Evaluation of Roseville Electric's New Construction Energy-Efficiency Rebate Programs for FY 2012

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Program Description and Introduction

Roseville Electric (RE) began offering energy-efficiency programs to production-home builders in 1998. These programs generally required the installation of an HVAC unit with minimum SEER and EER ratings (usually in excess of applicable codes and standards), coupled with other energy-efficiency measures. Solar photovoltaic (PV) was added as an option in 2000.

In FY12, RE featured two new production home energy-efficiency programs: (1) BEST Homes and (2) Preferred Homes. Both programs offered rebates to new home production builders for installation of the following measures:

- High efficiency air conditioning, 15 SEER / 12 EER with
  - Thermal expansion valve
  - Electrically commutated motor
- 20% cooling energy savings documented by Title 24 reports

The BEST Homes program also required installation of a PV system, where the Preferred Homes program did not. As shown in Table 1, seven home builders received program rebates for installing the required energy-efficiency measures in 158 new homes in Roseville in FY12. RE used slightly different methods to determine savings for earlier program participants as will be shown below.

Table 1. Program Participation

Program	Contractor	Number of Homes
BEST Homes	Centex Homes	36
BEST Homes	Elliott Homes	11
BEST Homes	Lennar Homes	22
Preferred Homes	Lakemont Homes	14
Preferred Homes	Meritage Homes	25
Preferred Homes	D.R. Horton Inc	20
Preferred Homes	Meritage Homes	11
Preferred Homes	Pulte Homes	19
	Total	**158**

RE selected Cadmus to conduct an independent evaluation of the energy-efficiency measures supported through the BEST Homes and Preferred Homes programs. As required by RE, this evaluation followed the California Energy Commission (CEC) EM&V Guidelines for Publicly Owned Utilities Energy Efficiency Programs (January 2011).

Objectives and Approach

The objectives of this evaluation include:

- Impact evaluation to determine gross savings and net savings of RE's new homes programs;
- Evaluation of new construction rebate processing interactions between builders, the City of Roseville Permit Department, and RE;
- Completion of the EM&V Checklist from the CEC EM&V Guidelines (January 2011); and
- Recommendations to further improve the program.

This evaluation does not include energy savings from photovoltaic systems or shade trees.

Approach

To meet the evaluation objectives, Cadmus' approach included the activities shown in Table 2.

Table 2. Evaluation Activities

Evaluation Activities	Overview of Approach
Project Document Review	Assess whether paper records are consistent with tracking data.
Engineering Review	Algorithm review and/or deemed savings assessment; verification of calculations.
Site Visit Verification	Verification of builders' construction practices, measure verification, and diagnostic testing.
Stakeholder Interviews	Interviews with builders, City of Roseville permit staff, and RE staff to determine program processes and opportunities for improvements.

In terms of rigor, Cadmus' evaluation was generally conducted at the level described in the CEC EM&V Guidelines as "verification with deemed savings." As noted in the guidelines, this approach is appropriate for smaller projects and where there is not a great deal of uncertainty.

In the context of the overall objectives, focus areas for the evaluation were identified as verification of program measures through site visits and estimation of free ridership. The two measures verified through site visits—HVAC system efficiency and envelope air sealing (or infiltration)—were selected since they each have a large impact on energy consumption and because they can be verified through inexpensive and nonintrusive methods. Estimation of freeridership was identified as a focus area since it supports calculation of a net-to-gross factor that could be used with gross savings to calculate net savings.

These programs require participating builders to submit CF-1R[1] forms to RE as verification that homes rebated under the programs meet the requirements. The CF-1R form shows compliance with the current 2008 Title 24 Building Energy Efficiency Standard. Builders submit the forms to RE for each home plan to

[1] The CF-1R form documents the expected energy consumption and energy use compared to code based on MICROPAS or EnergyPro software simulation for a specific home plan. The forms include energy consumption for the home as specified and for the home built to just meet the Title 24 requirements.

be built in a development. All participating builders in the FY2012 program produce multi-home developments and offer between three and seven different home plans to prospective home buyers. The CF-1R forms are used by the Roseville code enforcement officials to track code compliance of individual homes. RE leverages these forms to also show compliance with BEST and Preferred homes.

To find an average per-home savings value, RE first calculated average savings for each home plan. This figure was the average energy savings for the plan when the home was oriented to each of the four cardinal directions.

Prior to 2012, RE calculated the average energy savings per home value for all of the BEST Homes in the program and an energy savings per home value for all of the Preferred Homes in the program. The average value used for BEST Homes can be seen in the first three rows of Table 3 and the last three rows under Preferred Homes are all calculated with the earlier method. The average value for each program was found using a planning estimate developed by RE

Beginning in 2012, RE calculated an average energy savings per-home value for each development. The average value for each development then was found by averaging the savings for the home plans included in that specific development. These per-homes savings were calculated using the UITL-1R form that calculates savings above Title-24 code. The values for the fourth and fifth programs shown in Table 3 are calculated using that method.

Table 3. Average Per-Home Savings

Program	Contractor	kWh Savings per Home*	kW Savings per Home*
BEST Homes	Centex Homes	1,098	0.7
BEST Homes	Elliott Homes	1,098	0.7
BEST Homes	Lennar Homes	1,098	0.7
Preferred Homes	Lakemont Homes	841**	1.7**
Preferred Homes	Meritage Homes	854**	1.7**
Preferred Homes	D.R. Horton Inc	1,000	0.6
Preferred Homes	Meritage Homes	1,000	0.6
Preferred Homes	Pulte Homes	1,000	0.6

*Does not include energy saving from PV.

**These two developments used the newer method described above to calculate savings for the Preferred Homes program.

Project Document Review

Cadmus compiled the following documents for review.

- Builder submitted CF-1R Forms;
- Annual summary of activities;
- Database of participating homes;

- Annual program reports; and
- Rebate applications for BEST/Preferred Homes.

