gold Camp Data Center	HVAC, HVAC Control, Lighting Retrofit	3,092,234	0
Total for Loan Fund Program Sample (18 sites)				20,574,132	1,068,072

Source: DGS Program in Progress Summary, August 25, 2012, and DNV KEMA Evaluation Plan 2011

The six projects sampled from the small buildings program account for about 28 percent of the expected annual electricity savings and 22 percent of natural gas savings from all 45 small buildings program projects. About 40 percent of the expected annual electricity savings and 41 percent of the expected natural gas savings were accounted for in the five sampled projects from the large buildings program. The evaluation sample consists of all seven projects implemented at CDCR and OCIO facilities; therefore, 100 percent of the expected savings from these program elements was accounted for in the sample.

Data Collection Methods

This section provides a brief overview of data collection methods. Additional detail on data collection methods are provided in Appendix A.

Data collection fell into roughly five steps: data requests and review, site scheduling, site planning, site-specific M&V activities, and in-depth interviews with participants.

- **Data requests and review.** The evaluation team requested from DGS and site contacts relevant information for calculating energy savings, including detailed measure descriptions; savings calculation spreadsheets and related documentation; feasibility studies; and contractor, vendor, and equipment manufacturer information. This information was then reviewed to begin planning for the site-specific M&V data collection and analysis.
- **Site scheduling.** For each sampled project, an evaluation engineer contacted the site to initiate site planning, confirm project details, and schedule the site visit.
- **Site planning.** Following data review and assessment, the evaluation engineers developed customized data collection and analysis plans, including brief descriptions of the data requirements and analysis approaches that would be used to determine both the pre- and postinstallation assumptions and conditions.
- **Site-specific M&V.** The evaluation team collected data to catalog pre- and postretrofit operations and conditions, including equipment nameplates, feasibility study reviews, self-reported operational data, and spot measurements. At many sites, the evaluation team installed data loggers and collected long-term measurements over a two-week or more period. The team also collected billing data for some projects, as needed to support the evaluation calculations.
- **In-depth interviews with participants.** Evaluators developed an in-depth interview guide for participants, a copy of which is located in Appendix B. The interview guide was designed to address research questions ranging from program attribution to participant satisfaction.

Site-Specific Analyses to Determine Energy Savings

Calculating energy savings depends on the estimated base-case energy use of a given end use before a retrofit and the estimated energy use after the retrofit. The base-case conditions were established for the preretrofit conditions as follows:

- Preretrofit data were collected to establish the control scheme, operating conditions, equipment load, and equipment efficiency. In the absence of metered data, information from the feasibility study, site contact, as-built drawings, and research and engineering judgment were used to establish the base-case parameters.
- Postretrofit data were similarly collected, and base-case parameters were established.

Both pre- and postretrofit data were normalized to the same operating conditions to establish savings estimates that could be directly compared.

For each site within the sample, evaluators determined a measure's efficiency, measure effective useful life (EUL), and remaining useful life (RUL) of the preretrofit equipment. Appendix A provides the detailed methodology employed to determine these parameters.

The evaluation team calculated life-cycle savings of the energy efficiency measures. Each measure was assigned an EUL, and the savings for each year of EUL were summed over the measure life to determine the life-cycle savings.

Evaluated energy savings for the Loan Fund Program were calculated relative to two established baselines, referred to as Baseline 1 and Baseline 2. DNV KEMA developed annual savings for each baseline.

- Baseline 1 corresponds to the existing conditions found before implementation of the energy efficiency measures and considers the operating efficiency of the equipment along with the control strategies found at that time. This baseline is relevant when considering payback periods.
- Baseline 2 corresponds to the expected replacement conditions (for example, standard practice or code minimum). The annual savings are estimated comparing the installed measure to expected replacement. This baseline represents the savings from improvements in efficiency due to the measure, compared to currently available options.

Life-cycle savings were developed for each baseline. Life-cycle savings are sum of the annual savings expected to accrue for each year of the life of the measure.

- The evaluation team calculated life-cycle savings for Baseline 1 by using the same annual savings for every year of measure life. The evaluation team assumes that the pre-existing equipment would have operated for the full EUL of the new equipment regardless if the existing equipment was at the end of its useful life. The Energy Commission requested the evaluation team to report these results to assist DGS in calculating payback periods from observed pre- and postretrofit energy use.
- Baseline 2 uses the pre-existing equipment as the measure's baseline only until the end of the existing equipment's RUL. After that, an expected replacement baseline (such as standard practice or code minimum) is used until the EUL is reached. Resource planners use this baseline as a conservative assumption so that efficiencies that would be gained over time are not double counted.

For measures where the existing equipment was still within its EUL, Baseline 2 was applied at the end of the EUL of the equipment to calculate the life-cycle savings. For example, if a chiller with an EUL of 20 years was replaced after only 15 years of service, the life-cycle savings calculations used the existing equipment (Baseline 1 annual savings) as a baseline for the first 5 years and an "expected" replacement (Baseline 2 annual savings) for the remaining 15 years. However, there were many sites where the equipment replaced was beyond the EUL. If this equipment was still operational, it was given an RUL of one year. This means the first year of the life-cycle savings would use the existing equipment as the baseline (Baseline 1 annual savings), and the rest of the years would use the "expected" replacement annual savings (Baseline 2 annual savings). If there was no pre-existing equipment (as in the case of many

controls measures), the RUL was effectively zero. In this case, there is no difference between Baseline 1 and 2.

GHG Reductions Calculations

The evaluation team calculated the total GHG emissions reduction that resulted from the Loan Fund Program. The team used calculation methods following guidelines and emissions conversion factors from the Energy Commission. Because of California's efforts to reduce greenhouse gas emissions from the power generation industry and avoidance of coal generation, these factors are lower than nationwide factors. Thus, California must save more energy to achieve a similar level of GHG emissions reductions of other states. It applied the emissions conversion factors to net energy savings, based on energy source, to calculate the carbon dioxide (CO_2) emissions reduction mass in pounds, which was then converted to metric tons. The team used the following factors:

- Electric conversion factor: 690 pounds (lbs) CO_2/MWh
- Natural gas conversion factor: 11.69 lbs CO_2/therm
- Weight conversion: 2204.6 lbs/metric ton

CHAPTER 4: Results

This chapter presents the overall results from the evaluation of the Loan Fund Program. Presented first is a discussion of the final sample disposition, followed by the overall realization rates and precision estimates achieved from the evaluation sample. The next section presents the gross energy savings results for the overall program, including summaries by loan group and measure type. The evaluation team then discusses the results of the net savings analysis, as well as other findings from the in-depth interviews with participants.

Additional results can be found in the appendices:

- Appendix C summarizes program tracking information, including ex ante savings estimates, for all of the Loan Fund Program projects included in the scope of this evaluation.
- Appendix D presents ex post evaluation results for the sites included in the evaluation sample.
- Appendix E provides the final evaluation site reports for projects included in the evaluation sample.

Final Sample Disposition

Initially, 21 of the 64 total projects implemented through the Loan Fund Program were selected to be sampled for the evaluation. These 21 projects were selected to represent the "High," "Medium," and "Low" variability groups discussed in Chapter 3. All of the projects included in the "High" group were selected for the sample.

In some cases, projects were selected to be included in the evaluation sample before they were completed and/or before installations had even begun. Four projects were removed from the sample due to scheduling and budgeting constraints. One of these projects was replaced, but the remaining three were not; thus, the final evaluation sample consists of 18 projects.

Realization Rates for Sampled Sites

Table 10 shows the realization rates by measure type for the sampled sites. The realization rate is the ratio between ex post and ex ante savings. The CDCR loan group had the highest electric realization rates, at 108 percent and 107 percent for Baselines 1 and 2, respectively. The small buildings loan group had the highest natural gas realization rates, at 137 and 115 percent, respectively, for Baselines 1 and 2. The realization rate for the large building group was lower, which was not surprising given the higher uncertainty with the retrocommissioning contract.

Table 10: Loan Fund Program Realization Rates for Sampled Sites by Loan Group

Loan Group	Realization Rate – Electricity		Realization Rate – Natural Gas	
	Baseline 1	Baseline 2	Baseline 1	Baseline 2
Small Buildings	93%	92%	137%	115%
Large Buildings	82%	84%	62%	47%
CDCR	108%	107%	121%	88%
OCIO	83%	83%	NA	NA
Total	95%	95%	120%	89%

Source: DNV KEMA analysis

As discussed previously, ex post energy savings were estimated relative to two baselines—the existing conditions found before the energy efficiency measures implementation (Baseline 1) and either minimally code-compliant conditions or standard practice when no code is applicable (Baseline 2). Baseline 2 uses the pre-existing equipment as the measure baseline only until the end of the RUL of the existing equipment or for a minimum of one year.

For many sites, the ex ante savings estimates were in fairly reasonable alignment with the Baseline 1 ex post savings estimate. However, the RUL of existing equipment was rarely taken into account in the calculation of ex ante savings.

For each sampled site, evaluators discussed the RUL conditions of existing conditions with the facility and/or contract engineers. When these contacts could not provide estimates but it was agreed that the existing equipment was on the verge of failure, a default RUL of one year was assigned, and the remainder of the lifetime savings was calculated against standard practice or minimally code-compliant conditions. For this reason, Baseline 2 ex post savings would likely be consistently lower than Baseline 1 ex post savings.

Table 11 and Table 12 below present ex ante and ex post electricity and natural gas savings results, respectively, for each of the sampled sites. All measures are assigned to one of three groups: HVAC (including controls and boilers), lighting (including lighting controls), and DHW.

Table 11: Loan Fund Program Sampled Sites – Annual Ex Post Electricity Savings and Realization Rates

Loan Group	Site Name	Measure Group	Annual Ex Ante Electricity Savings (kWh)	Baseline 1		Baseline 2	
				Annual Ex Post Electricity Savings (kWh)	Realization Rate	Annual Ex Post Electricity Savings (kWh)	Realization Rate
CDCR	Norco Rehabilitation Center	HVAC	45,505	144,014	316%	57,186	126%
	Corcoran State Prison	HVAC, Lighting	4,620,466	4,667,065	101%	4,667,065	101%
	Salinas Correctional Training Facility	HVAC, Lighting	730,160	747,192	102%	747,192	102%
	Salinas Valley State Prison at Soledad	DHW, Lighting	966,396	837,464	87%	834,315	86%
	Substance Abuse Treatment Facility	Lighting, HVAC	5,413,745	6,295,111	116%	6,295,111	116%
	Tehachapi	HVAC	430,116	440,303	102%	431,373	100%
Large Buildings	Caltrans District 11	HVAC	405,830	371,377	92%	503,889	124%
	Energy Commission Building	Lighting, HVAC, DHW	171,200	76,004	44%	76,004	44%
	Office of Fleet Management, Parking Lots	Lighting	761,436	661,318	87%	661,318	87%
	DGS, Jesse Unruh Building	Lighting, HVAC	374,587	53,289	14%	53,289	14%

Loan Group	Site Name	Measure Group	Annual Ex Ante Electricity Savings (kWh)	Baseline 1		Baseline 2	
				Annual Ex Post Electricity Savings (kWh)	Realization Rate	Annual Ex Post Electricity Savings (kWh)	Realization Rate
	Secretary of State Building	Lighting, HVAC	1,015,995	498,895	49%	498,895	49%
OCIO	Gold Camp Data Center	Lighting, HVAC	3,092,234	2,572,269	83%	2,572,269	83%
Small Buildings	CHP, Oakland Area	Lighting	119,777	35,394	30%	17,605	15%
	CHP, South Los Angeles Area	Lighting	137,410	84,629	62%	84,629	62%
	CHP, Coalinga	Lighting, HVAC	45,403	63,737	140%	42,377	93%
	DMV, Oakland Coliseum Field Office	Lighting	37,350	41,115	110%	41,115	110%
	DDS, Sonoma	Lighting, HVAC	2,160,715	1,612,993	75%	1,612,993	75%
	DMV, Yuba City	Lighting, HVAC	45,807	54,822	120%	24,069	53%
Total			20,574,132	19,256,991	94%	19,220,694	93%

Source: DNV KEMA analysis and DGS data

Table 12: Loan Fund Program Sampled Sites – Annual Ex Post Natural Gas Savings and Realization Rates

Loan Group	Site Name	Measure Group	Annual Ex Ante Natural Gas Savings (therms)	Baseline 1		Baseline 2	
				Annual Ex Post Natural Gas Savings (therms)	Realization Rate	Annual Ex Post Natural Gas Savings (therms)	Realization Rate
CDCR	Norco Rehabilitation Center	HVAC	220,746	215,180	97%	72,251	33%
	Corcoran State Prison	HVAC	66,906	54,625	82%	54,625	82%
	Salinas Correction Training Facility	HVAC	223,021	223,021	100%	165,420	74%
	Salinas Valley State Prison at Soledad	DHW	95,799	58,027	61%	17,502	18%
	Substance Abuse Treatment Facility	HVAC	49,944	231,016	463%	231,016	463%
	Tehachapi	HVAC	345,322	428,250	124%	343,436	99%
Small Buildings	DDS, Sonoma	HVAC	36,114	51,955	144%	51,955	144%
	DMV, Yuba City	HVAC	713	339	48%	323	45%
Large Buildings	Caltrans District 11	HVAC	29,507	0	0%	0	0%
Total			1,068,072	1,262,413	118%	936,528	88%

Source: DNV KEMA analysis and DGS data

Gross Energy Savings Results

As shown above, the evaluation results indicate that the program achieved greater than 90 percent of its expected savings overall. As shown in Table 13, the 64 projects implemented through the Loan Fund Program were evaluated to realize 95 percent of the overall expected annual electricity savings – or about 30 GWh – relative to either Baseline 1 or Baseline 2. As shown in the table below, annual natural gas savings were estimated at either 1.4 million therms (120 percent relative to Baseline 1) or 1.1 million therms (89 percent relative to Baseline 2).

