CONSULTANT REPORT

# IMPACT EVALUATION FOR ENERGY EFFICIENCY AND CONSERVATION BLOCK GRANT SMALL CITIES AND COUNTIES PROGRAM

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# ABSTRACT

This report presents the results of the evaluation of the California Energy Commission's Energy Efficiency and Conservation Block Grant Small Cities and Counties Program administered by the California Energy Commission and funded by the American Recovery and Reinvestment Act of 2009. The program funded cost-effective energy efficiency projects for small local governments in California. The evaluation team verified the energy savings realized from grants issued during 2009 – 2012, estimated greenhouse gas emission reductions, assessed job creation, and determined the effectiveness of the program implementation.

The evaluation methodology was based on a stratified sample of projects representing the ease or difficulty of predicting energy savings. The evaluation estimated actual energy savings results with calculations relative to two baselines—existing conditions found before measure implementation (Baseline 1), and minimally code-compliant conditions or standard practice when no code is applicable (Baseline 2).

Overall, the Energy Efficiency and Conservation Block Grant Small Cities and Counties Program realized significant annual net savings, about 33 gigawatt-hours of electric savings and 172,000 therms of natural gas savings. Electricity savings are primarily from lighting measures, and heating, ventilation, and air-conditioning measures comprised the bulk of natural gas savings. Life-cycle savings total more than 460 gigawatt-hours and more than 2 million therms. More than 11,000 metric tons of greenhouse gas emissions were avoided annually as a result of this program.

The program effectively focused the funding on projects that could be easily developed and measures that could be implemented quickly. Streetlighting, interior and exterior lighting, heating, ventilating, and air-conditioning package units, and variable frequency drives were common measures. Participants also reported high satisfaction with the grant program. The program funded energy efficiency projects which may not have happened otherwise at smaller jurisdictions across California.

**Keywords:** California Energy Commission, Energy Efficiency and Conservation Block Grant Small Cities and Counties Program, loan program, evaluation, measurement and verification; energy savings, electricity savings, natural gas savings, energy efficiency, local jurisdictions, ARRA funding, evaluation measurement and verification.

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# EXECUTIVE SUMMARY

The American Recovery and Reinvestment Act of 2009 (ARRA) and the Energy Independence and Security Act of 2007 established the Energy Efficiency and Conservation Block Grant (EECBG) Small Cities and Counties Program to provide formula-based grants for cost-effective energy efficiency projects. The United States Department of Energy (U.S. DOE) allocated $46 million to the California Energy Commission for the EECBG Small Cities and Counties Program. The Department of Energy required the Energy Commission to distribute at least 60 percent of these funds to small cities and counties throughout the state since small jurisdictions were ineligible for direct grants. The Energy Commission distributed a total of $31.8 million in funding to small cities and counties for projects falling within two categories: energy efficiency projects and direct equipment purchase projects. An additional $13.4 million went to the California Comprehensive Residential Retrofit programs and Energy Retrofit Municipal Financing projects, which are evaluated separately.

The EECBG Small Cities and Counties Program achieved savings primarily from lighting and heating, ventilation, and air-conditioning (HVAC) measures. The program allowed a broader range of measures, providing some flexibility, but maintained focus on a limited number of easily implementable measures with known potential to achieve savings. Examples of qualifying energy efficiency measures implemented through EECBG Small Cities and Counties Program projects include:

- Lighting (interior, exterior, traffic and street lights, and lighting controls).
- HVAC (new equipment, controls, and retrofits).
- Other measures (domestic hot water equipment upgrades, variable frequency drives, high-efficiency motors, vending machine controls, and others).

The Energy Commission implemented 204 program grants to small cities and counties, totaling $31.8 million, between 2009 and 2012. Annual energy savings were predicted to be about 34 gigawatt-hours and 240,000 therms. Evaluators determined that net annual energy savings were nearly 33 gigawatt-hours and 172,000 therms. Local jurisdictions in both urban and rural areas across the state-implemented projects, from the city of Adelanto to the town of Yucca Valley. Typical facilities included a range of local government buildings and facilities, including community centers, libraries, city halls, parking lots, and jails.

The Energy Commission designed the program to use two approaches:

- **Energy efficiency projects.** Cost-effective energy efficiency projects, for which energy savings and cost estimates were supported by a feasibility study. There were a total of 77 energy efficiency projects agreements funded at $14.3 million.
- **Direct equipment purchase projects.** For those jurisdictions without the resources or expertise to develop complex energy efficiency projects, the Energy Commission provided a list of preselected energy efficiency equipment that qualified for funding and

did not need an associated feasibility study. One hundred and sixteen direct equipment purchase projects were initially funded at $14.1 million. In a second round of funding known as Phase II, eleven additional direct equipment purchase projects were funded at $3.5 million.

## Evaluation Results

The Energy Commission retained DNV KEMA Energy & Sustainability as evaluators to assess the effectiveness of the EECBG Small Cities and Counties Program implementation and verify the energy savings. Additional evaluation goals included attributing program influence, estimating greenhouse gas emission reductions and program cost-effectiveness, assessing job creation, and informing the Energy Commission of any waste, fraud, or abuse of grant funds. Following development of an evaluation plan, the evaluation was completed between May 2011 and May 2013.

### *Summary of Results*

- **The program design concept was successful.** In general, the results from the evaluation demonstrate that the Energy Commission effectively used ARRA funding to initiate energy efficiency projects in smaller jurisdictions that may not have had the resources to participate in this type of program before. The program effectively targeted often-overlooked opportunities in small cities and counties for which small investments could result in significant savings. This was especially evident in jails and facilities with exceptionally out-of-date equipment. Program-funded projects resulted in better operations and long-term savings for the state.
- **Both energy efficiency projects and direct equipment purchase approaches proved to be successful.** Feasibility studies provided a good basis for energy efficiency projects, and measures that were known to be effective yielded good results for direct equipment purchase projects, as expected.
- **Targeting "shovel-ready," "low-hanging fruit" was key to program success.** The evaluation team found that the types of projects completed were appropriate for ARRA funding use. The program required projects to be easily implementable, "shovel-ready" projects that yielded cost-effective energy savings and showed wise use of public funds. Because so few small jurisdictions had previously implemented energy efficiency projects, there was a wealth of "low-hanging fruit" to be picked. Evaluators observed very old equipment replaced by the program with efficient units. These projects provided reliable savings with minimal effort and resources.
- **The program achieved significant savings, due in part to flexible program delivery.** The Energy Commission was able to get the program off the ground quickly, working closely with small jurisdictions through the evolution of their applications to find the most effective and efficient measures. The program achieved its goals of quick implementation, wide outreach, and significant savings.
- **Many jurisdictions also leveraged additional help and funding from other sources.** As a result, many local governments were able to implement more or larger projects using a

combination of its own capital funds, utility rebates, or low-interest loans provided through the Energy Commission's Energy Conservation Assistance Act (ECAA) program.

- **Technical support and assistance services were integral to the program.** The constant support of Energy Commission staff working closely with applicants was important to implement the program.
- **The Energy Commission was well-prepared to use ARRA funding effectively for this energy efficiency program.** The existing procedures, trained staff, and application review process all provided a good foundation for the grant program.
- **The program set a strong foundation for the future.** The program allowed small jurisdictions to enact energy efficiency projects when they were previously unable to. Participants reported instances of spillover in site visits and interviews; many site contacts identified additional projects they were hoping to undertake. Others indicated that the publicity from the projects caught the attention of their city councils, which opened the door for future projects.

### *Gross Energy Impacts*

The evaluation team calculated ex post energy savings results relative to two established baselines. Baseline 1 assumes that conditions found before implementation of energy efficiency measures would persist indefinitely without the program. Baseline 2 assumes that if the preexisting equipment has exceeded its remaining useful life that it would have been replaced with more efficient equipment without the program, based on codes or standard practice. Savings compared to Baseline 1 reflect the savings expected on the utility bill due to the energy efficiency measure. Savings compared to Baseline 2 show the value of selecting energy-efficient equipment that exceeds standard practice or code minimum requirements. Tables 1 and 2 compare the expected savings estimates (ex ante) with the verified savings (ex post) from the evaluation. Expected savings estimates were derived from the project savings documentation, which was used as the basis for the grant. In the case of the direct equipment purchase grants, preliminary expected savings were developed, to be revised with more accurate evaluation results once the projects were finalized.

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

| Phase[1] | Project Type[2] | Annual Ex Ante Electricity Savings (kWh*) | Annual Ex Post Electricity Savings (kWh*) | |
|---|---|---|---|---|
| | | | Baseline 1 | Baseline 2 |
| Phase I | DEP | 13,073,230 | 13,114,415 | 12,737,046 |
| | EEP | 18,639,925 | 17,781,299 | 16,847,071 |
| Phase II | DEP | 2,624,009 | 2,668,877 | 2,661,322 |
| Total | Total | 34,337,164 | 33,564,591 | 32,245,439 |

* kWh=kilowatt-hours

Source: DNV KEMA analysis

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

| Phase | Project Type | Annual Ex Ante Natural Gas (therms) | Annual Ex Post Natural Gas (therms) | |
|---|---|---|---|---|
| | | | Baseline 1 | Baseline 2 |
| Phase I | DEP | 31,957 | 25,273 | 18,134 |
| | EEP | 208,082 | 150,197 | 109,688 |
| Phase II | DEP | 0 | 0 | 0 |
| Total | Total | 240,039 | 175,470 | 127,822 |

Source: DNV KEMA analysis

Overall, the 204 projects implemented through the EECBG Small Cities and Counties Program realized about 34 gigawatt-hours relative to Baseline 1 or about 32 gigawatt-hours relative to Baseline 2. The program focused primarily on electric savings, but also achieved annual natural gas savings of about 175,000 therms (Baseline 1) or 128,000 therms (Baseline 2). The overall precision of these estimates, which indicates the reliability of the results, is 6 percent for Baseline 1 and 7 percent for Baseline 2 for electric savings, at the 90 percent confidence interval. The therm savings estimates were less precise, at 32 percent for Baseline 1 and 24 percent for Baseline 2, at the 90 percent confidence interval.

### *Net Energy Impacts*

Using participant self-reported responses, the evaluation team determined a net-to-gross ratio of 98 percent for the program. This ratio is applied to the gross energy savings impacts shown

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1 Phase I consisted of 193 grants funded at $28.4 million. Phase II funded eleven additional DEP projects at $3.5million.

2 DEP = Direct Equipment Purchase projects
EEP = Energy Efficiency Projects

in Table 1 and Table 2 to yield the net program impacts shown in Table 3. Net impacts are shown as both annual and life-cycle estimates.

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

| | Baseline 1 | | Baseline 2 | |
|---|---|---|---|---|
| | Net-Adjusted Ex Post Electricity Savings (kWh*) | Net-Adjusted Ex Post Natural Gas (therms) | Net-Adjusted Ex Post Electricity Savings (kWh*) | Net-Adjusted Annual Ex Post Natural Gas (therms) |
| Annual | 32,893,300 | 171,961 | 31,600,531 | 125,265 |
| Life-cycle | 461,636,663 | 2,730,498 | 442,789,525 | 2,013,578 |

* kWh=kilowatt-hours
Source: DNV KEMA analysis

### *Greenhouse Gas Emissions Reductions*

Greenhouse gas emissions reductions accrue when energy is saved or renewable energy is generated, thus avoiding or replacing fossil fuel generation. Because the State of California encourages lower greenhouse gas emissions from the power generation sector, California must save more energy to achieve a similar level of greenhouse gas emissions reductions compared to other states. Evaluators estimated that about 11,000 metric tons of greenhouse gas emissions reductions were avoided annually as a result of this program. Over the equipment lifetime, nearly 160,000 metric tons of greenhouse gas emissions are expected to be avoided. These results are shown in Table 4.

**Table 4: Evaluation Results – Avoided Greenhouse Gas Emissions**

| | Avoided Greenhouse Gas Emissions (metric tons) | |
|---|---|---|
| | Baseline 1 | Baseline 2 |
| Annual | 11,206 | 10,554 |
| Life-Cycle | 158,963 | 149,262 |

Source: DNV KEMA analysis

### *Participant Satisfaction and Suggestions for Improvement*

Participants revealed that they were generally very happy with the program. They found the Energy Commission's staff to be extremely helpful and believed that the program worked very well, citing the grant program as a positive experience that encouraged cities to enact more projects. They were also very satisfied with the installed equipment and the grant amount they received, although several respondents commented that the paperwork and application process was too bureaucratic and burdensome relative to the small size of the grants. Many participants

indicated they had or planned to implement further energy efficiency measures outside the program.

Participants felt that funding received through the EECBG Small Cities and Counties Program was essential or instrumental in their decision to implement the projects. Two participants who reported that funding was helpful but their projects would have been implemented without the program were considered to be free riders. Almost half of respondents indicated that their projects received funding from sources other than the EECBG Small Cities and Counties Program, including other ARRA programs and utility funding. The most common reasons for implementing energy efficiency projects at their facilities included reducing energy costs and energy use, followed by replacing poorly performing or outdated equipment, and getting funding from the program. Other reasons included reducing greenhouse gas emissions.

### *Self-Reported Evidence of Job Creation*

Evaluators asked participants to quantify job creation resulting from the grant program. Though not a rigorous or official job creation analysis, this assessment offers some insight into the effects of the program on local employment.[3] Participants reported that the program created about 42 jobs, both permanent and temporary, primarily in the mechanical and electrical trades. Many reported that while the program provided work for contractors, they did not know whether this work led to jobs retained or additional hiring. Jobs for contractors or other outsiders were reported to be primarily temporary hires, in particular tradesmen such as plumbers and electricians. Permanent hires included layoffs avoided and staff retained. These positions were electricians and technicians, mechanics, and crane operators.

## Recommendations

Overall, results of the evaluation of the EECBG Small Cities and Counties Program show that California was well-prepared to use ARRA funding effectively for this energy efficiency program. The types of projects completed were appropriate for ARRA funding use. Many projects were easily implementable, "shovel-ready" projects that yielded excellent results and showed wise use of public funds. The evaluation produced a set of recommendations for improving similar programs, should a grant program be developed:

- Program implementation recommendations:
  - The use of marketing and outreach, including a workshop to introduce the program, was an effective approach to kick off the program and provides a good example for similar future programs. The Energy Commission team worked with small jurisdictions to provide marketing and outreach to smaller cities and counties, including using clinics to support development of the application.

3 A comprehensive, rigorous model of employment effects and cost-effectiveness is being developed for all of the California Energy Commission's American Reinvestment and Recovery Act programs, the results from which will be reported separately in 2014.

- Include technical support and assistance services, working closely with individual applicants. The constant support of Energy Commission staff was important to implement the program.
- Continue to encourage leveraging other funding sources to provide unique opportunities to maximize funding. These may include incentives from both investor-owned and publicly owned utilities, as well as other Energy Commission funding, such as the Energy Conservation Assistance Act loans.
- Develop standards for defining the baseline. For example, the Energy Commission could require photographs of the equipment and nameplates and a short statement about the equipment age and operation.

- Project tracking and documentation:

- Continually improve the current approach of technical review and documentation of feasibility studies for energy efficiency projects, as this step is critical for effective project implementation.
- For energy efficiency projects, create a consistent set of requirements for feasibility studies and measure justification. Require that the feasibility studies and supporting data provide a high level of transparency with a sufficiently detailed breakdown of how the savings estimates were generated.
- For direct equipment purchase projects, require documentation details of the final installation, such as the number and wattages of lights installed.
- For accurate savings estimations, document preinstallation conditions. For example, preretrofit visits by staff would provide an opportunity to identify equipment age and operating conditions.
- Where cost-effectiveness and/or jobs analysis is a program goal, develop methods to provide labor and equipment breakdowns, as well as planning or administrative costs.

- Measure-specific recommendations:

- Continue the focus on lighting, as the low cost and simple installation make it ideal for small jurisdictions with limited experience with energy efficiency.
- For all measures, require that the improvements exceed minimum code requirements and are efficiency upgrades rather than normal replacements.

- Overall recommendations for subsequent programs:

- Continue direct equipment purchase and energy efficiency project approaches. Both approaches proved to be equally successful, yielding similarly high savings and realization rates.
- Subsequent programs should continue encouraging facilities to replace aging energy equipment by using the savings to pay for new, highly efficient equipment
- Consider additional research on ways to effectively reach small jurisdictions and replace aging equipment. Examine the effectiveness of other funding opportunities, such as loans, workshops, and technical assistance.

# CHAPTER 1: Introduction

This report provides the California Energy Commission with an independent evaluation of the Energy Efficiency and Conservation Block Grant (EECBG) Small Cities and Counties Program. The evaluation sought to assess the effectiveness of program implementation and to verify the energy savings realized from grants issued between 2009 and 2012.

The Energy Commission contracted with DNV KEMA Energy and Sustainability (DNV KEMA), along with its subcontractor, Katin Engineering, to conduct the evaluation. The primary objective of the evaluation was to determine the actual gross energy and peak demand savings from the EECBG Small Cities and Counties Program's 204 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 provided in the documentation of the expected savings, so, DNV KEMA was unable to derive peak savings. Therefore, this report focuses exclusively on energy savings, providing annual and life-cycle estimates. The evaluation also generated estimates of avoided greenhouse gas emissions. DNV KEMA conducted the evaluation from May 2011 to May 2013.

Using information collected from in-depth interviews with EECBG Small Cities and Counties Program participants, the evaluation team assessed:

- Free ridership, or the proportion of energy savings that would have occurred without the EECBG Small Cities and Counties 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 (for example, implementation of energy efficiency measures [EEMs] outside the EECBG Small Cities and Counties Program project scope).
- Participant satisfaction with equipment installed, grants received, the grant structure, compliance requirements (for example, National Historic Preservation Act, Buy American provision, Davis-Bacon Act), and interactions with Energy Commission staff.
- Participant self-reporting of employment effects attributable to the EECBG Small Cities and Counties Program.

Finally, the evaluation team also conducted a comprehensive assessment of the EECBG Small Cities and Counties Program's overall cost-effectiveness and direct and indirect employment effects. These evaluation components are ongoing, the results of which will be reported separately.

Subsequent sections of this report are organized as follows:

- **Chapter 2: Program Overview** provides a description of the EECBG Small Cities and Counties Program, its objectives, and expected results.
- **Chapter 3: Evaluation Approach** provides an overview of the evaluation method, including primary data sources, sample design, description of the final sample, data collection elements, and calculation method.
- **Chapter 4: Results** presents evaluation results, including program-level gross and net energy impacts, breakdown of savings results by measure type, and calculation of life-cycle savings. Results from in-depth interviews with EECBG Small Cities and Counties 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 the following:

- **Appendix A: Detailed Evaluation Methodology** provides a detailed evaluation method description.
- **Appendix B: Field Data Collection** provides specific field procedures for common measure types.
- **Appendix C: Participant In-Depth Interview Guide** provides the in-depth interview guide used to interview EECBG Small Cities and Counties Program participants.
- **Appendix D: Population-Level Program Tracking Data** summarizes the program's tracking information, including ex ante savings estimates, for all of the EECBG Small Cities and Counties Program projects included in this evaluation.
- **Appendix E: Evaluation Site Reports** provides the final project site reports for projects in the evaluation sample.

Appendices are provided in a separate file.

# CHAPTER 2: Program Overview

The EECBG Small Cities and Counties Program was created by the Energy Independence and Security Act of 2007 (EISA) and is funded by the American Recovery and Reinvestment Act of 2009 (ARRA). The U.S. Department of Energy (U.S. DOE) issued grants directly to states, U.S. territories, large cities and counties, and Indian tribes.

## Program Design Summary

Under ARRA, the U.S. DOE allocated $46 million to the Energy Commission for the EECBG Small Cities and Counties Program. The program was designed to implement shovel-ready and cost-effective energy efficiency opportunities that were readily available in municipal facilities throughout the state. The Energy Commission was required to distribute at least 60 percent ($27.6 million) of these funds to small cities and counties that were ineligible for direct grants from U.S. DOE. The U.S DOE defined small cities as those with fewer than 35,000 in population and small counties as those with fewer than 200,000 in population. The Energy Commission developed detailed guidelines for the program.[4] The Energy Commission designed the program to use two approaches:

- **Energy Efficiency Projects (EEP).** Cost-effective EEPs, for which energy savings and cost estimates were supported by a feasibility study. There were a total of 77 EEP agreements funded at $14.3 million.
- **Direct Equipment Purchase (DEP) projects.** For those jurisdictions without the resources or expertise to develop complex EEPs, the Energy Commission provided a list of preselected energy efficiency equipment that qualified for funding. One hundred and sixteen DEP projects were initially funded at $14.1 million. Eleven additional DEP projects were later funded at $3.5 million in a round of funding known as Phase II.

An additional $13.4 million in EECBG Small Cities and Counties Program funding went to the following programs, which are evaluated separately:

- **California Comprehensive Residential Programs**. The Energy Commission awarded $14.2 million in EECBG Small Cities and Counties Program discretionary funding to three jurisdictions to fund programs that are similar in design to the comprehensive residential retrofit programs funded through the State Energy Program (SEP). The three jurisdictions included the City of Fresno, Los Angeles County, and San Diego County.

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4 California Energy Commission, Block Grant Guidelines. August 9, 2012 (http://www.energy.ca.gov/2009publications/CEC-150-2009-002/CEC-150-2009-002-CMF-REV5.pdf).

- **Energy Retrofit Municipal Financing Projects (MFP)**. An additional allocation of roughly $500,000 in EECBG Small Cities and Counties Program funding was awarded to Santa Barbara County for the municipal financing program, originally modeled after the Property-Assessed Clean Energy programs. This program option permitted funding subrecipients to use grants to finance or support the finance of energy retrofits through specified loan activities.

## Program Delivery

The Energy Commission's Energy Division Special Projects Office administered the EECBG Small Cities and Counties Program. To encourage participation in the program, the Special Projects Office held a series of workshops for targeted local jurisdictions to support application development. These workshops aimed to explain the types of measures that the local jurisdictions could include in their grant proposals and work with local jurisdictions to identify projects that would qualify for EECBG Small Cities and Counties Program funding. The Energy Commission also held clinics to support application development.

An Energy Commission contract agreement manager (CAM) was assigned to oversee each award and provided assistance with the grant proposal process, made visits to the local jurisdictions and responded to telephone requests as needed. For many small cities and counties without the resources to conduct their own feasibility studies, the CAM often worked with them to develop actionable projects and target easily implementable, cost-effective projects. The predominance of lighting measures is consistent with this approach, which was confirmed in an interview with the EECBG Small Cities and Counties Program manager. Grant applications were often an evolving collaboration between the subrecipient and the CAM, with project scopes changing more than once during the application cycle.

The U.S. DOE's requirements under ARRA made the application process difficult from a compliance perspective. According to the program manager, the Energy Commission took a risk-averse approach to reporting requirements, anticipating in advance a high level of interest in the use of federal funds.

Recipients had the option to bill the Energy Commission incrementally or once at the close of the project. Small projects were often billed after projects closed, as small jurisdictions did not have the resources for periodic billing.

The Energy Commission monitored grants per the following milestones set in the grant agreement:

- Application (including meeting all ARRA requirements such as Davis-Bacon Act, National Historic Preservation Act, and National Environmental Policy Act)
- Execution of agreement
- Kickoff meeting
- Monthly reports

- Incremental invoices and associated payment requests received
- Completion of project installation
- Final invoice received (subcontractor, equipment costs, and detailed labor costs)
- Grantee requests final cost reimbursement for funds expended
- Project completion documentation is received
- Final grant payment

### Phase II

In the initial round of applications, many projects came in under budget, some cities applied for less than their maximum allowable grant, and some cities chose not to apply at all. Some small city and county grant subrecipients were able to complete more measures with money left over, and some completed fewer measures because they used up all applicable funds. The Energy Commission worked with the subrecipients to make sure that the remaining EECBG Small Cities and Counties Program funds would be spent on energy efficiency measures (EEMs). The Energy Commission tallied the remaining funds after program funds were mostly spent, and subrecipients chose either to implement more measures or return the funding to the Energy Commission. In early 2012, the Energy Commission opened up Phase II of the EECBG Small Cities and Counties Program to disburse the remaining funds. Some jurisdictions that did not originally apply under Phase I decided to apply during Phase II after seeing the successes of nearby cities and counties. Projects initiated under Phase II were not completed in time to be included in the evaluation sample, but their savings results have been incorporated into the final program analysis. A total of 11 projects were completed during Phase II; all were DEP lighting projects.

### Grant Structure

The EECBG Small Cities and Counties Program provided incentives and technical support to small cities and counties to implement energy efficiency projects. In addition, California State law requires the Energy Commission to prioritize grants based on cost-effective energy efficiency.[5] The DOE defines cost-effectiveness as achievement of minimum annual energy savings per dollar spent (10 million source British thermal units [Btu] saved per year for each $1,000 of EECBG funds spent). Customer-sited, renewable energy projects—including photovoltaic (PV) installations—were generally unable to meet these criteria.

The Energy Commission's EECBG Small Cities and Counties Program team calculated maximum grant awards for each city or county at $5 per capita plus an additional percentage based on the unemployment rate in that area based on population data provided from the U.S. DOE. Even though each maximum grant amount was published early on in the application

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5 Public Resources Code Sections 25450 – 25450.5, as enacted by Assembly Bill 2176 authored by Assembly Member Montanez, Stats. 2008, ch.229 and amended by Assembly Bill X4 11, Stats. 2009, 4th Ex. Sess., ch.11, sec. 16-21.

guidelines, many jurisdictions chose to apply for smaller amounts. The minimum allowable grant amount was set at $25,000 for cities and $50,000 for counties, although in some cases the communities were not able to develop projects that reached that value. Grants were made by allocations rather than competitive applications and were assessed by the Energy Commission for reasonableness and cost-effectiveness. Local jurisdictions participating in the EECBG Small Cities and Counties Program were encouraged to leverage other sources of funding, such as investor-owned utility (IOU) and publicly owned utility (POU) incentive programs, or ARRA funding in the form of Energy Conservation Assistance Account (ECAA-ARRA) loans.

DEP projects were composed of measures from a list of preselected energy efficiency equipment (primarily heating, ventilation, and air-conditioning [HVAC] and lighting measures) that qualified for funding. EEP projects primarily consisted of the same measures as DEP projects, yet allowed for more complex projects or different measures outside the narrow parameters of DEP projects. Larger jurisdictions with the resources to perform the required feasibility studies and engineering analyses were more likely to complete EEP projects. In general, however, there was little difference between the measures implemented under either DEP or EEP projects. Examples of the types of end-use technologies and measures installed for these projects include:

- HVAC equipment and controls.
  - Boilers
  - Packaged units
  - Heat pumps
  - Furnaces
  - Programmable thermostats
  - Control upgrades and retrocommissioning (improvements to existing operations)
- Lighting.
  - Exterior lighting
  - Interior lighting
  - Traffic signals
  - Street lights
- Other
  - Domestic hot water (DHW)
  - Premium efficiency pumps and variable-frequency drives (VFDs)
  - Building envelope, including cool roofs, insulation, and windows
  - Motors and drives
  - Plug loads, including server virtualization and vending machine misers

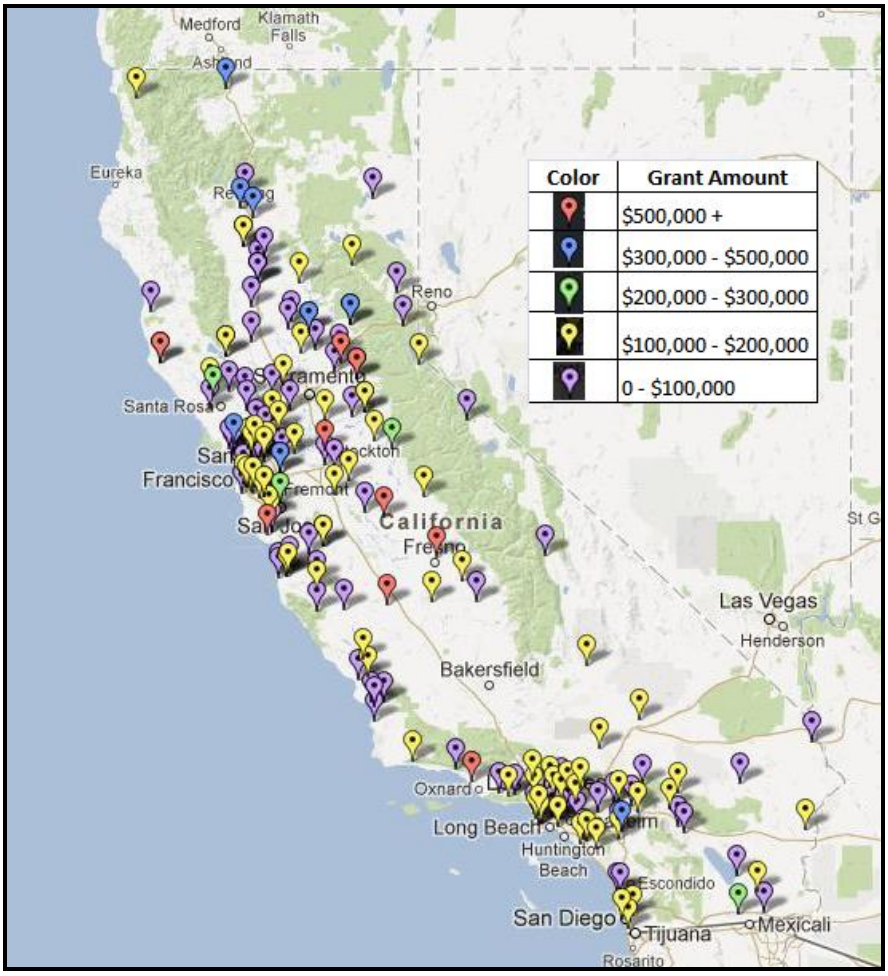
When evaluating EEP, the Energy Commission considered the savings of the entire project rather than measure by measure and promoted "bundling" of measures to lower the overall payback period. For example, very cost-effective measures like lighting were bundled to offset others that were less cost-effective, such as some HVAC measures. EEP projects were required to provide calculations that exceed the minimum cost-effectiveness ratio of 10. For DEP, the

Energy Commission allowed grant subrecipients to select from a specific list of preapproved measures, which were also deemed to meet the cost-effectiveness ratio. In the context of the EECBG Small Cities and Counties Program and this evaluation, a single measure may encompass several energy saving actions. One HVAC retrofit could include equipment installation and controls improvements, for example. Similarly, one measure could include the equipment installation of many units.