Reviewing these documents included checking the consistency between documents regarding *ex ante* energy savings, the number of participants, and the applicable program. Cadmus checked rebate applications for: consistency in documented savings, ability to capture necessary information, and ease of use. We cross-checked participating home addresses against applications and builder files.

Engineering Review

As noted, RE derived *ex ante* savings from code compliance documents, including CF-1R forms, with files generated by the modeling software MICROPAS or EnergyPro (which include the percent of energy savings compared to the 2008 Title 24 code). Cadmus reviewed model reports for reasonableness of the inputs and outputs.

Site Visit Verification

As noted above, Cadmus identified the HVAC system efficiency and home tightness as the two measures to verify at each site since they have a large impact on energy consumption and because they can be verified through quantitative methods. The 15 SEER high-efficiency cooling systems requirement provides the major driver behind cooling energy savings for these programs. Home tightness also has a significant impact on energy consumption so Cadmus chose to verify this value for each program home. Tightness is also a physical characteristic that can be directly measured readily by conducting a blower door test.

Cadmus selected a random sample of homes for site visit measurement and verification. The required sample sizes for a population of 158 participant homes are shown in Table 4.

Cadmus established a target of 20 homes for site visits. This number was expected to provide statistically significant—90% confidence with 20% precision—estimates for comparing actual home construction to the program requirements. This target also was set to allow a single field engineer to conduct all visits in a five day workweek which helped to keep costs within the project budget.

Table 4. Sample Confidence and Precision Estimates[2]

Confidence	Precision	Sample Size	Percent of Population
80	20	10	6
90	20	16	10
80	10	33	21
90	10	48	30

Stakeholder Interviews

Cadmus conducted interviews with stakeholders including representatives for five current and three past participating homebuilders, building officials, and one Home Energy Rating System (HERS) Rater.

[2] These estimates assume the coefficient of variation is 0.5

The purposes of these interviews were to determine the following factors affecting program performance:

- Builder freeridership;
- BEST and Preferred Home programs implementation details; and
- Builders' program participation problems or issues.

Findings

Gross Savings

Cadmus evaluated RE's *ex ante* gross energy savings shown in Table 5 for the BEST and Preferred homes programs.

Table 5. BEST / Preferred Homes FY 12 Gross Savings Ex Ante

Program	Contractor	Number of Homes	Incentive	Gross Savings Ex-Ante	
				Total Kw	Total kWh
BEST Homes	Centex Homes	36	$18,000	24.8	39,528
BEST Homes	Elliott Homes	11	$5,500	7.6	12,078
BEST Homes	Lennar Homes	22	$11,000	15.2	24,156
Preferred Homes	Lakemont Homes	14	$7,000	24.0	11,774
Preferred Homes	Meritage Homes	25	$12,500	43.0	21,342
Preferred Homes	D.R. Horton Inc	20	$10,000	12.0	20,000
Preferred Homes	Meritage Homes	11	$5,500	6.6	11,000
Preferred Homes	Pulte Homes	19	$9,500	11.4	19,000
	Total	**158**	**$79,000**	**144.6**	**158,878**

*Data provided by RE's annual summary of activities.

Project Document Review

RE provided home-level energy savings and documentation for 158 participating homes during its FY12 program year. Cadmus audited home-level and program-level data for incentives, kW savings, and kWh savings, for consistency and tracking errors, with no tracking errors detected.

Cadmus reviewed annual program reports for FY12, but we were unable to verify consistency with the program data since the annual reports included photovoltaic energy savings in addition to savings from energy efficiency.

Engineering Review

Participating builders submitted CF-1R forms to RE, along with rebate applications showing compliance of a planned development. Builder-submitted CF-1R forms contained design features such as window areas and types, insulation levels, envelope tightness, and, most importantly, the percent improvement above code for heating, cooling, and water heating energy. Cadmus reviewed these forms, and found they document home characteristics that simulation shows will result in the expected (ex ante) reductions in energy consumption.

The demand savings estimated for newer homes were calculated using the more recent method and resulted in a larger than expected claimed demand savings of 1.7kW. These demand savings are well documented in a UTIL-1R[3] form for each home rebated. The demand savings in this form are generated

[3] The UTIL-1R form is used to show energy saving compared to a code equivalent home

by the code compliance software package EnergyPro. Cadmus notes that the 1.7kW demand saving is large compared to findings from other new homes programs we have evaluated. The typical size air conditioner installed in program homes was 3.5tons. A baseline 13 SEER air conditioner draws approximately 3.8kW during operation, while the more efficient 15 SEER air conditioner draws approximately 3.4kW. This means that approximately 0.4kW of demand savings can be attributed to the 15 SEER air conditioner requirement. When effects from a more efficient building envelope are accounted we estimate the demand savings would be approximately 0.9kW, which is still considerable less than the claimed 1.7 kW.

Site Visit Verification

Cadmus conducted site visits for 22 of the FY2012 program homes in March of 2013, slightly exceeding the target of 20 site visits. At each site we attempted to verify two major factors influencing cooling energy usage: air conditioner SEER value and home tightness (infiltration). All other things being equal, we estimate that a 15 SEER air conditioner can account for cooling energy savings of up to 15% when compared to a 13 SEER unit.[4] We verified home tightness using a blower door test.[5]

Air Conditioner SEER Value

Cadmus attempted to verify SEER value in two ways. The primary method was to confirm that the installed units matched the program documentation. A secondary check was to use the AHRI database[6] to confirm the SEER level for the installed equipment combination.

Primary Method

We were able to confirm that the installed HVAC equipment matched the program documentation in all cases. For the new homes programs, the HVAC performance level recorded in the CF-1R energy compliance form is based on the CF-6R form provided by a HERS rater. Using the CF-6R form, HERS raters certify system performance (SEER level).

