Process and Impact Evaluation of Roseville Electric's Residential New Construction, HVAC Retrofit and Commercial Custom Rebate Programs: FY2007/08

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Final Report

CITY OF ROSEVILLE CALIFORNIA

Roseville Electric

MORRISON Energy Services

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1 INTRODUCTION

The City of Roseville provides a full menu of energy efficiency and renewable energy programs through its electric utility department, Roseville Electric. This report describes the Evaluation, Measurement, and Verification for selected Roseville Electric (RE) energy efficiency incentive programs.

Two legislative bills (SB1037 and AB2021) were signed into law a year apart. SB1037 (signed September 29, 2005) requires that the Publicly Owned Utilities (POUs), similar to the Investor Owned Utilities (IOUs), place cost effective, reliable, and feasible energy efficiency and demand reduction resources at the top of the loading order. They must now procure "negawatts" first. Additionally, SB1037 requires an annual report that describes the programs, expenditures, expected energy savings, and actual energy savings.

Assembly Bill 2021, signed by the Governor a year later (September 29, 2006), reiterated the loading order and annual report stated in SB1037 as well as expanded on the annual report requirements. The expanded report must include investment funding, cost-effectiveness methodologies, and an independent evaluation that measures and verifies the energy efficiency savings and reductions in energy demand achieved by the energy efficiency and demand reduction programs. AB2021 additionally requires a report every three years that highlights cost-effective electrical and natural gas potential savings from energy efficiency and established annual targets for energy efficiency and demand reduction over ten years. The legislative reports require an on-going third party evaluation, measurement and verification (EM&V) study of the programs and their impacts.

The goal of Morrison Energy Services' review of the programs at RE is to provide an unbiased, objective, and independent program evaluation.

This report reviews the residential new construction programs, the residential HVAC retrofit program and the 2008 Commercial Custom Program. This review includes:

- Evaluation of the processes and impacts of the selected RE Programs.
- Assessment of program effectiveness.
- Recommendations and feedback to improve selected RE programs.
- Recommendations to increase the level of confidence in reported program results.

These goals are met through the process evaluation and impact evaluation of RE programs. The EM&V efforts assess the program impacts from 7/1/07 through 6/30/08 (FY 2007/08). In the RE EM&V Plan submitted by Summit Blue Consulting, the consultant suggested that the residential new construction, the residential retrofit HVAC and the commercial custom programs be reviewed as first priority due to their significant contribution to the overall program savings.

Many of the energy saving estimates used by RE in its planning and reporting are deemed saving values. These savings are used in the E3 benefit/cost calculator and the RE Net Present Value (NPV) calculator to determine cost effectiveness of the programs. The E3 calculator was developed for the Northern California Power Authority (NCPA) members and is used for reporting program costs and impacts to the California Energy Commission (CEC). The RE NPV calculator is an in-house calculator developed by RE staff to evaluate not only energy efficiency program but all demand-side utility projects.

Summit Blue provided the table below to help RE understand the International Performance Measurement and Verification Protocol (IPMVP) that is used to determine the proper EM&V option for each measure. This table lists the IPMVP protocols, the nature of the performance characteristics of the measures to which M&V options typically apply, and an overview of the data requirements to support each option.

Table 1-1

IPMVP M&V Option	Measure Performance Characteristics	Data Requirements
Option A: Engineering calculations based on spot or short-term measurements, and/or historical data. Deemed energy savings fall in this Option.	Constant performance	• Verified installation • Nameplate or stipulated performance parameters • Spot measurements • Run-time hour measurements
Option B: Engineering calculations using metered data.	Constant or variable performance	• Verified installation • Nameplate or stipulated performance parameters • End-use metered data
Option C: Analysis of utility meter (or sub-meter) data using techniques from simple comparison to multivariate regression analysis.	Variable performance	• Verified installation • Utility metered or end-use metered data • Engineering estimate of savings input to SAE model
Option D: Calibrated energy simulation/modeling; calibrated with hourly or monthly utility billing data and/or end-use metering.	Variable performance	• Verified installation • Spot measurements, run-time hour monitoring, and/or end-use metering to prepare inputs to models • Utility billing records, end-use metering, or other indices to calibrate models

For HVAC measures that utilize deemed energy savings estimates, Summit Blue recommended Option A as the appropriate EM&V option. In Option A the deemed saving estimates are to be reviewed to insure assumptions of correct values for program savings. A review of the documentation of installation is required, but no field work involving metering or billing analysis is needed. However, if the paper verification finds that insufficient documentation has been maintained, Summit Blue recommends that installation verification be performed on a sample that will provide a confidence level of 90% with a confidence interval of +/- 10%.