## Program Accomplishments

The Energy Commission awarded individual grants through the EECBG Small Cities and Counties Program that ranged in size from $6,300 to more than $2.2 million, with an average grant amount of about $160,000. Grants were awarded to small cities and counties throughout California, as shown in Figure 1. Two of the largest grants were awarded to the San Joaquin Valley Air Pollution Control District (SJVAPCD), but these awards consisted of 37 smaller subprojects developed for other local jurisdictions. Table 5 shows the program breakdown for each program element.

**Figure 1: EECBG Small Cities and Counties Program Projects − Statewide Distribution**




Source: California Energy Commission

**Table 5: Summary of EECBG Small Cities and Counties Program Accomplishments**

| EECBG Small Cities and Counties Program Element | Subrecipients | Total Awarded Grant Amount | Number of Grants |
|---|---|---|---|
| EEP | 77 Local Jurisdictions | $14,300,895 | 77 |
| DEP | 116 Local Jurisdictions | $14,086,685 | 116 |
| DEP (Phase II) | 11 Local Jurisdictions | $3,493,647 | 11 |
| Energy Retrofit Financing* | County of Santa Barbara, Alameda[6] | $539,466 | 1 |
| Energy Efficiency Retrofits* | City of Fresno, Los Angeles and San Diego counties | $14,399,899 | 3 |
| Total | | $46,820,592 | 208 |

* These projects were not included in the scope of this EECBG Small Cities and Counties Program evaluation. These projects were evaluated as part of the California Comprehensive Residential Program (CCRR) and reported separately.
Source: California Energy Commission

Table 6 presents summary information for all EEP and DEP projects in the EECBG Small Cities and Counties Program. As shown, about $32 million in ARRA funding was awarded through 204 grants. With total project-level costs estimated at about $40 million, these EECBG Small Cities and Counties Program funds were responsible for funding about 80 percent of total project costs.

As shown, about $3 million in other ARRA funding was provided to 11 EECBG Small Cities and Counties Program projects (5 percent), most of which was distributed through the ECAA-ARRA Loan Program. Nearly $350,000 in utility incentives was provided to 20 EECBG Small Cities and Counties Program projects (10 percent of grant subrecipients).

**Table 6: Summary of EECBG Small Cities and Counties Program Projects – Funding Levels, Sources**

| | DEP | EEP | Total EECBG Small Cities and Counties Program |
|---|---|---|---|
| Total Projects | 127 | 77 | 204 |
| Total Grant Expenditures | $17,580,332 | $14,300,895 | $31,881,227 |
| Total Project Costs | $20,497,047 | $19,232,176 | $39,729,223 |
| EECBG Funding as Percent of Total Project Costs | 86% | 74% | 80% |
| **Other ARRA Funding Sources** | | | |

6 Alameda loan was cancelled, but $22,344 was spent.

| | DEP | EEP | Total EECBG Small Cities and Counties Program |
|---|---|---|---|
| ECAA-ARRA | $266,302 | $2,472,659 | $2,738,961 |
| Other ARRA | $0 | $293,462 | $293,462 |
| Total Other ARRA Funding Sources | $266,302 | $2,766,121 | $3,032,423 |
| Number of Projects Receiving Other ARRA Funding | 3 | 8 | 11 |
| Percent of EECBG Small Cities and Counties Program Projects[7] | 2% | 10% | 5% |
| **Other Funding Sources** | | | |
| City/County Funded Cost Share | $2,177,220 | $2,001,323 | $4,178,543 |
| Utility Incentives | $184,203 | $163,837 | $348,040 |
| Other | $288,990 | $0 | $288,990 |
| Total Other Funding Sources | $2,650,413 | $2,165,160 | $4,815,573 |
| Number of Projects Receiving Utility Incentives | 12 | 8 | 20 |
| Percent of EECBG Small Cities and Counties Program Projects | 9% | 10% | 10% |

Source: California Energy Commission

Table 7 shows the breakdown of all grants by grant and measure group. Both DEP and EEP grant projects expected the majority of savings to come from lighting measures. As shown, EECBG Small Cities and Counties Program projects were expected to achieve annual energy savings of about 34.3 gigawatt-hours (GWh) and more than 240,000 therms.

7 Energy Conservation Assistance Account (ECAA) values listed were provided by the Energy Commission when the same measures were co-funded from these two programs. Overlapping savings from these projects were accounted for in the cost-effectiveness study by attributing a portion of savings in both the ECAA-ARRA and EECBG Small Cities and Counties Programs.

**Table 7: Summary of Phase I and Phase II EECBG Small Cities and Counties Program Projects – Annual Ex Ante Energy Savings**

| EECBG Small Cities and Counties Program Element and Measure Group | Total Grant Expenditures | Annual Ex Ante Electricity Savings (kWh*) | Annual Ex Ante Therm Savings (therms) |
|---|---|---|---|
| DEP Lighting | $17,580,332 | 9,842,026 | - |
| DEP Lighting (Phase II) | | 2,624,009 | - |
| DEP HVAC | | 1,409,040 | 31,957 |
| DEP Other | | 1,822,164 | - |
| EEP Lighting | $14,300,895 | 12,752,301 | - |
| EEP HVAC | | 3,780,750 | 162,438 |
| EEP Other | | 2,106,874 | 45,644 |
| Total | $31,881,227 | 34,337,164 | 240,039 |

* kWh=kilowatt-hours
Source: California Energy Commission

These 204 projects involved a variety of end-use technologies and EEMs. As shown in Table 8, similar measures were grouped together to create measure-type categories, such as boiler, HVAC equipment, lighting, and so forth. About 67 percent of the measures implemented across all projects were lighting upgrades. HVAC measures composed about 24 percent of all measures implemented, and the remaining measures were composed of plug-load, pumps, fans, motors, and hot water system replacement measures. Table 9 provides a list of each grant, the grant amount, total project cost, and the expected savings. Project costs for Phase II projects were not made available to the evaluation team and thus are not included in Table 9. Appendix D provides detailed savings by measure for the program population.

**Table 8: EECBG Small Cities and Counties Program Measure Summary**

| Measure Group | Measure Type | Total Number of Grants |
|---|---|---|
| HVAC | Air Conditioning | 11 |
| | HVAC Controls and Retrocommissioning | 30 |
| | HVAC − Chiller | 7 |
| | HVAC − Furnace | 4 |
| | HVAC − Packaged Units | 46 |
| | HVAC − Heat Pump | 5 |
| | HVAC − Programmable Thermostats | 16 |
| | HVAC − Boilers | 4 |
| Lighting | Interior and Exterior Lighting | 140 |
| | Lighting Controls | 37 |
| | Streetlighting | 67 |
| | Traffic Signals | 13 |
| Other | Aeration unit | 2 |
| | Building Shell Measures | 9 |
| | Climate Action Plan | 1 |
| | DHW | 8 |
| | PC Power Management Measure | 4 |
| | Premium Efficiency Motor | 15 |
| | Premium Efficiency Motor with VFD | 6 |
| | VFD | 13 |
| | Vending Machine Controls | 11 |
| | Ozone Laundry | 1 |

Source: California Energy Commission

**Table 9: EECBG Small Cities and Counties Program Projects – Grant Expenditures, and Annual Ex Ante Energy Savings**

| Sub-Award Number | Subrecipient Name | EECBG Small Cities and Counties Program Component | Total Grant Expenditures | Annual Ex Ante Electricity Savings (kWh) | Annual Ex Ante Natural Gas Savings (therms) |
|---|---|---|---|---|---|
| CBG-09-001 | Scotts Valley, City of | DEP | $61,709 | 46,976 | - |
| CBG-09-002 | Soledad, City of | DEP | $144,013 | 80,024 | - |
| CBG-09-003 | Santa Cruz, County of | EEP | $746,372 | 373,749 | 63,102 |
| CBG-09-004 | Greenfield, City of | DEP | $82,019 | 39,742 | - |
| CBG-09-005 | Albany, City of | DEP | $88,548 | 36,742 | - |
| CBG-09-006 | Placer, County of | EEP | $591,392 | 792,743 | 8,567 |
| CBG-09-007 | King City, City of | DEP | $63,544 | 40,734 | - |
| CBG-09-008 | Laguna Woods, City of | EEP | $99,414 | 70,678 | 58 |
| CBG-09-009 | Marysville, City of | DEP | $69,804 | 35,208 | - |
| CBG-09-010 | San Joaquin, County of | DEP | $836,781 | 1,458,403 | - |
| CBG-09-011 | Ripon, City of | EEP | $65,547 | 74,900 | 200 |
| CBG-09-012 | Tehama, City of | DEP | $6,371 | 12,801 | - |
| CBG-09-013 | Del Mar, City of | EEP | $25,000 | 21,478 | - |
| CBG-09-014 | Lafayette, City of | DEP | $137,000 | 51,798 | - |
| CBG-09-015 | Inyo, County of | EEP | $65,204 | 353,799 | - |
| CBG-09-016 | Coronado, City of | DEP | $125,762 | 142,559 | - |
| CBG-09-017 | Nevada, County of | EEP | $373,291 | 403,119 | 12,728 |
| CBG-09-018 | San Juan Capistrano, City of | DEP | $167,171 | 35,719 | - |
| CBG-09-019 | La Verne, City of | EEP | $172,377 | 445,948 | - |
| CBG-09-020 | Calaveras, County of | EEP | $126,592 | 178,460 | - |
| CBG-09-021 | Merced, County of | DEP | $511,566 | 393,230 | - |
| CBG-09-022 | Hollister, City of | DEP | $199,673 | 128,466 | - |
| CBG-09-023 | Lathrop, City of | DEP | $79,746 | 34,327 | - |
| CBG-09-025 | East Palo Alto, City of | DEP | $179,868 | 70,361 | - |
| CBG-09-026 | Mono, County of | EEP | $49,350 | 44,521 | 113 |
| CBG-09-027 | San Marino, City of | DEP | $71,904 | 45,936 | 608 |
| CBG-09-028 | El Paso de Robles, City of | DEP | $155,239 | 68,328 | - |
| CBG-09-029 | Yucca Valley, Town of | DEP | $95,918 | 36,106 | - |
| CBG-09-030 | Siskiyou County Economic Development Council | EEP | $270,511 | 270,503 | - |
| CBG-09-031 | Oakley, City of | DEP | $168,314 | 100,556 | - |
| CBG-09-032 | Foster City, City of | DEP | $157,426 | 149,397 | - |
| CBG-09-034 | Tehama, County of | DEP | $119,816 | 73,647 | 28,339 |

| Sub-Award Number | Subrecipient Name | EECBG Small Cities and Counties Program Component | Total Grant Expenditures | Annual Ex Ante Electricity Savings (kWh) | Annual Ex Ante Natural Gas Savings (therms) |
|---|---|---|---|---|---|
| CBG-09-035 | Yolo, County of | EEP | $129,238 | 107,007 | 2,636 |
| CBG-09-036 | Seaside, City of | EEP | $185,282 | 212,836 | - |
| CBG-09-037 | Dixon, City of | DEP | $97,561 | 54,019 | - |
| CBG-09-038 | Walnut, City of | EEP | $172,254 | 312,640 | - |
| CBG-09-039 | Loma Linda, City of | DEP | $123,200 | 122,640 | - |
| CBG-09-040 | Menlo Park, City of | DEP | $163,154 | 15,100 | - |
| CBG-09-041 | Beaumont, City of | DEP | $145,746 | 120,607 | 417 |
| CBG-09-042 | Burlingame, City of | EEP | $150,010 | 249,413 | - |
| CBG-09-043 | Pinole, City of | DEP | $60,555 | 39,484 | - |
| CBG-09-044 | Fairfax, Town of | DEP | $38,178 | 11,261 | - |
| CBG-09-045 | Goleta, City of | DEP | $159,293 | 129,056 | - |
| CBG-09-046 | Norco, City of | EEP | $84,248 | 154,570 | - |
| CBG-09-047 | Willows, City of | DEP | $31,957 | 39,289 | - |
| CBG-09-048 | Calimesa, City of | DEP | $42,246 | 32,628 | 87 |
| CBG-09-049 | Orland, City of | DEP | $25,000 | 10,187 | 351 |
| CBG-09-050 | Lemoore, City of | DEP | $136,469 | 49,857 | - |
| CBG-09-051 | Hercules, City of | DEP | $126,555 | 40,195 | - |
| CBG-09-052 | Benicia, City of | DEP | $94,686 | 130,392 | - |
| CBG-09-053 | Laguna Hills, City of | DEP | $144,399 | 389,559 | - |
| CBG-09-054 | Desert Hot Springs, City of | EEP | $137,872 | 291,475 | 404 |
| CBG-09-055 | Dinuba, City of | EEP | $103,780 | 106,933 | - |
| CBG-09-056 | Duarte, City of | EEP | $122,117 | 160,199 | 556 |
| CBG-09-057 | Laguna Beach, City of | EEP | $131,079 | 166,665 | - |
| CBG-09-058 | Artesia, City of | DEP | $44,500 | 1,414 | - |
| CBG-09-059 | Belmont, City of | DEP | $131,286 | 116,633 | - |
| CBG-09-060 | Larkspur, City of | DEP | $62,025 | 41,849 | - |
| CBG-09-061 | Brawley, City of | DEP | $120,000 | 58,657 | - |
| CBG-09-062 | Windsor, Cotati, and Cloverdale Collaborative | DEP | $208,663 | 58,218 | - |
| CBG-09-063 | Patterson, City of | DEP | $111,563 | 98,688 | - |
| CBG-09-064 | San Benito, County of | EEP | $69,958 | 108,407 | - |
| CBG-09-065 | Piedmont, City of | DEP | $58,369 | 23,596 | - |
| CBG-09-066 | Grover Beach, City of | EEP | $71,058 | 71,452 | - |
| CBG-09-067 | American Canyon, City of | DEP | $88,498 | 67,255 | - |
| CBG-09-068 | Signal Hill, City of | DEP | $60,000 | 16,172 | - |

| Sub-Award Number | Subrecipient Name | EECBG Small Cities and Counties Program Component | Total Grant Expenditures | Annual Ex Ante Electricity Savings (kWh) | Annual Ex Ante Natural Gas Savings (therms) |
|---|---|---|---|---|---|
| CBG-09-069 | Canyon Lake, City of | DEP | $48,020 | 38,093 | - |
| CBG-09-070 | Clayton, City of | DEP | $61,811 | 57,740 | - |
| CBG-09-071 | Los Alamitos, City of | DEP | $22,682 | 134,668 | - |
| CBG-09-072 | Grand Terrace, City of | DEP | $33,238 | 15,645 | - |
| CBG-09-073 | Farmersville, City of | DEP | $40,500 | 43,685 | 461 |
| CBG-09-074 | Gonzales, City of | DEP | $47,225 | 44,698 | - |
| CBG-09-075 | San Juan Bautista, City of | DEP | $24,439 | 17,856 | - |
| CBG-09-076 | Live Oak, City of | EEP | $26,223 | 48,680 | - |
| CBG-09-077 | Villa Park, City of | EEP | $26,985 | 27,333 | - |
| CBG-09-078 | Agoura Hills, City of | DEP | $124,741 | 35,248 | - |
| CBG-09-079 | Carpinteria, City of | DEP | $74,117 | 96,750 | - |
| CBG-09-080 | Mill Valley, City of | EEP | $71,550 | 107,172 | - |
| CBG-09-082 | Monterey, City of | DEP | $146,313 | 125,369 | - |
| CBG-09-083 | La Palma, City of | DEP | $85,346 | 131,499 | 158 |
| CBG-09-084 | Oroville, City of | DEP | $82,126 | 72,708 | - |
| CBG-09-085 | El Cerrito, City of | EEP | $123,066 | 59,720 | - |
| CBG-09-087 | Brisbane, City of | DEP | $25,000 | 24,295 | - |
| CBG-09-088 | Colma, Town of | DEP | $25,000 | 14,368 | - |
| CBG-09-089 | Morro Bay, City of | DEP | $55,314 | 64,207 | - |
| CBG-09-090 | Fort Bragg, City of | EEP | $36,458 | 37,473 | - |
| CBG-09-091 | Emeryville, City of | DEP | $52,097 | 60,844 | - |
| CBG-09-092 | Loyalton, City of | EEP | $24,038 | 23,475 | - |
| CBG-09-093 | Livingston, City of | EEP | $77,464 | 182,344 | - |
| CBG-09-094 | Millbrae, City of | DEP | $112,630 | 64,957 | - |
| CBG-09-095 | San Carlos, City of | DEP | $127,449 | 223,968 | - |
| CBG-09-096 | Big Bear Lake, City of | DEP | $34,836 | 31,168 | - |
| CBG-09-097 | Gridley, City of | DEP | $34,602 | 24,173 | - |
| CBG-09-099 | Shasta Lake, City of | DEP | $58,554 | 30,982 | - |
| CBG-09-101 | Moraga, Town of | EEP | $80,824 | 67,311 | 5,922 |
| CBG-09-102 | NCPA Collaborative | DEP | $165,711 | 143,416 | - |
| CBG-09-103 | Acterra | EEP | $166,746 | 73,877 | 12,000 |
| CBG-09-104 | Imperial Beach, City of | DEP | $128,625 | 142,632 | - |
| CBG-09-105 | Santa Clara, County of | EEP | $229,952 | 269,369 | 3,218 |
| CBG-09-106 | Tuolumne, County of | EEP | $289,483 | 296,119 | 40 |

| Sub-Award Number | Subrecipient Name | EECBG Small Cities and Counties Program Component | Total Grant Expenditures | Annual Ex Ante Electricity Savings (kWh) | Annual Ex Ante Natural Gas Savings (therms) |
|---|---|---|---|---|---|
| CBG-09-107 | Calistoga, City of | DEP | $27,207 | 10,730 | - |
| CBG-09-108 | Del Rey Oaks, City of | EEP | $15,811 | 13,703 | 534 |
| CBG-09-109 | Truckee, Town of | EEP | $89,354 | 77,739 | 1,523 |
| CBG-09-110 | Blythe, City of | DEP | $129,700 | 117,000 | - |
| CBG-09-111 | Stanislaus, County of | EEP | $128,782 | 128,856 | - |
| CBG-09-112 | San Pablo, City of | DEP | $169,886 | 271,214 | - |
| CBG-09-113 | La Habra Heights, City of | DEP | $32,860 | 43,311 | 9 |
| CBG-09-114 | Wildomar, City of | DEP | $130,998 | 132,442 | - |
| CBG-09-115 | Loomis, Town of | DEP | $31,814 | 29,965 | - |
| CBG-09-116 | Pismo Beach, City of | DEP | $46,401 | 12,180 | - |
| CBG-09-117 | Marina, City of | DEP | $98,913 | 99,824 | - |
| CBG-09-118 | Corning, City of | EEP | $40,604 | 30,975 | 1,951 |
| CBG-09-119 | Mammoth Lakes, Town of | EEP | $41,646 | 0 | 4,730 |
| CBG-09-120 | Calipatria, City of | DEP | $48,369 | 52,299 | - |
| CBG-09-121 | Carmel-by-the-Sea, City of | EEP | $16,900 | 17,939 | 416 |
| CBG-09-122 | San Anselmo, Town of | DEP | $64,622 | 39,315 | - |
| CBG-09-123 | Pacific Grove, City of | DEP | $80,900 | 60,001 | - |
| CBG-09-124 | Atascadero, City of | DEP | $101,585 | 172,003 | - |
| CBG-09-125 | Pleasant Hill, City of | EEP | $179,963 | 164,671 | 7,230 |
| CBG-09-126 | Marin, County of | EEP | $376,953 | 547,565 | 44,723 |
| CBG-09-128 | Suisun City, City of | EEP | $122,994 | 239,715 | - |
| CBG-09-129A | Alameda, County of | DEP | $300,000 | 1,007,962 | - |
| CBG-09-130 | Needles, City of | DEP | $29,999 | 11,160 | - |
| CBG-09-131 | Sutter, County of | EEP | $139,130 | 66,791 | - |
| CBG-09-132 | Menifee, City of[8] | DEP | $355,491 | 113,094 | - |
| CBG-09-134 | Ventura County Collaborative | EEP | $932,807 | 1,484,443 | - |
| CBG-09-135 | San Joaquin Valley Unified Air Pollution Control District | EEP | $2,261,746 | 2,709,907 | - |
| CBG-09-136 | San Joaquin Valley Unified Air Pollution Control District | DEP | $1,689,732 | 1,603,798 | - |
| CBG-09-137 | Barstow, City of | EEP | $140,166 | 191,210 | - |
| CBG-09-138 | Saratoga, City of | DEP | $165,863 | 39,934 | - |

8 The city of Menifee is not small by population but was not an incorporated city at the time the U.S. DOE developed the large cities and counties categorization.

| Sub-Award Number | Subrecipient Name | EECBG Small Cities and Counties Program Component | Total Grant Expenditures | Annual Ex Ante Electricity Savings (kWh) | Annual Ex Ante Natural Gas Savings (therms) |
|---|---|---|---|---|---|
| CBG-09-139 | San Fernando, City of | DEP | $132,666 | 91,472 | - |
| CBG-09-140 | Imperial, County of | DEP/EEP | $243,506 | 745,000 | - |
| CBG-09-141 | Hillsborough, Town of | DEP | $58,463 | 45,373 | - |
| CBG-09-142 | Westlake Village, City of | DEP | $47,351 | 45,078 | - |
| CBG-09-143 | Galt, City of | DEP | $133,547 | 101,266 | - |
| CBG-09-144 | Susanville, City of | EEP | $99,685 | 159,879 | -7,785 |
| CBG-09-145 | Indian Wells, City of | DEP | $29,130 | 128,312 | - |
| CBG-09-147 | Lawndale, City of | EEP | $175,818 | 116,802 | 7,513 |
| CBG-09-149 | Hermosa Beach, City of | EEP | $108,136 | 139,720 | - |
| CBG-09-151 | Rolling Hills Estates, City of | EEP | $43,580 | 32,225 | - |
| CBG-09-152 | Twentynine Palms, City of | EEP | $171,551 | 152,412 | 1,297 |
| CBG-09-153 | Del Norte, County of | EEP | $122,157 | -2,296 | 12,548 |
| CBG-09-154 | Seal Beach, City of | EEP | $127,425 | 124,558 | - |
| CBG-09-155 | El Segundo, City of | EEP | $82,237 | 547,916 | - |
| CBG-09-156 | Lake, County of | EEP | $160,088 | 73,073 | 1,382 |
| CBG-09-157 | Auburn, City of | DEP | $72,403 | 39,987 | - |
| CBG-09-158 | Amador, County of | EEP | $117,983 | 110,004 | 318 |
| CBG-09-159 | Santa Fe Springs, City of | DEP | $95,064 | 287,560 | - |
| CBG-09-160 | Winters, City of | DEP | $35,302 | 20,721 | - |
| CBG-09-161 | Sebastopol, City of | EEP | $35,701 | 9,490 | - |
| CBG-09-162 | Calabasas, City of | EEP | $85,972 | 82,481 | - |
| CBG-09-163 | Glenn, County of | DEP | $73,640 | 45,575 | 388 |
| CBG-09-164 | Mendocino, County of | EEP | $339,888 | 438,231 | 3,095 |
| CBG-09-165 | Commerce, City of | EEP | $74,956 | 93,124 | - |
| CBG-09-166 | Anderson, City of | EEP | $60,746 | 39,976 | - |
| CBG-09-167 | South El Monte, City of | EEP | $108,256 | 128,746 | 257 |
| CBG-09-168 | Jackson, City of | DEP | $21,489 | 6,363 | - |
| CBG-09-169 | Clearlake, City of | EEP | $86,138 | 145,682 | -902 |
| CBG-09-170 | Placerville, City of | DEP | $55,226 | 56,739 | - |
| CBG-09-171 | Sierra Madre, City of | EEP | $51,242 | 63,510 | - |
| CBG-09-172 | Orinda, City of | DEP | $24,437 | 19,084 | - |
| CBG-09-173 | Solana Beach, City of | EEP | $70,365 | 70,958 | - |
| CBG-09-175 | Ridgecrest, City of | DEP | $59,417 | 155,172 | - |
| CBG-09-176 | Irwindale, City of | DEP | $6,613 | 30,422 | - |

| Sub-Award Number | Subrecipient Name | EECBG Small Cities and Counties Program Component | Total Grant Expenditures | Annual Ex Ante Electricity Savings (kWh) | Annual Ex Ante Natural Gas Savings (therms) |
|---|---|---|---|---|---|
| CBG-09-177 | El Dorado, County of | DEP | $729,734 | 352,441 | - |
| CBG-09-178 | Arroyo Grande, City of | EEP | $92,236 | 69,715 | 1,085 |
| CBG-09-179 | Hawaiian Gardens, City of | EEP | $85,105 | 84,330 | - |
| CBG-09-180 | South Lake Tahoe, City of | DEP | $130,311 | 186,889 | - |
| CBG-09-182 | Rancho Mirage, City of | EEP | $95,052 | 97,156 | - |
| CBG-09-183 | South Pasadena, City of | EEP | $126,885 | 222,717 | - |
| CBG-09-184 | Los Gatos, Town of | DEP | $162,712 | 65,990 | - |
| CBG-09-185 | Guadalupe, City of | DEP | $30,640 | 13,569 | - |
| CBG-09-186 | Nevada City, City of | DEP | $25,000 | 26,161 | - |
| CBG-09-187 | Holtville, City of | DEP | $34,425 | 19,572 | 351 |
| CBG-09-189 | Adelanto, City of | EEP | $143,447 | 181,477 | - |
| CBG-09-190 | Yuba, County of | EEP | $328,909 | 465,124 | - |
| CBG-09-191 | Ione, City of | DEP | $13,779 | 16,506 | - |
| CBG-09-192 | Mariposa, County of | DEP | $102,062 | 25,798 | 606 |
| CBG-09-193 | Wheatland, City of | DEP | $24,698 | 27,050 | - |
| CBG-09-194 | Shasta, County of | EEP | $404,857 | 494,268 | 1,470 |
| CBG-09-195 | Yountville, Town of | EEP | $25,000 | 97,808 | 580 |
| CBG-09-196 | St. Helena, City of | EEP | $31,605 | 14,220 | - |
| CBG-09-197 | Solano, County of | DEP | $112,319 | 244,592 | - |
| CBG-09-198 | Northern Rural Training & Employment Consortium | DEP | $211,111 | 150,606 | 182 |
| CBG-09-199 | North Coast Integrated Regional Water Management Plan | EEP | $972,824 | 1,389,606 | 16,419 |
| CBG-09-201 | Williams, City of | DEP | $25,182 | 13,674 | - |
| CBG-09-202 | La Cañada Flintridge, City of | DEP | $115,667 | 137,272 | - |
| CBG-09-203 | Red Bluff, City of | DEP | $75,265 | 49,687 | - |
| CBG-09-204 | Plumas, County of | DEP | $108,509 | 91,189 | - |
| CBG-09-205 | Lomita, City of | EEP | $99,718 | 106,616 | - |
| CBG-09-206 | Beverly Hills, City of | EEP | $191,742 | 334,190 | 154 |
| CBG-09-207 | Half Moon Bay, City of | DEP | $53,832 | 199,548 | - |
| CBG-09-208 | Lemon Grove, City of | DEP | $132,374 | 149,870 | - |
| CBG-11-002 | Marysville, City of | Phase II | $447,790 | 335,000 | - |
| CBG-11-003 | East Palo Alto, City of | Phase II | $247,231 | 94,870 | - |
| CBG-11-004 | Riverbank, City of | Phase II | $536,033 | 430,800 | - |
| CBG-11-005 | Sausalito, City of | Phase II | $78,514 | 110,000 | - |

| Sub-Award Number | Subrecipient Name | EECBG Small Cities and Counties Program Component | Total Grant Expenditures | Annual Ex Ante Electricity Savings (kWh) | Annual Ex Ante Natural Gas Savings (therms) |
|---|---|---|---|---|---|
| CBG-11-006 | Lemoore, City of | Phase II | $635,144 | 232,349 | - |
| CBG-11-007 | Big Bear Lake, City of | Phase II | $66,555 | 19,513 | - |
| CBG-11-008 | Shasta Lake, City of | Phase II | $365,000 | 144,750 | - |
| CBG-11-010 | Foster City, City of | Phase II | $747,814 | 710,280 | - |
| CBG-11-011 | Del Mar, City of | Phase II | $25,000 | 31,000 | - |
| CBG-11-012 | Laguna Beach, City of | Phase II | $16,272 | 810 | - |
| CBG-11-013 | Menlo Park, City of | Phase II | $328,294 | 514,637 | - |
| Total (204 Grants) | | | $31,881,227 | 34,337,164 | 240,039 |

Source: California Energy Commission

# CHAPTER 3: Evaluation Approach

The overall goal of the evaluation was to assess the EECBG Small Cities and Counties Program's implementation effectiveness and to verify energy savings from grants issued between 2009 through 2012. Evaluators also sought to estimate GHG reductions, to collect qualitative data about job creation and the ability to penetrate hard-to-reach local jurisdictions, and to assess the program's cost-effectiveness.