Table 13: Evaluation Results – Gross Annual Program-Level Electricity Savings by Loan Group

Loan Group	Measure	Total Number of Tracked Measure Groupings	Annual Ex Ante Electricity Savings (kWh)	Baseline 1		Baseline 2	
				Annual Ex Post Electricity Savings (kWh)	Realization Rate	Annual Ex Post Electricity Savings (kWh)	Realization Rate
Small Buildings (45 projects)	Lighting	81	6,135,792	6,221,832	101%	6,176,097	101%
	HVAC	17	2,891,751	2,196,198	76%	2,151,609	74%
Large Buildings (12 projects)	Lighting	12	3,805,210	3,281,207	86%	3,271,503	86%
	HVAC	18	2,872,243	2,270,156	79%	2,401,898	84%
	DHW	3	111,168	40,060	36%	37,900	34%
CDCR (6 projects)	Lighting	7	3,745,521	4,677,917	125%	4,677,917	125%
	HVAC	8	8,300,493	8,394,821	101%	8,299,063	100%
	DHW	1	160,374	58,411	36%	55,262	34%
OCIO (1 project)	Lighting	1	213,857	319,572	149%	319,572	149%
	HVAC	3	2,878,377	2,252,697	78%	2,252,697	78%
Total Loan Fund Program (64 projects)		151	31,114,786	29,712,871	95%	29,643,518	95%

Source: DNV KEMA analysis and DGS data

Table 14: Evaluation Results – Gross Annual Program-Level Natural Gas Savings by Loan Group

Loan Group	Measure	Total Number of Tracked Measure Groupings	Annual Ex Ante Natural Gas Savings (therms)	Baseline 1		Baseline 2	
				Annual Ex Post Natural Gas Savings (therms)	Realization Rate	Annual Ex Post Natural Gas Savings (therms)	Realization Rate
Small Buildings (45 projects)	Lighting	81	-3,032[1]	-130	4%	-130	4%
	HVAC	17	133,277	178,624	134%	149,324	112%
Large Buildings (12 projects)	Lighting	12	NA	NA	NA	NA	NA
	HVAC & Controls	18	53,468	31,384	59%	24,101	45%
	DHW	3	7,425	6,545	88%	4,260	57%
CDCR (6 projects)	Lighting	7	NA	NA	NA	NA	NA
	HVAC	8	682,956	929,108	136%	701,365	103%
	DHW	1	318,782	281,010	88%	182,884	57%
OCIO (1 project)	Lighting	1	NA	NA	NA	NA	NA
	HVAC	3	NA	NA	NA	NA	NA
Total Loan Fund Program (64 projects)		151	1,192,876	1,426,541	120%	1,061,804	89%

Source: DNV KEMA analysis
Note 1: The ex ante negative therm estimates for lighting measures reflects a few instances of the use of models estimating interactive effects.

As shown, higher overall realization rates were achieved for lighting and HVAC measures. The relatively low overall realization rates achieved for DHW measures were due to differences in operating conditions found onsite during the ex post evaluation and those reported in the ex ante savings documentation.

Precision Results

As mentioned in Chapter 3, model-based statistical sampling methods were used to select the sample, with the goal of achieving relative precision of the overall program ex post savings estimates within ± 10 percent at the 90 percent confidence level (90/10 precision). The sample was selected based on ex ante savings estimates converted to source energy, or kBtu, which allows combining electric and natural gas savings. Table 15 shows the gross savings, confidence intervals, standard error, and relative precision for the program. The evaluation team calculated the gross savings using the realization rates achieved based on the sample evaluation for each measure group. The evaluation team calculated the standard error on the realization rate (MMBtu, kWh, and therms), which was used to determine the 90 percent confidence interval proportion. The team calculated the relative precision by dividing the confidence interval

proportion by the realization rate. Hence, where the realization rate is high, the confidence interval proportion and relative precision are nearly equal.

As shown, the results indicate the overall precision achieved at the 90 percent confidence interval for source energy was 9 percent for Baseline 1 and 12 percent for Baseline 2. The electric savings are more precise at 8 percent, consistent with the large amount of savings from low-variability lighting measures. The ex post annual natural gas savings results show more variability, with relative precision at 14 percent for Baseline 1 and 18 percent for Baseline 2.

Table 15: Confidence Intervals and Precision for Gross Annual Savings

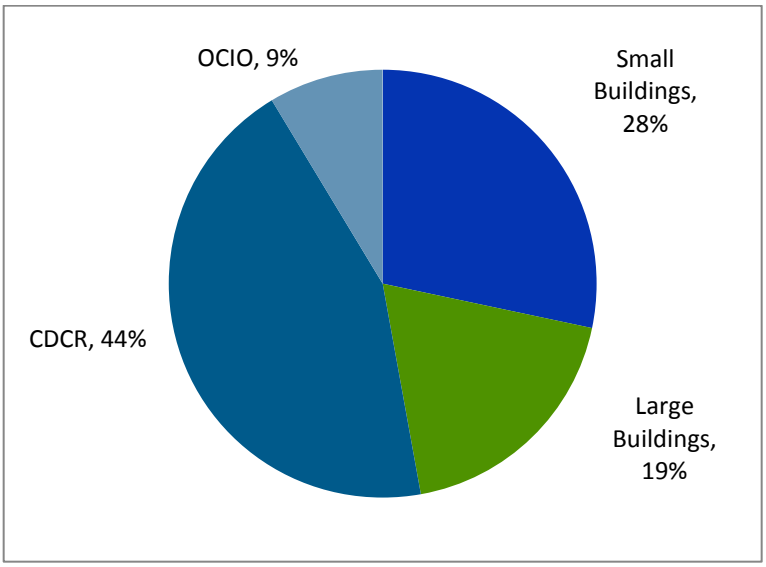
	Baseline 1			Baseline 2		
	Annual Ex Post Source Energy Savings (MMBTU)	Annual Ex Post Electricity Savings (kWh)	Annual Ex Post Natural Gas Savings (therms)	Annual Ex Post Source Energy Savings (MMBTU)	Annual Ex Post Electricity Savings (kWh)	Annual Ex Post Natural Gas Savings (therms)
Program Savings	447	29,712,871	1,426,541	410	29,643,518	1,061,804
90% Confidence Interval Savings	± 40	± 2,091,741	± 228,247	± 45	± 2,384,703	± 191,125
90% Confidence Interval Proportion, ± %	9%	7%	16%	11%	8%	18%
Precision	9%	8%	14%	12%	8%	20%
Standard Error	5%	4%	10%	6%	5%	11%

Source: DNV KEMA analysis

Gross Energy Savings by Loan Group

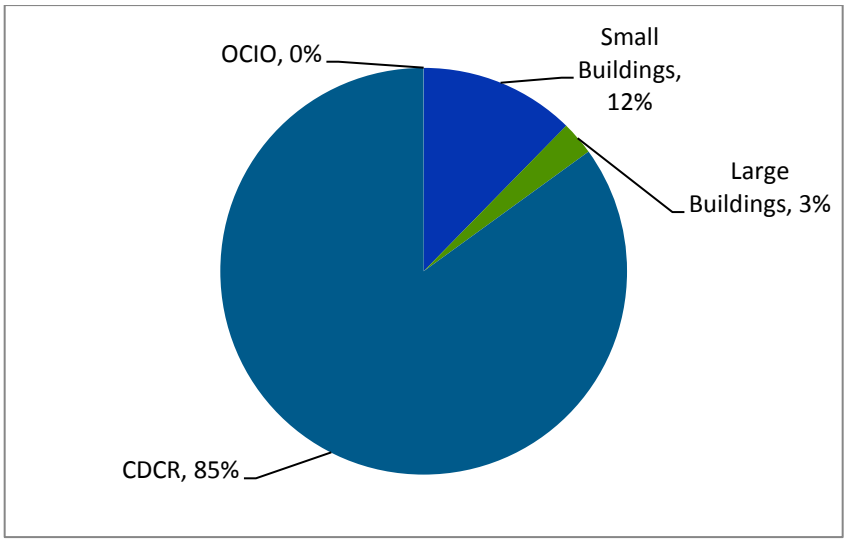
Figure 2 and Figure 3 give a snapshot of proportional savings achieved by each loan group compared against Baseline 1. The six projects implemented at CDCR facilities accounted for 44 percent of the total ex post annual electricity savings, whereas the 45 projects implemented through the small buildings component and the 12 projects implemented through the large buildings component accounted for 28 percent and 19 percent of the total ex post annual electricity savings, respectively. The OCIO project accounted for 9 percent of the total ex post annual electricity savings. The six projects implemented at CDCR facilities accounted for 85 percent of the total ex post annual natural gas savings.

Figure 2: Ex Post Electricity Savings by Loan Group, Baseline 1



Source: DNV KEMA analysis

Figure 3: Ex Post Natural Gas Savings by Loan Group, Baseline 1



Source: DNV KEMA analysis

Small Buildings Program

Of the evaluated measures, two HVAC controls (VFDs on fans) and two HVAC equipment (high-efficiency HVAC units and associated controls) measures yielded greater-than-expected savings. These savings differences are attributed to differences in postretrofit measurements between the program and the evaluators, as well as differences between the pre- and postretrofit modeling inputs.

Small building program lighting measures at sample sites included occupancy sensor installation and interior and exterior lighting fixture retrofits. The majority of ex ante savings for these measures were realized. Differences between ex ante and ex post results arose primarily from differences in operating hours from data collected during the site visit and those used to estimate ex ante savings.

The program tracking data reported negative natural gas ex ante values for a few sites. These negative values may have resulted from interactive effects calculated by ex ante eQuest modeling. For lighting measures, the evaluation team methods did not include assessing interactive effects; thus the ex post estimates did not identify negative therm savings at these sites.

Large Buildings Program

Seventeen HVAC equipment and controls measures were evaluated and included comprehensive chiller retrofits, retrocommissioning, and maintenance (for example, evaporator coil cleaning). Large chiller retrofit projects generated the greatest energy savings within this program, benefitting from hot Sacramento summers. HVAC controls measures had the greatest energy performance variability when compared to initial expectations. There were observed instances when lighting and HVAC control measures were not installed or controlled as planned and consequently did not generate the expected amount of savings. In other cases, controls were installed, but no initial savings were assumed; in these cases, ex post calculations realized energy savings.

CDCR

The CDCR projects had realization rates higher than 100 percent for electric savings and made up the bulk of the natural gas program savings. Based on discussions with the Loan Fund Program manager, the CDCR loan group was the most successful due to long-term planning for energy efficiency, supported by both onsite staff members and their ongoing participation in a utility partnership program that provided enhanced incentives. One significant factor for reliably returning savings appears to be the development of rigorous and reviewed engineering plans.

Due to the location of the buildings within correctional facilities, the CDCR loan group could not allow the evaluation team to perform any significant metering. The evaluation calculations, therefore, relied primarily on verification, interviews, and spot measurements.

Most of the natural gas savings in the CDCR sample resulted from HVAC projects, including several large equipment replacements. For example, an effective project at the California Correctional Institution at Tehachapi replaced an old, large boiler and its associated long-distance piping with multiple small boilers positioned closer to the areas they served. This project resulted in fewer line losses as well as better boiler operational efficiency.

Of the sampled projects, the greatest savings came from the Corcoran State Prison and the Substance Abuse Control Facility, both of which installed EMS controls. The EMS controls reduced the number of hours that HVAC equipment operated and allowed for programmed set points. At the Substance Abuse Control Facility, EMS controls linked and controlled interior

lighting fixtures to promote accurate operations and compound savings. Moreover, lighting savings were particularly high because the ex ante tracking data were based on an earlier iteration of the project that included only the EMS controls upgrade and not the lighting retrofit. This error led to ex post savings that were considerably greater than ex ante savings. The high realization rate of 107 percent for lighting is attributable to this project.

There was one hot water retrofit project in the sample. During the onsite visit, evaluators gathered information about the system's efficiency and run hours to determine the new system's load. Evaluators found that the facility required less hot water than had been anticipated. The load factor was lower than anticipated, and thus natural gas savings were less than originally estimated for ex ante savings.