Based on the HERS raters' certification of system efficiency (SEER level), we found that all of the FY 12 program homes met the program's 15 SEER requirement.

Secondary Method

Cadmus relied on the primary method and documentation described above as proof that all program homes met the program requirements. In addition to checking the documentation provided by HERS raters, Cadmus also checked the system components against their rated performance in the AHRI database. An air conditioner has three components that affect its performance: condenser, evaporator coil, and furnace fan. If the system contains a variable-speed furnace fan, all three components must be

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4 As 13 SEER is the federal minimum SEER level for air conditioners, it is considered the baseline SEER value for new homes. Compared to this baseline, a 15 SEER system can provide a 15.3% improvement: (15 SEER – 13 SEER)/13 SEER = 15.3% improvement

5 A blower door test uses a calibrated fan and differential pressure gauge to determine how much air moves through a building envelope at a specific pressure.

6 The AHRI directory can be accessed at www.ahridirectroy.org

found in the AHRI database to identify the system's performance. Otherwise, only the condenser and evaporator must be found.

Using the AHRI data, Cadmus found the following:

- 12 homes contained 15 SEER rated air conditioners,
- 4 homes contained air conditioners rated above 15 SEER ,
- 3 homes contained air conditioners rated below 15 SEER , and
- 3 systems could not be independently con firmed

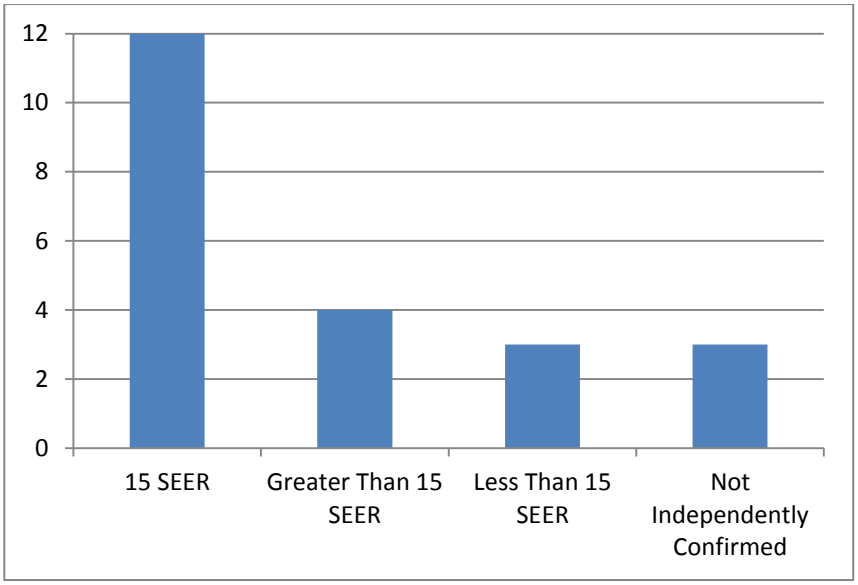
These results are also shown in Figure 1.

The three systems Cadmus identified as rated below 15 SEER were rated based on the combination evaporator and condenser found in the AHRI database. Using the database, we found these systems were rated in the AHRI database to be 14.5 SEER. It is possible that these units, in combination with the furnace fan motor, achieved a rating of 15 SEER or higher, but Cadmus had no information to confirm that they did. The HERS Raters certified these units met the 15 SEER requirement, but no supporting information was available in the program documentation. The manufacturer should be able to provide a certificate documenting the performance of the complete system. In the absence of supporting information, we could not confirm the units met the 15 SEER requirement, but we could not determine conclusively that they did not, which would indicate that participating homes were not meeting the overall program requirements. Going forward, requiring the builders to provide certificate of performance from AHRI or the manufacturer would eliminate uncertainty of the true verifiable SEER rating of these systems.

Systems were described as not independently confirmed when the condenser and evaporator coil combination could not be found in the AHRI database.[7] In our experience, system manufacturers may provide an AHRI certificate of performance, but that certified equipment combination may not be documented in the AHRI-certified products directory. In general, Roseville building permits do not include AHRI certificates. Instead, as noted above, HERS Raters certify that a system has achieved a certain level of performance through a CF-6R form.

[7] The AHRI certified products directory contains hundreds of thousands of system combinations, and interpretations must be made regarding a product's certification and SEER level. In some cases, exact model number matches cannot be made as the directory does not include every air conditioner submodel.