After finalizing an evaluation plan in April 2011, evaluators conducted the evaluation from May 2011 through May 2013.

The evaluation relied on a number of data sources:

- **Interviews and ongoing discussions with the Energy Commission's staff, including contract agreement managers (CAM), engineers, and technical support staff.** Initial interviews covered topics related to developing an understanding of the program's overall goals and design and to identifying uncertainties and risks associated with the program's delivery and execution. Ongoing discussions addressed the program's organization and management and tracked changes in project-specific scope and implementation.
- **Program-specific documents, including a range of summary data and project-specific documents such as feasibility studies and savings calculations.** The evaluation team developed a Microsoft® Excel database to store project-specific details and periodically reviewed and updated it using EECBG Small Cities and Counties Program status reports and project documentation reviews throughout the evaluation.
- **Site visits, which were conducted for a sample of 51 project sites across 38 subrecipients to support program savings estimates.** The evaluation team completed site-specific engineering analyses and measurement and verification (M&V) activities for the sampled projects and extrapolated results to the full project population.
- **In-depth interviews, which were attempted by telephone for each of the 51 sampled project sites.** The evaluation team was successful in conducting a total of 30 interviews with decision-makers representing 39 project sites. The primary purpose of the interviews was to gather information about the program's effectiveness and attribution.

The following sections provide short descriptions of key evaluation activities. Appendix A provides a detailed description of the method of the evaluation, and Appendix B provides detailed field collection protocols for the most common measures.

## Sample Design

As discussed in Chapter 2, the EECBG Small Cities and Counties Program targeted a wide variety of measures: simple HVAC equipment replacements and street light upgrades, more complicated projects such as large lighting and HVAC retrofits in many buildings across a city or county, and VFDs for city well pumps. The major targets were lighting and HVAC retrofits for both the EEP and DEP projects.

Within a grant, many measures could be implemented—sometimes across a broad geographic area. Some of the larger or geographically diverse grants were broken into project sites for the evaluation. The initial population based on tracking data updated by the Energy Commission in June 2011 consisted of 266 projects defined for the evaluation, across 198 grants. A primary sample and backup sample were generated as part of the design; the final population consisted of 257 projects across 193 grants.

To develop a representative sample of projects, DNV KEMA stratified the projects into three groups, representing the ease or difficulty of predicting the energy savings. The evaluation team assessed the uncertainty and cost to evaluate each project. The uncertainty is expressed by an error ratio. An error ratio was assigned to each measure and then extrapolated to each project, based on the weighted sum of measures in each project. Where savings are more easily predicted, less difference is expected between the savings estimates developed by the Energy Commission (ex ante savings) and the evaluation (ex post savings). The EECBG ex ante savings estimates were assessed by reviewing project documentation; each project was then 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 straight-forward lighting measures, were expected to have less variation and assigned to a "Low" group. The remaining projects were assigned to a "Medium" group. The "High" variability group projects were sampled at a higher frequency, to improve the accuracy of the evaluation.

Model-based statistical sampling methodology was 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, or kilo British thermal units (kBtu), which allows combining electric and natural gas savings.

## Evaluation Sample

Table 10 lists the 38 sampled projects by measure group and energy savings. The evaluation team sampled 51 sites within these 38 projects. The sampled EECBG sites account for 32 percent of ex ante annual kWh results and 57 percent of reported annual therm outcomes. Detailed site reports for each sampled project may be found in Appendix E.

**Table 10: Sampled EECBG Small Cities and Counties Program Projects – Measure Groups and Annual Ex Ante Energy Savings**

| Sub-Award Number | Subrecipient Name | Measure Group | Annual Ex Ante Electricity Savings (kWh) | Annual Ex Ante Natural Gas Savings (therms) |
|---|---|---|---|---|
| CBG-09-003 | Santa Cruz, County of | HVAC, Other | 373,749 | 63,102 |
| CBG-09-006* | Placer, County of | HVAC, Lighting, Other | 686,761 | 6,317 |
| CBG-09-010* | San Joaquin, County of | HVAC, Other | 1,346,012 | - |
| CBG-09-015 | Inyo, County of | Lighting, Other | 353,799 | - |
| CBG-09-017 | Nevada, County of | HVAC, Lighting | 403,119 | 12,728 |
| CBG-09-021 | Merced, County of | Lighting | 393,230 | - |
| CBG-09-026 | Mono, County of | HVAC, Lighting | 44,521 | 113 |
| CBG-09-027 | San Marino, City of | HVAC | 45,936 | 608 |
| CBG-09-028 | El Paso de Robles, City of | Lighting | 68,328 | - |
| CBG-09-032* | Foster City, City of | Lighting | 149,397 | - |
| CBG-09-035 | Yolo, County of | HVAC, Lighting | 107,007 | 2,636 |
| CBG-09-037 | Dixon, City of | Lighting | 54,019 | - |
| CBG-09-038 | Walnut, City of | HVAC, Lighting | 312,640 | - |
| CBG-09-042 | Burlingame, City of | Lighting | 249,413 | - |
| CBG-09-057 | Laguna Beach, City of | HVAC, Lighting | 166,665 | - |
| CBG-09-088 | Colma, Town of | Lighting | 14,368 | - |
| CBG-09-090 | Fort Bragg, City of | Lighting, Other | 37,473 | - |
| CBG-09-094 | Millbrae, City of | Lighting | 64,957 | - |
| CBG-09-099 | Shasta Lake, City of | Other | 30,982 | - |
| CBG-09-106 | Tuolumne, County of | HVAC, Lighting | 296,119 | 40 |
| CBG-09-111 | Stanislaus, County of | Lighting | 128,856 | - |
| CBG-09-126* | Marin, County of | HVAC, Lighting, Other | 311,655 | 44,723 |
| CBG-09-129A* | Alameda, County of | Lighting | 706,777 | - |
| CBG-09-134* | Ventura County Collaborative | HVAC, Lighting | 265,239 | - |
| CBG-09-135* | San Joaquin Valley Unified Air Pollution Control District | Lighting, HVAC, Other | 767,362 | - |

| Sub-Award Number | Subrecipient Name | Measure Group | Annual Ex Ante Electricity Savings (kWh) | Annual Ex Ante Natural Gas Savings (therms) |
|---|---|---|---|---|
| CBG-09-136* | San Joaquin Valley Unified Air Pollution Control District | HVAC, Lighting, Other | 313,692 | - |
| CBG-09-137* | Barstow, City of | Lighting, Other | 169,064 | - |
| CBG-09-154 | Seal Beach, City of | HVAC, Lighting | 124,558 | - |
| CBG-09-158 | Amador, County of | HVAC, Lighting | 110,004 | 318 |
| CBG-09-164-01 | Mendocino, County of | HVAC, Lighting | 438,231 | 3,095 |
| CBG-09-167 | South El Monte, City of | HVAC, Lighting, Other | 128,746 | 257 |
| CBG-09-169* | Clearlake, City of | Lighting, Other | 130,629 | (902) |
| CBG-09-171 | Sierra Madre, City of | HVAC, Lighting | 63,510 | - |
| CBG-09-184 | Los Gatos, Town of | Lighting | 65,990 | - |
| CBG-09-190* | Yuba, County of | Lighting, Other | 312,300 | - |
| CBG-09-192 | Mariposa, County of | HVAC, Lighting, Other | 25,798 | 606 |
| CBG-09-194* | Shasta, County of | HVAC, Lighting | 406,074 | 1,470 |
| CBG-09-199* | North Coast Integrated Regional Water Management Plan | HVAC, Lighting, Other | 296,549 | 1,818 |
| Total for the sampled projects (38 Grants) | | | 9,963,529 | 136,929 |
| Total for all Phase I projects (193 Grants) | | | 31,713,155 | 240,039 |
| Sampled projects as percent of all Phase I projects | | | 31% | 57% |

* The sampled activities for these grants represent only a portion of the total project activities completed under the EECBG Small Cities and Counties Program. The annual ex ante savings estimates shown for each of these 13 grants are a subset of the total for each grant, as listed above in Table 9.
Source: California Energy Commission

The projects in the EECBG Small Cities and Counties Program involved a variety of end-use technologies and energy efficiency measures. In each grant, specific project activities designed to save energy were grouped together and tracked by measure category or in ways that were consistent with loan. For example, some loans included only one grouping, such as a lighting retrofit, regardless of how many fixtures were replaced. Other projects might track project components by location and may list four lighting retrofits. These tracked measure groupings were compiled into a database, and the evaluation reported savings results by these groupings. A total of 1,353 electric- and 123 gas-tracked measure groupings are included in the 2009 through 2011 projects evaluated.

## Data Collection Method

This section provides a brief overview of data collection method. Additional detail on data collection methodis provided in Appendices A and B.

Data collection activities 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 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 from site contacts and the Energy Commission. The evaluation team reviewed this information.
- **Site scheduling.** For each sampled project, an evaluation engineer contacted a site representative to initiate site planning, to confirm project details, and to schedule a site visit.
- **Site planning.** Following data review and assessment, evaluation engineers developed customized data collection and analysis plans for each sampled project, including brief descriptions of data requirements and analysis approaches to determine pre- and postinstallation assumptions and conditions. Where possible, baseline conditions were evaluated with preinstallation site visits or monitoring. Sites were selected early in the evaluation for preinstallation monitoring, specifically for HVAC measures. These sites were chosen based on whether it was possible to collect useful data, either from an existing energy management system or from conducting an additional site visit and installing monitoring equipment. Since HVAC system operation is seasonally driven, sites were selected based on the type of equipment and the timing of the evaluation. For streetlighting projects, evaluators used a standardized approach.
- **Site-specific M&V**. The evaluation team verified installed equipment and collected data to catalog pre- and postretrofit operations and conditions, including equipment nameplates, feasibility study reviews, self-reported operational data, and spot measurements. At several sites, the evaluation team installed data loggers and collected measurements over a two-week or longer period. The on-site visits allowed the evaluation team to collect additional information to verify savings claims that would not have been otherwise available had the team conducted only desk reviews. This additional information led to significantly more accurate estimates of program savings. Where available and appropriate, billing data was collected as an additional cross-check of savings achieved.
- **In-depth interviews with participants.** Evaluators developed an in-depth interview guide, located in Appendix C, to ask participants research questions that ranged from attribution to satisfaction. In this stage evaluators also derived information concerning preexisting equipment (condition, age, reasons for installing, and so on) that was used to inform analysis.

## Site-Specific Analyses to Determine Energy Savings

Energy savings calculations depended on the estimated base-case energy use of a given measure before a retrofit and its estimated energy use subsequent to the retrofit. The evaluation team established base-case conditions 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, the evaluation team used information from a feasibility study, site contact, as-built drawings, and research and engineering judgment to establish the base-case parameters.
- Postretrofit data were collected similarly, and base-case parameters were established.

The evaluation team identified sites where monitoring could be done to document the conditions before installation of the measure. In many cases, the equipment had already been installed, and monitoring of the preinstallation condition was not possible. The evaluation team selected several sites for preinstallation monitoring, based on when the existing equipment was available to monitor in the appropriate season to collect useful information. In one case, preinstallation monitoring was performed for the HVAC system, but the final project scope changed and the HVAC project was not included.

For each site within the sample, evaluators determined the efficiency of a measure, the effective useful life (EUL) of a measure, and the remaining useful life (RUL) of the preretrofit equipment. The evaluation team also normalized both pre- and postretrofit data to the same operating conditions to establish savings estimates that could be directly compared. If the final scope included measures not installed during the on-site evaluation, the evaluation team included only the evaluated measures as sampled measures. The savings for additional measures were estimated as part of the extrapolation to nonsampled measures. When the final scope didn't match the measures found on-site, the evaluation team included only the savings from the measures in the final scope. Appendix A provides the detailed method employed to determine these parameters.

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

For EEP, the Energy Commission based its project approval decisions on the ex ante savings estimates of each block grant provided in the feasibility studies. To supply a basis for comparing ex ante savings estimates, this evaluation report provides the Energy Commission with estimated gross savings, which assumed the same annual savings from a measure regardless of whether the measure would have been implemented due to equipment failure at some estimated future time. Throughout the report, the evaluation team refers to these savings estimates as Baseline 1 gross savings. To be consistent with evaluation practice, evaluators also

report a second baseline, which recognizes that as equipment fails it is replaced with equipment which meets the current efficiency standard.

As a result, energy savings calculated for this program are relative to two established baselines: Baseline 1 and Baseline 2.

- 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 by 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 preexisting 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. This baseline is useful for calculation of payback period.
- Baseline 2 uses the preexisting equipment as the baseline of the measure only until the end of the RUL of the existing equipment. 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 the 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 preexisting 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.

For many measures, the two baselines are the same. Add-on measures, such as occupancy sensors to reduce lighting energy and retrocommissioning[9] measures to improve controls and operation, do not change the efficiency of the underlying equipment; there are no differences between the baselines. Lighting retrofits do not warrant Title 24 lighting power-density requirements when only lamps and ballasts are replaced through this program—and in this case, both baselines are the same.

Because the evaluation occurred concurrently with the implementation, the documentation for sites was often based on plans or information that did not reflect the final project. Also, for DEP projects, sites were not required to estimate savings in the beginning of the project. To calculate ex ante savings, the evaluation team determined exactly what measures were implemented at each site and performed independent savings calculations. There were a large number of sites where the original planned measures did not match those installed. The Energy Commission approved scope changes to projects, and the sites implemented measures that were allowed under the terms of the grants. The evaluation team provided an additional check on the final scope. If the final scope included measures not installed during the on-site evaluation, the evaluation team included only the evaluated measures as sampled measures. The savings for additional measures were estimated as part of the extrapolation to nonsampled measures. When the final scope didn't match the measures found on-site, the evaluation team included only the savings from the measures in the final scope.

## Measure Approaches for On-Site Activities and Analysis

The following provides the guidelines for general measure approaches, including data collection, field measurement, and analysis, for performing site-level evaluations for nearly all of the EECBG Small Cities and Counties Program's project types. The high-level measure approaches discussed below are described in detail in Appendix B.

### Street Lights and Traffic Signals

Evaluators verified streetlighting and traffic signal measures by direct inspection. The evaluator obtained a comprehensive list of the installed lights of the project from the site contact or CAM. The list specified fixture type and location for each newly installed fixture as well as for the preexisting lights. To verify the age and type of preexisting equipment, during the site visit the evaluator inspected a few preexisting lights that were removed from the lighting poles (if possible); this supported estimation of whether first-year energy savings would be adjusted for Baseline 2. The evaluator then selected a random sample of lighting fixtures to verify that installations matched records. The sampled fixtures were dispersed throughout the city and in a range of fixture wattages and types. Typically, a few hundred fixtures were verified in a single day, even though thousands may have been installed. Site contacts provided lighting schedules

9 Retrocommissioning examines existing building systems to find ways to improve energy performance in buildings

if timers were in use; if photocells were in use, the evaluator typically assumed an average of 12 hours of operation per day. Savings were calculated using operating hours, fixture counts, and the difference between the preexisting and installed fixture wattages.

### Exterior Lighting

Exterior lighting measures followed the same protocol as used with streetlighting measures, with one exception. Evaluators verified all fixtures for exterior lighting projects, unless the fixture quantities were too high to be counted during a single-day site visit. Similar to street lights, outdoor lights typically operate either on a fixed schedule or on photo sensor controls. In both cases, there is insufficient schedule variability to necessitate data logging.

### Interior Lighting and Lighting Controls

Interior lighting measures include a wide range of energy-efficient controls, fixtures, and lamps, including linear fluorescents, light-emitting diodes (LEDs), exit signs, compact fluorescent lights (CFLs), and high bay lighting for high ceilings. Evaluators calculated direct savings from lighting measures based on the following variables:

- Baseline and installed fixture wattages
- Baseline and installed fixture counts
- Baseline and installed fixture operating hours

In retrofit projects, fixture wattages and counts typically changed. In controls projects—which involve occupancy sensors, daylighting sensors, and/or timer controls—operating hours were generally affected. In all cases, the evaluator collected the wattage, counts, and hours of operation for baseline and installed fixtures and confirmed these with the site contact. In the event that observed fixture counts or types varied markedly from those claimed in the application, evaluators surveyed additional fixtures of the errant type.

### Vending Machine Misers

Direct savings calculations for vending machine misers are based on unit operating hours, number of units, energy load per unit, and number of occupants. Evaluators collected spot measurements of the energy load and verified that misers were installed and operating properly. Evaluators used either a research factor of expected energy reduction to determine the energy savings or an analysis based on the estimated reduction in operating hours and load.

### Industrial Motors and Pumps

Generally, projects industrial motors and pump projects entailed switching from less efficient motors and/or pumps to premium-efficiency motors and/or high-efficiency pumps, or installing variable-frequency drives. For pumps and motors, two factors dictated savings: the differing efficiencies between the installed and base case equipment and the load profile of the equipment. For variable-frequency drives, evaluators collected information from the site about the power draw of the motor and the load profile. During site visits, evaluators verified the equipment specifications for the newly installed and removed pumps and/or motors, confirmed pre- and postinstallation operating hours with the site contacts, and determined the load profile of the equipment using spreadsheet analysis. For sites where it was available, billing and

supervisory control and data acquisition (SCADA) data were used to develop annual usage profiles for the new pumps and motors and determine savings.

### Packaged HVAC Equipment

Evaluators determined savings from packaged HVAC retrofit measures using one of four approaches as defined in Appendix B. For each case, evaluators followed the same general steps. Evaluators verified unit installation, schedules, and operations with the site contact. The evaluator also gathered any available data on the preexisting units of a site, information on the control system, how the system typically operated, the age of the equipment, and operational maintenance issues. Depending on the number of newly installed units of a project, evaluators metered either a sample of the units or all of the units, as well as took spot measurements to ensure the validity of the metered data. Where a simulation modeling was developed by the implementer, the evaluator collected building information to verify a sample of the model inputs, including schedules and building shell characteristics; wall and roof insulation values, and roof color; window types, dimensions, orientations, window rate of heat transfer values, and solar heat gain coefficients; plugs loads (computers, monitors, copy machines, refrigerators, coffee machines, and so forth) and plug load schedules; lighting loads and schedules; process loads and schedules; HVAC system heating and cooling set points and scheduling, nameplate information; and fan operating strategies.

For a spreadsheet analysis, evaluators created a spreadsheet to develop the load profiles for both pre- and postretrofit conditions. When using an existing simulation model of the building, the evaluator calibrated the HVAC end use of the model to metered data by adjusting loads and other parameters in the model to bring the observed and modeled profiles into agreement.

### Built-Up HVAC Measures: Central Plant

Central plant HVAC measures include boiler retrofits, chiller retrofits, pump retrofits, and VFD installations, as well as many other possibilities. Evaluators established a load profile for newly installed central plant HVAC measures (pumps, cooling tower fans, chiller compressors, and so on). For most chilled-water measures, establishing a load profile for the loan- or grant-financed equipment required determining a load profile for the chiller, regardless of whether the measure directly affected the chiller. The evaluator correlated the power draw of the chiller to its corresponding outdoor conditions (or time of day for process chillers), and used the resulting load profile to project other parameters, such as flow rates and temperature drops.

For gas-related plant measures (boilers and large DHW heaters), evaluators used a different approach. In most instances, equipment specifications, schedule and data about the set points of controls, utility gas bills, and verified combustion efficiency data were the only data available to the evaluator. If the boilers or DHW heaters of the project were the only large gas users on the project participant's utility bills, the evaluators conducted an analysis using the differing efficiencies of the base case, installed boilers, and the gas load of the project facility. If other large gas users comprised a significant portion of the participant's gas utility bills, evaluators used a simplified building simulation-based analysis to assess project savings.

### Built-Up HVAC Measures: Air Side

Air-side HVAC measures may include air handler constant volume (CV) to variable air volume (VAV) conversions, economizer retrofits and retrocommissioning, programmable thermostat installations, energy management systems (EMS) upgrades (which may also affect plant equipment), and building set-point adjustments. For mechanical measures, evaluators used a spreadsheet analysis, informed by metered data, when the air delivery system of a site changes in some measureable way. Evaluators determined the effect of control measures using either spreadsheet analysis or simulation modeling. Evaluation engineers used simulation modeling for control measures only when ex ante simulation models were provided for review and modification.

### Custom Measures

Custom measures include a disparate array of measure types, ranging from computer server virtualization to mechanical aerators used in wastewater treatment. Each measure type requires that evaluators use their best engineering judgments to develop a measure-specific evaluation approach.

## Gross Energy Savings Calculations

Evaluators calculated gross site savings using the difference between the measure-treated energy usage and the appropriate baseline. Savings for most measures were calculated using a spreadsheet analysis. Evaluators collected end-use metered data, which were incorporated into the calculations or used to calibrate models.

## Net Energy Savings Calculations

Evaluators used participant interviews and information from Energy Commission managers to estimate to what extent the program was responsible for the achieved gross savings. Participants were asked a series of questions about the program's influence on their decision to implement measures. In addition, data gathered during the site evaluation about why the project was undertaken were considered in the determination of which participants were not influenced by the program. Evaluators weighted the achieved gross savings for projects from the fraction of participants who were not influenced by the program and compared those to the total gross savings of the sample; this percentage was subtracted from 100 percent to calculate the program's net-to-gross (NTG) ratio. This ratio is a factor that is applied to gross program impacts to convert them into net program load impacts. Therefore, if two participants who were not influenced by the program had a combined savings equaling 10 percent of sampled program savings, the program's NTG ratio would equal 90 percent.

## Life-Cycle Savings Calculations

Savings continue to accrue beyond the first year a local jurisdiction implements an energy-efficient measure. Lighting measures, including streetlighting, have an expected useful life of 15 years; HVAC equipment upgrade projects often have an expected useful life of 20 years. Controls and repair measures typically have shorter lifetimes of five to eight years, depending on the project. To calculate life-cycle savings for the total program, evaluators summed up the net life-cycle savings for all measures across all projects. Using Baseline 1, the life-cycle savings for a given measure equal the savings multiplied by the expected useful life of the measure. For Baseline 2, the calculation reflects both the RUL for the old equipment (at the annual savings of Baseline 1) and annual savings under standard conditions after the old equipment would have likely been replaced.

## GHG Reductions Calculations

The evaluation team calculated the total GHG emissions reduction resulting from the EECBG Small Cities and Counties Program. The team used emissions conversion factors approved by the Energy Commission. Because of California's efforts to reduce GHG 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. The method applied conversion factors to net energy savings, based on energy source, to calculate the carbon dioxide ($CO_2$) emissions reduction mass in pounds (lbs), which was then converted to metric tons. The team used the following factors:

- Electricity conversion factor: 690 lbs $CO_2$/MWh
- Natural gas conversion factor: 11.69 lbs $CO_2$/therm
- Liquid propane: 13.55 lbs $CO_2$/therm
- Diesel fuel oil: 16.31 lbs $CO_2$/therm
- Weight conversion: 2,204.6 lbs/metric ton

# CHAPTER 4: Results

This chapter presents the overall results from the EECBG Small Cities and Counties Program evaluation. This section begins with a discussion of the final sample disposition, followed by discussion of overall sample-level realization rates. The next section presents gross energy savings results for the program overall, including summaries by grant and measure type, and precision estimates for the evaluation sample. Then, net savings analysis results and other findings from the in-depth participant interviews are presented.

Overall, the program achieved significant energy savings, as shown in Table 11.

**Table 11: Evaluation Results – Gross Annual Program-Level Energy Savings**

| Baseline 1 | | Baseline 2 | |
|---|---|---|---|
| Annual Ex Post Electricity Savings (kWh) | Annual Ex Post Natural Gas Savings (therms) | Annual Ex Post Electricity Savings (kWh) | Annual Ex Post Natural Gas Savings (therms) |
| 33,564,591 | 175,470 | 32,245,439 | 127,822 |

Source: DNV KEMA analysis

Additional results are located in the appendices:

- Appendix D summarizes program tracking information, including ex ante savings estimates, for all projects covered under the scope of the evaluation.
- Appendix E provides the final project site reports of the evaluation sample.

## Sample Disposition

The evaluation team first reviewed the initial tracking data 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 (MBtu). 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 the equivalent of 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.

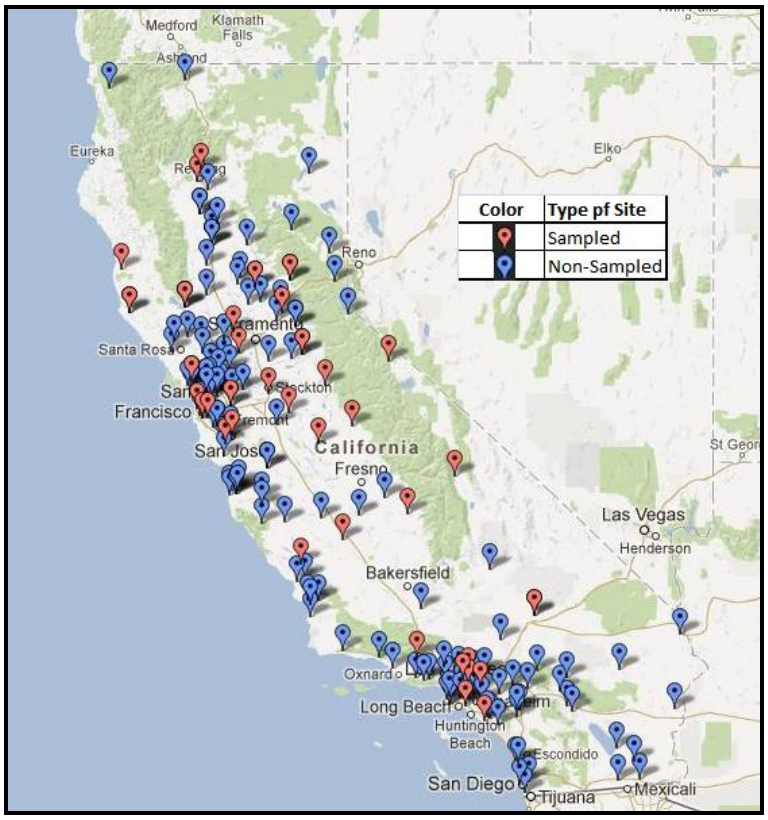
A primary sample and backup sample were generated as part of the design, which was based on the tracking data updated by the Energy Commission in June 2011. Of the initial 50 project sites selected for the sample, 15 were replaced with back up sites. In all cases, the reason for the

replacement was that the projects were not installed or commissioned within the evaluation time frame. One sampled site was replaced because the grant was cancelled. An additional site was added (part of the Santa Cruz County grant, CBG-09-033), resulting in a final sample size of 51 sites representing 38 unique grants.

The EECBG Small Cities and Counties Program allowed grant subrecipients to amend their scope throughout their projects, and many did. Thus, the ex ante savings estimates in the tracking data that the evaluation team initially used to draw the sample were not the same as the final ex ante savings estimates in this report. For example, seven grants in the initial tracking data were not in the final tracking data. In June 2011, there were 198 grants. At the end of 2012, 193 grants had been completed. The total ex ante savings in the EECBG Small Cities and Counties Program tracking data decreased from the initial sample to the final sample by about 20 percent. As discussed in Section 2, the Energy Commission opened up Phase II of the EECBG Small Cities and Counties Program in early 2012. These projects were not yet initiated at the time of evaluation and, as such, could not be included in the sample design; however, these projects were included in the final savings analysis for the overall program.

Figure 2 shows the statewide distribution of sampled and nonsampled projects. Table 12 shows the sample initially selected in June 2011 and the final sample.