OCIO

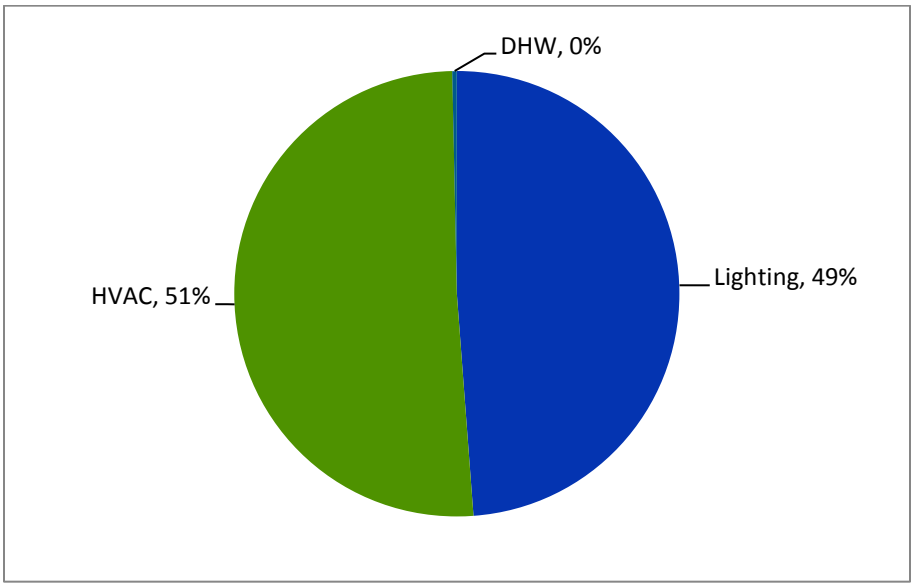
Under the HVAC project, the OCIO upgraded an air-conditioning system and installed variable-frequency drives that serve a computer room. Although ex post savings were less than ex ante savings (because the power draw was greater than expected), this measure alone yielded 1.2 GWh of savings. This project's lighting measures had a realization rate greater than 100 percent since the verified hours of operation were longer than had been estimated.

Gross Energy Savings by Measure Type

The figures below show the proportional program savings by measure type, compared against Baseline 1. In terms of total ex post annual electricity savings, the results were split with 49 percent of the savings realized from lighting measures and 51 percent from HVAC measures. DHW measures accounted for less than 1 percent of the electricity savings. HVAC measures accounted for 80 percent of the total ex post annual natural gas savings.

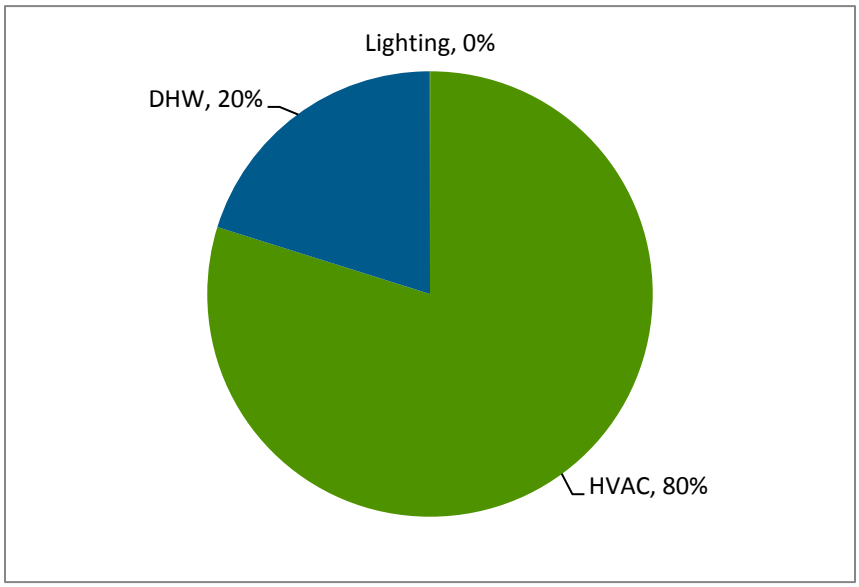
The evaluation team observed that the most variation occurred for controls measures for both lighting and HVAC. This variability often resulted from an inability to predict a measure's operating hours, the last-minute changes to the number of units and model of equipment installed, and sometimes an overly simple analysis of baseline load. EMS measures often generated the largest savings. However, large facilities with complex load schedules can be more difficult to assess, leading to savings variations.

Figure 4: Ex Post Electricity Savings by Measure Group, Baseline 1



Source: DNV KEMA analysis

Figure 5: Ex Post Natural Gas Savings by Measure Group, Baseline 1



Source: DNV KEMA analysis

Differences in Ex Ante and Ex Post Gross Energy Savings

Though overall realization rates were high at the program level, there was high variability for specific projects. The evaluation team examined the reasons for differences between ex ante and ex post savings for measures and for specific projects. Following the site visits, each engineer listed one of several standard reasons why the evaluation results differed from ex ante estimates, as shown in Table 16.

Table 16: Reasons for Differences Between Ex Ante and Ex Post Savings Estimates

Reasons for Difference Between Ex Ante and Ex Post Savings Estimates	Site Name	Number of Measures
Calculation Method Unclear	CHP, Coalinga	1
	DMV, Yuba City	1
Facility Reported Different Parameter(s)	Salinas Valley State Prison at Soledad	1
	Gold Camp Data Center	2
Different Analysis or Calculation Method	Norco Rehabilitation Center	1
	Caltrans District 11	1
	Energy Commission Building	2
	CHP, Coalinga	2
	Corcoran State Prison	3
	Office of Fleet Management, Parking Lots	1
	Gold Camp Data Center	1
	DGS, Jesse Unruh Building	2
	Salinas Correctional Training Facility	1
	Salinas Valley State Prison at Soledad	1
	Secretary of State Building	3
	DDS, Sonoma	2
	Substance Abuse Treatment Facility	1
	DMV, Yuba City	1
Different Baseline or Installation	CHP, Oakland Area	2
	CHP, South Los Angeles Area	2
	Corcoran State Prison	1
	DMV, Oakland Coliseum Field Office	2
	Gold Camp Data Center	1
	Substance Abuse Treatment Facility	1
	Tehachapi	1
Not Applicable, No Significant Differences	Salinas Correctional Training Facility	1
	Corcoran State Prison	1
	Jesse Unruh Building	1
	Salinas Valley State Prison at Soledad	1
	Secretary of State Building	1
	DDS , Sonoma	1
Not Installed	Energy Commission Building	5
	Jesse Unruh Building	1
	Secretary of State Building	1
Other Savings in Documentation	Salinas Correctional Training Facility	2

Source: DNV KEMA analysis

Several consistent themes emerged:

- **Higher realization rates were realized for projects with high rigor in ex ante calculations.** The evaluation team saw a correlation between high realization rates and projects that were carefully considered and documented. Typically these projects also participated in utility programs. Projects within the Loan Fund Program that did not go through more rigorous planning and engineering at inception often did not realize expected savings.
- **Different baselines were used for ex ante calculations.** Many measures did not realize the expected savings because ex ante estimates were based on broad generalizations of operating hours and standard assumptions of code compliance. This was especially the case for lighting and HVAC measures, both of which had high model input variability. In some cases spot measurements revealed that the installed equipment's power draw was different from what was expected. This occurred with a boiler retrofit at a CDCR site, which resulted in a high realization rate because the ex ante calculation used the standard baseline and not existing conditions. Another CDCR project had a 316 percent realization rate for one boiler replacement measure, resulting from fewer boilers actually operating than reported. Spot measurements also revealed that the installed blowers had a smaller power draw than assumed.
- **Measures were not installed or were installed incorrectly.** For one project in the large buildings program, five of seven measures realized no savings because they were either not implemented or turned off. These measures included delamping, occupancy sensors, and fan rescheduling. Another such scenario happened for an air filter measure, which was found onsite uninstalled. After an unsuccessful attempt to operate with the more efficient filter, the facility removed the efficient filter and operated with a standard filter. Onsite verifications conducted by the evaluation team sometimes revealed a disparity between the actual and documented numbers of equipment retrofitted per measure, which also effected the ex post savings and realization rates.
- **There was insufficient ex ante documentation to determine reasons for differences.** A few other projects with ex ante and ex post savings differences cannot be explained because the evaluators lacked sufficient documentation regarding ex ante methodology. One project had a VFD fan measure experiencing a realization rate of 197 percent for natural gas. It was unclear to the evaluation team why the ex ante therm savings estimate was so low, given the measure and building's similarity to another building that had a much higher ex ante savings estimate (and realization rate closer to 100 percent). The evaluation team attributed the discrepancy to a data entry error. Additionally, for a few measures at one site, neither the source of the assumptions nor the methods used to derive baseline energy use was provided for review. This prevented the evaluation team from determining the reason for the differences.
- **Parameters reported by the operators were different from the ex ante documentation**. Sometimes the planned operating parameters were not confirmed at the site visit. For

example, in one case the economizer was not operating as specified in the ex ante documentation.

Life-Cycle Analysis

The evaluation team calculated savings over the expected effective lifetime of the energy efficiency measures. Each measure was assigned an EUL, which—where possible—was determined from the Database for Energy Efficient Resources (DEER). If a given measure was not included in DEER, the EUL was determined from relevant sources such as the 2001 California Public Utilities Commission Energy Efficiency Policy Manual and based upon best practices in energy efficiency evaluation. EULs are shown in Table 17.

Table 17: EUL for Loan Fund Program Measures

Measure Group	Measure Type	Measure Description	EUL
DHW	DHW	Water heaters, DHW only	15
HVAC	HVAC Controls and Retrocommissioning	Chiller upgrade	15
		Cooling towers waterside economizer	15
		Computer room air-conditioning (CRAC) units upgrade	15
		Constant volume to variable air volume (VAV) conversion of 4 fans	15
		Wirelessly controlled VAV system for a data center	15
		Direct digital synthesis controls	15
		EMS controls and programmable thermostats for 80+ buildings	13
		EMS controls for prison buildings	15
		Evaporator coil cleaning	3
		Low differential pressure air filters	0.5
		Programmable thermostats for buildings not wired to EMS	11
		Reschedule bathroom fans	15
		VFD on fans	15
		VFD replacements	15
	HVAC Equipment	Boiler plant retrofit	20
		Boiler retrofit + plant reconfiguration	20
		Chiller retrofit	20
		Chiller retrofit, VFD installations, plant controls	20
		High-efficiency HVAC units	15
		New HVAC units, controls, economizers	15
Lighting	Exterior Lighting	Bilevel parking lot lights	15
		High bay and exterior lights	17
		High bay lighting	15
		High bay lighting + lighting controls	15
		Wall pack fixture retrofit	16
	Interior Lighting	High bay lighting retrofit for prison blocks	16
		High bay lights	15
		Interior lighting retrofit	15
		Lighting occupancy sensors and controls	8
		Lighting retrofit	15

Source: DNV KEMA analysis

Life-cycle energy savings totaled more than 400 GWh and nearly 23 million therms, as shown in Table 18. Projects implemented at CDCR facilities accounted for more than 95 percent of the life-cycle natural gas savings and more than 40 percent of the life-cycle electricity savings.

Table 18: Evaluation Results – Life-Cycle Savings

Loan Group	Life-Cycle Electricity Savings (kWh)		Life-Cycle Natural Gas Savings (Therms)	
	Baseline 1	Baseline 2	Baseline 1	Baseline 2
Small Buildings	123,312,089	122,070,160	908,705	2,265,331
Large Buildings	77,753,805	78,515,581	37,929	468,909
CDCR	189,924,241	188,060,770	21,997,804	16,239,306
OCIO	38,584,035	38,584,035	-	-
Total	429,574,170	427,230,546	22,944,438	18,973,546

Source: DNV KEMA analysis

Net Energy Savings Results

The Loan Fund Program was to provide financial assistance to implement energy efficiency projects in state-owned buildings. These projects were previously identified by DGS and were determined to have cost-effective, energy-efficient upgrade opportunities but were prohibited from moving forward due to a lack of funding. This was confirmed in interviews conducted with 11 decision-makers representing 16 projects, and, as discussed below, the evaluators concluded that 100 percent of the energy savings from projects implemented through the Loan Fund Program are attributable to the program. That is, free ridership is assumed to be 0 percent, and the net-to-gross ratio is assumed to be 1.0.

GHG Emission Reductions

The evaluation team calculated the total annual reduction in GHG emissions resulting from the Loan Fund Program. GHG emissions reductions accrue when energy is saved. Evaluators calculated annual program-related emissions savings using both baselines. Approximately 17,000 metric tons of GHG emissions reductions were calculated to have been avoided annually as a result of this program, as shown in Table 19.