Figure 1. SEER Level in Homes Visited

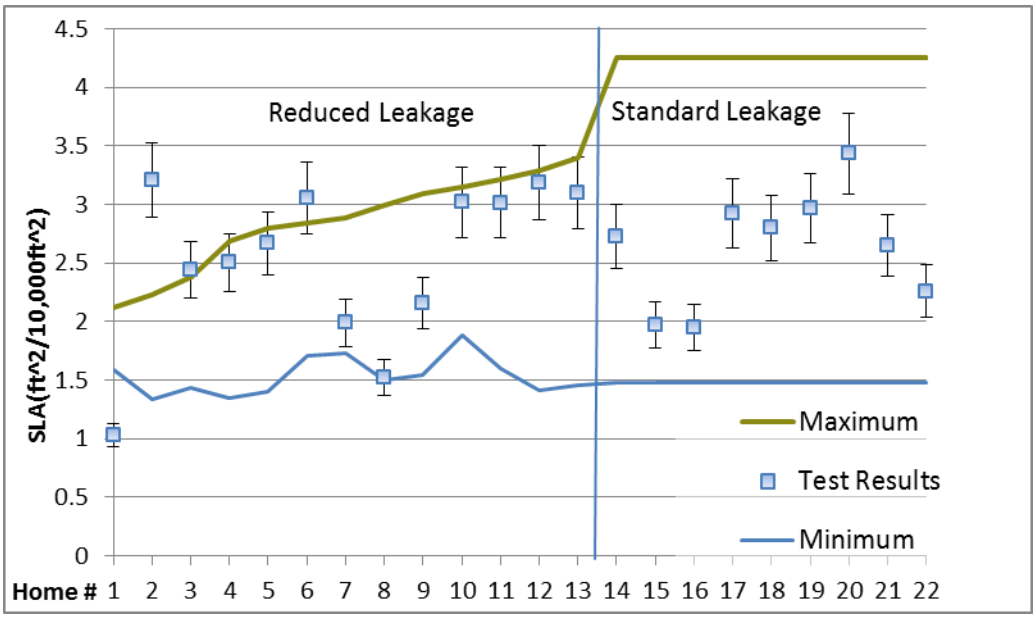


Because almost 15% of the SEER levels were found to be lower than the SEER level in the program documentation, Cadmus recommends that RE require HERS raters to provide either an AHRI certificate for each system or an explanation of each system's SEER level if an AHRI certificate is not available.

Air Leakage from Infiltration

For the 22 homes receiving site visits, Cadmus also measured air leakage using an industry standard blower door test. To reflect the plus or minus 10% measurement error typical for this test, results are shown in Figure 2 as a central value with error bars that show the potential measurement error. To verify that a home was built to the documented specifications for air sealing, leakage must fall between maximum and minimum limits specified in the code compliance requirements given on the CF-1R form. Our test results and the respective maximum and minimum values for each home are shown in Figure 2.

Figure 2. Air Leakage in Participating Homes



The nine data points on the right side of the figure represent homes that complied using a standard leakage approach, according to code. These homes did not specify a low infiltration package, and were subject to the statewide minimum infiltration rate of 4.3 specific leakage area (SLA).[8]

The data points on the left side of the figure represent homes that complied by specifying a low infiltration or "Reduced Leakage" approach.

Even after taking measurement errors into account, two homes fell outside the maximum and minimum ranges of test values. One home was found to have air leakage 44% above the upper limit. This home may have a leakage problem, but additional testing would be needed to confirm the issue. Another home fell below the minimum leakage value that has been established to protect occupants from a too-tight house that suffers from poor air quality. This problem can be alleviated by adding mechanical ventilation[9] to the home. We did not record whether this specific house contained mechanical ventilation; however, the code enforcement office checks infiltration and requires builders to install ventilation when a home falls below the lower limit.

We found that the large majority of homes were within the required maximum and minimum value and that leakage in program homes was, on average, 22% lower than the maximum allowed.

[8] SLA is defined in the code as square feet of opening net opening per 10,000 square feet of floor area. (ft^2/10,000ft^2). The code minimum would be an equivalent 4.3square foot opening for a 10,000 square foot home.

[9] Mechanical ventilation would typically be implemented with a fan that brings outside air into the home.

Program Gross Savings

As described above, Cadmus found that installed HVAC equipment matched program documentation and all of the homes visited met the programs' 15 SEER requirement.

Although two homes had infiltration rates outside the prescribed range, the average across all homes sampled met the code. Furthermore, the average infiltration rate was lower than the maximum allowed.

Our overall finding is that program homes meet the program requirements, and should achieve the documented energy savings. Therefore, we assign a realization rate of 100% to *ex ante* gross savings as shown in Table 6.

Table 6. *Ex Post* Program Gross Impacts

Program	Number of homes	Gross *Ex Ante*		Gross Realization Rate	Gross *Ex Post*	
		Total Kw	Total kWh		Total Kw	Total kWh
BEST Homes	69	47.6	75,762	100%	47.6	75,762
Preferred Homes	89	97.0	83,116	100%	97.0	83,116
Total	158	144.6	158,878	100%	144.6	158,878

Net Impacts

Builders Survey

Cadmus conducted a telephone survey of the participating builders. This survey sought to determine whether builders faced process issues in participating with the BEST and Preferred homes programs; potential issues addressed included: trouble with the rebate process; problems complying with program requirements; and communication issues with Roseville Electric. The survey also sought to determine builder freeridership for the program.

Builders were asked several questions to determine the importance of several factors in their decision to participate in the BEST or Preferred homes programs. They were asked to score each factor on a scale of 0 to 10 with 0 being not important at all and 10 being very important. Table 7 contains the average score for each question. The most important reason builders participated was to help the builder stand out in the marketplace, while the two least important reasons were customer requests and HERS Rater inspection services.[10]

Table 7. Program Influence (N=4)

Factor	Average Score
Differentiating your homes from other builders	9.0
The program incentives help meet financial goals	6.7
Relationship with RE staff	5.3
Easier to qualify for the building standard	5.0
Customers requesting/asking about the program	3.0
HERS Rater Inspection Services	2.7

Builder were asked to rate how well the program worked based on their interactions with RE and the Roseville building department. Overall, builders gave high scores to both Roseville Electric and the city building department. Using a scale from 0 to 10, with 0 being not very well and 10 being very well, Table 8 presents average scores. Only three builders responded to these questions.

Table 8. Interactions with RE and the building department (N=3)

Interaction with	Average Score
Roseville Electric	9.0
Roseville Building Department	9.3

[10] HERS Raters are required by the energy code to inspect homes regardless of the program

When asked what works well with RE builders responded:

- "Very good communication from the Roseville staff"
- "For us it was the additional rebate for our standard of construction."

When asked what could be improved with RE builders responded:

- "Nothing"
- "More of a financial incentive"
- "No problems to report"

When asked what works well with Roseville building department builders responded:

- "Processing and permitting goes smoothly in Roseville so no complaints there"
- "They had their procedures to quickly qualify for the program"

When asked what could be improved with the Roseville building department builders responded:

- "Don't know"
- "Nothing"
- "Communication"

Builders were asked how satisfied they are with the program they participated in (BEST homes or Preferred homes) with 0 being not at all satisfied and 10 being very satisfied. Table 9 presents the average score.