**Figure 2: EECBG Sampled Projects – Statewide Distribution**




Source: California Energy Commission

**Table 12: EECBG Small Cities and Counties Program – Final Evaluation Sample Disposition**

| Original Sample Sub Award Number | Original Subrecipient and Site Name | Final Sample? | Replacement Sub Award Number | Replaced Subrecipient and Site Name |
|---|---|---|---|---|
| CBG-09-003 | Santa Cruz, County of − Santa Cruz | Yes | NA | |
| CBG-09-003 | Santa Cruz, County of − Watsonville | Yes | NA | |
| CBG-09-006 | Placer, County of | Yes | NA | |
| CBG-09-010 | San Joaquin, County of − French Camp | Yes | NA | |
| CBG-09-026 | Mono, County of | Yes | NA | |
| CBG-09-028 | El Paso de Robles, City of | Yes | NA | |
| CBG-09-030 | Siskiyou County Economic Development Council | No | CBG-09-158 | Amador, County of |
| CBG-09-033 | Sonoma, City of | No | CBG-09-184 | Los Gatos, Town of |
| CBG-09-036 | Seaside, City of | No | CBG-09-090 | Fort Bragg, City of |
| CBG-09-037 | Dixon, City of | Yes | NA | |
| CBG-09-038 | Walnut, City of | Yes | NA | |
| CBG-09-042 | Burlingame, City of | Yes | NA | |
| CBG-09-046 | Norco, City of | No | CBG-09-032 | Foster City, City of |
| CBG-09-057 | Laguna Beach, City of | Yes | NA | |
| CBG-09-061 | Brawley, City of | No | CBG-09-136 | San Joaquin Valley Unified Air Pollution Control District − Shafter |
| CBG-09-073 | Farmersville, City of | No | CBG-09-035 | Yolo, County of |
| CBG-09-088 | Colma, Town of | Yes | NA | |
| CBG-09-094 | Millbrae, City of | Yes | NA | |
| CBG-09-105 | Santa Clara, County of | No | CBG-09-017 | Nevada, County of |
| CBG-09-106 | Tuolumne, County of (#26) | Yes | NA | |
| CBG-09-111 | Stanislaus, County of | Yes | NA | |
| CBG-09-124 | Atascadero, City of | No | CBG-09-192 | Mariposa, County of |
| CBG-09-126 | Marin, County of | Yes | NA | |
| CBG-09-129 | Alameda, County of | Yes | NA | |
| CBG-09-134 | Ventura County Collaborative − Fillmore | Yes | NA | |

| Original Sample Sub Award Number | Original Subrecipient and Site Name | Final Sample? | Replacement Sub Award Number | Replaced Subrecipient and Site Name |
|---|---|---|---|---|
| CBG-09-135 | San Joaquin Valley Unified Air Pollution Control District − Avenal | Yes | NA | |
| CBG-09-135 | San Joaquin Valley Unified Air Pollution Control District − Corcoran | Yes | NA | |
| CBG-09-135 | San Joaquin Valley Unified Air Pollution Control District − Riverbank | Yes | NA | |
| CBG-09-136 | San Joaquin Valley Unified Air Pollution Control District − Chowchilla | Yes | NA | |
| CBG-09-136 | San Joaquin Valley Unified Air Pollution Control District − Dos Palos | Yes | NA | |
| CBG-09-136 | San Joaquin Valley Unified Air Pollution Control District − Exeter | Yes | NA | |
| CBG-09-136 | San Joaquin Valley Unified Air Pollution Control District − Fowler | Yes | NA | |
| CBG-09-136 | San Joaquin Valley Unified Air Pollution Control District − Sanger | Yes | NA | |
| CBG-09-137 | Barstow, City of | Yes | NA | |
| CBG-09-147 | Lawndale, City of | No | CBG-09-015 | Inyo, County of |
| CBG-09-154 | Seal Beach, City of | Yes | NA | |
| CBG-09-164 | Mendocino, County of − Mendocino | Yes | NA | |
| CBG-09-165 | Commerce, City of | No | CBG-09-134 | Ventura County Collaborative − Oxnard |
| CBG-09-167 | South El Monte, City of | Yes | NA | |
| CBG-09-169 | Clearlake, City of | Yes | NA | |
| CBG-09-171 | Sierra Madre, City of | Yes | NA | |

| Original Sample Sub Award Number | Original Subrecipient and Site Name | Final Sample? | Replacement Sub Award Number | Replaced Subrecipient and Site Name |
|---|---|---|---|---|
| CBG-09-177 | El Dorado, County of | No | CBG-09-135 | San Joaquin Valley Unified Air Pollution Control District − Madera |
| CBG-09-185 | Guadalupe, City of | No | CBG-09-027 | San Marino, City of |
| CBG-09-190 | Yuba, County of | Yes | NA | |
| CBG-09-191 | Ione, City of | No | CBG-09-199 | North Coast Integrated Regional Water Management Plan − Rio Dell |
| CBG-09-194 | Shasta, County of | Yes | NA | |
| CBG-09-197 | Solano, County of | No | CBG-09-021 | Merced, County of |
| CBG-09-199 | North Coast Integrated Regional Water Management Plan − Crescent City | Yes | NA | |
| CBG-09-199 | North Coast Integrated Regional Water Management Plan − Eureka | Yes | NA | |
| CBG-09-204 | Plumas, County of | No | CBG-09-099 | Shasta Lake, City of |
| NA - Added as extra site | | | CBG-09-003 | Santa Cruz, County of − Felton |

Source: California Energy Commission

## Sample-Level Realization Rates

This section describes the realization rates for the three measure groups. The realization rate is the ratio between ex post and ex ante savings. Ideally, realization rates are close to 100 percent; this demonstrates that measured savings are close or equal to expected savings. Realization rates are typically regarded as good indicators of program performance. However, for the EECBG Small Cities and Counties Program, because little emphasis was placed initially on ex ante estimates of measure savings, realization rates results are less meaningful. Sample-level realization rates are used in this evaluation to calculate overall program-level savings.

The EECBG Small Cities and Counties Program was designed to generate energy savings effectively through wise use of grant funds. In particular, the Energy Commission developed DEP projects with essentially a deemed savings approach, on the assumption that average savings generated would meet ARRA requirements for cost-appropriate savings. Additionally, the fast-track nature of the program did not allow much time for developing ex ante estimates or performing monitoring to serve as a basis for the estimates. Initial estimates were prepared only to guide funding to cost-effective projects. Savings for some measures, however, are

difficult to estimate before implementation of a project. For example, the subrecipient might make changes to controls or operations that were not anticipated in the ex ante savings estimate but are observed by evaluators and reflected in the ex post estimate. The Energy Commission initially developed ex ante estimates for all projects. The evaluation team calculated ex ante savings for all projects (less than 30 percent) for which the scope changed over project implementation.

The Energy Commission emphasized getting the funds to eligible small cities and counties and provided them the technical support to implement appropriate measures. Despite not being focused on realization rates, the overall program results were quite high, with the electric energy savings at 96 and 91 percent for Baselines 1 and Baseline 2, respectively. Table 13 shows the realization rates for electric and natural gas measures.

**Table 13: EECBG Small Cities and Counties Program Realization Rates for Sampled Sites by Project Type**

| Phase | Project Type | Realization Rate – Electricity | | | Realization Rate – Natural Gas | | |
|---|---|---|---|---|---|---|---|
| | | Number of Sampled Tracked Measure Groupings | Baseline 1 | Baseline 2 | Number of Sampled Tracked Measure Groupings | Baseline 1 | Baseline 2 |
| Phase I | DEP | 46 | 104% | 100% | 3 | 116% | 79% |
| | EEP | 137 | 92% | 86% | 35 | 70% | 51% |
| Phase II | DEP | 0 | N/A | N/A | 0 | N/A | N/A |
| Total | | 183 | 96% | 91% | 38 | 70% | 51% |

Source: DNV KEMA analysis

Ex post savings and realization rate for each of the sampled projects are shown in Table 14 for electric-tracked measure groupings and Table 15 for natural gas-tracked measure groupings.

**Table 14: EECBG Small Cities and Counties Program Sampled Sites – Annual Ex Post Electricity Savings and Realization Rates**

| Sub Award Number | Subrecipient Name | Site Name (where relevant) | Ex Ante Electric Savings (kWh) | Baseline 1 | | Ex Post Baseline 2 | |
|---|---|---|---|---|---|---|---|
| | | | | Ex Post Electric Savings (kWh) | Realization Rate | Ex Post Electric Savings (kWh) | Realization Rate |
| CBG-09-003 | Santa Cruz, County of | Felton | 102,624 | 59,413 | 58% | 59,413 | 58% |
| | | Santa Cruz | 245,236 | 487,739 | 199% | 445,772 | 182% |
| | | Watsonville | 25,889 | 41,624 | 161% | 40,926 | 158% |
| CBG-09-006 | Placer, County of | | 686,761 | 550,092 | 80% | 417,419 | 61% |
| CBG-09-010 | San Joaquin, County of | | 1,346,012 | 1,398,550 | 104% | 1,353,713 | 101% |
| CBG-09-015 | Inyo, County of | | 353,799 | 401,658 | 114% | 401,658 | 114% |
| CBG-09-017 | Nevada, County of | | 403,119 | 240,644 | 60% | 177,332 | 44% |
| CBG-09-021 | Merced, County of | | 393,230 | 448,550 | 114% | 431,271 | 110% |
| CBG-09-026 | Mono, County of | | 44,521 | 13,098 | 29% | 13,098 | 29% |
| CBG-09-027 | San Marino, City of | | 45,936 | 24,862 | 54% | 1,900 | 4% |
| CBG-09-028 | El Paso de Robles, City of | | 68,328 | 89,111 | 130% | 89,111 | 130% |
| CBG-09-032 | Foster City, City of | | 149,397 | 149,397 | 100% | 149,397 | 100% |
| CBG-09-035 | Yolo, County of | | 107,007 | 95,237 | 89% | 95,237 | 89% |
| CBG-09-037 | Dixon, City of | | 54,019 | 54,019 | 100% | 54,019 | 100% |
| CBG-09-038 | Walnut, City of | | 312,640 | 163,341 | 52% | 158,130 | 51% |
| CBG-09-042 | Burlingame, City of | | 249,413 | 262,928 | 105% | 262,928 | 105% |
| CBG-09-057 | Laguna Beach, City of | | 166,665 | 164,427 | 99% | 133,514 | 80% |
| CBG-09-088 | Colma, Town of | | 14,368 | 14,927 | 104% | 14,927 | 104% |
| CBG-09-090 | Fort Bragg, City of | | 37,473 | 43,035 | 115% | 43,035 | 115% |
| CBG-09-094 | Millbrae, City of | | 64,957 | 74,390 | 115% | 74,390 | 115% |
| CBG-09-099 | Shasta Lake, City of | | 30,982 | 34,240 | 111% | 34,240 | 111% |
| CBG-09-106 | Tuolumne, County of | | 296,119 | 294,210 | 99% | 294,210 | 99% |

| Sub Award Number | Subrecipient Name | Site Name (where relevant) | Ex Ante Electric Savings (kWh) | Baseline 1 | | Ex Post Baseline 2 | |
|---|---|---|---|---|---|---|---|
| | | | | Ex Post Electric Savings (kWh) | Realization Rate | Ex Post Electric Savings (kWh) | Realization Rate |
| CBG-09-111 | Stanislaus, County of | | 128,856 | 164,241 | 127% | 164,241 | 127% |
| CBG-09-126 | Marin, County of | | 311,655 | 118,516 | 38% | 118,516 | 38% |
| CBG-09-129 | Alameda, County of | | 706,777 | 750,535 | 106% | 750,535 | 106% |
| CBG-09-134 | Ventura County Collaborative | Fillmore | 139,854 | 129,193 | 92% | 122,190 | 88% |
| | | Oxnard | 125,385 | 177,686 | 142% | 177,686 | 142% |
| CBG-09-135 | San Joaquin Valley Unified Air Pollution Control District | Madera | 433,533 | 468,526 | 108% | 468,526 | 108% |
| | | Avenal | 20,180 | 58,806 | 291% | 58,806 | 291% |
| | | Corcoran | 75,838 | 78,762 | 104% | 78,762 | 104% |
| | | Riverbank | 237,811 | 116,394 | 49% | 116,394 | 49% |
| CBG-09-136 | San Joaquin Valley Unified Air Pollution Control District | Chowchilla | 86,814 | 71,150 | 82% | 71,150 | 82% |
| | | Dos Palos | 17,443 | 11,777 | 68% | 7,797 | 45% |
| | | Exeter | 60,228 | 47,850 | 79% | 24,564 | 41% |
| | | Fowler | 24,305 | 32,920 | 135% | 32,920 | 135% |
| | | Sanger | 67,589 | 70,150 | 104% | 70,150 | 104% |
| | | Shafter | 57,313 | 37,354 | 65% | 37,354 | 65% |
| CBG-09-137 | Barstow, City of | | 169,064 | 183,101 | 108% | 183,101 | 108% |
| CBG-09-154 | Seal Beach, City of | | 124,558 | 109,086 | 88% | 109,086 | 88% |
| CBG-09-158 | Amador, County of | | 110,004 | 110,151 | 100% | 82,088 | 75% |
| CBG-09-164 | Mendocino, County of | | 438,231 | 335,322 | 77% | 320,478 | 73% |
| CBG-09-167 | South El Monte, City of | | 128,746 | 120,179 | 93% | 113,594 | 88% |
| CBG-09-169 | Clearlake, City of | | 130,629 | 87,722 | 67% | 87,722 | 67% |
| CBG-09-171 | Sierra Madre, City of | | 63,510 | 40,267 | 63% | 40,267 | 63% |
| CBG-09-184 | Los Gatos, Town of | | 65,990 | 73,964 | 112% | 73,964 | 112% |
| CBG-09-190 | Yuba, County of | | 312,300 | 391,181 | 125% | 391,181 | 125% |
| CBG-09-192 | Mariposa, County of | | 25,798 | 25,798 | 100% | 17,157 | 67% |

| Sub Award Number | Subrecipient Name | Site Name (where relevant) | Ex Ante Electric Savings (kWh) | Baseline 1 | | Ex Post Baseline 2 | |
|---|---|---|---|---|---|---|---|
| | | | | Ex Post Electric Savings (kWh) | Realization Rate | Ex Post Electric Savings (kWh) | Realization Rate |
| CBG-09-194 | Shasta, County of | | 406,074 | 339,295 | 84% | 264,578 | 65% |
| CBG-09-199 | North Coast Integrated Regional Water Management Plan | Crescent City | 214,553 | 214,553 | 100% | 214,553 | 100% |
| | | Eureka | 81,061 | 74,663 | 92% | 74,663 | 92% |
| | | Rio Dell | 935 | 375 | 40% | 41 | 4% |
| Total | | | 9,963,529 | 9,545,009 | 96% | 9,017,704 | 91% |

Source: DNV KEMA analysis

**Table 15: EECBG Small Cities and Counties Program Sampled Sites – Annual Ex Post Natural Gas Savings and Realization Rates**

| Sub Award Number | Subrecipient Name | Site Name | Ex Ante Natural Gas Savings (therms) | Baseline 1 | | Baseline 2 | |
|---|---|---|---|---|---|---|---|
| | | | | Ex Post Natural Gas Savings (therms) | Realization Rate | Ex Post Natural Gas Savings (therms) | Realization Rate |
| CBG-09-003 | Santa Cruz, County of | Felton | 8,419 | 4,668 | 55% | 4,668 | 55% |
| | | Santa Cruz | 46,216 | 12,131 | 26% | 12,131 | 26% |
| | | Watsonville | 8,467 | 3,938 | 47% | 3,938 | 47% |
| CBG-09-006 | Placer, County of | | 6,317 | 15,562 | 246% | 6,554 | 104% |
| CBG-09-017 | Nevada, County of | | 12,728 | 24,332 | 191% | 8,728 | 69% |
| CBG-09-026 | Mono, County of | | 113 | 1,499 | 1327% | 1,499 | 1327% |
| CBG-09-027 | San Marino, City of | | 608 | 618 | 102% | 618 | 102% |
| CBG-09-035 | Yolo, County of | | 2,636 | 2,432 | 92% | 2,432 | 92% |
| CBG-09-106 | Tuolumne, County of | | 40 | 40 | 100% | 40 | 100% |
| CBG-09-126 | Marin, County of | | 44,723 | 24,490 | 55% | 24,490 | 55% |

| Sub Award Number | Subrecipient Name | Site Name | Ex Ante Natural Gas Savings (therms) | Baseline 1 | | Baseline 2 | |
|---|---|---|---|---|---|---|---|
| | | | | Ex Post Natural Gas Savings (therms) | Realization Rate | Ex Post Natural Gas Savings (therms) | Realization Rate |
| CBG-09-136 | San Joaquin Valley Unified Air Pollution Control District | Exeter | 0 | 183 | NA | 183 | NA |
| CBG-09-158 | Amador, County of | | 318 | 327 | 103% | 327 | 103% |
| CBG-09-164 | Mendocino, County of | | 3,095 | 3,996 | 129% | 3,606 | 117% |
| CBG-09-167 | South El Monte, City of | | 257 | 46 | 18% | 36 | 14% |
| CBG-09-169 | Clearlake, City of | | -902 | -857 | NA | -857 | NA |
| CBG-09-192 | Mariposa, County of | | 606 | 606 | 100% | 153 | 25% |
| CBG-09-194 | Shasta, County of | | 1,470 | 1,470 | 100% | 1,470 | 100% |
| CBG-09-199 | North Coast Integrated Regional Water Management Plan | Eureka | 1,415 | 219 | 15% | 171 | 12% |
| | | Rio Dell | 403 | 420 | 104% | 420 | 104% |
| Total | | | 136,929 | 96,120 | 70% | 70,607 | 52% |

Source: DNV KEMA analysis

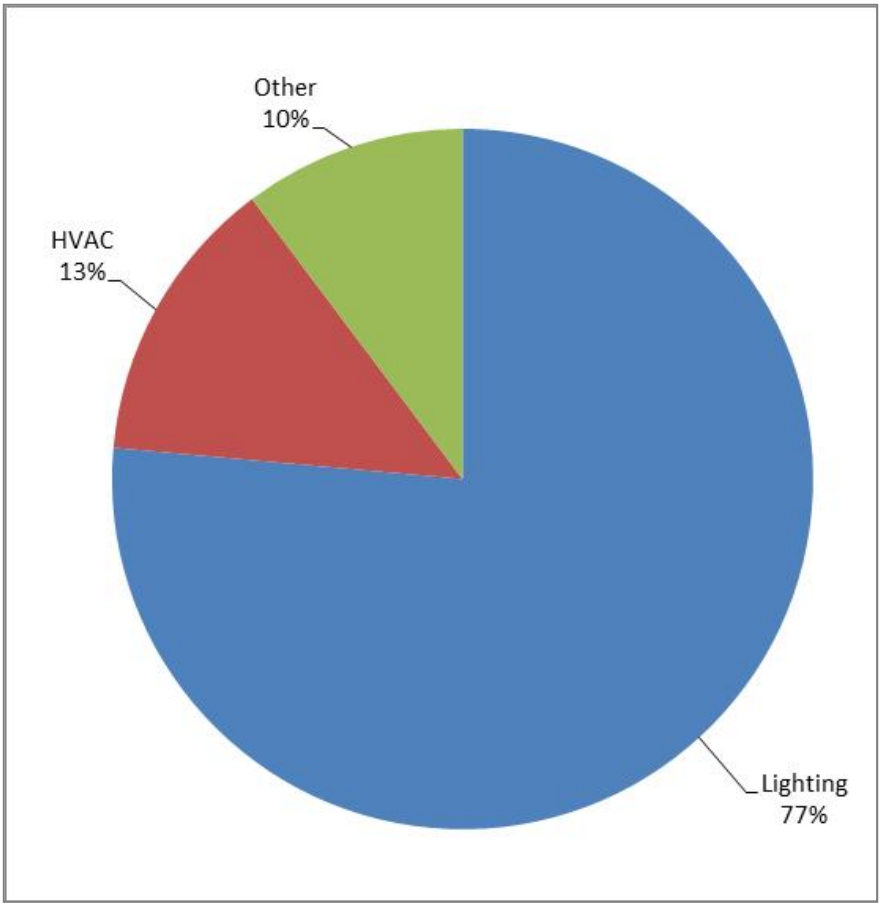
## Gross Program Savings

The evaluation team developed realization rates for measure groups based on the results from the sampled projects. Using these realization rate results by measure group, the team extrapolated the savings to the program's population. Lighting and HVAC were well-represented in the sample sites. Measures that make up the "Other" category occurred less frequently and were, therefore, grouped together to allow extrapolation.

### Program-Level Gross Impacts

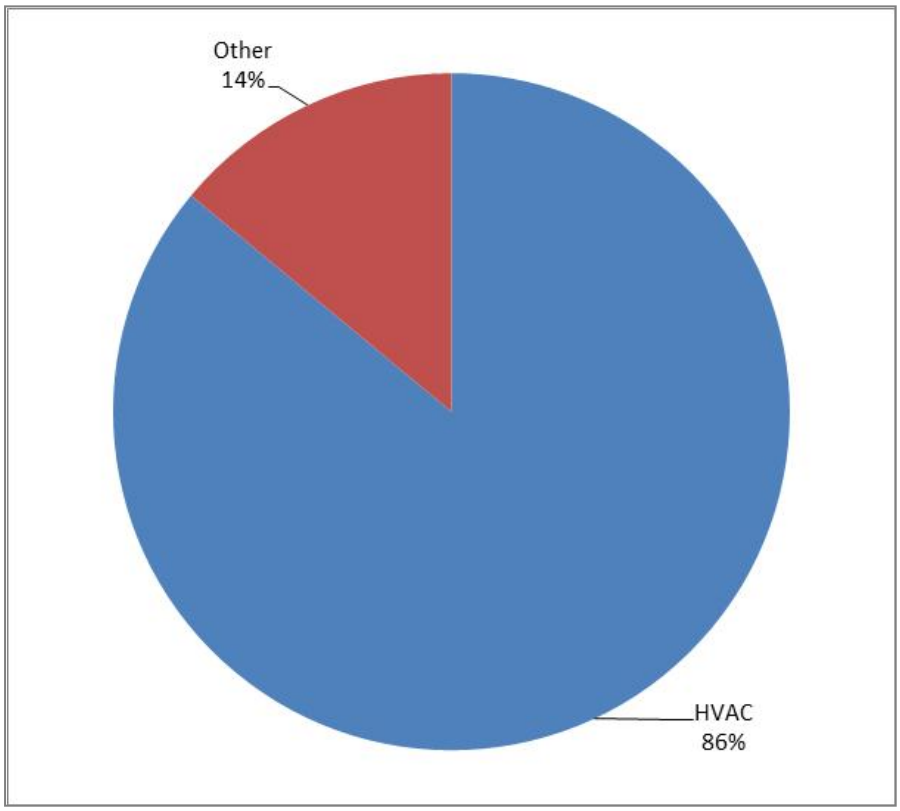
Figure 3 and Figure 4 show the proportional program savings by measure type, compared against Baseline 1, for electricity and natural gas, respectively. The electricity savings can be attributed mostly to lighting projects, with lighting being responsible for 77 percent of the total electric savings realized. HVAC measures are responsible for the majority (86 percent) of natural gas program savings.

**Figure 3: Ex Post Electricity Savings by Measure Group, Baseline 1**




Source: DNV KEMA analysis

**Figure 4: Ex Post Natural Gas Savings by Measure Group, Baseline 1**




Source: DNV KEMA analysis

Table 16 below shows program-level electricity savings by measure group. The majority of lighting projects yielded excellent overall program savings and produced a group realization rate of more than 100 percent. Interior and exterior lighting retrofits were especially instrumental, comprising the majority of the ex post electric savings for the program. For lighting measures, the documentation typically adequately detailed and accurately reflected what was installed and operated through the program. Where the ex ante and ex post differed, it was often due only to minor adjustments to hours of operation, number of fixtures, or type of fixtures installed. This happened for a variety of reasons. For example, one project included upgrades of more than 2,000 fixtures across six towns and 211 miles of road. The original ex ante estimate was based on operating hour assumptions from POU and IOU audits. The site evaluator asked the site contact to provide operating schedules for the 36 buildings included in the project; the site contact provided detailed schedule information for specific areas, including occupied areas, closets, and hallways. The site contact and his contractor revised the ex ante values in some but not all cases for the schedule change. The ex post evaluation reflected the detailed operating hours by room, provided by the site contact.

**Table 16: Evaluation Results − Gross Annual Program-Level Electric Savings**

| Phase | Project Type | Measure Group | Number of Tracked Measure Groupings | Number of Sampled Tracked Measure Groupings | Annual Ex Ante Electric Savings (kWh) | Baseline 1 | | Baseline 2 | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Annual Ex Post Electric Savings (kWh) | Realiz-ation Rate | Annual Ex Post Electric Savings (kWh) | Realiz-ation Rate |
| Phase I | DEP | Lighting | 606 | 25 | 9,842,026 | 10,118,044 | 103% | 10,077,518 | 102% |
| | | HVAC | 178 | 11 | 1,409,040 | 1,227,477 | 87% | 890,633 | 63% |
| | | Other | 53 | 10 | 1,822,164 | 1,768,895 | 97% | 1,768,895 | 97% |
| | EEP | Lighting | 288 | 82 | 12,752,301 | 12,862,612 | 101% | 12,838,083 | 101% |
| | | HVAC | 151 | 39 | 3,780,750 | 3,244,364 | 86% | 2,334,664 | 62% |
| | | Other | 66 | 16 | 2,106,874 | 1,674,323 | 79% | 1,674,324 | 79% |
| Phase II | DEP | Lighting | 11 | 0 | 2,624,009 | 2,668,877 | 102% | 2,661,322 | 101% |
| Total | | | 1,353 | 183 | 34,337,164 | 33,564,591 | 98% | 32,245,439 | 94% |

Source: DNV KEMA analysis

As shown above in Table 16 and in Table 17 below, HVAC measures also generated significant savings, especially gas savings. HVAC measures were responsible for 85 percent of the total therm savings. However, there were very few measures with associated therm savings. Of the 51 sites sampled, only 37 installed measures were expected to save natural gas.

Most of the realized savings in the HVAC measure category came from packaged HVAC units and controls measures. However, the ex post savings fell short of the ex ante estimates and yielded natural gas realization rates of 73 percent (for Baseline 1) and 53 percent (Baseline 2). This result is mainly due to the fact that many of the ex ante calculations relied on simplistic methods that did not accurately predict real-world results to estimate the savings potential for HVAC measures, especially controls measures. Given that the program goal was to implement projects quickly rather than develop highly accurate estimates, the simplistic approach was appropriate. A relatively small number of sites employed gas measures, and, thus, a few low savings results affected the totals. In one case, the lack of preretrofit verification of the boiler operating information meant reliance on site contact estimates rather than measurements. Furthermore, the ex ante estimate did not provide information on how the savings were estimated. Moderate improvement could be achieved by considering the climate where the measures were installed. More transparency in the calculations and measured information about preretrofit conditions and/or a preinstallation site visit would improve the results.

**Table 17: Evaluation Results – Gross Annual Program-Level Natural Gas Savings**

| Phase | Project Type | Measure Group | Number of Tracked Measure Groupings | Number of Sampled Tracked Measure Groupings | Ex Ante Natural Gas Savings (therms) | Baseline 1 | | Baseline 2 | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Ex Post Natural Gas Savings (therms) | Realiz-ation Rate | Ex Post Natural Gas Savings (therms) | Realiz-ation Rate |
| Phase I | DEP | HVAC | 29 | 3 | 31,957 | 25,273 | 79% | 18,134 | 57% |
| | EEP | HVAC | 77 | 28 | 162,438 | 125,637 | 77% | 90,494 | 56% |
| | | Other | 17 | 6 | 45,644 | 24,560 | 54% | 19,194 | 42% |
| Total | | | 123 | 37 | 240,039 | 175,471 | 73% | 127,822 | 53% |

Source: DNV KEMA analysis

As shown, natural gas measures consistently had lower realization rates through Baseline 2. The reason for this result relates back to the definitions of Baselines 1 and Baseline 2. HVAC replacement measures in the sample were often replacing units that were very old and inefficient (for example, a 70 percent efficient boiler). The savings between the new unit and that very old unit, otherwise known as Baseline 1 savings, would be significantly greater than Baseline 2 annual savings, which would use more efficient equipment (such as an 80 percent efficient boiler). Thus, lower Baseline 2 savings leads to a lower realization rate.

The sampled HVAC and "other" measures were not typically installed in restricted areas or spread over large areas; therefore, these measures were visually confirmed by the surveyor on-site. There were, however, some sites where the large number of retrofit HVAC units prevented meters from being installed on each unit. For example, at CBG-09-006 (Placer County) 12 HVAC units ranging from 5 to 12 tons were installed at the county jail. The surveyor installed meters on two of the units—one 8-ton unit and one 12-ton unit. The data from these meters were used to determine the average unit loading and, in turn, the average consumption.

"Other" measures included PC power management, vending machine controls, DHW, building shell, and (non-HVAC) pumps and motors measures. While the measures in this category generated a fair amount of savings, the measures consistently produced less than expected in relation to the ex ante estimates. Like the HVAC measures, the ex ante savings were often estimated using simple assumptions instead of more rigorous methodology, and without preinstallation equipment and operations verification. This was the main reason savings differed significantly between ex ante and ex post.

The program as a whole achieved significant savings. Realization rate should not be viewed as the best metric to evaluate this program's effectiveness since the ex ante estimates were not considered a main focus of the program. The finite list of measures and involved administration team got the program started quickly and provided the ability to focus on measures with short payback periods to produce considerable savings. The program specifically targeted often overlooked opportunities, such as jails and economically depressed counties and cities. In cases

where the facilities had out-of-date equipment, savings were larger than would normally be expected when equipment age was more typical. These upgrades resulted in better operations and long-term savings for the state that likely would not have happened without the program.

### Precision Results

As mentioned in Chapter 3, the evaluation team used a model-based statistical sampling method 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). Table 18 shows the gross savings, confidence intervals, and relative precision for the program. The gross savings were calculated 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, which was used to determine the 90 percent confidence interval. The team calculated the relative precision by dividing the confidence interval by the realization rate. Hence, where the realization rate is high, the confidence interval and relative precision are nearly equal.

As shown, the results indicate that the overall precision achieved at the 90 percent confidence interval for electric savings was 6 percent overall for Baseline 1 and 7 percent overall for Baseline 2, meeting the evaluation goal. This precision level is consistent with low-variability lighting measures. Evaluators found greater variation in realization rates with HVAC and other measures, which was expected given the range of conditions observed. The ex post annual natural gas savings results show more variability, with relative precision at 32 percent for Baseline 1 and 24 percent for Baseline 2. The larger relative precision and confidence intervals for HVAC and DHW are consistent with more variability in the observed results. There were far fewer fuel measures than electric and more variation in the results, leading to less precision for gas measures than for electric measures.

**Table 18: Confidence Intervals and Precision for Gross Annual Savings**

| | Baseline 1 | | Baseline 2 | |
|---|---|---|---|---|
| | Annual Ex Post Electricity Savings (kWh) | Annual Ex Post Natural Gas Savings (therms) | Annual Ex Post Electricity Savings (kWh) | Annual Ex Post Natural Gas Savings (therms) |
| Gross Annual Program-level Energy Savings | 33,564,591 | 175,470 | 32,245,439 | 127,822 |
| 90% Confidence Interval Savings, ± | 1,678,509 | 40,351 | 1,935,059 | 19,169 |
| 90% Confidence Interval Proportion, ± % | 5% | 23% | 6% | 15% |
| Precision | 6% | 32% | 7% | 24% |
| Standard Error | 3% | 14% | 4% | 9% |

Source: DNV KEMA analysis

## Differences in Ex Ante and Ex Post

The evaluation team examined reasons for the differences between ex ante and ex post savings for each measure evaluated. 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 19. Note that realization rate is not emphasized in this evaluation, and this section is provided to inform and support future programs.