Table 19: Evaluation Results – Avoided Greenhouse Gas Emissions

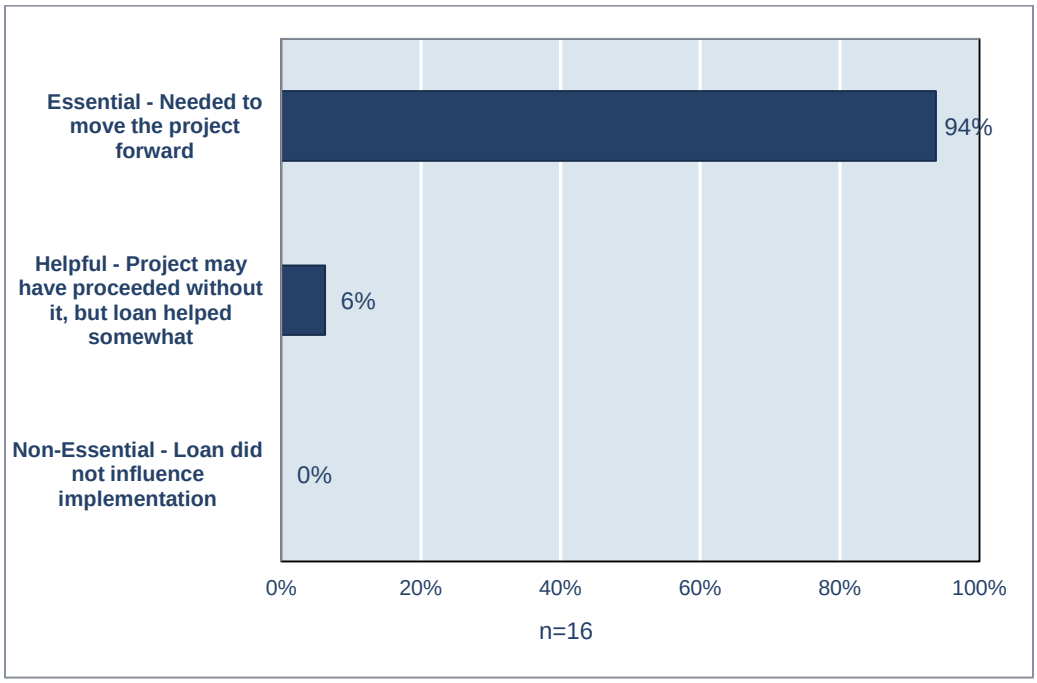
Loan Group	Annual Avoided GHG Emissions (metric tons)		Life-Cycle Avoided GHG Emissions (metric tons)	
	Baseline 1	Baseline 2	Baseline 1	Baseline 2
Small Buildings	3,581	3,398	43,413	50,218
Large Buildings	1,951	1,938	24,537	27,060
CDCR	10,527	8,768	176,087	144,969
OCIO	805	805	12,076	12,076
Total	16,864	14,909	256,113	234,323

Source: DNV KEMA analysis

Program Role and Influence

The evaluation team completed in-depth interviews with 11 decision-makers representing 16 of the 18 sampled project sites. Evaluators asked respondents questions about the role and influence of the Loan Fund Program on their implementation decisions and decisions related to the scope and timing of the projects. They confirmed that, despite the obvious paybacks and much-needed upgrades in old buildings and equipment, without the loan money they could not have overcome the lack of funding. Results are shown in Figure 6. The overwhelming majority of respondents indicated the funding was essential to move the project forward. Only one respondent said the project may have proceeded without the funding; he went on to state that, without the program, the project would have been delayed until another funding source was located or the existing equipment failed. Overall, 100 percent of the respondents relied on the program to fund their projects. All things considered, it is clear that without the Loan Fund Program, the projects would not have proceeded in the same manner, or in some cases, at all.

Figure 6: Role of Funding on Project Implementation

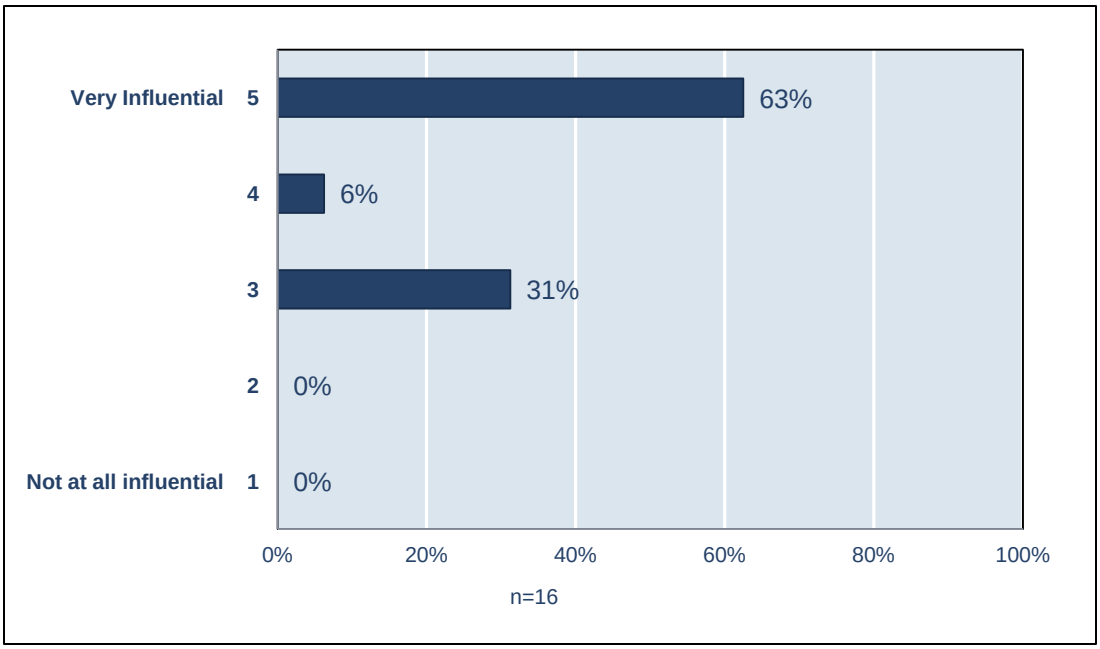


Source: DNV KEMA analysis

Influence of Program on Project Implementation

Respondents were also asked about the influence of the program on their decision to implement the projects. On a scale of 1 to 5, 1 means "Not at All Influential," and 5 means "Very Influential." More than half responded that the program was "very influential," as shown in Figure 7. No respondents claimed it was "Not at All Influential."

Figure 7: Influence of the Loan Fund Program on Project Implementation

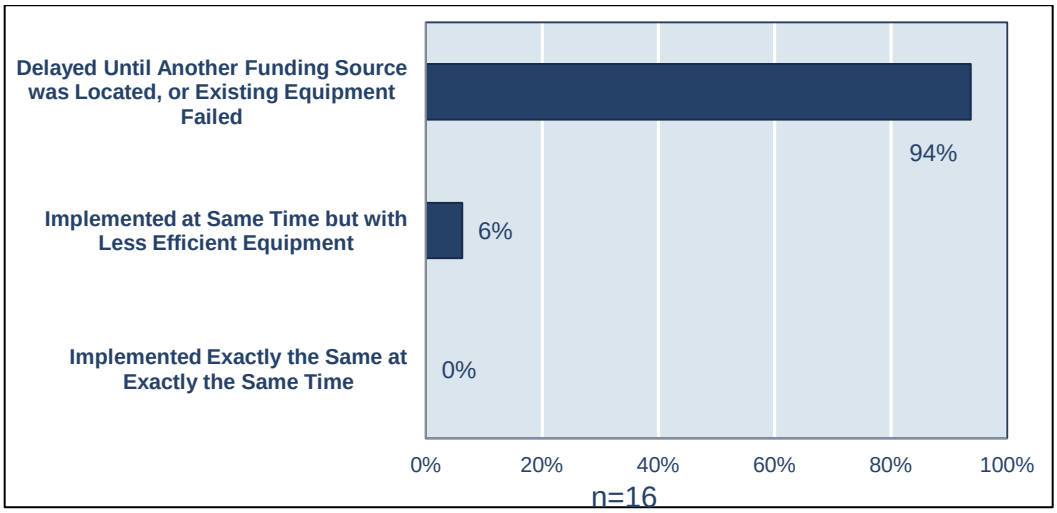


Source: DNV KEMA analysis

Project Implementation Without the Program

Participants were asked to discuss the influence of the program on the scope and timing of project implementation. Figure 8 shows what the decision-makers report they would have done without the program. The overwhelming majority of participants interviewed said the project would have been delayed until another source of funding was identified, or existing equipment failed. None of the respondents indicated projects would have been implemented exactly as scoped and during the same exact time frame.

Figure 8: Project Implementation Without the Program



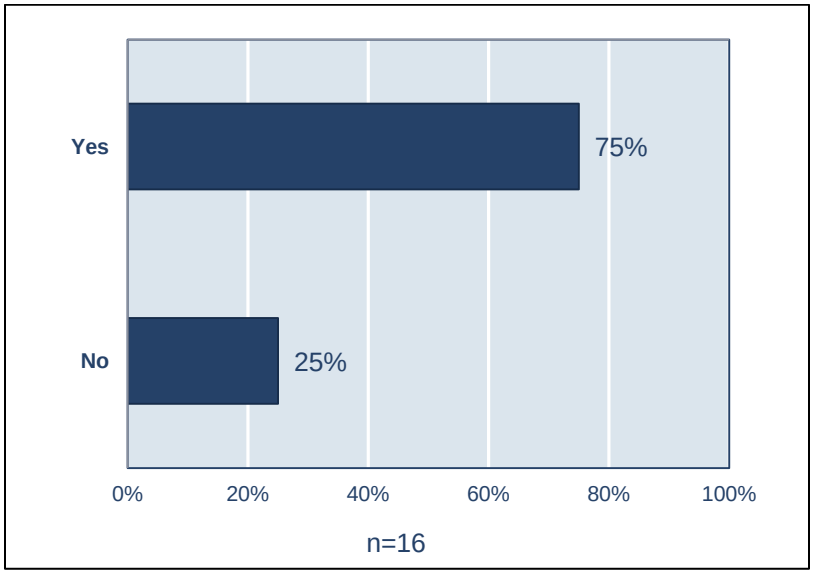
Source: DNV KEMA analysis

Role and Influence of Project Co-funding

Respondents were asked whether their projects received any funding from sources other than the Loan Fund Program, and, if so, respondents were asked the same set of questions about the role and influence of co-funding in scope and timing decisions related to project implementation. In summary, the results from these questions suggest that while co-funding was influential in moving many projects forward, it was not as essential as the financial assistance provided through the Loan Fund Program. These results are presented below.

Only three-quarters of participants reported their projects received funding from sources other than the Loan Fund Program, as shown in Figure 9.

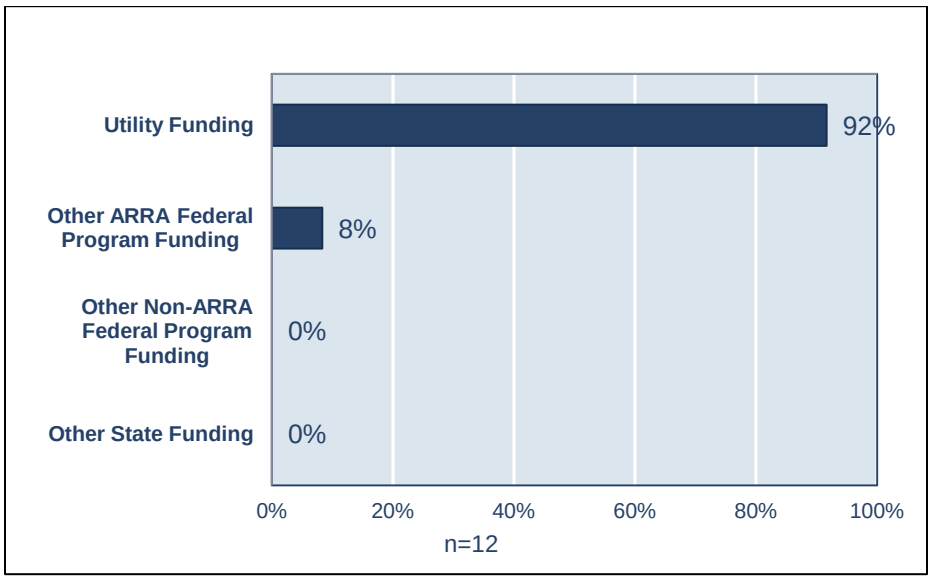
Figure 9: Percentage of Loan Fund Projects With Funding From Other Sources



Source: DNV KEMA analysis

Of those participants who received funding outside the Loan Fund Program for their project, the majority reported it came from utility sources, as shown in Figure 10. Only one project received funding from another ARRA program. No respondents received help from other state or federal fund programs.