Table 9. Satisfaction (N=3)

Question	Average Score
Satisfaction	8.7

Nonparticipant Builders

We also interviewed three builders who had participated or attempted to participate in the programs in the past, but were not currently participating. As expected those builders were less satisfied with the BEST homes or Preferred homes program, scoring an average of 4.0 on the 0 to 10 scale. When asked why they may have dropped out of the program, one builder mentioned that it was difficult to count on the incentive dollars being available when their projects were complete. Another builder estimated that it cost them approximately $2,500 to participate in the program and the incentive was not large enough for them to continue participating.

Freeridership and Net-to-Gross

Our approach to determining a builder's level of freeridership is summarized in Table 10. In this approach a builder can receive a score from 0% to 100% in 25% increments. Builders are placed into

either a high, medium, or low band based on the level of influence that the program has on their decision to build energy-efficient homes. These bands are indicated by shading in the table.

A builder would be scored as a 100% freerider if they reported that the program has little influence (influence = 0, 1, 2, 3, or 4) on their decision and, in the absence of the program that they would build the same number of homes to the same level of efficiency.

At the opposite extreme is a builder scored as a 0% free rider. This builder reports high program influence and, in the absence of the program, reports that they would build fewer energy-efficient homes.

Table 10. Freeridership Matrix

FR Score	How much influence does the program have on your decision to build energy-efficient homes? (0=no influence, 10=a lot of influence)	In the absence of the program, how many energy-efficient homes would you build in Roseville Electric's service territory?	
		Quantity	Efficiency
0%	8, 9, or 10	Less	
25%	8, 9, or 10	Same	Less efficient than RE program requirements
50%	8, 9, or 10	Same	Same efficiency as the RE program requirements
25%	5, 6, or 7	Less	
50%	5, 6, or 7	Same	Less efficient than RE program requirements
75%	5, 6, or 7	Same	Same efficiency as the RE program requirements
50%	0, 1, 2, 3, or 4	Less	
75%	0, 1, 2, 3, or 4	Same	Less efficient than RE program requirements
100%	0, 1, 2, 3, or 4	Same	Same efficiency as the RE program requirements

Due to the small size of the population—seven builders—we attempted to interview all builders rather than sampling the program participants. After making at least three attempts to contact each builder, we obtained inputs from representatives of five of the program builders[11] representing 68% of the FY 2012 volume.

The self-report interview method to determine free ridership and estimate the net-to-gross (NTG) value is a standard procedure. However, during the course of this study we learned about RE's efforts to encourage the City of Roseville to insert requirements in Development Agreements (DAs) with land developers to require high-efficiency air conditioners in new homes. This process is an ongoing effort

[11] We spoke to four individuals who represented five builders since two of the builders are owned by the same parent company

and requires RE staff to work on a regular basis with the City Planning Department and Utility Director to ensure these agreements are in place. Developers can request an amendment that alters or nullifies the requirements. The existence of these requirements in DAs diminishes the accuracy of the freeridership analysis because builders may say they would have installed 15 SEER air conditioners without the RE program due to the existence of the DA requirement. If this is the case, RE should receive additional attribution credit, but through their efforts to establish DA requirements and not through the BEST or Preferred Homes programs.

We were unable to estimate the effects of the DA on air conditioner efficiency levels or the freeridership estimated with our interview methodology for several reasons. First, the instrument was not designed to ask about the DA. We did not have sufficient information to design questions about these requirements until after the interviews were conducted. Second, builders would likely not be able answer questions about the effect of the DA on their decisions for specific projects. Third, if builders were subject to DA requirements for high-efficiency air conditioners in one project, it seems likely this would influence them adopt a practice of installing similar units in their other projects.

The main implication of the involvement of RE in establishing these DA requirements is that they are achieving energy savings through this mechanism for which they are not getting credit. The effect of the DAs on the freeridership analysis for the BEST and Preferred Homes programs is to increase the apparent freeridership.

Table 11 presents the freeridership values we calculated based on the builders' responses to the freeridership interviews.

Table 11. Builder Freeridership

Builder	Program Influence	Number of energy-efficient homes?	Same efficiency level?	Freeridership
Builder 1	0	Same	Same	100%
Builder 2	0	Same	Same	100%
Builder 3	7	Same	Lower	50%
Builder 4	2	Same	Lower	75%
Builder 5	2	Same	Lower	75%
			Weighted Average*	**82%**

* Responses were weighted by builder's volume as a percentage of the total volume for all respondents

Taken alone, these results indicate high freeridership levels in the program. The following quotes from builders address these issues:

- "As a division, we were already building the homes to this standard and above for 'Homes for Better Living' and our standard construction techniques already qualified us for the program."
- "We generally build 25% above Title 24 across all of California."

The results shown in Table 11 correspond to an 18% NTG value. Table 12 shows overall program impacts using this value.

Table 12. Program Evaluated Impacts Based on Initial Freeridership Analysis

Program	Number of homes	Gross *Ex Ante*		Gross Realization Rate	Gross *Ex Post*		NTG	Net *Ex Post*	
		Total Kw	Total kWh		Total Kw	Total kWh		Total Kw	Total kWh
BEST Homes	69.0	47.6	75,762	100%	47.6	75,762	18%	8.568	13,637
Preferred Homes	89.0	97.0	83,116	100%	97	83,116	18%	17.46	14,961
Total	**158.0**	**144.6**	**158,878**	**100%**	**144.6**	**158,878**	18%	**26.0**	**28,598**

We caution against relying on these NTG and freeridership estimates. One reason—the role of the DA requirements—has been discussed. Another is the myriad of factors that affect the behavior or builders and how they respond to questions about the influence of the programs. For example, one participating builder reported that their organization builds in several utility territories, and participates in other new construction rebate programs. Generally, they build to a high efficiency level as their standard business practice; reasons for this include offering marketing advantages and making it simpler to participate in the various programs. As several participating builders operate nationally or throughout California, they also are influenced by the many rebate programs and building standards they encounter, including RE's past programs. The cumulative effect on such builders may be to change their standard business practice. In this case, a builder may appear to be a freerider when in reality rebate programs have made a difference to their standard practice, or helped transform the market.