**Table 19: Reasons for Differences Between Ex Ante and Ex Post Savings Estimates**

| Reason for Difference Between Ex Ante and Ex Post Savings Estimates | Number of Lighting Tracked Measures Groupings | Number of HVAC Tracked Measures Groupings | Number of Other Tracked Measures Groupings | Total |
|---|---|---|---|---|
| Calculation Method Unclear | 30 | 14 | 2 | 46 |
| Different Analysis or Calculation Method | 0 | 21 | 14 | 35 |
| Different Baseline or Installation | 24 | 7 | 5 | 36 |
| Different Hours of Operation | 25 | 3 | 0 | 28 |
| No Difference (Ex Ante and Ex Post Savings Equal) | 25 | 4 | 4 | 33 |
| Not Installed | 1 | 1 | 1 | 3 |
| Other Savings in Documentation | 1 | 0 | 0 | 1 |
| Total | 106 | 50 | 26 | 182 |

Source: DNV KEMA analysis

There were 33 measures where the ex ante and ex post savings results were equal. For the remaining measures, several consistent themes emerged:

- **Calculation method unclear.** This was the most common reason site engineers noted for differences between ex ante and ex post savings. As expected for the DEP approach, there were a large number of measures where little to no ex ante documentation was provided, and, therefore, DNV KEMA was unable to determine the method of how the ex ante savings were estimated.
- **Different analysis or calculation.** The ex ante calculations for many sites used overly simplified analysis methodology that did not accurately reflect consumption, which was especially common for HVAC measures. For example, the ex ante calculations for a chiller replacement at one site used a basic, single-line formula with inputs of effective full-load hours (EFLH), tonnage, and pre- and postretrofit integrated part-load efficiencies (IPLV). The EFLH and IPLVs were the implementer's estimates and did not accurately represent the actual operating conditions. To calculate the ex post savings, the engineer conducted an analysis where savings are calculated for each hour over an

entire year. The calculation is informed by weather data and data from a power logger installed during the cooling season. This analysis method calculates the power draw of the chillers at every hour of a year and offers a more realistic estimate of savings. Ex post chiller efficiencies were obtained from 1978 CA Title 24 codes (for the preretrofit case) and manufacture literature (for the postretrofit case).

- **Different baseline or installation.** In some cases, the exact quantities or types of equipment reported in the ex ante savings documentation did not always match what the evaluator observed as installed on-site. This was most common for lighting measures, where hundreds or even thousands of fixtures could be installed. There was also one site where the savings documentation showed a VFD measure; however, a premium efficiency motor was actually installed (without a VFD). These variations are not unusual for a nonresidential retrofit program.
- **Different hours of operation.** Many inconsistencies seen for lighting measures can be explained by different operating hours between ex ante and ex post calculations. For example, some ex ante calculations for street lights and exterior fixtures controlled by photocells assumed annual operating hours of 4,100 hours, while others assumed 4,380 hours. The evaluation team estimated photocells caused lights to operate for 12 hours per day and adjusted their annual operating hours to 4,380 hours to reflect actual operating times. In other cases, interviews with the on-site contact confirmed that ex ante assumptions did not reflect actual operating conditions. For these measures, annual hours of operation were modified to better reflect the schedule as described by the on-site contact.

## Net Program Savings

As referenced in the Net Energy Savings Calculations section in Chapter 3, evaluators used participant interviews and information from Energy Commission managers to estimate to what extent the program was responsible for the achieved gross savings. Evaluators weighted the achieved gross savings for projects from the fraction of participants who were not influenced by the program and compared those to the program's total gross savings; this percentage was subtracted from 100 percent.

The NTG ratio for the EECBG Small Cities and Counties Program was determined to be very high, at 0.98. Survey results indicate that two subrecipients (5 percent) were not influenced by the program in their choice to implement EEMs. When asked about the program's effect, these respondents indicated in three responses that the project would have been implemented regardless of the support provided through the EECBG Small Cities and Counties Program. These projects contributed only a very small fraction of the total sample sites overall savings (2 percent). Therefore, the NTG ratio for the EECBG Small Cities and Counties Program was determined to be 0.98. Table 20 and Table 21 show net program savings for electric and natural gas measures, respectively.

**Table 20: Evaluation Results – Net Annual Program-Level Electric Savings**

| Phase | Project Type | Project Type | Net to Gross Ratio | Baseline 1 | | Baseline 2 | |
|---|---|---|---|---|---|---|---|
| | | | | Gross Electric Savings (kWh) | Net-adjusted Electric Savings (kWh) | Gross Electric Savings (kWh) | Net-adjusted Electric Savings (kWh) |
| Phase I | DEP | Lighting | 98% | 10,118,043 | 9,915,683 | 10,077,518 | 9,875,968 |
| | | HVAC | | 1,227,477 | 1,202,927 | 890,633 | 872,820 |
| | | Other | | 1,768,895 | 1,733,517 | 1,768,895 | 1,733,517 |
| | EEP | Lighting | | 12,862,612 | 12,605,360 | 12,838,083 | 12,581,321 |
| | | HVAC | | 3,244,364 | 3,179,476 | 2,334,664 | 2,287,971 |
| | | Other | | 1,674,323 | 1,640,837 | 1,674,324 | 1,640,838 |
| Phase II | DEP | Lighting | | 2,668,877 | 2,615,500 | 2,661,322 | 2,608,096 |
| Total | | | | 33,564,591 | 32,893,300 | 32,245,439 | 31,600,531 |

Source: DNV KEMA analysis

**Table 21: Evaluation Results – Net Annual Program-Level Natural Gas Savings**

| Phase | Project Type | Project Type | Net to Gross Ratio | Baseline 1 | | Baseline 2 | |
|---|---|---|---|---|---|---|---|
| | | | | Gross Natural Gas Savings (therms) | Net-adjusted Natural Gas Savings (therms) | Gross Natural Gas Savings (therms) | Net-adjusted Natural Gas Savings (therms) |
| Phase I | DEP | HVAC | 98% | 25,273 | 24,768 | 18,134 | 17,771 |
| | | Other | | 0 | 0 | 0 | 0 |
| | EEP | HVAC | | 125,637 | 123,124 | 90,494 | 88,684 |
| | | Other | | 24,560 | 24,069 | 19,194 | 18,811 |
| Total | | | | 175,470 | 171,961 | 127,822 | 125,266 |

Source: DNV KEMA analysis

## Life-Cycle Analysis

The evaluation team calculated life-cycle savings for each measure over its lifetime. 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 and based upon best practices in energy efficiency evaluation.

As shown in Table 22, most of lighting measures have an expected useful life of about 15 years; HVAC equipment upgrade projects often have an expected useful life of 15-20 years. Measures

for controls and repairs typically have shorter lifetimes of five to eight years, depending on the project. Sources for the noted measures are shown immediately following the table.

**Table 22: EUL for EECBG Small Cities and Counties Program Measures**

| Measure Group | Measure Type | Measure | EUL (years) |
|---|---|---|---|
| Lighting | Lighting Controls | Occupancy Sensor | 8 |
| Lighting | Lighting Controls | Daylighting Controls | 8 |
| Lighting | Lighting Controls | Photocell Controls | 8 |
| Lighting | Lighting, Exterior | Exterior Induction Lighting | 15[1] |
| Lighting | Lighting, Exterior | Exterior LED Lighting | 11.4[2] |
| Lighting | Lighting, Exterior | High-Pressure Sodium | 15 |
| Lighting | Lighting, Exterior | Metal Halide | 15 |
| Lighting | Lighting, Exterior | Unknown Lighting Type | 15[3] |
| Lighting | Lighting, Exterior | Exterior CFLs | 2.7[4] |
| Lighting | Lighting, Interior | Interior CFLs | 4.6[5] |
| Lighting | Lighting, Interior | Fluorescent Lighting | 15 |
| Lighting | Lighting, Interior | Interior Induction Lighting | 15[6] |
| Lighting | Lighting, Interior | Unknown Lighting Type | 15 |
| Lighting | Lighting, Interior | Exit Signs | 16 |
| Lighting | Lighting, Interior | Interior LED Lighting | 19[7] |
| Lighting | Lighting, Interior, Lighting, Exterior | Unknown Lighting Type | 15 |
| Lighting | Lighting, Traffic | Traffic Signals | 9[8] |
| HVAC | HVAC Controls | EMS | 15 |
| HVAC | HVAC Controls | Retrocommissioning | 10[9] |
| HVAC | HVAC Controls | Programmable Thermostats | 11 |
| HVAC | HVAC Controls | VFDs | 15 |
| HVAC | HVAC Controls | Economizer Repair | 5 |
| HVAC | HVAC Controls | Coil Cleaning | 3 |
| HVAC | HVAC Equipment | Economizer Replacement | 10 |
| HVAC | HVAC Equipment | HVAC-Packaged Units | 15 |
| HVAC | HVAC Equipment | HVAC-Split System | 15 |
| HVAC | HVAC Equipment | HVAC-Heat Pump | 15 |
| HVAC | HVAC Equipment | HVAC-Chiller | 20 |
| HVAC | HVAC Equipment | HVAC-Boilers | 20 |
| Other | Building Envelope | Window Replacement | 20 |
| Other | Building Envelope | Insulation | 20 |
| Other | Building Envelope | Duct Sealing | 18 |

| Measure Group | Measure Type | Measure | EUL (years) |
|---|---|---|---|
| Other | Building Envelope | Cool Roof | 15 |
| Other | DHW | Instantaneous Water Heater | 20 |
| Other | DHW | Pipe Insulation - Gas Water Heater | 11 |
| Other | DHW | Ozone Laundry | 15[10] |
| Other | DHW | High Efficiency Commercial Storage Water Heater | 15 |
| Other | Motors and Drives | VFD for Well Pumps | 10 |
| Other | Motors and Drives | Premium Efficiency Motor | 15 |
| Other | Motors and Drives | VFD for HVAC applications | 15 |
| Other | Motors and Drives | VFD for other applications | 15 |
| Other | Motors and Drives | Aeration unit | 15 |
| Other | None | Climate Action Plan | 5 |
| Other | Plug Load | PC Power Management--Smart Strip | 4[10] |
| Other | Plug Load | PC Power Management--Other measures | 5[11] |
| Other | Vending Machine Controls | Vending Machine Controls | 5 |

Source: DNV KEMA analysis

Sources:

1. No induction fixtures in DEER. ENERGY STAR® source says induction fixtures have an EUL from 10-20 years. All induction fixtures used an EUL of 15 as an average. [http://www.energystar.gov/index.cfm?fuseaction=challenge.showChallengeStory&ch_id=9892]
2. No exterior LED lighting in DEER. LED lifetime ~50,000 hours. Exterior fixtures were assumed to operate 12 hours/day, resulting in an EUL of 11.4 years. [http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/lifetime_white_leds.pdf]
3. If lighting type was not clear, an average lighting EUL of 15 was assumed.
4. DEER assumes CFL bulbs have a lifetime of up to 12,000 hours. Exterior fixtures were assumed to operate 12 hours/day, resulting in an EUL of 2.7 years.
5. DEER assumes CFL bulbs have a lifetime of up to 12,000 hours. Interior fixtures were assumed to operate 10 hours/day Monday through Friday, resulting in an EUL of 4.6 years.
6. No interior LED lighting in DEER. LED lifetime ~50,000 hours. Interior fixtures were assumed to operate 10 hours/day Monday through Friday, resulting in an EUL of 19 years. [http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/lifetime_white_leds.pdf]

7. SCE workpaper lists EUL as 10 for green lights. A report from AEP Efficiency lists 7-10 years for red (7), green (10) and yellow (10) lights. The average EUL of 9 was used. [http://www.aepefficiency.com/oklahoma/ci/downloads/Deemed_Savings_Report.pdf]
8. No HVAC RCx in DEER, used refrigeration RCx.
9. No ozone laundry measures in DEER. A GreenFinanceSF commercial measure list puts the EUL at 15. [https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CDQQFjAA&url=https%3A%2F%2Fcontent.renewfund.com%2Fproduction%2Fsan_francisco_county_ca_commercial%2Fgfsf_eligible_measures.en.pdf&ei=JlXSUP7BHqqF2AXk7YDQDQ&usg=AFQjCNF7YrxUuEjNKHJgR3OHU7]
10. A spreadsheet from the Northwest Power and Conservation Council lists an EUL of 4 years. [https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&ved=0CD0QFjAB&url=http%3A%2F%2Fwww.nwcouncil.org%2Fenergy%2Frtf%2Fsubcommittees%2Fmeasurelife%2FRTFEULChecklistSummarySheetAPDX_ABD_SERA_v13.xlsx&ei=ao_kUNbvAYfC2QXax4CYBQ&usg=AFQjCNFd]
11. SDGE Network Desktop Computer Power Management Software workpaper.

To calculate life-cycle savings for the total program, evaluators summed up the life-cycle savings for all measures across all projects. For Baseline 1, the life-cycle savings for a given measure equal the savings multiplied by the expected useful life of the measure. For Baseline 2, the calculation reflects both the RUL for the old equipment (at the annual savings of Baseline 1) and annual savings under standard conditions after the old equipment would likely have been replaced. Table 23 shows life-cycle savings for Baselines 1 and Baseline 2.

**Table 23: Evaluation Results – Life-Cycle Savings**

| Phase | Project Type | Baseline 1 | | Baseline 2 | |
|---|---|---|---|---|---|
| | | Life-Cycle Electricity Savings (kWh) | Life-Cycle Natural Gas Savings (therms) | Life-Cycle Electricity Savings (kWh) | Life-Cycle Natural Gas Savings (therms) |
| Phase I | DEP | 174,786,189 | 358,681 | 169,694,780 | 265,384 |
| | EEP | 247,617,981 | 2,371,817 | 233,964,782 | 1,748,194 |
| Phase II | DEP | 39,232,493 | 0 | 39,129,963 | 0 |
| Total | | 461,636,663 | 2,730,498 | 442,789,525 | 2,013,578 |

Source: DNV KEMA analysis

## Greenhouse Gas Emissions Reductions

GHG emissions reductions accrue when energy is saved or renewable energy replaces fossil generation. The evaluation team calculated the total reduction in GHG emissions resulting from the EECBG Small Cities and Counties Program, as shown in Table 24. Overall, electric savings generated the greatest amount of GHG avoidance, and EEP projects comprised the majority of those savings. Overall, EEP projects generated 6,235 and 5,739 metric tons of GHG reduction for Baselines 1 and Baseline 2, respectively. DEP projects also achieved significant reductions, with about 4,800 metric tons (including both Phase I and II) avoided under both Baselines 1 and Baseline 2.

**Table 24: Evaluation Results – Avoided Greenhouse Gas Emissions**

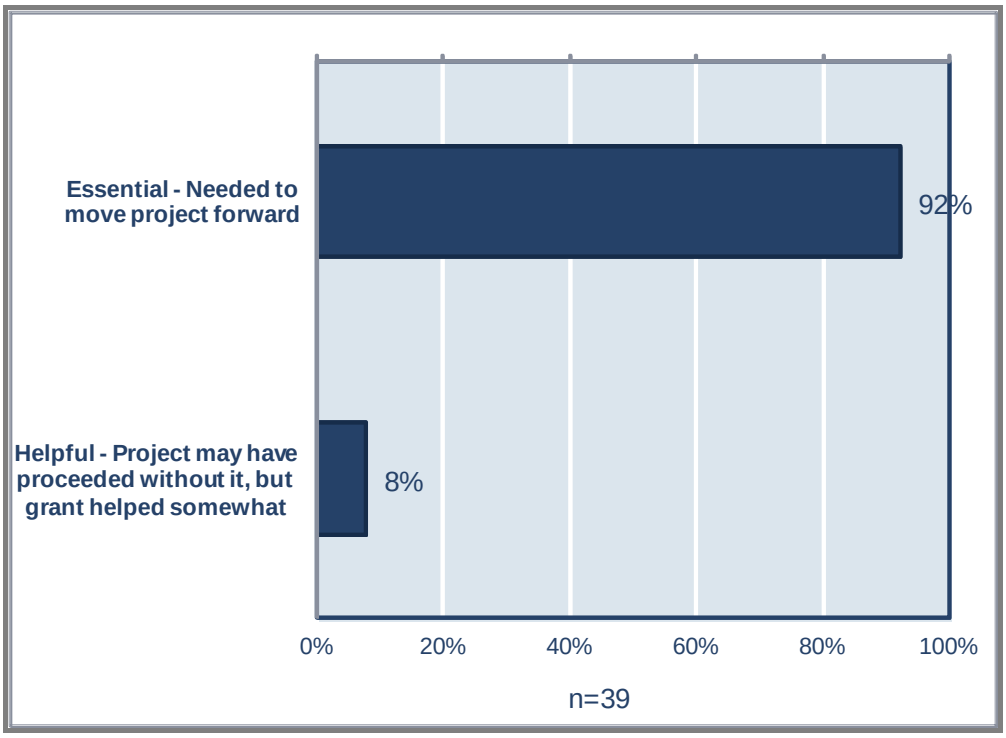
| Phase | Project Type | Baseline 1 | | | Baseline 2 | | |
|---|---|---|---|---|---|---|---|
| | | Avoided GHG Emissions From Electricity Savings (metric tons) | Avoided GHG Emissions From Natural Gas Savings (metric tons) | Overall Avoided GHG Emissions (metric tons) | Avoided GHG Emissions From Electricity Savings (metric tons) | Avoided GHG Emissions From Natural Gas Savings (metric tons) | Overall Avoided GHG Emissions (metric tons) |
| Phase I | DEP | 4,022 | 131 | 4,153 | 3,907 | 94 | 4,001 |
| | EEP | 5,454 | 780 | 6,234 | 5,167 | 570 | 5,737 |
| Phase II | DEP | 819 | 0 | 819 | 816 | 0 | 816 |
| Total | | 10,295 | 911 | 11,206 | 9,890 | 664 | 10,554 |

Source: DNV KEMA analysis

## Program Role and Influence

The evaluation team completed in-depth interviews with 30 decision-makers representing 37 of the 51 sampled project sites.[10] Evaluators asked respondents questions about the role and influence of the EECBG Small Cities and Counties Program on their projects' implementation decisions and decisions related to the projects' scope and timing. As shown in Figure 5, the majority of respondents (92 percent) indicated that funding was essential to move the project forward. Three respondents (8 percent) reported that funding was helpful, but the project might have proceeded without it.

**Figure 5: Role of Funding on Project Implementation**

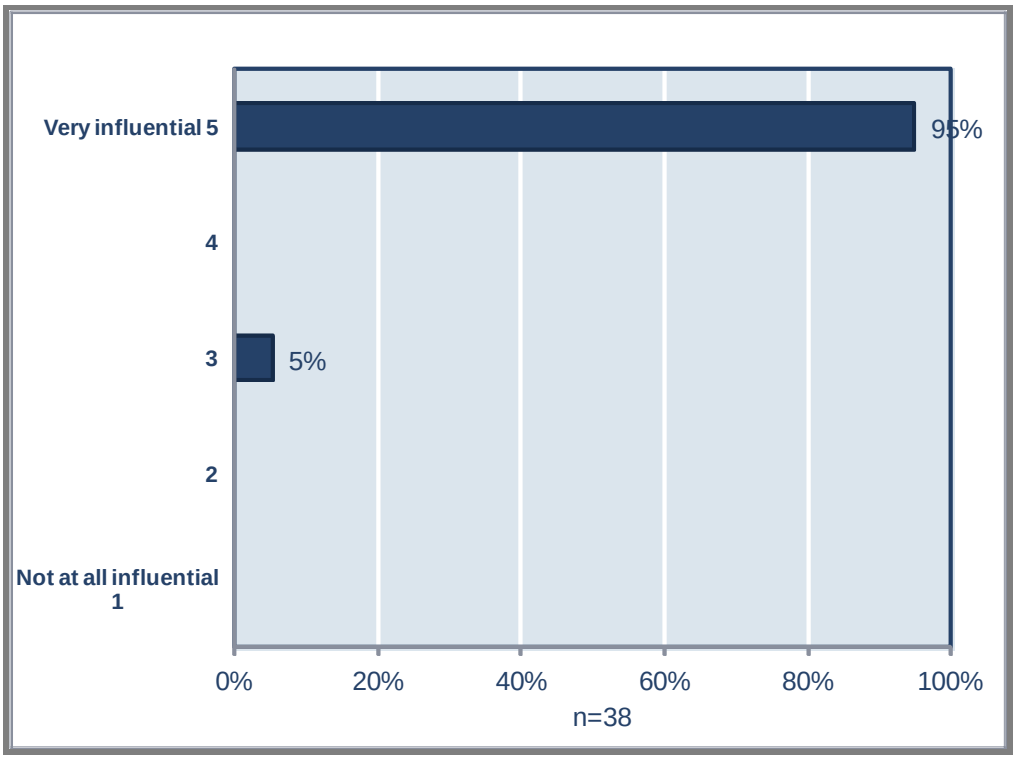



Source: DNV KEMA analysis

10 Multiple attempts were made to contact decision-makers from all 51sampled sites. However, only 30 contacts were responsive. These 30 contacts represented the key decision-makers for 39 of the sampled sites.

Respondents were also asked about the influence—on a scale of 1 to 5—of the EECBG Small Cities and Counties 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." The overwhelming majority (95 percent) of respondents indicated that the program was "Very influential," as shown in Figure 6. Two of the respondents (6 percent) that previously indicated the funding was only "helpful" both rated its influence as "3." No respondents claimed that it was not at all influential.

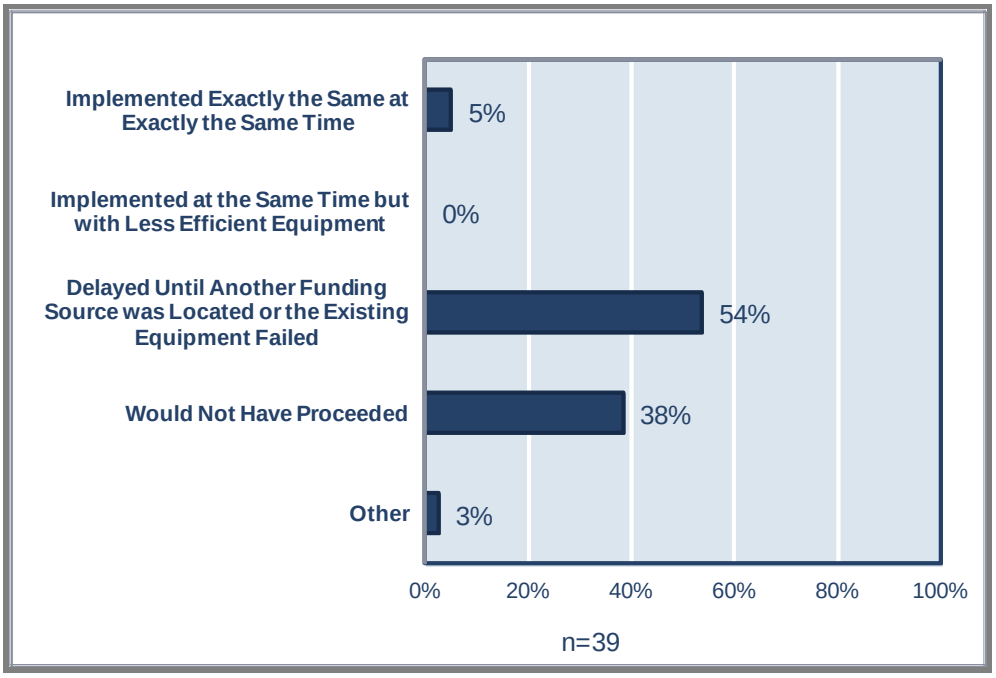
**Figure 6: Influence of the EECBG Small Cities and Counties Program on Project Implementation**




Source: DNV KEMA analysis

Participants were asked to discuss the influence of the program on the scope and timing of the project implementation. As shown in Figure 7, 38 percent reported that the project would not have proceeded at all; about half (54 percent) reported that projects would have been delayed until another funding source was identified or existing equipment failed. Lastly, the two respondents who reported that their projects would have been implemented exactly the same and at the same time also rated the program as "Not at all Influential." As discussed above, these two respondents have been considered free riders.

**Figure 7: Project Implementation Without the Program**

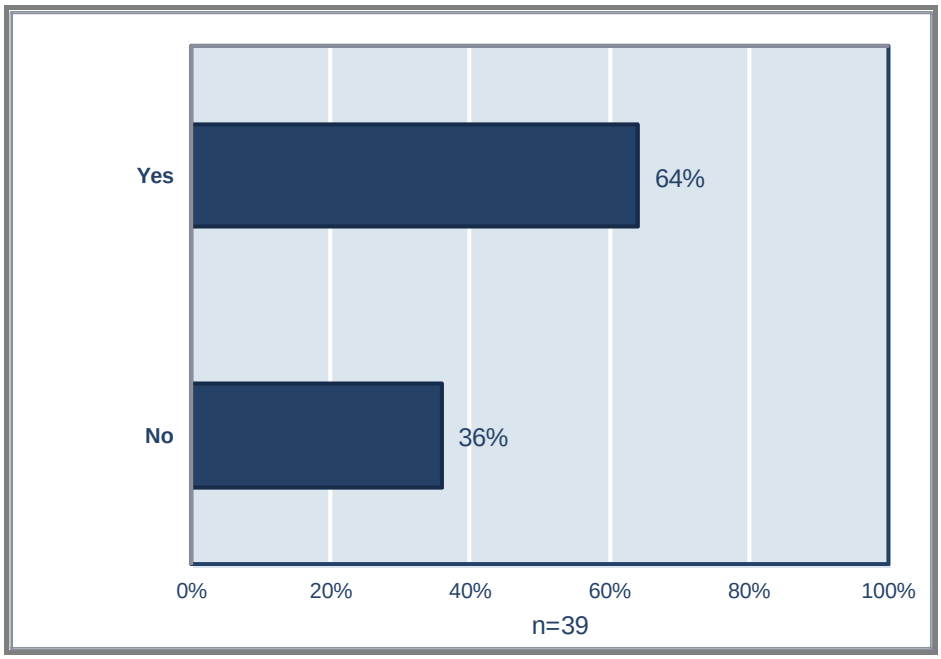



Source: DNV KEMA analysis

## Role and Influence of Co-Funding

Respondents were asked whether their projects received any funding from sources other than the EECBG Small Cities and Counties 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. As shown in Figure 8, about two-thirds (64 percent) of respondents indicated that they received some sort of co-funding. This finding is in line with the information presented in Chapter 2; most jurisdictions received funding in addition to the EECBG Small Cities and Counties Program grant. This funding came in the form of utility incentives, other ARRA funding, and city/county funding.

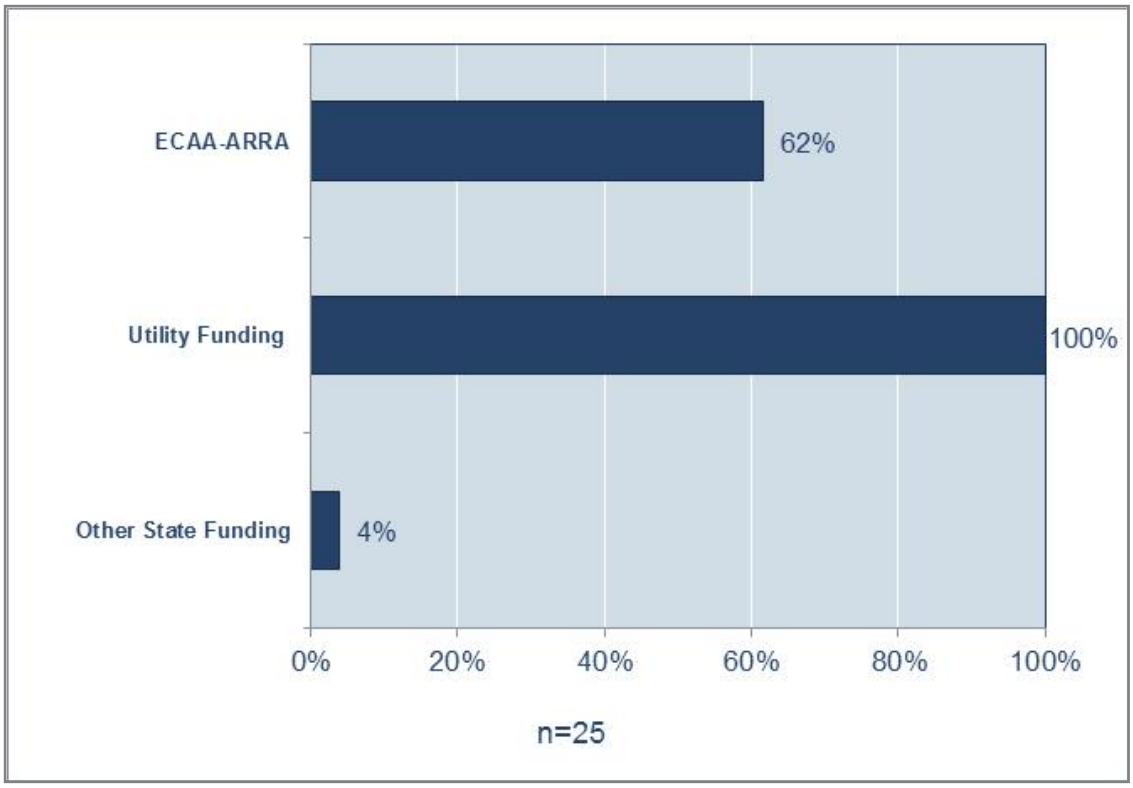
**Figure 8: Percentage of EECBG Small Cities and Counties Program Projects With Funding From Other Sources**




Source: DNV KEMA analysis

EECBG Small Cities and Counties Program participants also commonly received funding through another ARRA-funded program, the ECAA-ARRA Loan Program. Figure 9 shows the percentage of respondents who received utility, the ECAA-ARRA Loan Program, or other state funding in addition to EECBG funding. All respondents who indicated that they obtained funding in addition to the EECBG Small Cities and Counties Program grant reported that they received utility program funding. Eight respondents received both utility funding as well as funding through the ECAA-ARRA Loan Program. One respondent additionally received other state funding in the form of local government funding in addition to the EECBG Small Cities and Counties Program grant and utility program funding.