2 Residential New Construction Program

The Preferred Homes and the BEST Homes programs each are designed to improve the efficiency of newly constructed homes beyond Title 24 minimum levels. The BEST Homes program also includes integration of rooftop solar PV into the new home construction.

The BEST Homes and Preferred Homes programs incorporate a variety of energy efficient measures, including high efficiency air conditioning units. Many rooftop PV systems have also been installed on BEST Homes, but are tracked separately. Renewable energy systems, such as rooftop PV, do not need to be evaluated under this current effort.

RE's participation goal for BEST Homes is 20% of all new homes. RE rebated 154 BEST Homes in FY08, exceeding the program goal. RE's goal for Preferred Homes is 30% of all new homes. RE rebated 161 Preferred Homes which is slightly more than 50% of the goal according the program manager.

Roseville Electric staff processes the rebates for the new construction programs, BEST Homes & Preferred Homes. This evaluation addresses the energy efficiency part of these programs.

2.1 Residential New Construction Process Evaluation

RE requires reservations for both new construction programs. The documents submitted to make these reservations include:

- an application for each subdivision phase
- a copy of Title 24 for each house plan
- a subdivision lot map
- an equipment schedule for each phase of the subdivision

The equipment list includes the air conditioners' model numbers for each house plan. After these documents are reviewed and found complete RE confirms the reservation.

As the homes are completed, the builder sends in a request for payment. This request includes:

- an address/lot list of the completed homes
- a completed duct test certification (CF-6R 4, 5 &6)
- an air flow test certification (CF-6R 4, 5 &6)

RE reviews these documents and if complete and within compliance, they process the rebate. RE's goal is to inspect 10% of the homes' air conditioning equipment.

In reviewing this process, we inspected the paper work of 57 applications out of 315 rebates. Summit Blue recommended this number for 90% confidence.

The rebates processed in calendar year 2008 have been scanned providing RE with electronic versions while calendar year 2007 paperwork has not been scanned. It was found that in either case, documentation is inconsistent. Some documents include the CF-6R with the address list while others were in a second location. In all 57 applications reviewed, we were able to locate all the documents. The hard copies are filed with the retrofit program rebates. We suggest that they be filed separately from the retrofit program and that all the required/associated documentation be included when scanned or filed.

There are some inconsistencies in new construction section of the rebate tracking database. Part of this issue is the update of the database for BEST & Preferred programs was not completed before the staff started entering data for these programs. The savings for the previous program, Advantage Homes, was calculated per ton and BEST and Preferred program savings are calculated per home. The problem has been corrected for all entries going forward. The new construction part of the rebate database has a lot of information that is not needed for analysis or reporting. We suggest this part of the database be reviewed and revised to better reflect the new construction programs and the needs of RE staff for effective tracking and reporting.

2.2 Residential New Construction Impact Evaluation

Program requirements include:

- 15 SEER/12 EER AC unit
  - w/Thermal Expansion Valve
  - w/Electrically Commutated Motor
- Tight ducts – 6% leakage or less
- 20% cooling savings documented by Title 24
- Energy Star appliances for BEST Homes
- Shade trees for BEST Homes

RE hired Enercomp, the creator of MicroPas, one of the software programs used for Title 24 compliance, to develop the energy savings assumptions of the new construction programs. According to the RE's program manager, Enercomp made many runs of MicroPas that included the required measures with combinations of other energy efficient measures to reach the 20% cooling savings. Then the kW and kWh savings of all the runs that showed 20% cooling savings were averaged. The average savings results for Preferred Homes were 0.6 kW and 1000 kWh saved per home. Because BEST Homes includes Energy Star appliances the savings were 0.69 kW and 1098 kWh. The shade tree savings are counted separately.