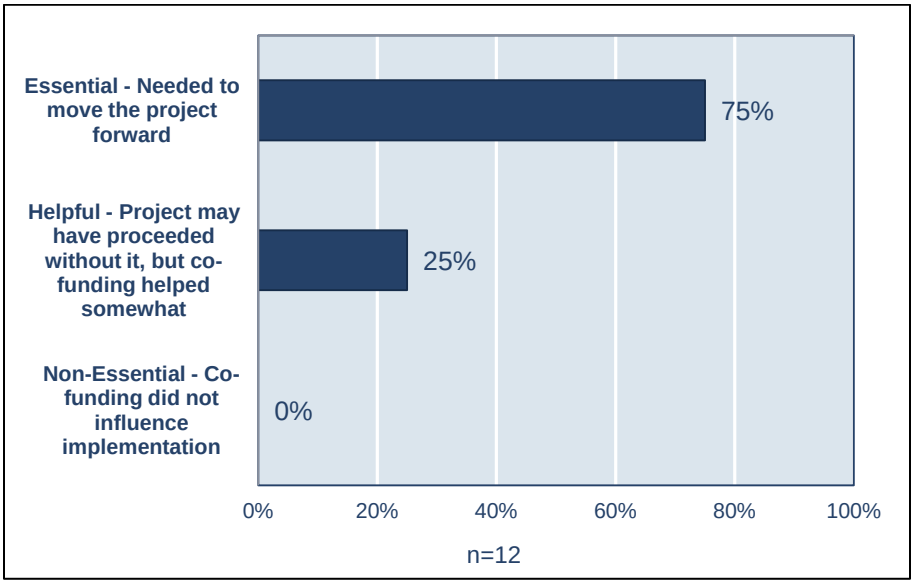
Figure 10: Co-Funding Obtained in Addition to the Loan Fund Program



Source: DNV KEMA analysis

Only three-quarters of the respondents reported that receiving additional funding sources was essential to moving the project forward, as shown in Figure 11. Although co-funding is still essential, the proportion of respondents in agreement is less than those who said the same about program funding. This demonstrates that while more than one funding source may have been required for some, the Loan Fund Program was necessary in all cases.

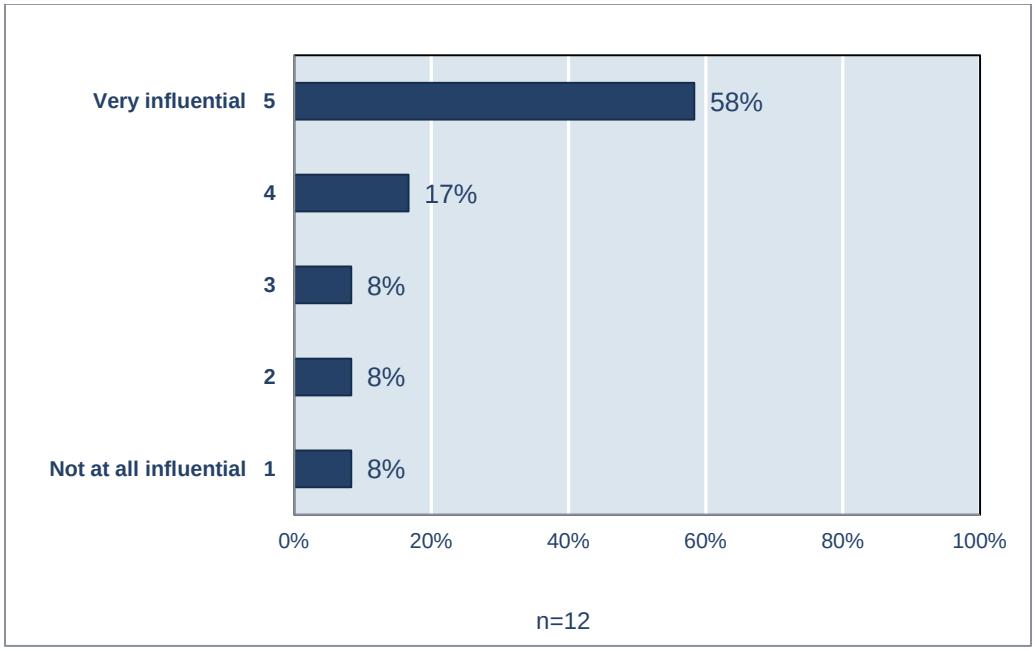
Figure 11: Role of Co-funding on Loan Fund Project Implementation



Source: DNV KEMA analysis

Fewer participants reported that other funding was "very influential" on project implementation, as compared to Loan Fund Program funding. As shown in Figure 12, when asked to rank the influence of co-funding on project implementation on a scale of 1 to 5, where 1 is "Not at All Influential" and 5 is "Very Influential," only 58 percent reported that co-funding was "Very Influential," as compared to 63 percent for Loan Fund Program funding. In addition, 8 percent reported co-funding as "Not at All Influential," whereas no respondents referred to Loan Fund Program funding in this manner.

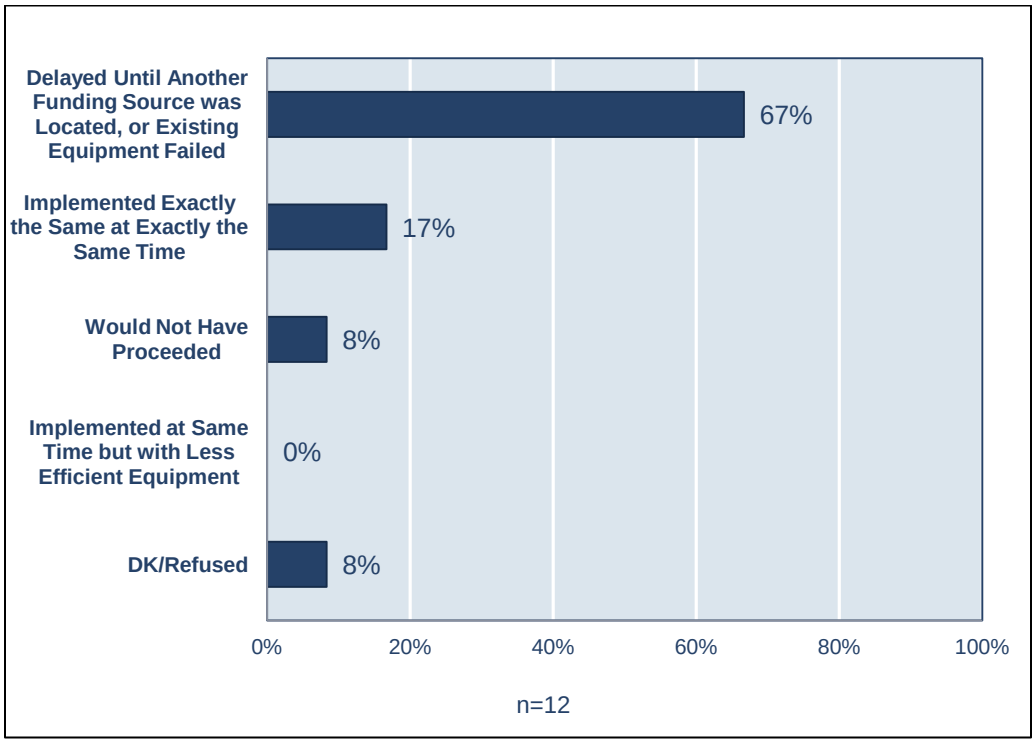
Figure 12: Influence of Co-funding on Loan Fund Project Implementation



Source: DNV KEMA analysis

Figure 13 shows how respondents reported the projects would have been implemented without other funding sources. As shown, about 17 percent of respondents whose projects received funding from additional sources indicated their projects would have been implemented the same at the same time. Two-thirds reported that their project would have been delayed until another source of funding was identified or existing equipment failed – which is much less than reported for Loan Fund Program funding. Overall, the findings shown in Figure 13 suggest that other funding affected project scope and timing much less significantly than Loan Fund Program funding.

Figure 13: Loan Fund Project Implementation Without Co-funding



Source: DNV KEMA analysis

Three respondents consistently rated other funding as less important – that is, it was not essential to moving projects forward (Figure 11), it was not very influential on project implementation decisions (Figure 12), and had additional funding not been available, the projects (with Loan Fund Program funding) would have been implemented at the same time (Figure 13). This result – in addition to three respondents reporting they did not receiving financial assistance from any source other than the Loan Fund Program – suggests that for 6 of 15 projects (or 40 percent), additional funding was relatively inconsequential.

Decision-Making Factors Influencing Project Implementation

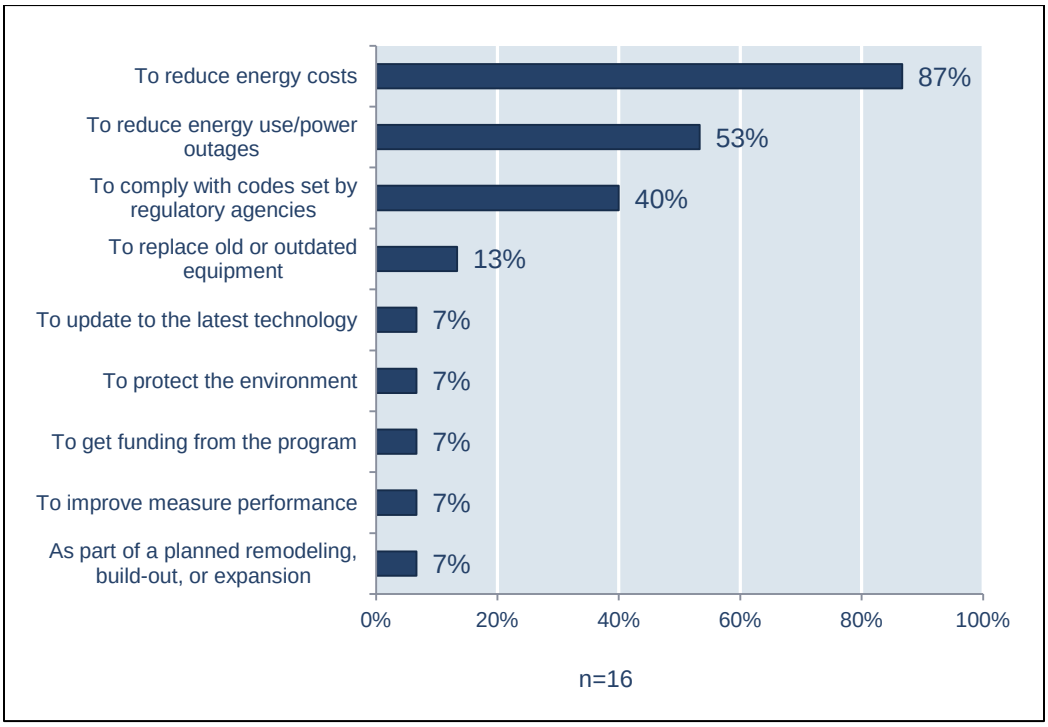
Participants were asked to discuss other factors that may have influenced project implementation. The following sections discuss results related to:

- Reasons for project implementation (for example, reducing energy costs, complying with codes, and so forth).
- Project origination (that is, how specific projects were identified).
- Consideration of other factors (life-cycle savings, payback criteria, and so forth).

Reasons for Project Implementation

Respondents were asked to indicate reasons why they implemented projects at their facilities. Figure 14 shows the percentage of respondents who listed each reason for implementation. The most common reasons included reducing energy costs and energy use, followed by compliance with codes set by regulatory agencies. Respondents named Assembly Bill 32 (Núñez, Chapter 488, Statutes of 2006) and Executive Order S-20-04 as the codes that prompted their energy upgrades.

Figure 14: Reasons for Loan Fund Project Implementation



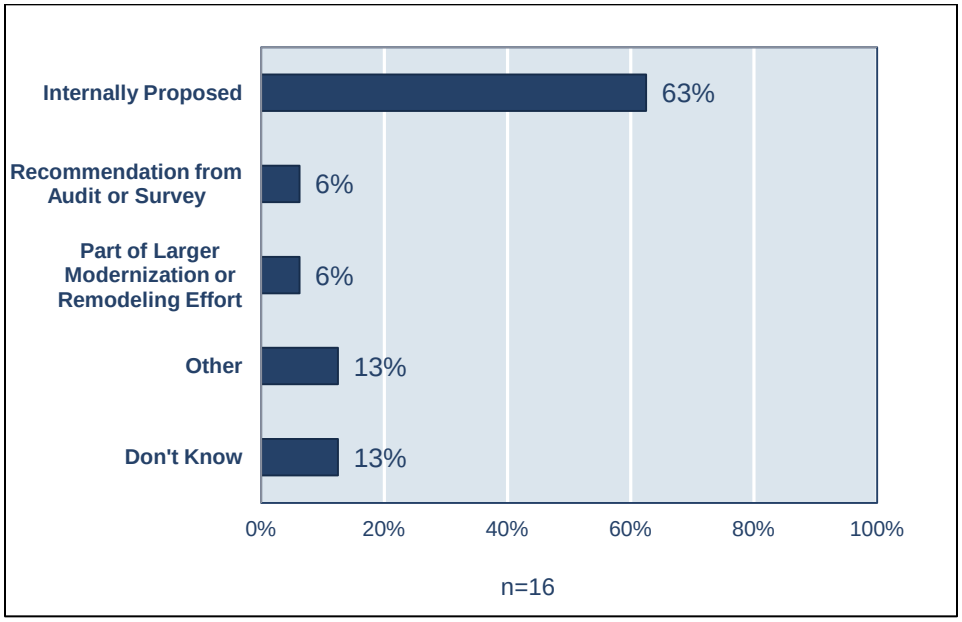
Source: DNV KEMA analysis

Project Origination

Respondents were also asked to discuss the origin of their projects, specifically how or who was responsible for identifying and developing the project. As shown in Figure 15, the majority of the projects sampled were internally proposed. Participants noted that the ideas for energy upgrades had been sitting around for several years before funding could make it a reality. These findings support other statements made regarding the influence of the program on project implementation – that is, decision makers for internally proposed projects had also stated that without the program, projects would have been delayed until other funding was located.