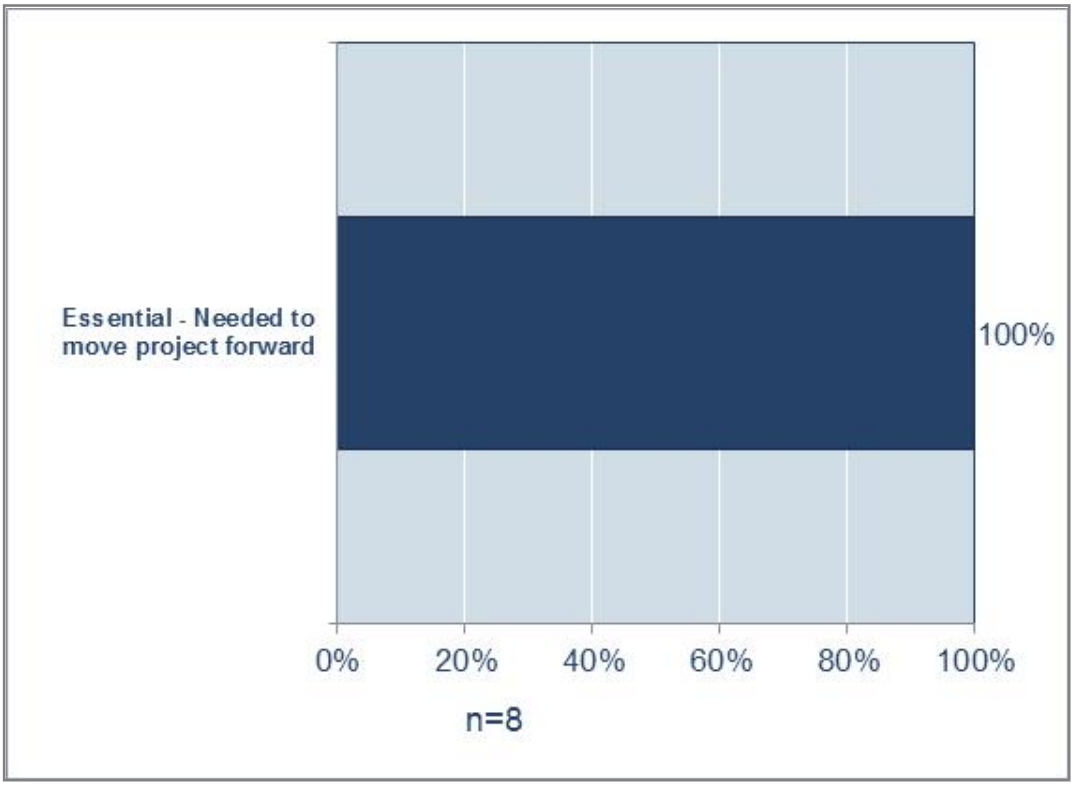
**Figure 9: Co-Funding Obtained in Addition to EECBG Small Cities and Counties Program Grant**




Source: DNV KEMA analysis

Respondents whose projects received co-funding were asked the same set of questions about the role and influence of these co-funding sources on their project's implementation, scope, and timing. Figure 10 shows the results for respondents who received co-funding from the ECAA-ARRA Loan Program. As shown, 100 percent who received ECAA-ARRA funding claimed it was essential to move their projects forward.

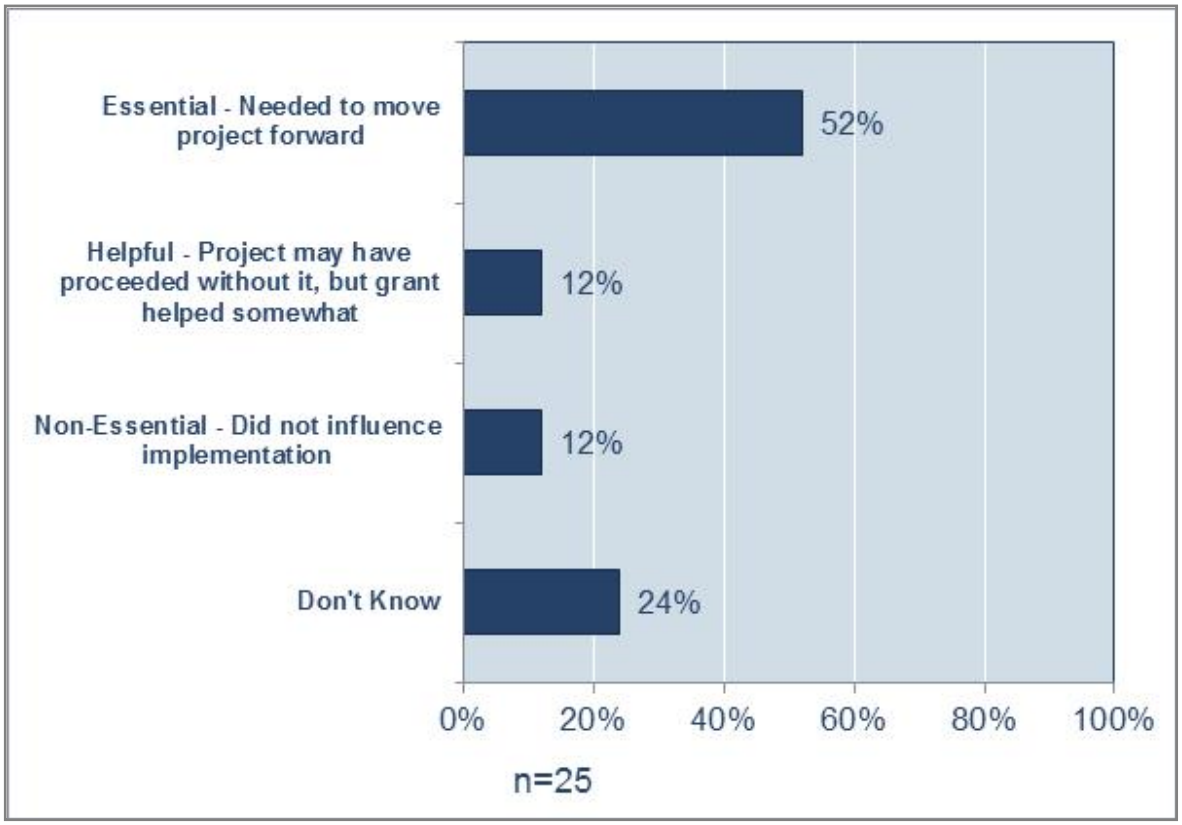
**Figure 10: Role of ECAA-ARRA Co-Funding on EECBG Small Cities and Counties Program Project Implementation**




Source: DNV KEMA analysis

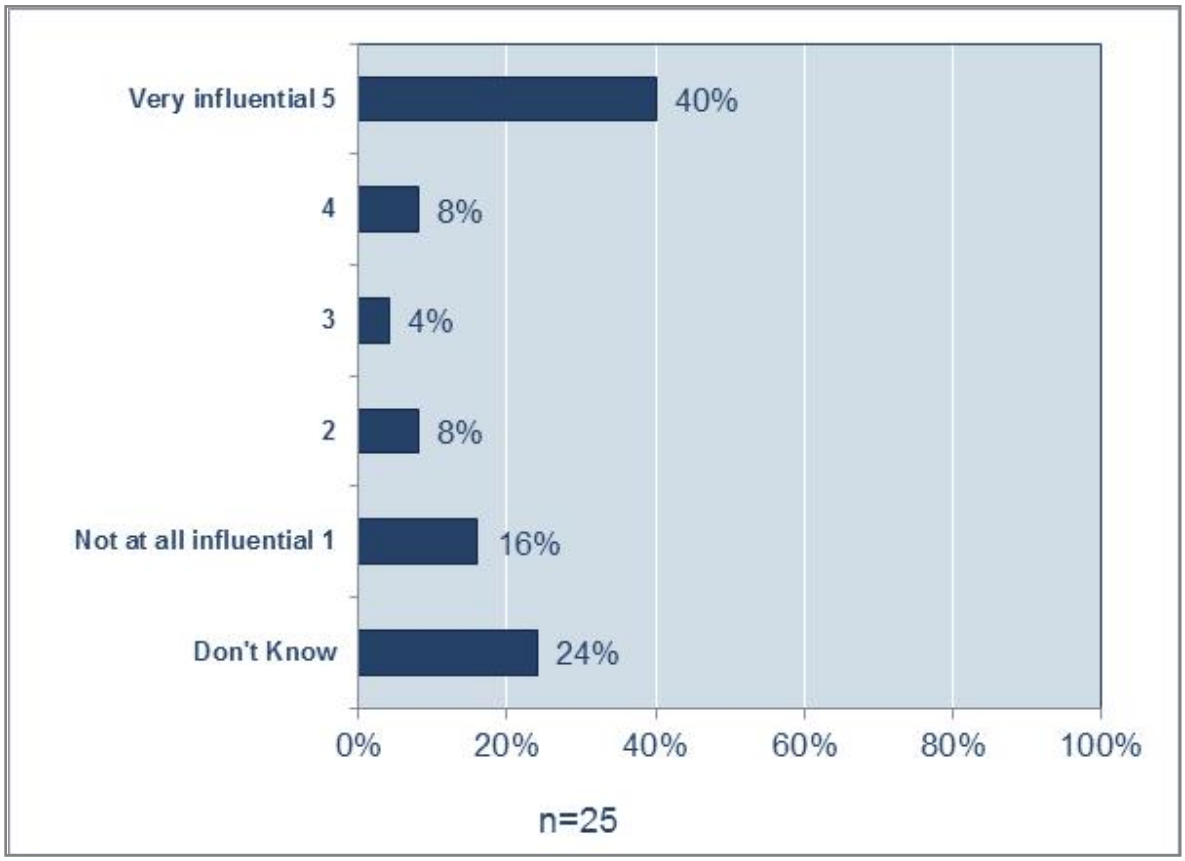
Figure 11 and Figure 12 show results for respondents who received utility co-funding. Of 25 respondents, about half considered their utility funding to be essential to move the project forward. Three respondents (12 percent) said that utility co-funding was nonessential to project implementation; only the EECBG Small Cities and Counties Program grant was essential.

**Figure 11: Role of Utility Co-Funding on EECBG Small Cities and Counties Program Project Implementation**




Source: DNV KEMA analysis

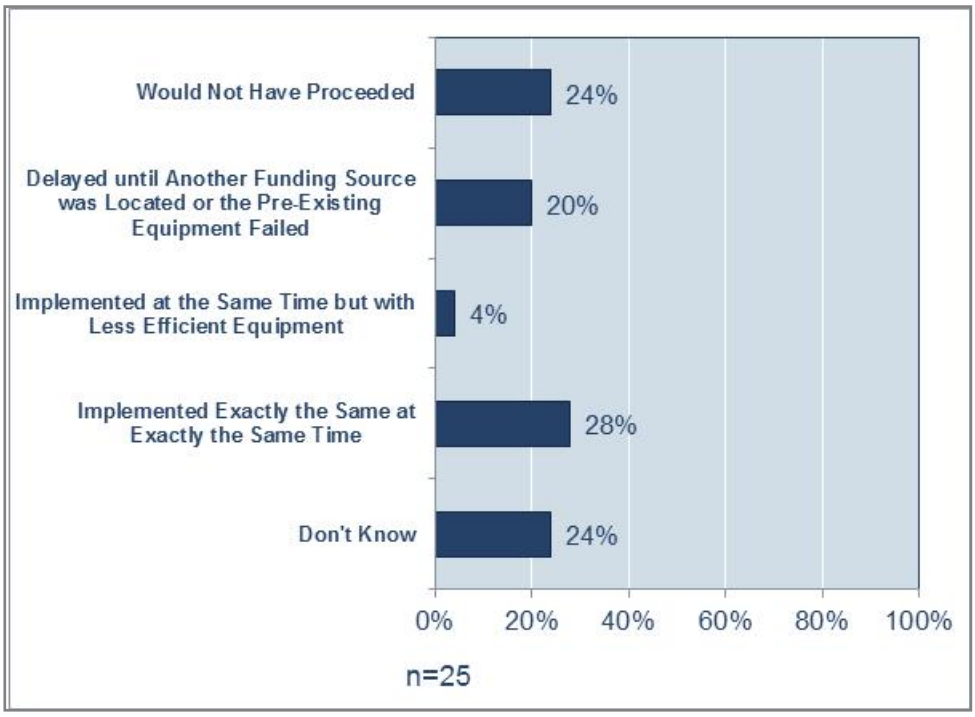
**Figure 12: Influence of Utility Co-Funding on EECBG Small Cities and Counties Program Project Implementation**




Source: DNV KEMA analysis

Respondents were also asked about the influence of utility co-funding on project scope and timing decisions, as shown in Figure 13. About a third of respondents (28 percent) indicated that the project would have been implemented exactly the same at exactly the same time without utility co-funding, further indication that the EECBG Small Cities and Counties Program grant was the funding source of primary importance. Six respondents (24 percent) indicated that without additional utility funding, the project would not have been implemented.

**Figure 13: EECBG Small Cities and Counties Program Project Implementation Without Utility Co-Funding**




Source: DNV KEMA analysis

One respondent received other state funding, in the form of local government funding out of their city's general fund, in addition to utility funding and the EECBG Small Cities and Counties Program grant. This respondent reported that the local government funding was more essential than utility funding, rating it "5,"or "very influential," compared to "1," or "not at all influential" for utility funding. The respondent also indicated that the project would not have been implemented without the local government funding, while without utility funding it would have been implemented exactly the same at exactly the same time.

## Decision-Making Factors Influencing Project Implementation

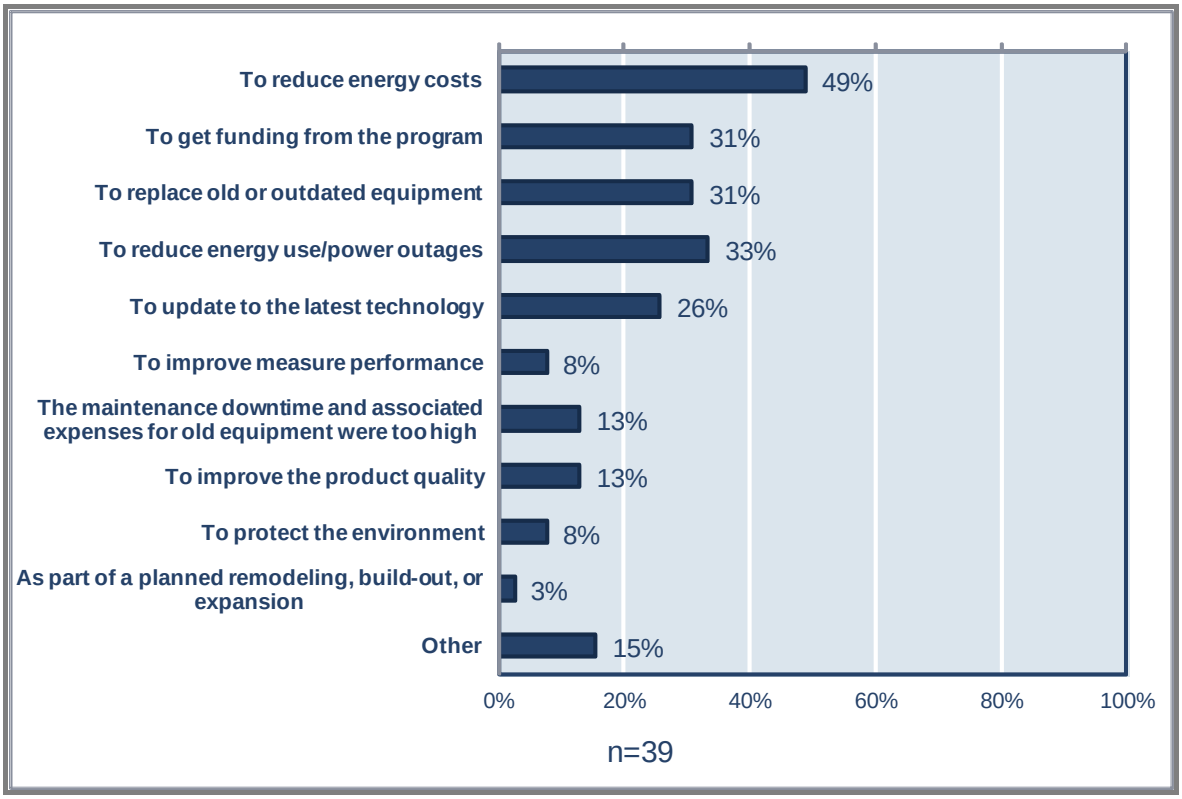
Respondents were asked to discuss other factors that might have influenced their projects implementation. This section discusses results related to three areas:

- 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 (for example, life-cycle savings, payback criteria, and so forth)

### *Reasons for Project Implementation*

Respondents were asked to discuss 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 include reducing energy costs and energy use, followed by replacing old or outdated equipment, and getting funding from the program. Other reasons include reducing GHG emissions and replacing obsolete equipment. One respondent noted that it was “basically free money"; the EECBG Small Cities and Counties Program grant combined with utility program co-funding covered the entire cost of the project, and there was no reason to turn it down.

**Figure 14: Reasons for EECBG Small Cities and Counties Program Project Implementation**

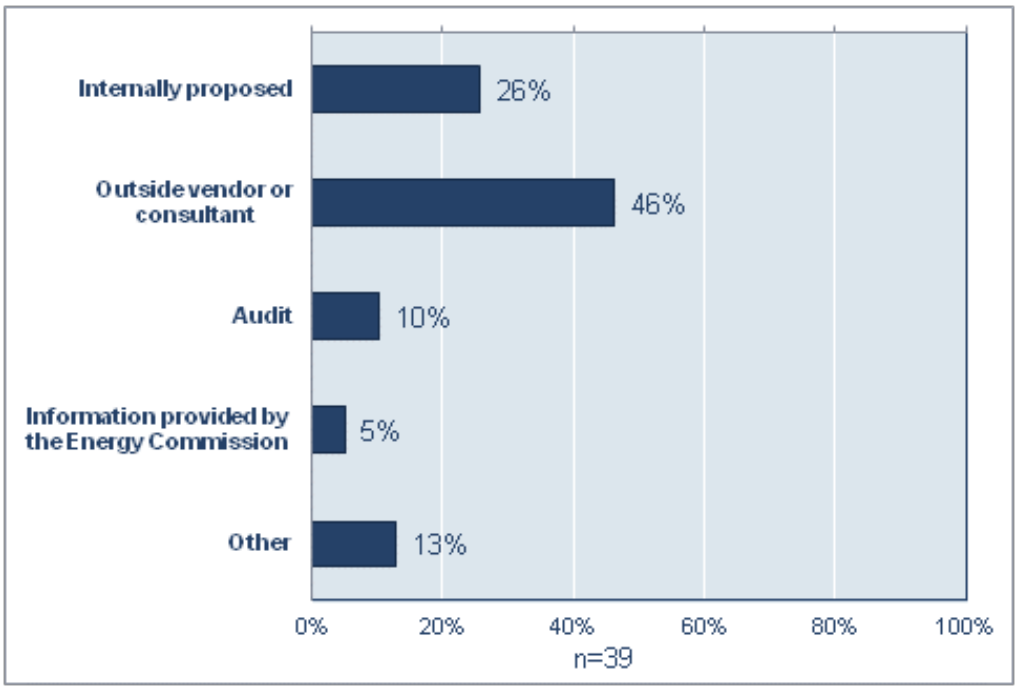



Source: DNV KEMA analysis

## Project Origination

Respondents were also asked to discuss their projects' origin, specifically how or who was responsible for identifying or developing the project. Most projects were proposed internally or were proposed by external vendors or consultants, as shown in Figure 15. "Other" sources include vendors, the U.S. DOE, and regional entities such as the Ventura County Regional Energy Alliance, a joint powers authority, and the High Sierra Energy Foundation. One respondent noted that the Energy Commission suggested lighting measures to them because their proposed solar measures did not qualify under the EECBG Small Cities and Counties Program.

**Figure 15: EECBG Small Cities and Counties Program Project Origination**



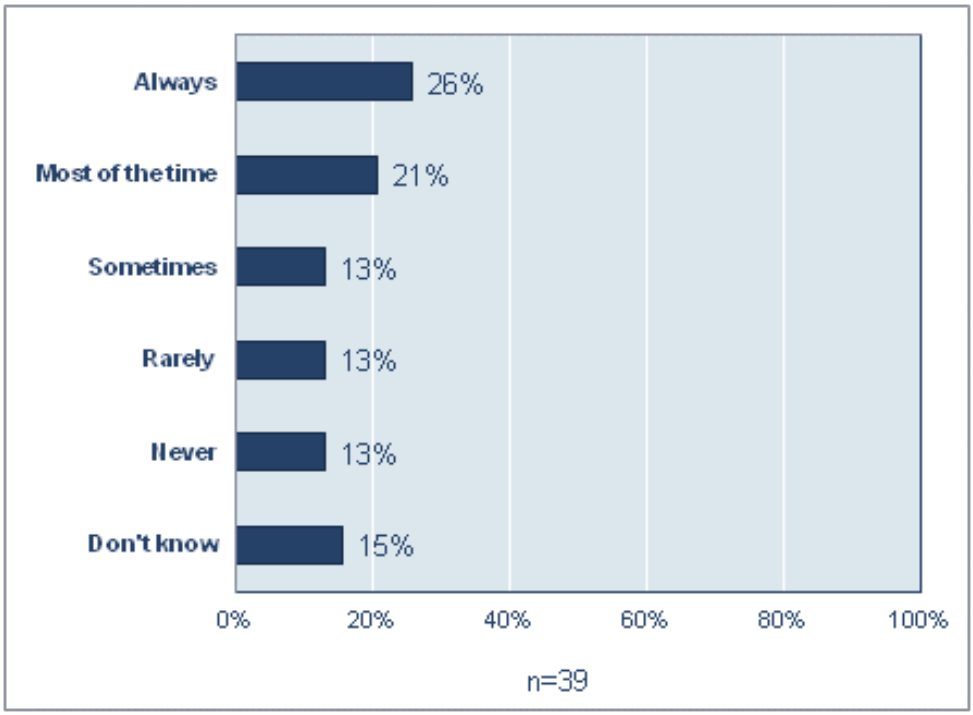

Source: DNV KEMA analysis

*Decision-Making Factors Considered in Project Implementation*

Respondents were asked questions to determine key financial factors that contributed to their projects' final adoption decisions, such as organizationally mandated criteria or tools to factor routine equipment upgrades or rate of return on investments. The results can be summarized as follows:

- **Consideration of Life-Cycle Costs.** As shown in Figure 16, about one-quarter of respondents (26 percent) indicated that they "always" factor life-cycle costs (including energy and maintenance costs) when purchasing new equipment. A similar percentage (26 percent) indicated that they "rarely" or "never" consider life-cycle costs in their purchasing decisions.

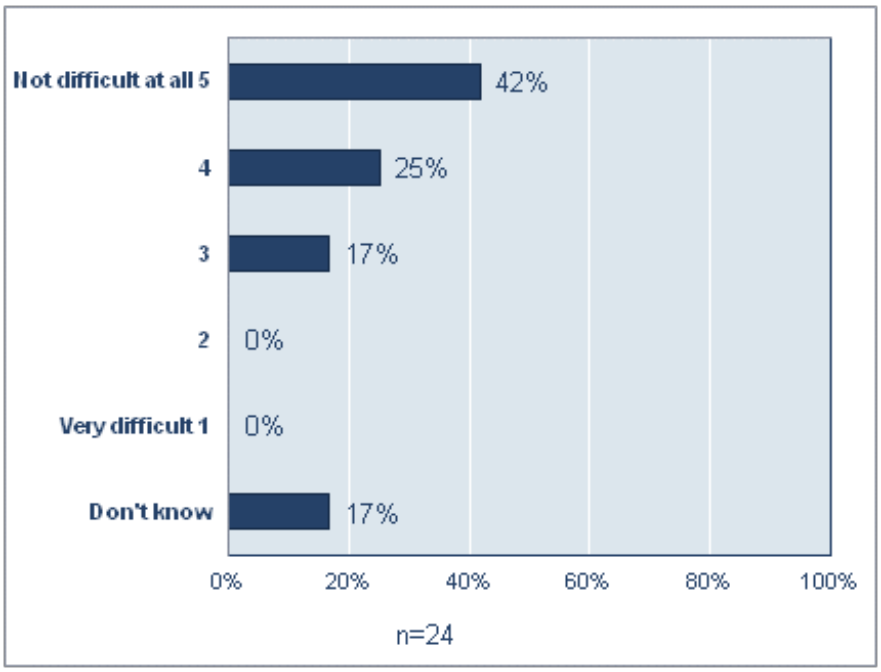
**Figure 16: Consideration of Life-Cycle Costs**




Source: DNV KEMA analysis

- **Payback Period Thresholds**. Respondents routinely named payback period as an important financial calculation to consider when undertaking projects like those in the EECBG Small Cities and Counties Program. Several respondents mentioned that they typically look for payback periods between 5 to 10 years. Respondents were asked to discuss the difficulty of meeting payback period requirements when applying for the EECBG Small Cities and Counties Program. As shown in Figure 17, most respondents reported that it was not difficult to meet the program's payback period requirement.

**Figure 17: Difficulty of Meeting Payback Period Requirements**




Source: DNV KEMA analysis

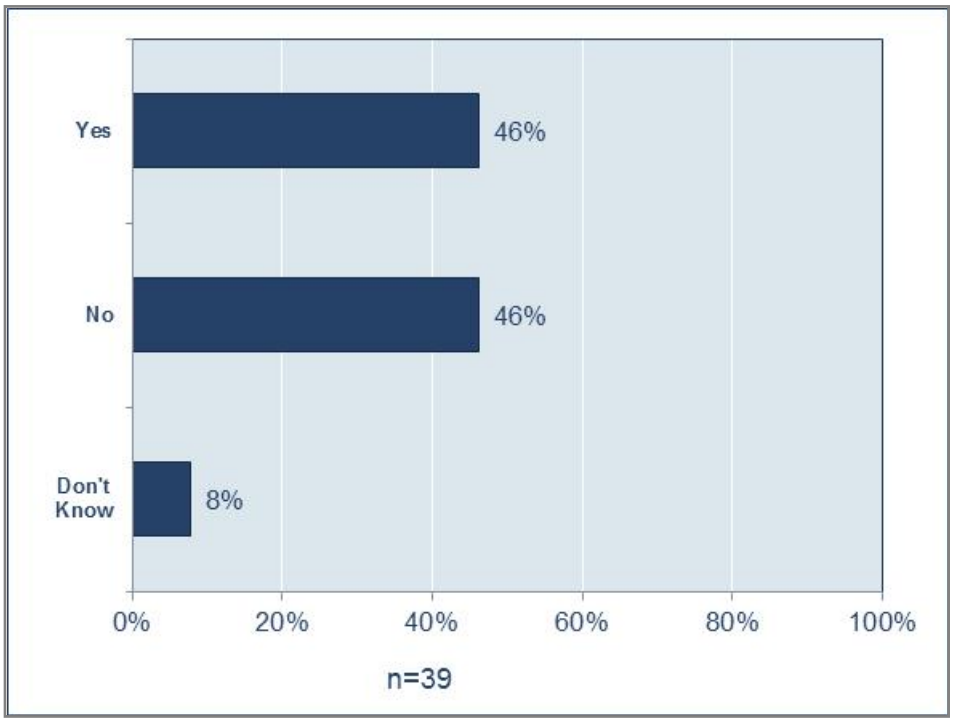
One respondent indicated that his organization did not have any existing financial guidelines for large energy projects; the EECBG Small Cities and Counties Program provided the funding for the city's first large energy project.

## Evidence of Participant Spillover

Evaluators asked respondents if their participation in the EECBG Small Cities and Counties Program directly influenced additional measure implementations at their facilities. There was some evidence of spillover in the sample, as shown in Figure 18. Sixteen respondents (46 percent) reported implementing additional EEMs outside the program with funding from other sources.

Many respondents indicated that because of the EECBG Small Cities and Counties Program, they intended to further improve the energy efficiency of equipment and have since enacted more measures including many streetlighting upgrades, HVAC installations, and pool pump upgrades. In many cases, city and county officials took notice of the success of the EECBG Small Cities and Counties Program; one respondent said the savings from this project impressed the city council, which made council members more receptive to the idea of going forward with a future variable-frequency pool pump motor project. Another respondent reported adopting a new countywide energy efficiency policy or replacing inefficient halogen task lighting fixtures with LED task lighting. The EECBG Small Cities and Counties Program projects also prompted several respondents to consider other upgrades, such as solar installations.