Benchmark Values for Similar Programs

For comparison, Table 13 shows NTG values estimated for other utilities' new home programs.

Table 13. NTG Values of Similar Programs

Program Administrator	State	Program Year(s)	NTG	Freeridership	Spillover
EmPOWER Maryland (Baltimore Gas & Electric and Southern Maryland Electric Cooperative)	MD	2011	0.84	–	–
Midwest Utility	MN	2009	0.89	11.7%	1.0%
Nova Scotia Power	NS, Canada	2009	0.45	55%	–
Nova Scotia Power Efficiency Nova Scotia Corporation	NS, Canada	2010	0.46	54%	–
NYSERDA	NY	2010	1.17	29.7%	46.4%
Pacific Gas & Electric San Diego Gas & Electric Southern California Edison	CA	2006–2008	4.12	–	–

Note: See the References section for a full list of table citations.

When program requirements remain the same, NTG values tend to decrease over time, as freeridership increases. This occurs as the market transforms to a higher efficiency baseline. For programs to maintain low freeridership, they must periodically increase program efficiency requirements.

In the analysis of one set of programs shown in Table 13, those in California, an analysis was conducted to explicitly account for the effects of new homes programs on non-program homes. This study estimated the energy savings due to effects of the programs on the efficiency level of homes built outside the programs. Taking these effects into account, the study demonstrated there was a significant spillover effect that led to an NTG value for the programs of 4.12.

Builder incentive amounts play a critical role in program performance. Relatively high incentives may result in unnecessary spending, and relatively low incentives may result in low participation.

Table 14 shows incentive amounts for similar new homes programs across the country.

Table 14. Incentive Amounts of Similar Programs

Program Administrator	State	2012 Incentives	Requirements
EAI	AR	$600	ENERGY STAR version 2.5 guidelines.
		$1,000	ENERGY STAR version 3.0 guidelines.
City of Tallahassee Utilities	FL	$1 per square foot up to $2,000	January–June 2012: HERS index ≤ 77 or Florida builder option package. All checklists from ENERGY STAR version 3.0 completed and enforced. July–December 2012: Florida ENERGY STAR version 3.1 reference design. All checklists from ENERGY STAR version 3.0 completed and enforced.
CPS Energy	TX	$800	ENERGY STAR compliant (HERS rating of 58 to 75) or other rating methods (15% to 30% above code).
		$1,500	ENERGY STAR Compliant (HERS rating of 57 or less) or other rating methods (31% or more above code).
First Energy Ohio	OH	$400 plus $0.10/kWh saved annually over the reference home, as calculated by REM/Rate, up to $1,200	Home must be 15% more efficient than current code and be ENERGY STAR-qualified.
PNM Resources, Inc.	NM	$750	ENERGY STAR version 2.5 guidelines.
EmPOWER Maryland (Delmarva Power & Light)	MD	$1,000	HERS index between 71 and 75.
		$1,300	HERS index between 66 and 70.
		$1,600	HERS index ≤ 65.
South River Electric Membership Corporation	NC	$400 for builder	Home must be 30% more energy-efficient than homes built to 2012 North Carolina Energy Conservation Code.
		$200 for a customer moving into existing efficient home	
		$600 for a customer, for a custom-built efficient new home	

Recommendations

Process

As described above, Cadmus was not able to independently confirm the SEER level of all air conditioners installed in program homes.

Recommendation: Require HERS raters' to provide documentation such as an AHRI Certificate of system SEER performance, documentation from the manufacturer, or a brief explanation of the method used to determine SEER level.

Program Design: Efficiency Requirements and Incentives

Input gathered from builders and Roseville Electric staff was consistent with finding of high freeridership in the BEST and Preferred Homes programs. Since at least one Roseville planning area already requires 15 SEER air conditioners for all new homes, we estimate that builders in this part of the city need only build an additional 5% above local requirements to reach the 20% above-code threshold required by the program[12]. Several participating builders reported that they build even further above program requirements as their standard practice.

Consistent with high freeridership, builders for whom the program does not add much (if any) incremental cost choose to participate in order to receive the rebates. One nonparticipating builder we spoke to estimated it would cost him approximately $2,500 per home to participate in the program. While this is just one data point, the incentives shown in

Table 14 above indicate the BEST and Preferred homes program incentives are low relative to other similar programs.

Recommendation: Consider changes to the program design and specifically increases to the efficiency requirements for program homes AND a higher incentive for participating builders.

Local Efficiency Requirements

Cadmus learned that the City of Roseville has inserted above-code efficiency requirements into Development Agreements for several housing projects in one or more of the city Planning Areas. RE had a significant role in the adoption of this requirement. Therefore, RE shares some responsibility and credit for increased efficiency and the corresponding energy savings in all new homes that were constructed to meet the local requirement. Without accounting for these savings, the effect is an apparent increase in freeridership and decrease in the NTG value. The investor-owned utilities in California claim and receive credit for savings from building energy code adoption and so it may be possible for RE to make a similar claim based on the local DA requirements.

Recommendation: Investigate the potential for claiming savings from imposition of local efficiency requirements.

[12] Assuming that all other home features meet code and that tradeoffs are not being made due to the addition of a SEER 15 air conditioner.

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Appendix A: CEC EM&V Checklist

This section provides the CEC EM&V Checklist and the status of work related to the checklist requirements in this evaluation. The checklist text is shown in italics and the descriptions of relevant work follow in regular (non-italicized) text. Since many of the topics on the checklist are discussed in the preceding sections of the evaluation report, they are briefly described here along with references to the report sections where they are treated in more detail.