One participant received an audit or survey and reported being recommended for the Loan Fund Program through what was referred to as an "Energy Commission Pilot Program." Other respondents reported their projects originated directly from within DGS as part of a larger remodeling/modernization effort.

Figure 15: Loan Fund Project Origination



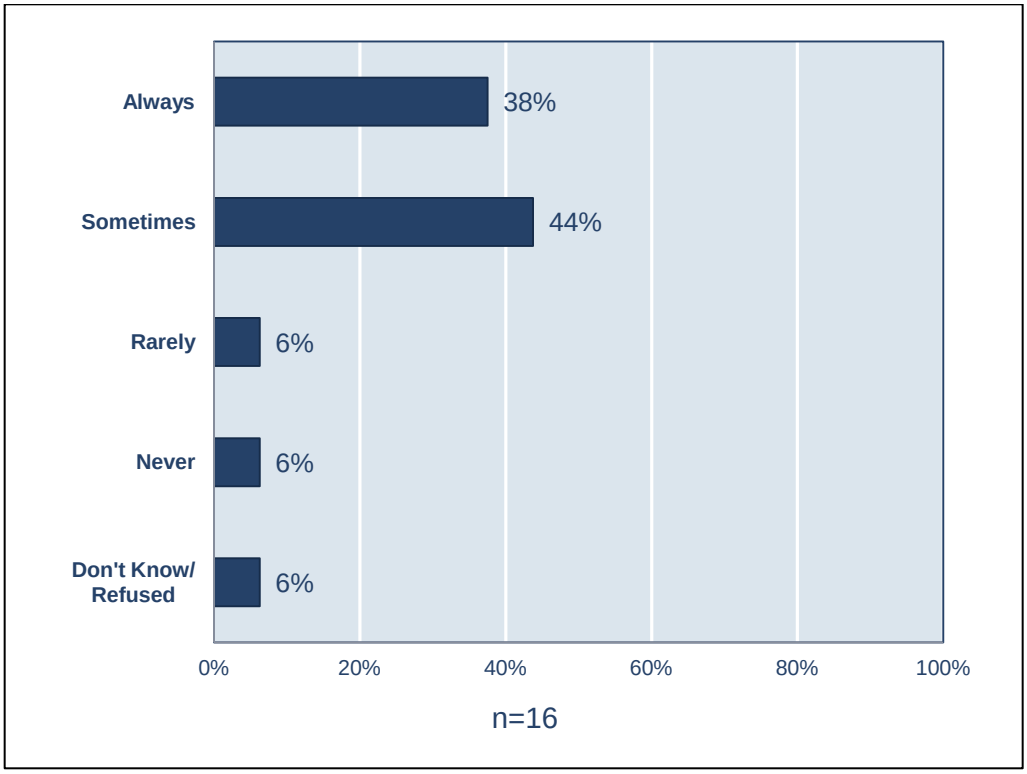
Source: DNV KEMA analysis

Decision-Making Factors Considered in Project Implementation

Respondents were asked a set of questions designed to understand factors that went into project implementation decision-making. In particular, respondents were asked if there were typical criteria and/or tools mandated by their organization when considering projects for implementation, such as mandates requiring energy efficiency upgrades, assessment of life-cycle costs (compared to least-cost or first-cost assessments), payback period thresholds, and so forth. Results are summarized below.

- **Energy Efficiency "Mandates."** In a few cases, respondents indicated that their management had established guidelines that were in line with executive orders mandating energy efficiency upgrades. However, others said that there were no criteria/requirements for energy upgrades because they simply did not happen; equipment replacement occurred only when the equipment had failed or was on the verge of failure.
- **Consideration of Life-Cycle Costs.** As shown in Figure 16, more than one-third of respondents indicated life-cycle costs (including energy costs and maintenance costs) are "always" considered when purchasing new equipment.

Figure 16: Consideration of Life-Cycle Costs

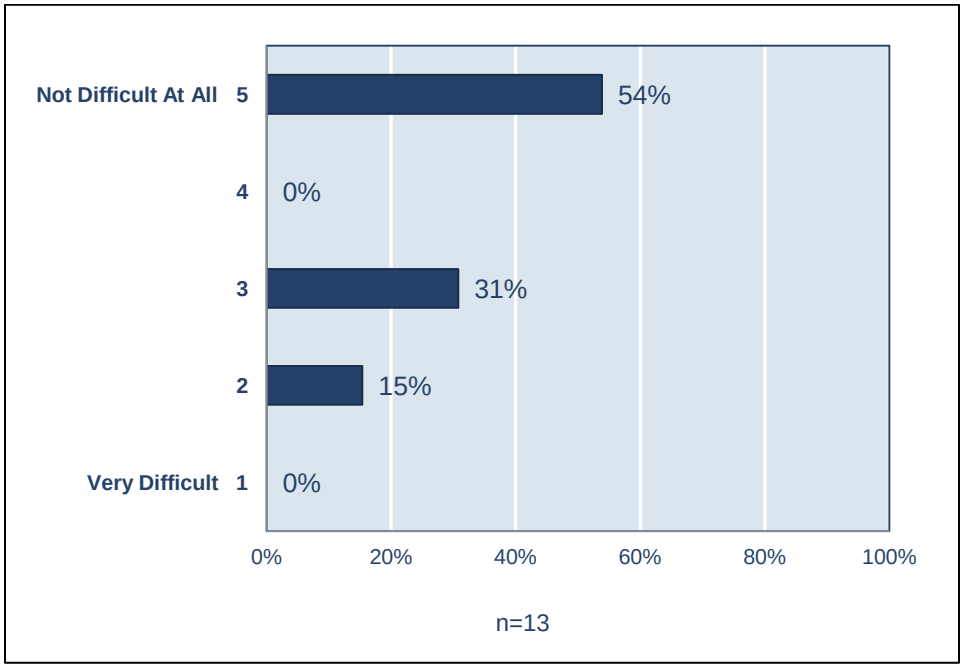


Source: DNV KEMA analysis

- **Payback Period Thresholds.** On average, respondents reported that they typically look for payback periods within 6 to 10 years, which is well within the Loan Fund Program

requirement (13 years maximum). As shown in Figure 17, most respondents reported that it was not difficult to meet the program's payback requirement. In many cases, this was due to the aging equipment and facilities. Some respondents reported difficulty in meeting the program's payback requirement, and several went on to indicate they had several other projects in mind that did not fit the requirements.

Figure 17: Difficulty of Meeting Payback Period Requirements

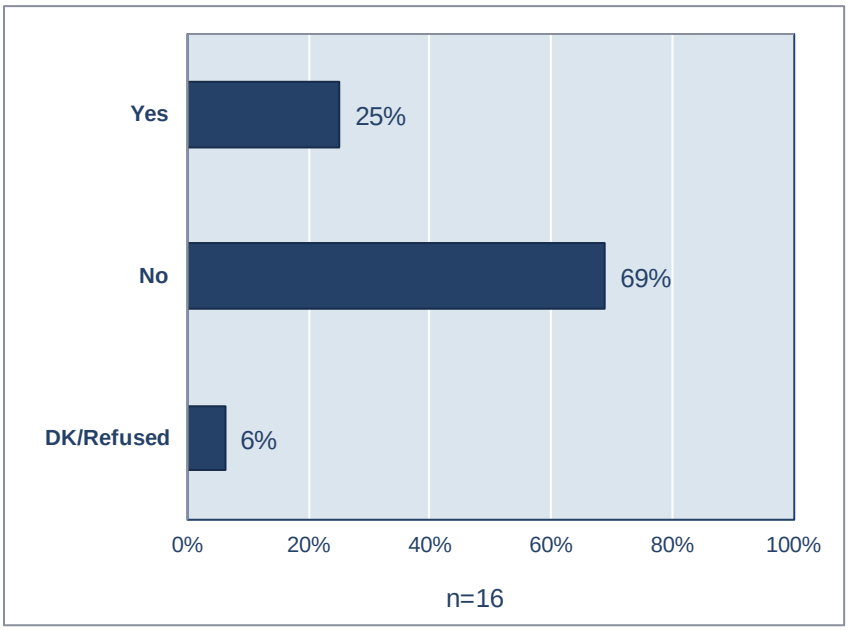


Source: DNV KEMA analysis

Evidence of Participant Spillover

Respondents were asked if their participation in the DGS Loan Fund Program directly influenced the implementation of additional energy efficiency measures at their facilities. In total, 4 out of 16 respondents (25 percent) reported that additional energy efficiency measures had been implemented outside the program using funding from other sources. Respondents indicated that the program had "opened their eyes" to other energy efficiency programs through local utilities, such as building-automation controls programs. Another respondent noted that the Loan Fund Program was "like a floodgate of knowledge and awareness" and that there are other funding sources available to help with project implementation. These results confirm energy efficiency project identification does not necessarily appear to be a barrier to project implementation, but lack of funding (or awareness of the existing of available funding sources) continues to be an obstacle.

Figure 18: Additional Measures Implemented Outside the Loan Fund Program



Source: DNV KEMA analysis

Participant Satisfaction

Respondents were asked to discuss their overall satisfaction with the Loan Fund Program as well as their satisfaction with certain aspects and requirements of the program. On a scale of 1 to 5, where 1 was "Very Dissatisfied" and 5 was "Very Satisfied," respondents were asked to rank their satisfaction with certain aspects of the program, shown in Table 20. Overall, participants were satisfied with the equipment installed and loan amounts received. They ranked those two aspects very highly, with averages of 4.4 and 4.3, respectively. Satisfaction with the loan structure and amortization schedule was scored less highly, at 3.8 out of 5, with two respondents refusing to answer.

Table 20: Loan Fund Program Satisfaction Results

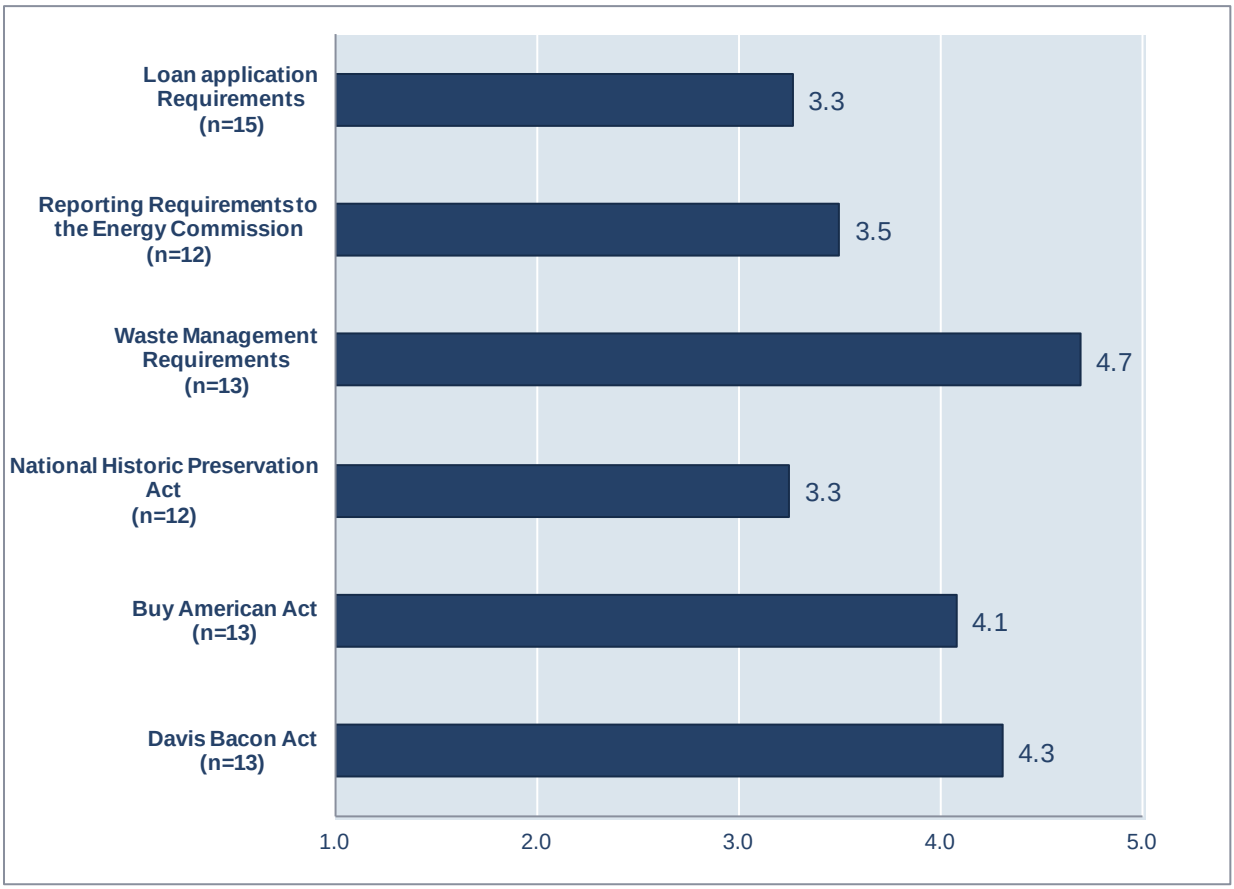
Program Aspect	Average Satisfaction	Number of Responses
Equipment installed as part of this project	4.4	16
Loan amount received for this project	4.3	16
Loan structure and amortization schedule	3.8	14

Source: DNV KEMA analysis

On a scale of 1 to 5, where 1 was "Very Difficult" and 5 was "Not at All Difficult," respondents were asked to rate their level of difficulty with complying with application, reporting, and waste management requirements as well as complying with the National Historic Preservation Act, Buy American Act, and Davis Bacon Act. Results are shown in Figure 19. As shown, respondents found it least difficult complying with the program's waste management requirements, followed by the Davis Bacon Act and the Buy American Act. Respondents had the most difficulty complying with the Energy Commission's reporting requirements, the DGS loan application requirements, and the National Historic Preservation Act.