**Figure 18: Additional Measures Implemented Outside the EECBG Small Cities and Counties Program**

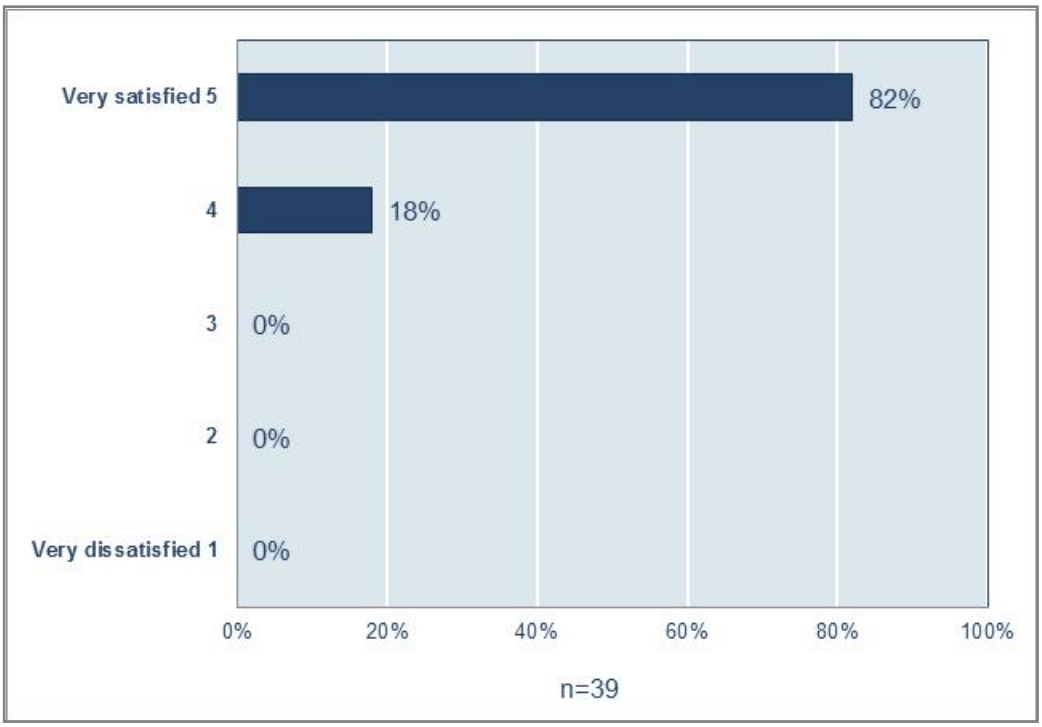



Source: DNV KEMA analysis

## Participant Satisfaction and Suggestions for Improvement

Evaluators asked participants to discuss their overall satisfaction with the EECBG Small Cities and Counties Program and with certain aspects of the program and its requirements. On a scale of 1 to 5, where 1 is "very dissatisfied" and 5 is "very satisfied," respondents ranked their satisfaction levels with the equipment installed, grant amounts received, and grant structure. Figure 19 below shows the distribution of responses for satisfaction with equipment installed. The overwhelming majority (82 percent) were "very satisfied" with the equipment installed.

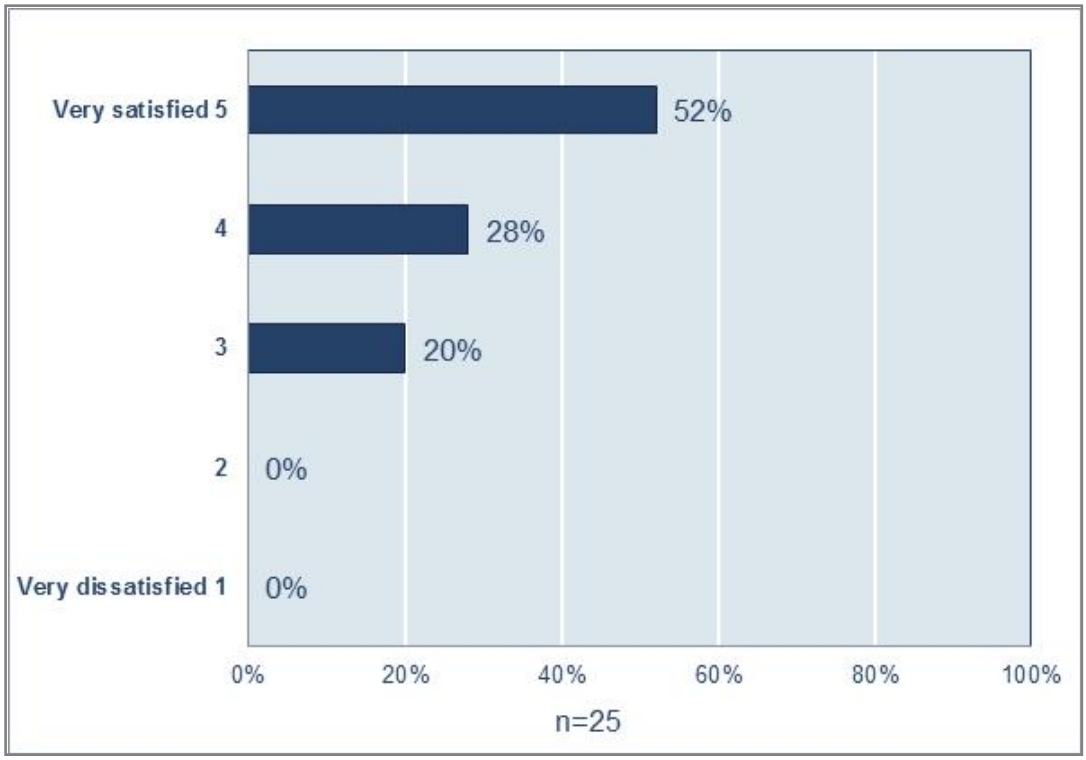
**Figure 19: Satisfaction With Equipment Installed**




Source: DNV KEMA analysis

Respondents were also asked to rate their satisfaction with EECBG Small Cities and Counties Program grant amount. As shown in Figure 20, respondents were also very satisfied with the amount of the grants received.

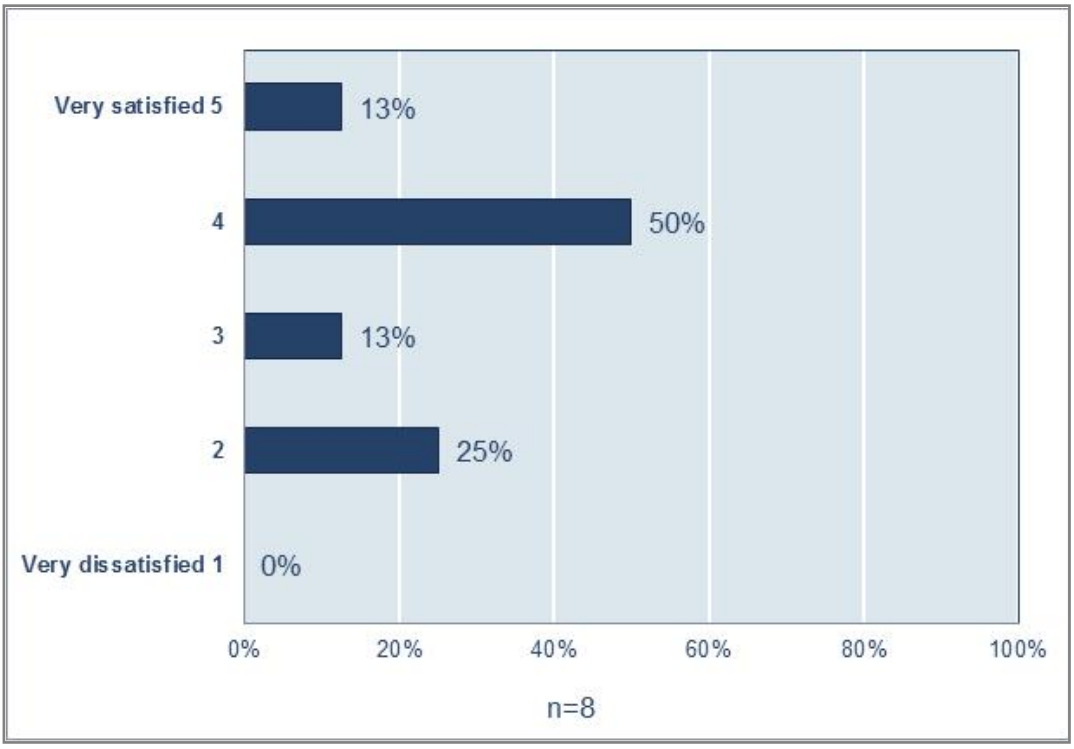
**Figure 20: Satisfaction With EECBG Small Cities and Counties Program Grant Amount Received**




Source: DNV KEMA analysis

Respondents rated their satisfaction with the structure of the EECBG Small Cities and Counties Program grant somewhat lower, as shown in Figure 21. Two respondents commented that the paperwork and application process were too bureaucratic and burdensome.

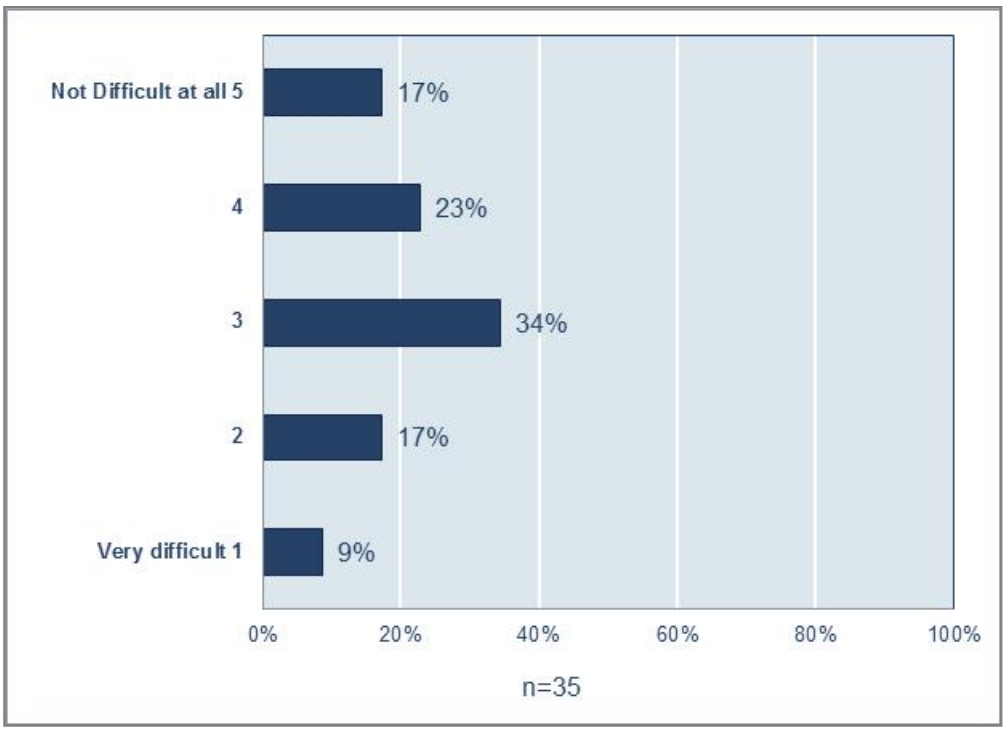
**Figure 21: Satisfaction With EECBG Small Cities and Counties Program Grant Structure**




Source: DNV KEMA analysis

Midway through the first round of applications, the U.S. DOE informed the Energy Commission of federal program requirements, including application, reporting, waste management requirements, and complying with the National Historic Preservation, the Buy American provision of ARRA funding, and the Davis-Bacon Act. Up until that point—due to lack of guidance—the Energy Commission had provided its own interim requirements. This was confirmed through interviews with EECBG Small Cities and Counties Program project representatives. Figure 22 below shows respondents' difficulty with complying with grant application requirements. Respondents ranked the difficulty level, on a scale of 1 to 5 where 1 is "very difficult" and 5 is "not difficult at all," to comply with those requirements. Respondents complained that there was a large amount of paperwork and the requirements were confusing. The overcomplicated paperwork seemed more appropriate for larger-scale projects and did not seem necessary for the small amount of EECBG funding. One respondent claimed that for a simple lighting project, the respondent was required to perform a CEQA Notice of Exemption. Another respondent complained that even once the documents were fully executed, the requirements and financial forms changed midway, which were extra work. According to Energy Commission staff, many EECBG Small Cities and Counties Program grant recipients eventually canceled the grant application due to the bureaucratic and burdensome paperwork.

**Figure 22: Difficulty With Complying With EECBG Small Cities and Counties Program Grant Application Requirements**

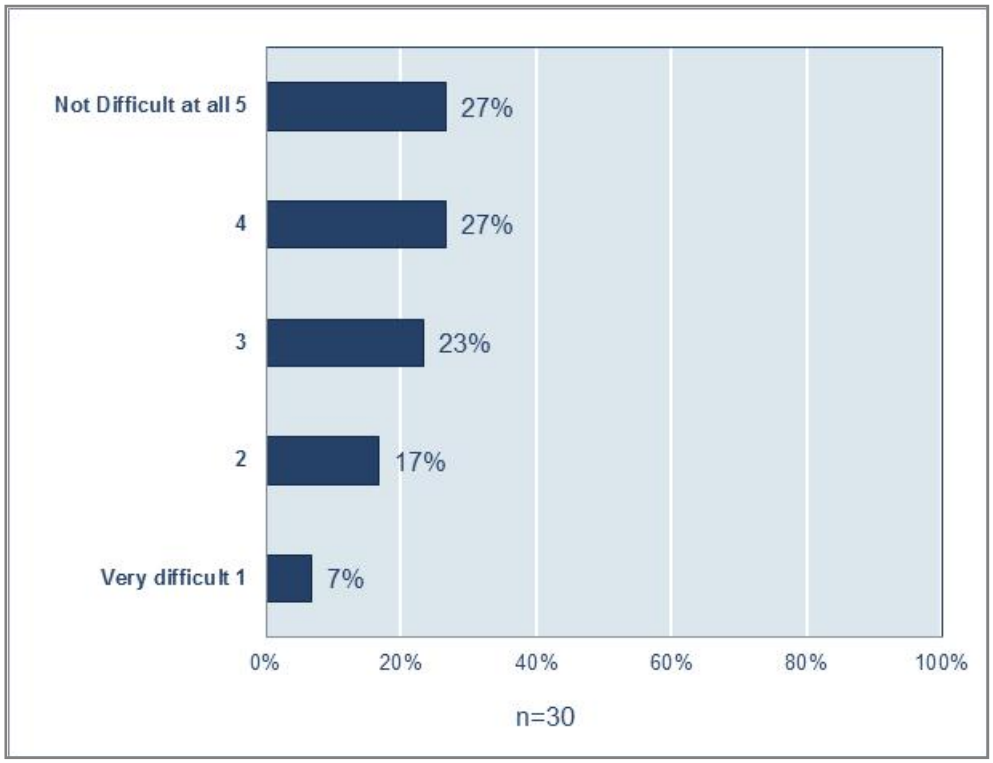



Source: DNV KEMA analysis

Several respondents withheld responses to these questions because they were either not familiar with these requirements or their projects were exempt (for example, National Historic Preservation Act).

Figure 23 below shows respondents' difficulty with complying with the Davis-Bacon Act. The evaluation team found this to be a primary issue surfacing in the in-depth interviews with participants, as well as interviews with program managers. The Davis-Bacon Act required contractors to pay at the prevailing wage. Some participants reported difficulty locating and submitting prevailing wages for subcontractors based upon federal and local standards. One site contact admitted that the planned HVAC measures were canceled because the city was unable to find a contractor willing to work at the wages stipulated by the contract requirements.

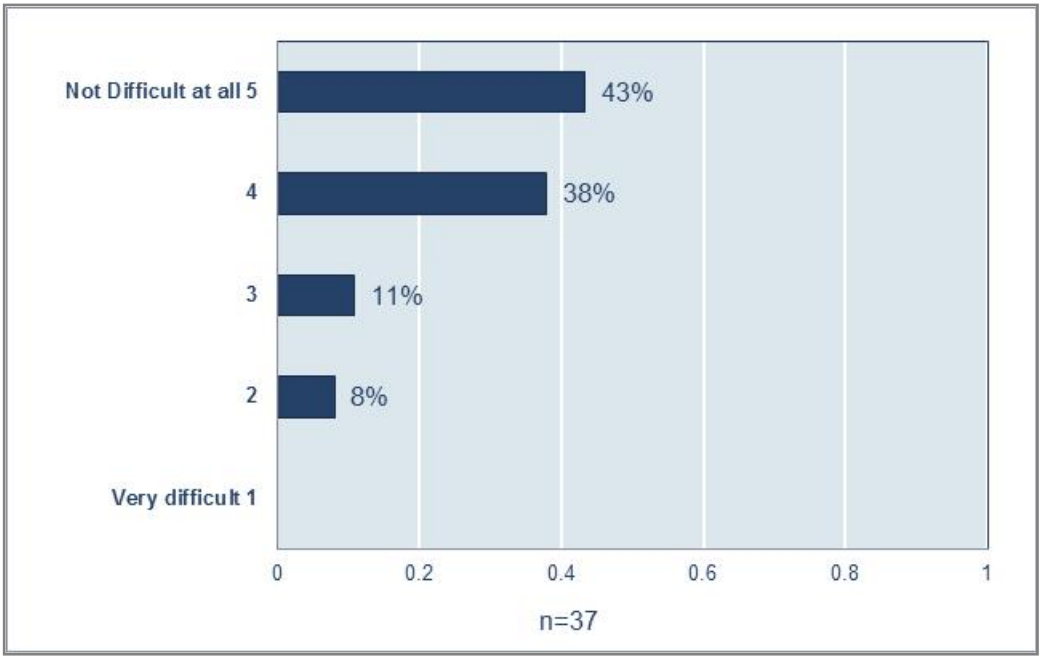
**Figure 23: Difficulty Complying With Davis-Bacon Act**




Source: DNV KEMA analysis

Figure 24 below shows respondents' difficulty with complying with the Buy American provision of the ARRA funding. Most respondents ranked it 4 or 5, "not difficult at all." However, these requirements were problematic for some respondents. For example, it was difficult to really know where a piece of equipment was made. One respondent who had difficulty determining the manufacture and assembly location for a piece of equipment was forced to replace a newly installed air-conditioning coil when the Energy Commission informed the respondent that it was manufactured in Mexico.

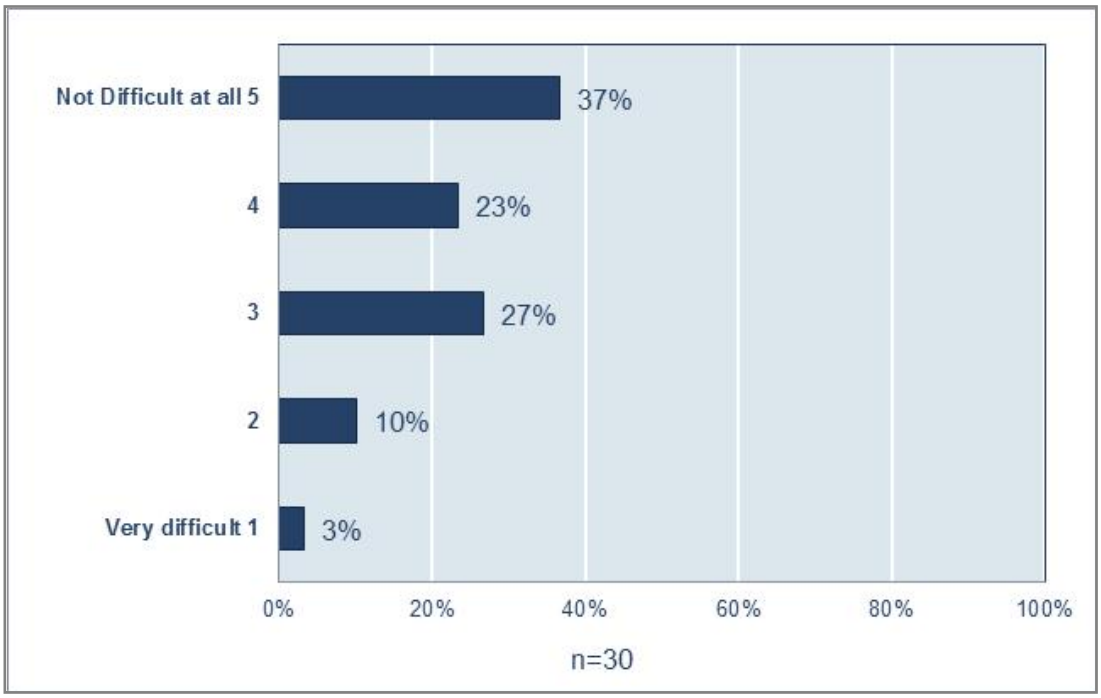
**Figure 24: Difficulty Complying With Buy American Provision Requirements**




Source: DNV KEMA analysis

Figure 25 shows respondents' difficulty with complying with the National Historic Preservation Act. Respondents found the National Historic Preservation Act requirements to be time-consuming, as it was difficult to explain technical and architectural aspects of the building to the Energy Commission. In particular, respondents felt that requirements should be relaxed for relamping projects in which the building structure is not altered. One respondent reported that someone came in mid-stream to ask for more proof, which pushed the schedule back, and, as a result, the interest rate for the leveraged funding (through the ECAA-ARRA Loan Program) had gone from 1 percent to 3 percent.

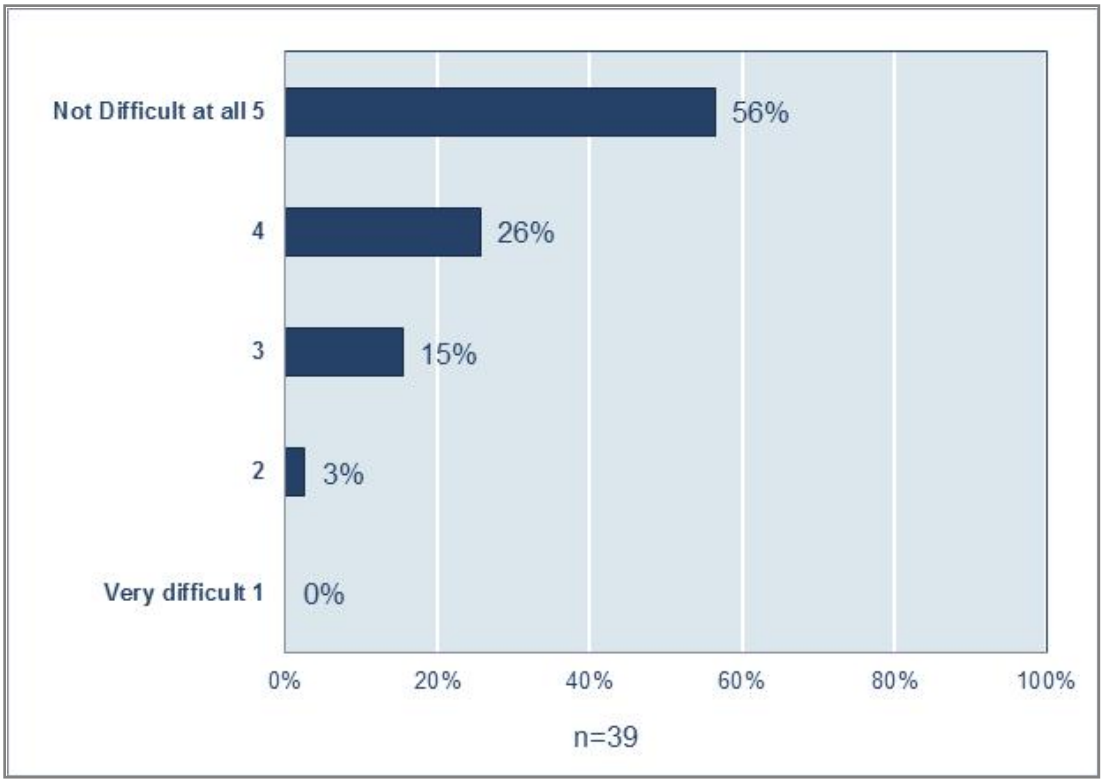
**Figure 25: Difficulty Complying With National Historic Preservation Act Requirements**




Source: DNV KEMA analysis

Figure 26 shows the difficulty of complying with Waste Management Requirements. More than half of respondents (56 percent) found it "not difficult at all." No respondents rated it "very difficult."

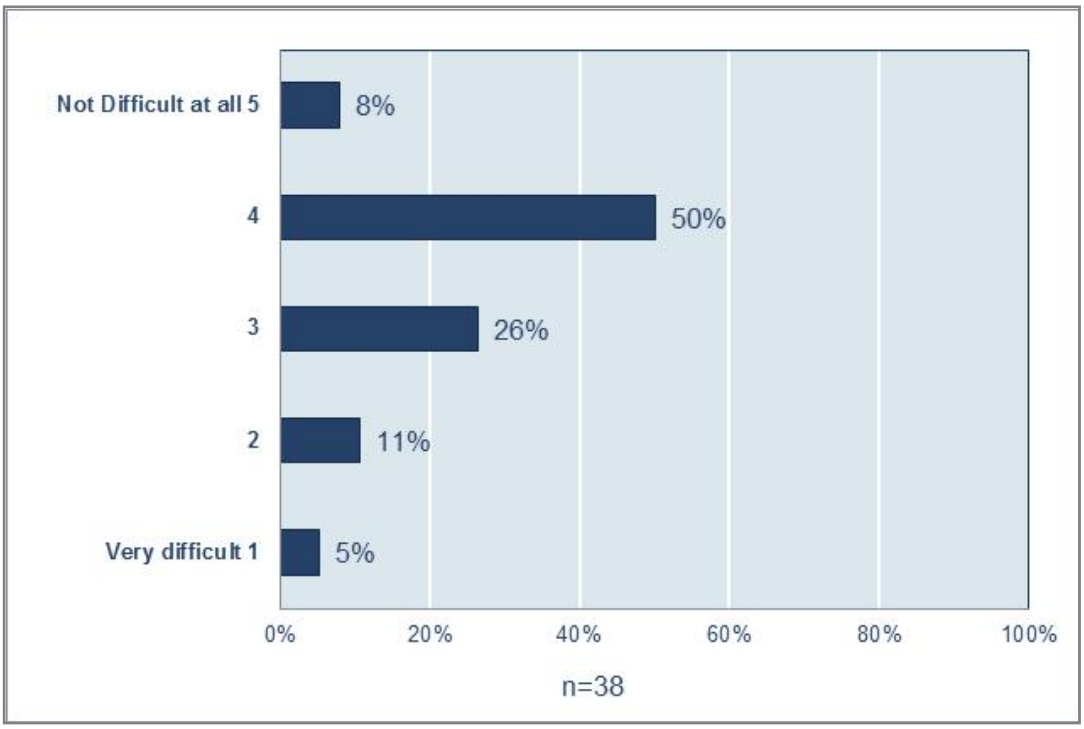
**Figure 26: Difficulty Complying With Waste Management Requirements**




Source: DNV KEMA analysis

Most respondents did not report having difficulties with the Energy Commission's reporting requirements, as shown in Figure 27. Some respondents, however, indicated in interviews that there were ongoing issues with the Energy Commission and with the subcontractors – in particular, reporting of the prevailing wage requirement. While the U.S DOE eventually allowed self-certification of wages, the Energy Commission decided to maintain a risk-averse approach due to an anticipated high level of interest. While some found the reporting tools to be easy to use, some respondents felt that reporting required a steep learning curve and too much time commitment. Additionally, respondents were unhappy with mid-stream changes in Energy Commission personnel, financial forms, and procedures.

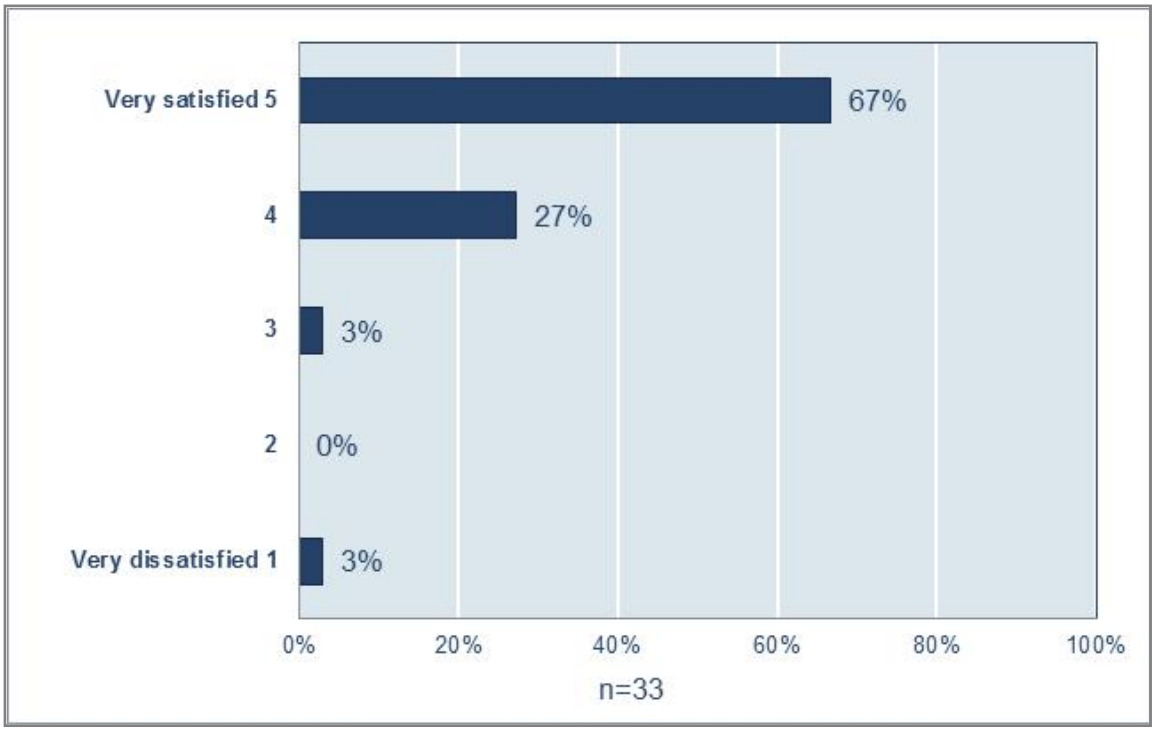
**Figure 27: Difficulty Complying With EECBG Small Cities and Counties Program Reporting Requirements**




Source: DNV KEMA analysis

Respondents were also asked to rank, on a scale of 1 to 5, their satisfaction with technical assistance received from the Energy Commission, communications with its staff members, and its overall project management. As shown in Figure 28, respondents were generally very satisfied with the Energy Commission's project management. Several respondents noted that Energy Commission staff was very helpful and easy to work with.