Contextual Reporting

- *Clearly state savings values and compare to the associated SB 1037 annual report.*
- *What portion of RE's portfolio is covered. Describe the programs or savings not evaluated?*
- *Assess risk or uncertainty in selecting the components of the portfolio to evaluate.*

Note: Per the CEC EM&V guidelines, contextual reporting is to be completed at the Publicly Owned Utility level and not as a part of individual program evaluations.

Overview and Documentation of Specific Evaluation Effort

- *Clearly identify what is being evaluated in the study (part of a program; an entire program; the entire portfolio).*
  This is an evaluation of the BEST Homes Program and the Preferred Homes Program offered by Roseville Electric. The scope includes the program processes and impact in FY12.
- *Include an assessment of EUL and lifecycle savings.*
  This evaluation does not include as assessment of EUL and lifecycle savings.
- *Provide documentation of all engineering and billing analysis algorithms, assumptions, survey instruments and explanation of methods.*
- *Describe the methodology in sufficient detail that another evaluator could replicate the study and achieve similar results.*
  The report provides sufficient detail for another evaluator to repeat the study.
- *Include all data collection instruments in an appendix.*
  The data collection instrument used for builder interviews is included in Appendix A.
- *Describe metering equipment and protocols in an appendix.*
  A brief description of the blower door test is included above.

Gross Savings

- *Review the program's choice of baseline.*
  The program used the 2008 Title 24 energy code as the baseline.
- *Characterize the population of participants.*
  The program participants are the seven home builders identified in Table 1. The home builders received rebates for 158 program homes. The buyers of these homes are the end users of the programs' energy-efficient homes.
- *Discuss the sampling approach and sample design.*

For builder surveys, a census of current and recent participant builders was attempted for participant surveys.
For document and engineering reviews, program records were all 158 program homes were reviewed.
For field verification, 22 homes, randomly selected from the FY12 program homes were visited. This number is expected to provide at least 80% confidence and 20% precision. The sample size was also determined based on the available evaluation budget.

- *State the sampling precision targets and achieved precision.*
  Sampling precision targets were 80% confidence and 20% precision.
  Achieved precision was 90% confidence with 20% precision.
- *Present ex post savings.*
  See Table 6 above.
- *Expand the results to the program population. If not, state reasons why and clearly indicate where ex ante savings are being passed through.*
  See Table 6 above.
- *Explain any differences between ex ante and ex post savings.*
  There are no differences between ex ante and ex post savings.

Net Savings

- *Include a quantitative assessment of net-to-gross. If not, clearly indicate the source of the assumed net-to-gross value.*
- *Discuss the sampling approach and sample design.*
- *If a self-report method is used, does the approach account for free-ridership?*
  A self-report method was used to estimate freeridership. The sampling approach was an attempted census of current and recent participant builders. The surveys and results are described in the section Net Impacts above.

EM&V Summary and Conclusions

- *Provide clear recommendations for improving program processes to achieve measurable and cost-effective energy savings.*
  These are provided in the section Recommendations above.
- *Assess the reliability of the verified savings and areas of uncertainty.*
  The evaluation focused on verifiable measures that have significant impact on the expected savings. Our review of program documentation found that gross savings are reasonable in that they are similar to savings found through evaluation of other similar programs. The field verification found that air conditioner performance level and air leakage meet program requirements.

Appendix B: Builders Survey

Roseville Electric FY12 Program Evaluation
BEST/Preferred Homes Program

Participant Builders Interview Guide
Cadmus Administered

Business name_____
Respondent _____
Date _____
Interviewer _____

Survey objectives for the FY11 evaluation:

- Assess impact of program processes, including efficiency improvements
- Assess the builder response to the program measures
- Determine energy and demand savings (free ridership estimate)

Introduction

[ASK TO SPEAK WITH PERSON LISTED ON CONTACT LIST]

Hello, my name is _____ from The Cadmus Group. We are conducting a study on behalf of Roseville Electric. We are evaluating builders and their experience with energy efficiency programs, such as Roseville Electric's BEST/Preferred Homes Program. Your individual answers are confidential and only summary information will be shared with Roseville Electric.

The interview will take approximately 30 minutes of your time. Do you have time right now for us to complete the interview?

If yes: continue
If no: What would be the best time for me to call back and talk with you?

Screening

1. First, I would like to confirm that your firm participated in Roseville Electric's BEST/Preferred Homes Program.
    1. Yes *[CONTINUE]*
    2. No *[DETERMINE IF THERE IS SOMEONE ELSE TO SPEAK WITH WHO IS FAMILIAR WITH THE PROGRAM; IF NOT THEN THANK AND TERMINATE INTERVIEW]*

Awareness & Participation Decisions

1. When did your company first start working with Roseville Electric's BEST/Preferred Homes Program?
    1. 2005 or before
    2. 2006
    3. 2007
    4. 2008
    5. 2009

98 Don't know
99 Refused

2. I am going to read a list of reasons that builders might participate in the program. I'd like you to tell me how important each factor was in your decision to participate in the program using a scale of 0 to 10 where 0 is not at all important and 10 is very important.

[IF THIS IS DIFFICULT, ASK INSTEAD WHETHER EACH FACTOR WAS NOT IMPORTANT/SOMEWHAT/ VERY IMPORTANT]

	Reasons	Rating
A	Relationship with Roseville Staff	
B	Customer requesting/asking about the program	
C	Differentiating your homes from other builders	
D	The program incentive helps meet financial goals	
E	HERS Rater Inspection Services	
F	Easier to qualify for the building standards	
G	Other *(RECORD REASON BELOW)*	

3. In terms of your interactions with Roseville Electric, how well does the program work?
On a scale of 0 to 10 with 0 being not very well and 10 being really well

4. What works well?

5. What could be improved?

6. In terms of your interactions with Roseville Building Department(or Building Inspectors), how is that department to work with?
On a scale of 0 to 10 with 0 being not very well and 10 being really well

7. What works well?

8. What could be improved?

Satisfaction

1. On a scale of 0 to 10, where 0 is not at all satisfied and 10 is very satisfied, how satisfied would you say you are with the BEST/Preferred Homes Program overall?
_____ [*RECORD RESPONSE*]
98. Don't know
99. Refused

2. [IF LESS THAN 6] Why did you give the program that rating?