Several respondents did not answer because they were not familiar with that aspect or their projects were exempt (for example, with the National Historic Preservation Act). One participant commented that most of these requirements were handled by the DGS Professional Services Branch as well as the third-party implementer.

Figure 19: Difficulty of Complying With Loan Fund Program Requirements



Source: DNV KEMA analysis

Those who ranked the difficulty as "1" or "2" were asked to elaborate on their experiences. They complained that reporting requirements were time-consuming and confusing, with no

obvious benefit to them. One participant commented that the Buy American Act has become more difficult to comply with as materials become more costly. Compliance with the National Historic Preservation Act was difficult due to the long processing time of two to three months, which slowed the project schedule. One respondent who ranked complying with the Davis Bacon Act as very difficult said it was due to the difficulty of getting the contractor on board in addition to extra cost and paperwork.

Participants' Overall Impressions of the Program and Suggestions for Improvement

Respondents were asked to report any overall impressions of the program, as well as offer any suggestions for improvement. Respondents indicated they were generally very happy with the program, but some offered a few suggestions. For example, one respondent reported the paperwork process and general running of the program had significantly improved since it was launched. Other respondents felt there was too much paperwork – for example, one respondent claimed half of the budget was dedicated to dealing with paperwork. Another respondent complained about micromanagement.

In addition to concerns about too much bureaucracy, there were a few aspects of the program that some respondents found cumbersome. They suggested that DGS make the Loan Fund Program more user-friendly and understandable. For example, one respondent noted it was initially difficult to get the correct documentation and forms and requested more workshops and training. Moreover, some respondents reported they, as well as their contractors, had issues determining what equipment would and would not qualify for installation. One respondent in particular was under the impression that the Loan Fund Program was a grant and was disappointed to hear the loan would have to be repaid, even at a low interest rate.

In general, the respondents who dealt with multiple projects found the process to be working well. The respondents who expressed the most frustration with the program were involved in single projects. This suggests the program delivery has improved since its inception.

Self-Reported Evidence of Job Creation

Respondents were asked a set of questions to assess the level of job creation by the Loan Fund Program. These self-reported, mostly anecdotal responses are not the only source for estimating employment effects from the Loan Fund Program. A comprehensive, rigorous model of employment effects is being developed for all of the Energy Commission's ARRA Programs, the results from which will be reported separately in 2014.

Table 21 shows the percentage of respondents who reported jobs were either created or retained due to the Loan Fund Program, inside the organization. As shown, 27 percent of respondents

reported jobs were retained (that is, would have been eliminated had projects not moved forward), and 20 percent of respondents reported jobs were created.

Table 21: Jobs Created or Retained Inside the Organization

Response	Jobs Retained	Jobs Created
Yes	27%	20%
No	67%	73%
Don't Know/ Refused	7%	7%
Total Respondents		n=16

Source: DNV KEMA analysis

Respondents were asked similar questions of jobs created or retained outside their organization. The results are shown in Table 22. More respondents reported witnessing hiring outside their operations, primarily by contractors.

Table 22: Jobs Retained or Created Specifically Outside the Organization

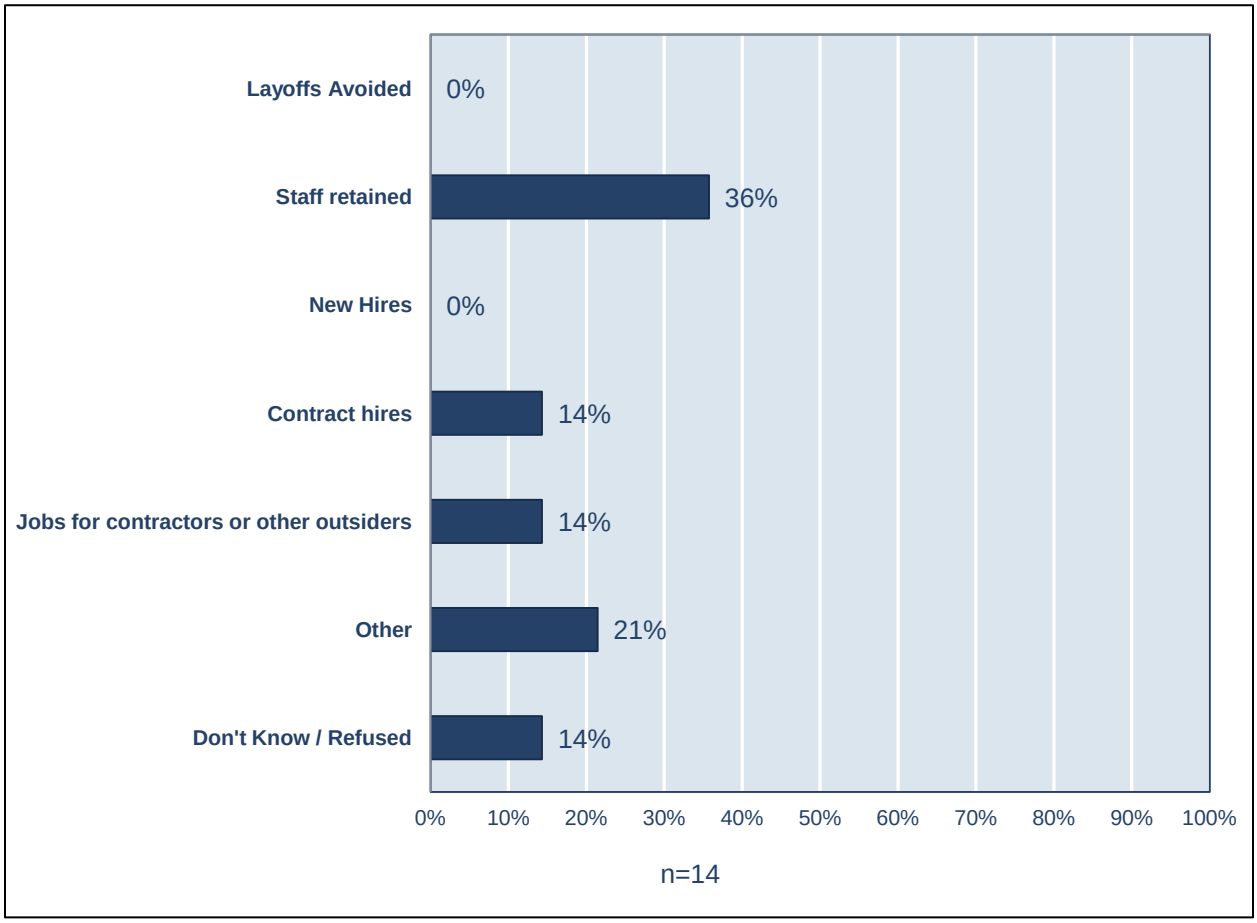
Response	Jobs Retained	Jobs Created
Yes	47%	27%
No	40%	60%
Don't Know/ Refused	13%	13%
Total Respondents		n=16

Source: DNV KEMA analysis

Jobs were created primarily through retaining staff whose jobs would have been otherwise eliminated, short-term contract hires, and contractor jobs.

A total of 31 jobs were reported as retained or created either inside or outside the organization.

Figure 20: Number of Jobs Retained or Created by Loan Funding



Source: DNV KEMA analysis

Respondents interviewed for this analysis were typically not the authority on hiring at their agencies, nor were they experts on job creation; however, they were able to provide qualitative insight into job creation due to the Loan Fund Program. Respondents reported broad limits to staffing at DGS, which restricted job creation. Many agencies interviewed were able to use funding from the Loan Fund Program to establish several permanent jobs, primarily in the engineering field. The job types included engineers and a few management position hires. When asked to categorize the hires they observed as temporary or permanent, the majority of respondents were unsure. A few respondents indicated contract hires were used during a project's implementation, but they were unaware if these turned into permanent positions. One respondent complained jobs went to engineering firms, which, in some cases, were out-of-state.

Market Transformation and Barrier Reduction

The reach of the Loan Fund Program extended to California state buildings only, limiting the potential for market transformation. While state buildings alone are not a true market, barriers to energy efficiency do exist within the operation of state-owned buildings. This section addresses how the Loan Fund Program affects these barriers and results in long-term change.

One barrier to energy efficiency upgrades has been incurring loan obligations on state buildings that are also encumbered under bond obligations. Given that the bond holder has a right to repayment, the state did not want the potential for liens from market loans or ESCO obligations for energy efficiency projects. The Loan Fund Program eliminated this barrier because the funding is internal to DGS, and no outside lender is required.

Another barrier to energy efficiency has been lack of interest by management. Managers want to focus on their core operations, and energy efficiency has long been a low priority. The program administrator stated since the loan fund was implemented, the number of energy efficiency projects completed at state owned buildings is the highest since the energy crisis in 2001. Following the implementation of successful projects, state agencies not involved in the first phase of loans are now requesting information about program loans. In particular, the state Food and Drug Administration, Parks and Recreation, Fish and Wildlife, and Border Control agencies have expressed interest in the Loan Fund Program. Both facility managers and agency management are now working with DGS, which was not occurring before ARRA funding, according to the loan administrator.

A significant barrier is access to funding. The state establishes a budget, which may not include energy efficiency projects. A project determined after the annual budget is established is very difficult to fund. The DGS Loan Fund Program provides the funding directly, allowing worthwhile projects to move forward swiftly. The CDCR provides the best example of the reduction of this barrier. Although the CDCR participates with IOUs in a partnership with enhanced incentives, many projects were not able to move forward due to budget constraints. The DGS Loan Fund Program reduced this barrier by providing funding for cost-effective energy efficiency projects. The CDCR projects overall had the shortest payback period, again showing how the loan fund allowed the implementation of very cost-effective projects that were not able to move forward without it.

California's commitment to funding this revolving loan program clearly has resulted in short-term change, with indications that it is likely to become a force for ongoing change, provided ongoing funds continue to be available for energy upgrades in DGS state facilities. The program was created to provide continuous energy upgrades for state agencies, leveraging support from utilities and federal, state, and other third-party organizations to achieve long-term, self-sustained energy efficiency in state facilities. In this respect, the program has affected lasting change. The program created a revolving loan system that may be used continually to support energy efficiency and conservation, for state buildings used by a range of organizations,

including office buildings, correctional facilities, treatment centers, small buildings, and other state facilities in California.

CHAPTER 5:
Summary and Recommendations

The overall goal of the evaluation was to assess the effectiveness of the Loan Fund Program implementation and verify the energy savings realized from loans issued during 2009-2010.

Energy Savings Results

Overall, the 64 projects implemented through the program were evaluated to realize 95 percent of the expected annual electricity savings – or about 30 GWh – relative to either Baseline 1 or Baseline 2. Annual natural gas savings were estimated at either 1.4 million therms (120 percent relative to Baseline 1) or 1.1 million therms (89 percent relative to Baseline 2). The overall precision of these estimates, which indicates the reliability of the results, is 9 percent for Baseline 1 and 12 percent for Baseline 2, at the 90 percent confidence interval.