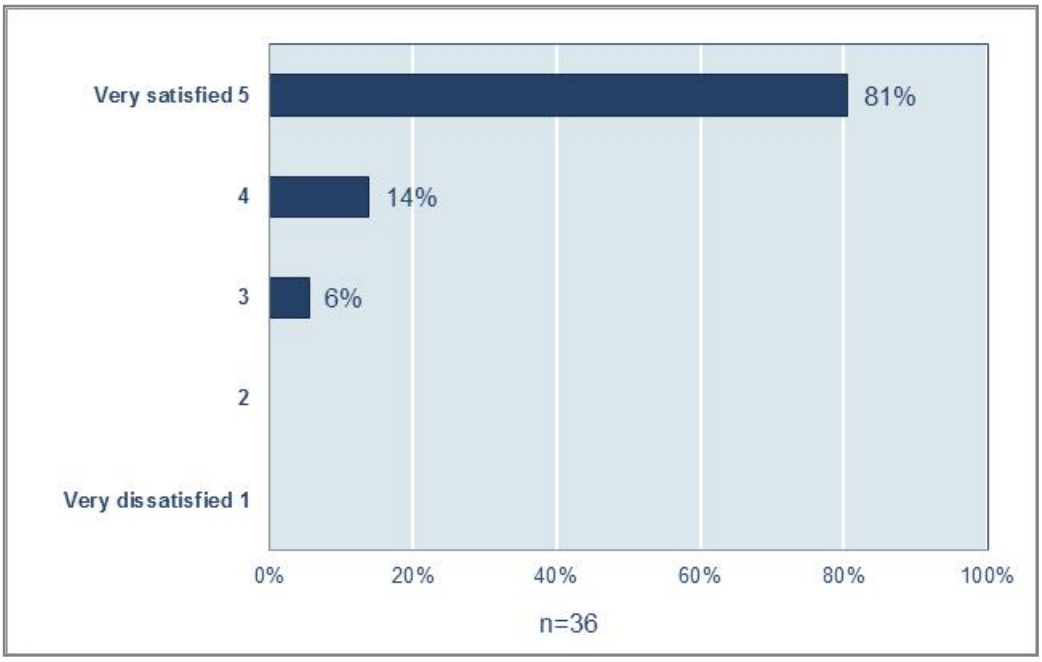
**Figure 28: Satisfaction With Energy Commission's Project Management**




Source: DNV KEMA analysis

Figure 29 shows respondents' satisfaction with communications with the Energy Commission's staff. The majority of respondents (81 percent) said they were "very satisfied."

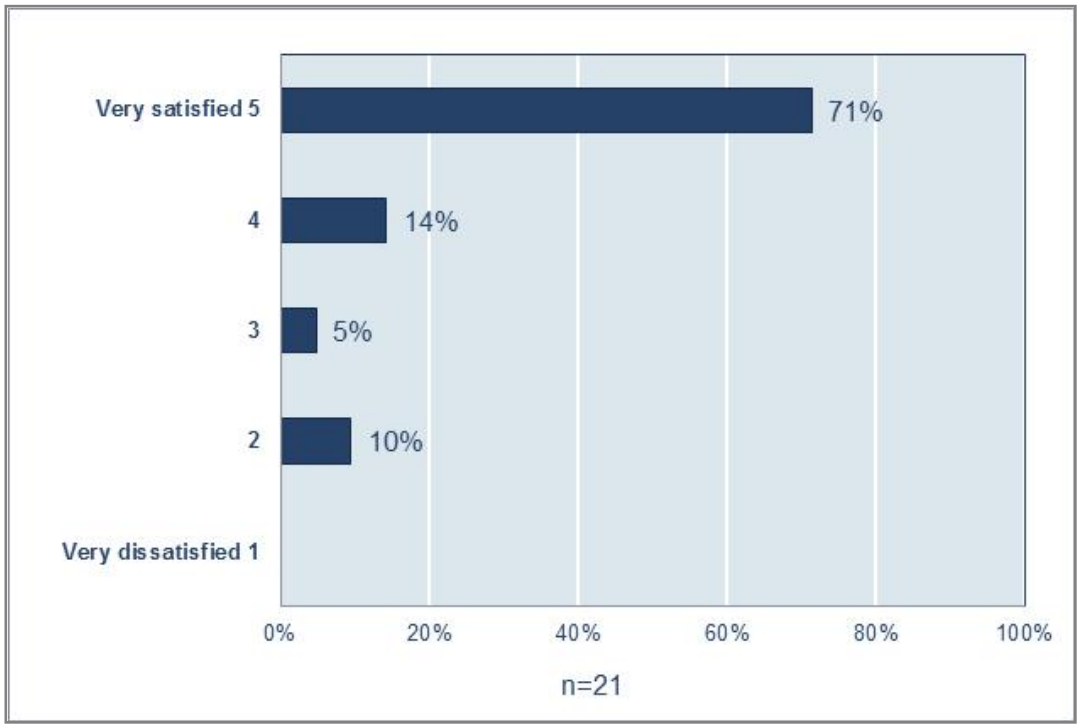
**Figure 29: Satisfaction With Communications With Energy Commission's Staff**




Source: DNV KEMA analysis

Figure 30 below shows respondents' satisfaction with the technical assistance received from the Energy Commission to develop projects. Many respondents reported that they did not ask for or receive technical assistance from the Energy Commission and, as a result, did not provide an answer to this question. Most of the respondents (74 percent) who received technical assistance said they were "very satisfied." According to Energy Commission staff, many projects were delayed or canceled because they could not get timely approval from the U.S. DOE and the Energy Commission. With the help from the technical assistance program (Energy Partnership program), many local jurisdictions were able to complete the project in time with help from the Energy Commission (technical audit, project identification, and performance specifications).

**Figure 30: Satisfaction With Technical Assistance Received From Energy Commission**




Source: DNV KEMA analysis

## Overall Impressions of the EECBG Small Cities and Counties Program

Evaluators asked respondents for their overall impressions about the program and to offer any suggestions for improvement. Respondents indicated that they were generally very happy with the program. They found the Energy Commission's staff to be extremely helpful and thought that the program worked well, citing the EECBG Small Cities and Counties Program as a positive experience that encouraged cities to enact more projects.

Respondents offered suggestions about the application process, suggesting that a longer application timeline and less paperwork would improve the ease of participation. One

respondent claimed that small cities were required to document more for grant money than larger cities. Several others criticized the amount of paperwork relative to the grant amount, saying that the effort their staff put into documentation was not worth the amount of grant money received. Many respondents were dissatisfied that the U.S. DOE did not inform them of the application requirements—in particular, the Davis-Bacon Act and Buy American provision—until halfway through the application process. The monthly reporting requirements also proved to be quite onerous, especially for small cities and counties with limited resources. Respondents suggested setting reporting deadlines by milestone rather than monthly.

## Self-Reported Evidence of Job Creation

Evaluators asked respondents to quantify job creation and retention resulting from the EECBG Small Cities and Counties Program. Though not a rigorous, official job creation analysis, the responses offer some insight into the program's temporary and lasting effects.[11] As shown in Table 25, most jobs created or retained were in the mechanical and electrical trades. Respondents reported a total of 43 jobs added or retained, and most were unsure whether the jobs were permanent or temporary positions.

**Table 25: Number of Jobs Created or Retained**

| Industry Category | Permanent/Temporary | Number of Jobs Created or Retained |
|---|---|---|
| Administration | Temporary | 1 |
| Construction | Don't Know | 5 |
| Management (Blue-Collar) | Don't Know | 1 |
| Mechanical and Electrical Trades | Permanent | 9 |
| | Temporary | 5 |
| | Don't Know | 18 |
| Don't Know | Permanent | 1 |
| | Don't Know | 3 |
| Total | | 43 |

Source: DNV KEMA analysis

Jobs for contractors or other outsiders were reported to be primarily temporary hires, in particular tradesmen such as plumbers and electricians. Contract hires included electrical

11 A comprehensive, rigorous model of employment effects and cost-effectiveness is being developed for all of the Energy Commission's ARRA programs, the results from which will be reported separately in 2014.

contractors and wiremen who were hired temporarily to install lights and fit pipes. One respondent noted that the EECBG was able to keep contractors and workers working but may not directly account for additional hiring or retaining of employees. These positions were HVAC electricians and technicians, mechanics, electricians, and crane operators. One respondent indicated that an unspecified number of city maintenance employees were retained for installation of equipment.

Respondents were asked similar questions about jobs created outside their operations, as shown in Table 26. Many reported that while the EECBG Small Cities and Counties Program grant provided work for the contractors, they did not know whether this work led to jobs retained or additional hiring. When asked how many people were hired and for how long, answers ranged from 4-8 people over periods of 1.5 weeks to 4 months. One respondent reasoned that "the purchased equipment had to be produced somewhere and had to come from a distributor… [This created] thousands of billable hours that would not have existed otherwise."

**Table 26: Jobs Retained or Created Outside the Organization**

| Response | Jobs Retained | Jobs Created |
|---|---|---|
| Yes | 28% | 13% |
| No | 18% | 28% |
| Don't Know/Refused | 54% | 59% |
| Total Respondents | | 39 |

Source: DNV KEMA analysis

# CHAPTER 5:
# Summary and Recommendations

The overall goal of the evaluation was to assess the effectiveness of EECBG Small Cities and Counties Program implementation and verify the energy savings realized from grants issued between 2009 and 2012. The following sections summarize the results from the evaluation effort and present recommendations for improvements for similar programs moving forward.

## Summary of Results

- **The program design concept was successful.** In general, the results from the evaluation demonstrate that the Energy Commission effectively used ARRA funding to initiate cost-effective, "shovel-ready" energy efficiency projects in smaller jurisdictions that may not have had the resources to participate in this type of program before. The widespread application of the program (as depicted in Figure 1) effectively targeted often-overlooked opportunities in small cities and counties for which small investments could result in significant savings. This was especially evident in jails and facilities with exceptionally out-of-date equipment. EECBG-funded projects resulted in better operations and long-term savings for the state.
- **Both EEP and DEP approaches proved to be successful.** Both project types yielded similarly high savings and realization rates. For EEP, feasibility studies provided a good basis for planning and documenting projects. Given that DEP was based on an approach of implementing measures that were known to be effective, DEP projects also yielded good results, as expected.
- **Targeting "shovel-ready," "low-hanging fruit" was key to program success.** The evaluation team found that the types of projects completed were appropriate for ARRA funding use. The program required projects to be easily implementable, "shovel-ready" projects that yielded cost-effective energy savings and showed wise use of public funds. In particular, that meant that because so few small jurisdictions had previously implemented energy efficiency projects, there was a wealth of "low-hanging fruit" to be picked. These projects provided reliable savings with minimal effort and resources. For example, streetlighting projects required relatively little effort to implement. California's climate is also appropriate to transition old equipment to cost-effective, efficient LED street lights.
- **The EECBG Small Cities and Counties Program achieved significant savings due in part to flexible program delivery.** The Energy Commission's EECBG Small Cities and Counties Program team was able to get the program off the ground quickly, working closely with small jurisdictions through the evolution of their applications to find the most effective and efficient measures. The program achieved its goals of quick implementation, wide outreach, and significant savings.
- **Many jurisdictions also leveraged additional help and funding from other sources.** As a result, many local governments were able to implement more or larger projects using a

combination of its own capital funds, utility rebates, or Energy Commission low-interest loans.

- **The program set a strong foundation for the future.** The program allowed small jurisdictions, which had previously been unable, to enact energy efficiency projects. Participants reported instances of spillover in site visits and interviews; many site contacts identified additional projects they were hoping to undertake. Yet others indicated that the publicity from the projects caught the attention of the city councils, which opened the door for future projects. The program created opportunities for previously overlooked counties and cities and resulted in better operations and long-term savings for the state that likely would not have happened otherwise.

## Energy Impact Results

Overall, the 204 grants awarded through the EECBG Small Cities and Counties Program were expected to achieve annual energy savings of about 34 GWh and 240,000 therms. Gross annual electric savings were estimated at either 33.6 GWh (98 percent realization rate, relative to Baseline 1) or 32 GWh (94 percent, Baseline 2). Gross annual natural gas savings were estimated at about 175,000 therms (73 percent realization rate, relative to Baseline 1) or 128,000 therms (53 percent, Baseline 2). The overall precision of these estimates for electric savings, which indicates the reliability of the results, is 6 percent for Baseline 1 and 7 percent for Baseline 2, at the 90 percent confidence interval. For natural gas savings, precision was 32 percent for Baseline 1 and 24 percent for Baseline 2. The evaluation met expected energy savings program goals. It also met evaluation goals for precision in the ex post results for electric and overall. Precision results for natural gas savings were higher than expected due to the relatively small number of projects executed.

The evaluation team determined net savings to the program to be nearly 100 percent of gross savings given that, according to participant self-reports, only two projects did not require EECBG funding to move forward. The savings from these projects represented a small fraction (less than 2 percent) of the overall savings expected from the 51 project sites included in the evaluation sample. The NTG ratio for the overall program was determined to be 0.98.

Life-cycle impacts from the enacted energy efficiency projects should amount to more than 450 GWh in net electricity savings over the life of the measures installed and more than 2 million therms. Life-cycle reductions in GHG emissions were estimated to be more than 150,000 metric tons.

The results are shown in Table 27.

**Table 27: EECBG Small Cities and Counties Program Evaluation Results Summary**

| Ex Ante Energy Impacts | | |
|---|---|---|
| Ex Ante Annual Electric Savings (kWh) | 34,337,164 | |
| Ex Ante Annual Natural Gas/Other Fuel Savings (therms) | 240,039 | |
| **Evaluation Results** | **Baseline 1** | **Baseline 2** |
| **Gross Energy Impacts** | | |
| Gross Annual Electric Savings (kWh) | 33,564,591 | 32,245,439 |
| kWh Realization Rate | 98% | 94% |
| Gross Annual Natural Gas/Other Fuel Savings (therms) | 175,470 | 127,822 |
| Therm Realization Rate | 73% | 53% |
| **Net Energy Impacts** | | |
| Net-to-Gross Ratio | 98% | 98% |
| Net Annual Electric Savings (kWh) | 32,893,300 | 31,600,531 |
| Net Annual Natural Gas/Other Fuel Savings (therms) | 171,961 | 125,266 |
| **Net Life Cycle Energy Impacts** | | |
| Electric Savings (kWh) | 461,636,663 | 442,789,525 |
| Natural Gas/Other Fuel Savings (therms) | 2,730,498 | 2,013,578 |
| **Greenhouse Gas Reductions** | | |
| Annual (metric tons of $CO_2$) | 11,206 | 10,554 |

Source: DNV KEMA analysis

## Differences in Ex Ante and Ex Post Energy Savings Results

Ex ante savings estimates were intended as a guide to determine realization rates to calculate overall program-level savings. Often, ex ante savings were not a firm estimate. Scope changes were allowed as long as projects were within the framework of approved measures. This flexibility in approach yielded savings similar overall to expected program results, but individual measure ex ante and ex post results showed differences. The evaluation team examined reasons for the differences for each measure evaluated; several consistent themes emerged. The most common reason site engineers noted for differences between ex ante and ex post savings was an unclear calculation method. For the DEP projects, the applicant was not required to provide the calculations. Other common reasons were baselines, installations, or operating hours articulated in the documentation differing from those found on-site, in particular for lighting measures.

## Program Role and Influence

The purpose of the EECBG Small Cities and Counties Program was to provide grants to small jurisdictions to implement energy efficiency projects. Evaluators asked respondents about the role and influence of the EECBG Small Cities and Counties Program on their implementation decisions for the projects and decisions related to the scope and timing of the projects. Relevant survey results are summarized below:

- **Role of Funding on Project Implementation**. The majority of respondents (92 percent) stated that the funding provided through the program was essential or instrumental in implementation of projects.
- **Influence of Program on Project Implementation.** The majority (95 percent) of respondents reported that the program was "Very Influential" in their decision to implement projects.
- **Scope and Timing of Projects Without Program.** More than half of the respondents reported that projects would have been delayed until funding sources were identified or until the existing equipment failed, and 38 percent indicated that their projects would not have proceeded at all had it not been for the EECBG Small Cities and Counties Program.
- **Role and Influence of Project Co-Funding.** Results from interview questions regarding the role and influence of co-funding sources indicate that, while co-funding was influential in moving many projects forward, it was not as essential as the financial assistance provided through the EECBG Small Cities and Counties Program. About two-thirds reported that their projects received funding from sources other than the EECBG Small Cities and Counties Program, including ECAA-ARRA funding, utility programs, and other local government sources. When compared to similar responses regarding EECBG funding, fewer respondents (who received co-funding) indicated that it was essential to projects moving forward, fewer reported that it was "Very Influential" in their decision to implement projects, and fewer reported that project scope and timing would have been affected if it was not available.
- **Evidence of Participant Spillover.** About half of respondents reported implementing additional energy efficiency measures outside the program with funding from other sources. Because of the EECBG Small Cities and Counties Program, they have since enacted more measures, including many streetlighting upgrades, HVAC installations, solar installations, and pool pump upgrades. In many cases, city and county officials took notice of the success of the EECBG Small Cities and Counties Program and were more open to future energy efficiency projects.

## Decision-Making Factors Influencing Project Implementation

Participants were asked to discuss other factors that might have influenced their projects implementation:

- **Reasons for Project Implementation.** The most common reasons include reducing energy costs and energy use, followed by replacing old or outdated equipment and getting funding from the program. Other reasons include reducing GHG emissions and replacing obsolete equipment.
- **Project Origination.** Most projects were proposed internally or were proposed by external vendors or consultants. "Other" sources include vendors, the DOE, and regional entities such as the Ventura County Regional Energy Alliance, a joint powers authority, and the High Sierra Energy Foundation.
- **Decision-Making Factors Considered in Project Implementation.** Respondents were asked questions to determine key financial factors that contributed to their projects' final adoption decisions.
    - **Life-Cycle Costs.** About one-quarter of respondents (26 percent) indicated that they "always" factor life-cycle costs (including energy and maintenance costs) when purchasing new equipment. A similar percentage (26 percent) reported that they "rarely" or "never" consider life-cycle costs in purchase decisions.
    - **Payback Period Thresholds**. Respondents routinely named payback period as an important financial calculation to consider when undertaking a project. Several respondents mentioned that they typically look for payback periods between 5 to 10 years. Most respondents, when asked, reported that it was not difficult to meet the program's payback period requirement.

### Participant Satisfaction, Impressions, and Suggestions for Improvement

Respondents were generally very happy with the EECBG Small Cities and Counties Program. Respondents were very satisfied with the equipment installed and the amount of grants received. They were also generally satisfied with their interactions with Energy Commission staff, in particular the technical assistance received and communications with the staff. Respondents found the Energy Commission's staff to be extremely helpful and said that the EECBG Small Cities and Counties Program was a positive experience that encouraged cities to enact more projects. The Energy Commission invested significant resources to make sure that the recipients had the technical information and knowledge to implement their projects.

Respondents offered suggestions about the application process, suggesting that a longer application timeline and less paperwork would improve the ease of participation. Another issue that surfaced in interviews with participants and program managers was the Davis-Bacon Act, which requires contractors to pay at the prevailing wage. Some participants reported difficulty locating and submitting prevailing wages for subcontractors based upon federal and local standards. Ongoing issues between the Energy Commission and subcontractors on reporting requirements proved to be quite onerous, especially for small cities and counties with limited resources. Respondents suggested setting reporting deadlines by milestone rather than monthly.

### Job Creation and Workforce Development

Many respondents reported that while the program provided work for the contractors, they did not know whether this work led to jobs retained or additional hiring. Respondents reported that the program created about 42 jobs, both permanent and temporary, primarily in the mechanical and electrical trades. Jobs for contractors or other outsiders were reported to be primarily temporary hires, in particular tradesmen such as plumbers and electricians. Contract hires included electrical and plumbing contractors who were hired temporarily to install lights and fit pipes. Permanent hires included those layoffs avoided and staff retained. These positions were HVAC or lighting electricians and technicians, mechanics, and crane operators. A comprehensive, rigorous model of employment effects and cost-effectiveness is being developed for all of the Energy Commission's ARRA programs, the results from which will be reported separately in 2014.

## Recommendations

The EECBG Small Cities and Counties Program was designed to provide low-risk, high-return energy efficiency opportunities to small cities and counties that were not eligible for direct grants from U.S. DOE. The program has achieved its goal of delivering energy efficiency to small jurisdictions. The evaluation team produced a set of recommendations for encouraging more energy efficiency in small jurisdictions going forward in subsequent programs.

Program implementation recommendations:

- Include technical and application support services. The high level of support and interaction provided by the Energy Commission contributed to the success of the program. The team worked closely over several months with each small jurisdiction to identify measures, fill out applications, answer questions, resolve technical issues, and oversee projects.
- Continue marketing and outreach efforts. The Energy Commission provided workshops, conference calls, and clinics to aid small jurisdictions with their applications. These efforts were successful for the EECBG Small Cities and Counties Program, as evidenced by wide participation across the state, and should be continued.
- Continue to encourage matching funding. Some of the projects received additional funding from local utilities, ECAA-ARRA loans, or other sources
- Continue to provide assistance in completing the application.
- Consider developing a flowchart to illustrate which stage the applicant is in.
- Develop standards for defining the baseline. For example, the Energy Commission could require photographs of the equipment and its nameplates and a short statement about the equipment age and operation, including enough information about maintenance history to identify how well it is operating, operating hours, and typical loads.

Project tracking and documentation:

- Continually improve the current approach of technical review and documentation of feasibility studies for energy efficiency projects. In a few projects, poor planning or limited technical review resulted in less-than-expected savings.
- For accurate savings estimations, preinstallation conditions should always be thoroughly documented. If a unit was extremely old and inefficient, DEER may underestimate the savings potential at only a given site, since DEER aims for an "average" savings value. The evaluation team found some instances of operating equipment older than the expected RUL.
- Program implementers should confirm that grant funding will be used for projects that are replacements with clear energy efficiency improvements, rather than replacing with like equipment.
- Consider options to improve oversight of contractors who install energy efficiency measures.
- For EEP, create a consistent set of requirements for feasibility studies and measure justification. In particular, require that the feasibility studies and supporting data provide a high level of transparency with a sufficiently detailed breakdown of how the savings estimates were generated. In general, all workbooks, models, and calculation tools used to generate the savings estimates included in feasibility studies should be provided in their unlocked and final forms with values that can be directly traced to the numbers in the studies/reports themselves. Feasibility studies should also clearly identify critical assumptions made in developing the savings assumptions that they contain. Information like planned efficiency, operating hours, load factors, and controls should be described for both the baseline situation and the planned measure.
- Where cost-effectiveness and/or jobs analysis is a program goal, develop methods to provide labor and equipment breakdowns, as well as planning or administrative costs. For example, invoices could be required to provide this data.

Measure-specific recommendations:

- Continue with lighting measures as a priority. The evaluation team identified lighting as the best performing measure group in terms of savings achieved and realization rate. The low cost and simple installation lighting measures make it ideal for counties and cities that do not have much experience in energy efficiency.
- For HVAC measures, the program can specify minimum efficiency levels above code. Given that HVAC equipment may be left in place for many years, using the grants to achieve higher efficiency pays off in the outgoing years.
- The Energy Commission should require a more rigorous approach for HVAC to "guarantee" that a particular site will meet a target payback. For example, a preinstallation site visit would confirm the conditions of the existing equipment. Climate-adjusted savings estimates improve accuracy of savings.

Overall recommendations:

- Continue DEP and EEP approaches. Both approaches proved to be equally successful, yielding similarly high savings and realization rates. Continue to require feasibility studies for EEP projects, which provided a good basis for planning and documenting projects. The DEP approach was particularly effective when considering cost-effective savings, because each measure was proven ahead of time to be cost-effective and yield savings.
- The program should continue encouraging facilities to replace aging energy equipment by using the savings to pay for the new equipment. In several cases, the equipment replaced was very inefficient and yet had continued operating beyond its expected useful life. The program provides a mechanism to remove these "energy hogs" and reduce operating costs.
- Use the results of the EECBG Small Cities and Counties Program to inform design of future programs.
    - Research program approaches to bring aging infrastructure to current codes and beyond.
    - Research remaining potential for street and traffic lighting projects.
    - Examine the effectiveness of other funding opportunities to reach small jurisdictions, such as loans.

# CHAPTER 6: Glossary

| | |
|---|---|
| ARRA | American Recovery and Reinvestment Act of 2009 |
| Baseline 1 | Considers the existing conditions found prior to the energy efficiency measures (EEMs) implementation and takes into account the operating efficiency of the equipment along with the control strategies found at that time. Life-cycle savings for Baseline 1 assumes the preexisting equipment would have continued to operate indefinitely, up to the effective useful life (EUL) of the new equipment. |
| Baseline 2 | Uses the preexisting equipment as the baseline of the measure until the end of remaining useful life (RUL) of the existing equipment. After the remaining useful-life period, and up until the end of the EUL of the installed measure, the expected-replacement baseline of the measure is used. This baseline considers either minimally code-compliant conditions or standard practice when no code is applicable. |
| Btu | British thermal unit |
| CAM | contract agreement manager |
| CCRR | California Comprehensive Residential Program |
| CEQA | California Environmental Quality Act |
| CFL | compact fluorescent light |
| $CO_2$ | carbon dioxide |
| Confidence interval | upper/lower limit of estimate, at the 90 percent confidence level in this report |
| CV | constant volume |
| DEER | Database for Energy Efficient Resources |
| DEP | direct equipment purchase |
| DHW | domestic hot water |
| DK | don't know |
| DNV KEMA | DNV KEMA Energy and Sustainability |
| DOE | U.S. Department of Energy |
| ECAA | Energy Conservation Assistance Act |
| EECBG | Energy Efficiency and Conservation Block Grant |
| EEM | energy efficiency measure |

| | |
|---|---|
| EEP | energy efficiency project |
| EFLH | effective full load hours |
| EISA | Energy Independence and Security Act of 2007 |
| EM&V | evaluation, measurement, and verification |
| EMS | energy management system |
| Energy Commission | California Energy Commission |
| Energy efficiency measure | installation of equipment, subsystems or systems, or modification of equipment, subsystems, systems, or operations on the customer side of the meter, for reducing energy and/or demand (and, hence, energy and/or demand costs) at a comparable level of service. |
| EUL | effective useful life |
| Ex ante | energy savings estimates for an energy efficiency measure developed by the site or the program implementers |
| Ex post | energy savings estimates for an energy efficiency measure developed by the evaluation team |
| Free rider | a program participant who would have implemented the program measure or practice in the absence of the program. Free riders can be total, partial, or deferred. |
| GHG | greenhouse gas |
| Gross savings | total savings of a given measure, project or program, does not take into account the effects of free riders |
| GWh | gigawatt-hour |
| HVAC | heating, ventilation, and air conditioning |
| IOU | investor-owned utility |
| IPLV | integrated part load value |
| IPMVP | International Performance Measurement and Verification Protocol |
| kBtu | kilo British thermal unit |
| kW | kilowatt |
| kWh | kilowatt-hour |
| Lb | pound |
| LED | light-emitting diode |
| Life-cycle savings | savings accrued for the effective useful life (EUL) of the measure, equal to the EUL multiplied by the annual savings |
| M&V | measurement and verification |

| | |
|---|---|
| MBtu | million British thermal units |
| 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 the amount of energy that would otherwise have been used to deliver an equivalent or improved level of end-use service.[12] |
| MFP | municipal financing program |
| MWh | megawatt-hour |
| NA | not applicable |
| NTG | net-to-gross; a factor representing net program savings divided by gross program savings that is applied to gross program impacts to convert them into net program load impacts. |
| Net savings | the total savings attributed to the program, does not include savings for measures that would have been installed without the program |
| POU | publicly owned utility |
| Project | an activity or course of action involving one or multiple energy efficiency measures, at a facility or site. |
| PV | Photovoltaic |
| Realization rate | a comparison of evaluated information to original estimated savings |
| Relative precision | ratio of the precision of a given measurement and the value of the measurement |
| Retrocommissioning | Retrocommissioning examines existing building systems to find ways to improve energy performance in buildings |
| RUL | remaining useful life |
| SCADA | supervisory control and data acquisition |
| SEP | State Energy Program |
| SJVAPCD | San Joaquin Valley Air Pollution Control District |
| Therm | 100,000 British thermal units (Btu) |
| TMY | typical meteorological year |
| U.S. DOE | United States Department of Energy |
| VAV | variable air volume |

12 Definition for measure and project from the Energy Efficiency Program Impact Evaluation Guide, December 2012, published by the State & Local Energy Efficiency Action Network.

| | |
|---|---|
| VFD | variable frequency drive |

# APPENDICES

Appendices are provided in a separate file.