_____ [*RECORD RESPONSE*]
98. Don't know
99. Refused

3. How would you improve the Roseville Electric BEST/Preferred Homes Program such as materials, guidelines, applications, etc?
_____ [*RECORD RESPONSE*]
98. Don't know
99. Refused

Building Energy Efficient Homes

Now I'd like to talk about how many of the homes that you build are certified as energy efficient homes. By energy efficient, I mean homes that are built to the BEST/Preferred homes standard in Roseville.

1. How many homes did you build in 2011 how many in 2012. How many BEST homes? How many Preferred homes?

	2011	2012
Best Homes		
Preferred Homes		
Total Homes		

2. Do the utility incentive programs make a difference in your decision to build energy efficient homes?
1. Yes
2. No
98. Don't know
99. Refused

3. [IF YES] How much influence does the Roseville Electric BEST/Preferred Homes Program program have on your decision to build efficent homes? On a scale from 0 to 10 with O being no influence and 10 being a lot of influence.

4. If Roseville did not offer the BEST/Preferred Homes program, how many energy efficient homes would you build in the Roseville service territory?
1. The same number (incentive and program make no difference)
2. Somewhat less, Ask for an estimated percentage of what they would have built
3. None

5. [IF 1. ABOVE] When you say the same number, would you have built these homes
To the Energy Star standard? _____
To the BEST Homes standards, that is with the same set of features? _____
To the Preferred Homes standards, that is with the same set of features? _____
Something else _____

6. Did you make changes to your standard business practices in order to participate in the BEST/Preferred Homes Program?

1. Yes *[ASK NEXT QUESTION]*
2. No *[SKIP NEXT QUESTION]*
98. Don't know
99. Refused

7. [IF YES] What changes were they? *[DO NOT READ]*

_____ *[RECORD RESPONSE]*
98. Don't know
99. Refused

Priority B

Marketing/Outreach

1. Do you market BEST/Preferred Homes differently than your other projects?

1. Yes
2. No
98. Don't know
99. Refused

2. [IF YES] What do you feel is different about the way you sell BEST/Preferred Homes ?

_____ *[RECORD RESPONSE]*
98. Don't know
99. Refused

3. What do **buyers** think are the advantages of owning a BEST/Preferred energy-efficient home?

_____ *[RECORD RESPONSE]*
98. Don't know
99. Refused

4. Do buyers ask about utility energy-efficiency homebuilder programs when they visit your model homes?

1 Yes
2 No
98 Don't know
99 Refused

5. What do Realtors think BEST/Preferred homes? What do they say about these homes?

_____ *[RECORD RESPONSE]*
98 Don't know
99 Refused

6. In the building trade in general, how well known are the BEST/Preferred building practices? Would you say they are:
[READ LIST AND MARK ONE]

1. Well known
2. Somewhat known

3. Not very well known
4. Virtually unknown

Heating and Cooling

The next set of questions refers to cooling and heating equipment.

1. Which of the following types of heating systems do you install in the homes you build?
[READ AND CHECK ALL THAT APPLY]

1. Standard efficiency gas furnace with AFUE 82 or less
2. High efficiency gas furnace with AFUE 90 or higher
3. Standard Efficiency Heat Pump with HSPF less than 8.0, or, with SEER 13 or less
4. High Efficiency Heat Pump with an HSPF of 8.0 or higher, or with SEER 13 or higher
5. Electric Resistance heating
6. Hot water heating
7. Gas/oil fired boiler
8. Wood burning stove
9. None
10. Other *[SPECIFY]*_____
98. Don't know
99. Refused

2. For homes built inside Roseville not in the BEST/Preferred homes program what air conditioner efficiency do you use.
[READ AND CHECK ALL THAT APPLY]

0. Standard Efficiency Heat Pump, SEER 12 or less
1. Standard Efficiency Heat Pump, SEER 13
2. High Efficiency Heat Pump, SEER 14 or higher
3. Standard Efficiency central air conditioner, SEER 13 or less
4. High efficiency central air conditioner, SEER 14 or higher
5. Room air conditioners
6. No cooling system
98. Don't know
99. Refused

***Note to interviewer**: Builders are required to install devices with a minimum SEER value of 13. Response option 0 is designed to capture any subpar practices.*

3. [IF THEY INSTALL AIR CONDITIONING]
What is the equipment SEER level that you usually install in your homes?
_____ *[RECORD RESPONSE]*
98. Don't know
99. Refused

Appliances

1. Which appliances do you typically install in the homes you build?
[DO NOT READ; CHECK ALL THAT APPLY]

1. dishwasher

2. refrigerators
3. range/oven/cook stove
4. Other *[SPECIFY]* _____
5. None
98. Don't know
99. Refused

2. Are any of these Energy Star labeled appliances?
[DO NOT READ; CHECK ALL THAT APPLY]

1. Energy Star dishwasher
2. Energy Star refrigerators
3. Energy Star range/oven/cook stove
4. Other *[SPECIFY]* _____
5. None
98. Don't know
99. Refused

Firmographics [SKIP IF TIME IS TIGHT]

My last few questions are about your building firm.

6. What is the average square footage of the homes you build?

_____Square footage
98. Don't know
99. Refused

7. What is the average selling price of the homes you build?

_____ *[RECORD RESPONSE]*
98. Don't know
99. Refused

Difference in selling price questions.

Thank you so much for your time. Roseville and Cadmus greatly values your feedback.

_____

_____

_____

Thanks again and have a nice day.