The six projects implemented at CDCR facilities accounted for 44 percent of the total ex post annual electricity savings, whereas the 45 projects implemented through the small buildings component and the 12 projects implemented through the large buildings component accounted for 28 percent and 19 percent of the total ex post annual electricity savings, respectively. The one OCIO project accounted for 9 percent of the total ex post annual electricity savings. In terms of total ex post annual electricity savings from different types of measures, the results were split with 49 percent of the savings realized from lighting measures, 51 percent from HVAC measures, and less than 1 percent from DHW measures. The six projects implemented at CDCR facilities accounted for 85 percent of the total ex post annual natural gas savings primarily due to the implementation of HVAC measures. Furthermore, projects in CDCR facilities generated the greatest reductions in GHG emissions. In total, the Loan Fund Program avoided emissions of 16,864 and 14,909 metric tons of CO_2 relative to Baselines 1 and 2, respectively. The majority of these reductions consisted of lighting, HVAC and controls measures.

Life-cycle savings for the measures implemented through the Loan Fund Program totaled more than 400 GWh and nearly 23 million therms. Projects implemented at CDCR facilities accounted for more than 95 percent of the life-cycle natural gas savings and more than 40 percent of the life-cycle electricity savings. These projects primarily consisted of HVAC retrofits in prisons and other large facilities.

Differences in Ex Ante and Ex Post Energy Savings Results

Though overall realization rates were high at the program level, there was high variability for specific projects. Several consistent themes emerged as reasons for differences between ex ante and ex post savings results.

Table 23: Reasons for Differences Between Ex Ante and Ex Post Savings Estimates

Reasons for Differences	Number of Measures
Calculation Method Unclear	2
Customer Reported Different Parameter(s)	3
Different Analysis or Calculation Method	22
Different Baseline or Installation	10
Not Installed	7
Other Savings in Documentation	2
No Significant Differences	6
Total	52

Source: DNV KEMA analysis

- **Higher rigor in ex ante calculations led to high realization rates.** High rigor applications prepared with detailed planning, such as engineering analyses based on audits and feasibility studies, consistently resulted in higher realization rates.
- **Different baselines were used for ex ante calculations.** Many measures did not realize the expected savings because ex ante estimates were based on broad generalizations of operating hours and standard assumptions of code compliance. This was especially the case for lighting and HVAC measures, both of which had high model input variability.
- **Measures were not installed or were installed incorrectly.** In some cases, measures were not implemented as planned – in other words, equipment was not installed, turned off, or not operating as intended. In other cases, there was considerable disparity between the actual and documented numbers of equipment retrofitted, affecting ex post savings calculations and realization rates.
- **Evaluators had insufficient ex ante documentation.** Some of the reasons for differences between ex ante and ex post savings estimates could not be explained due to insufficient documentation of the ex ante methodology.

Net Energy Savings Results

The Loan Fund Program sought to provide financial assistance to implement energy efficiency projects in state-owned buildings. These projects were previously identified by DGS and were determined to have cost-effective, energy-efficient upgrade opportunities but were prohibited from moving forward due to a lack of funding. Based on interviews conducted with 11 decision-makers representing 16 projects, the evaluators concluded that 100 percent of the energy savings from projects implemented through the Loan Fund Program are attributable to the program. That is, free ridership is assumed to be 0 percent, and the net-to-gross ratio is assumed to be 1.0.

Relevant survey results are summarized below:

- **Role of Funding on Project Implementation.** The overwhelming majority of respondents (94 percent of 16) indicated the funding provided through the program was essential to move projects forward.
- **Influence of Program on Project Implementation.** Two-thirds of respondents reported the program was "Very Influential" in their decision to implement projects.
- **Scope and Timing of Projects Without the Program.** None of the respondents indicated projects would have been implemented exactly as scoped and during the same time frame. Most reported that projects would have been delayed until funding sources were identified or until the existing equipment failed.
- **Role and Influence of Project Co-funding.** Three-quarters of respondents reported their projects received funding from sources, nearly all of which were utility programs, other than the Loan Fund Program. However, results from interviews indicate that, while co-funding was influential in moving many projects forward, it was not as essential as the financial assistance provided through the Loan Fund Program. In addition, when compared to similar responses regarding program funding, fewer respondents (who received co-funding) indicated it was essential to projects moving forward.
- **Self-Reported Evidence of Jobs.** Several participants reported that jobs were created in each of their facilities. A total of 31 jobs were reported as added or retained. Participants speculated that jobs may have been created and/or retained within the energy efficiency contracting industry.

Decision-Making Factors Influencing Project Implementation

Other factors influencing project implementation were discussed during interviews with participants:

- **Reasons for Project Implementation.** Most common reasons for project implementation included reducing energy costs and energy use, followed by compliance with codes, statutes, and mandates (for example, Assembly Bill 32).
- **Project Origination.** Most respondents reported their projects were internally proposed or had originated from larger DGS remodeling/modernization efforts.
- **Decision-Making Factors Considered in Project Implementation.** Respondents were asked a set of questions designed to understand factors that went into project implementation decision-making:
    - *Energy Efficiency "Mandates."* In a few cases, respondents indicated their management had established guidelines that were in line with executive orders mandating energy efficiency upgrades. However, others said there were no criteria/requirements for energy upgrades because they simply did not happen; equipment replacement occurred only when the equipment had already failed or was on the verge of failure.

- *Consideration of Life-Cycle Costs.* Roughly one-third of respondents indicated life-cycle costs (including energy costs and maintenance costs) are "always" considered when purchasing new equipment.
- *Payback Period Thresholds.* On average, respondents reported that they typically look for payback periods within 6 to 10 years, which is well within the Loan Fund Program requirement (13 years maximum). Most respondents reported it was not difficult to meet the program's payback requirement.

Participant Satisfaction, Impressions, and Suggestions for Improvement

Overall, participants were satisfied with the program, the equipment installed, the loan amounts received, and the loan structure and amortization schedule. Participants did not report any significant challenges to complying with most of the program's requirements, such as the waste management requirements, the Davis Bacon Act, and the Buy American Act. Participants reported some difficulty complying with the reporting requirements, the DGS loan application requirements, and the National Historic Preservation Act.

Recommendations

Finally, the Loan Fund Program was designed to provide a continuous pool of funding for continuous energy efficiency upgrades at state buildings, leveraging support from utilities, federal, state, and other third-party organizations. The program has achieved its goal of delivering long-term, self-sustained energy efficiency in state facilities and, given the $50 million allocation of additional funding, should continue to do so. Recommendations for improving the program going forward include:

- **Continue to identify, prioritize, and effectively target projects that will most cost-effectively contribute to meeting the state's energy and GHG reduction goals.**
  - Identify and work with agencies and entities that need to further reduce energy consumption to meet government mandates requiring state agencies to reduce GHG emissions by 10 percent by 2015 and 15 percent by 2020[9]. By identifying where opportunities at state agencies exist, DGS can target them more effectively.
- **Improve the loan selection process**.
  - The federal timeline for spending ARRA funds reduced the time available to scrutinize the loans and select projects designed to minimize risk. The ongoing

[9] The Governor's Executive Order B-18-12 requires all state-owned buildings to reduce their grid-based energy purchases by 20 percent by 2018 and to reduce GHG emissions by 20 percent by 2020.

program should incorporate a loan review stage to select projects that have reasonable certainty for achieving expected savings. DGS can adopt a more rigorous evaluation process of the feasibility of the project to save energy before granting the loan.
    - DGS may want to compare the Loan Fund Program approval process with other state or municipal revolving funds to seek the best practices for the loan approval process.
- **Consider researching and then implementing organizational "best practices" for meeting energy efficiency and building performance goals.**
    - Organizations have successfully implemented many activities to help reduce energy and meet building performance goals, ranging from the advanced (such as tracking energy consumption and mining energy management data to identify energy efficiency opportunities) to the simplistic (such as "treasure hunt" competitions among facility managers to identify opportunities).
    - Another energy efficiency building management best practice is to formally incorporate energy efficiency into long-term plant operations and capital planning.
    - Other organizations have found that building occupant and tenant education is key to realizing the full potential of energy efficiency measures. This practice is especially important when introducing new technologies, such as lighting and temperature controls.
    - In addition, creating a forum for agencies and facility managers to share energy efficiency success stories (and failures) within DGS should be considered. This forum will encourage innovative thinking and knowledge transfer.
    - Finally, revisit government procurement procedures to continually improve energy efficiency. This review will encourage agencies to keep energy innovation at the forefront.
- **Encourage project co-funding through other sources, such as utility programs and state budgets.**
    - Leveraging funding from utilities or internal state funding allows the completion of large comprehensive projects. The funding through ARRA, combined with the CDCR partnership program with the utilities, resulted in significant savings.
    - Access to funding from other sources allows agencies to implement a greater range of measures, such as demand response and advanced building automation technologies, in addition to effectively designed energy efficiency projects that improve state buildings.
- **Adopt more rigorous project savings analysis and documentation requirements.**
    - In general, the evaluators found less variation in realization rates from projects that were subject to more rigorous savings documentation early on, such as when developed by ESCOs or in partnership with utilities. During onsite verification, the evaluation team sometimes saw substantial deviations in what was recorded and what had been implemented. For example, estimates of operational parameters such as hours of equipment operation were significantly different in some cases than observed onsite.

- Preretrofit and baseline conditions should be carefully documented.
- In addition, it is important to consistently maintain tracking data at the measure level as the program evolves. Data on projects changes were not always available to the evaluation team, though status updates were useful. To ease future evaluation efforts, it would helpful to have a regularly maintained tracking database to keep abreast of project changes.
- Provide protocols on how to calculate peak demand savings so that they are developed in a consistent format.
- Require tracking of peak impacts.

- **Consider changes to program design.**
  - Develop an approach that focuses on small buildings across the state, allowing remote and rural locations to be addressed. Consider contracting terms that incentivize projects across the portfolio, regardless of contractor travel time.
  - Analyze performance of buildings and develop a targeted approach for specific building types.
  - Provide technical resources, such as staff and a toolkit for small buildings.
  - Adapt loan payment due dates to allow projects to generate a year's worth of savings before payment is due.
  - Consider including distributed generation projects that meet payback requirements.
  - Consider including long-term monitoring for savings persistence for the projects with the most savings.

CHAPTER 6: Glossary

ARRA	American Recovery and Reinvestment Act of 2009
Baseline 1	Considers the existing conditions found before energy efficiency measure implementation and takes into account the equipment's operating efficiency along with the control strategies found at that time. Life-cycle savings for Baseline 1 assumes the pre-existing equipment would have continued to operate indefinitely, up to the effective useful life (EUL) of the new equipment.
Baseline 2	Uses the pre-existing equipment as the measure's baseline until the end of the existing equipment's remaining useful life (RUL). After the remaining useful-life period, and up until the end of the EUL of the installed measure, the measure's expected replacement baseline is used. This baseline considers either minimally code-compliant conditions or standard practice when no code is applicable.
Caltrans	California Department of Transportation
CDCR	California Department of Corrections and Rehabilitation
CHP	California Highway Patrol
CRAC	computer room air conditioning
CO_2	carbon dioxide
CTF	Correctional Training Facility
DDS	Department of Developmental Services
DEER	Database for Energy Efficient Resources
DGS	Department of General Services
DHW	domestic hot water
DK	don't know
DMV	Department of Motor Vehicles

DNV KEMA	DNV KEMA Energy & Sustainability
DOE	U.S. Department of Energy
DWR	Department of Water and Resources
ECAA	Energy Conservation Assistance Act
EEM	energy efficiency measures
EM&V	evaluation, measurement, and verification
EMS	energy management system
Energy Commission	California Energy Commission
ESCO	energy service company
EUL	effective useful life
ex ante	estimated or claimed savings from an energy efficiency project
ex post	verified savings from an energy efficiency project as determined by the evaluation team
GHG	greenhouse gas
GWh	gigawatt-hour
HVAC	heating, ventilation, and air conditioning
IOU	investor-owned utility
IPMVP	International Performance Measurement and Verification Protocol
kBtu	kilo British thermal unit
kWh	kilowatt-hour
Lbs	pounds
LED	light-emitting diode
Loan Fund Program	Energy Efficient State Property Revolving Loan Fund Program
M&V	measurement and verification
Measure	At an end-use energy consumer facility, an installed piece of equipment or system; a strategy intended to affect consumer energy use behaviors, or modification of equipment, systems or

	operations that reduces energy that would otherwise have been used to deliver an equivalent or improved level of end-use service.
MWh	megawatt-hour
NA	not applicable
Net Savings	the total savings attributed to the program, does not include savings for measures that would have been installed without the program
OCIO	Office of the Chief Information Officer
Project	An activity or course of action involving one or multiple efficiency measures at a single facility or site.
Retrocommissioning	Retrocommissioning examines existing building systems to find ways to improve energy performance in buildings
Realization Rate	a comparison of evaluated information to original estimated savings
RUL	remaining useful life
SEP	State Energy Program
TMY	typical meteorological year
VAV	variable air volume
VFD	Variable-frequency drive

APPENDICES

Appendices are provided in a separate file.