In submitting program applications, builders submit Title 24 calculations for each plan. The cooling compliance margin for all cardinal orientations must be 20% or greater for participation in the program. RE does not account for the savings of the homes that surpass Title 24 by more than 20% because of the fixed savings discussed above. We recommend RE work with Enercomp to develop a procedure that will account for these additional savings.

2.3 Residential New Construction Recommendations

1. Morrison Energy Services recommends that the new construction program documentation be filed separately from the retrofit program documentation. We suggest that all the required documents for each application be filed together and scanned together.
2. We suggest the new construction part of the rebate database be reviewed and simplified to better fit the new programs.
3. RE should set a procedure that will account for the additional savings for the homes that surpass the program requirements.

3. Residential HVAC Retrofit Program

Under the residential HVAC Program, incentives are provided for installation of energy efficient A/C and heat pump units in existing homes. The High Efficiency Air Conditioner and Heat Pump rebate levels are provided in Table 3-1.

Table 3-1: Residential HVAC Incentives

	Split Systems			Package Systems			
	SEER	EER	HSPF	SEER	EER	HSPF	Rebate
AC w/TXV	14.0	12.0		14.0	11.0		$550/unit
AC w/TXV	15.0	12.5		14.0	12.0		$750/unit
Heat Pump			8.5			8.2	$200/unit

RE also provides a $100 incentive for the contractor for every high efficiency unit that flows through the program, rendering it a contractor driven program. For the fiscal year, FY08 there were 315 permits issued and 350 air conditioners rebated. The discrepancy occurred because some permits were issued in FY07, while the rebate was processed in FY08. Also some homes have 2 air conditioners with one permit.

3.1 Residential HVAC Retrofit Process Evaluation

RE contracts with Electric & Gas Industries Association (EGIA) to process the rebates for the residential retrofit programs due to the volume of activity of the rebate program. EGIA also processes rebates for several other utilities.

RE encourages customers to reserve a rebate for a new air conditioner. There is no guarantee of availability of funds without a reservation. The customer or contractor sends EGIA an application that describes the unit and EGIA will send them a reservation number. The application includes a return envelope addressed to EGIA to encourage the customer to send the application to EGIA rather than Roseville Electric. Some customers will hand deliver applications to RE and RE then sends them to EGIA to process. For quality control, no applications are input by RE directly into the rebate database. All applications are routed through EGIA.

Most customers do not use the reservation system. They send the paid invoice and other documentation in with the application after the installation of the AC system is complete. RE staff and EGIA have not enforced the reservation requirement because it is easier to process the rebates as they come in and funds have been sufficient to carry the program through to the end of the fiscal year. In the event the program becomes fully subscribed prior to year-end, we recommend that RE direct EGIA to enforce the reservation requirement with the customer and the contractors.

In processing the rebates, EGIA first date stamps the applications and then compares the applicant information with Roseville's customer service database to determine that they are a customer of Roseville Electric. RE sends EGIA an updated version of the customer service database monthly. EGIA then verifies all the other required documentation is attached to the application.

This documentation includes:

- an invoice or receipt of payment
- a duct test certificate
- a building permit.

Most contractors included a printout of the American Refrigeration Institute (ARI) web site showing the efficiency of the air conditioner they installed for the customer. RE may want to make this a requirement to make efficiency verification easier.

Once per week, EGIA sends a data file to RE to transfer into their rebate database. RE uses this database to prepare paperwork to pay the rebates, but it also calculates the savings for each air conditioner and is used in reporting savings.

In reviewing this process, we inspected the paper work of 57 randomly selected applications out of 350 rebates. Summit Blue recommended this number for 90% confidence. As with the new construction program, Summit Blue recommended Option A of the IPMVP protocols.

Out of the 57 inspected, we found one application that did not have all of the appropriate documentation. The application included the duct test certificate that was signed by the contractor without data pertaining to the test. The home may be exempt from this requirement, but those exemptions are normally noted in the appropriate place on the form.

Since one discrepancy was found on the 57 applications we reviewed, we do not have suggestions for improving the EGIA process. Again RE may want to require a print out from the ARI web site with the efficiency rating to make the verification easier.

3.2 Residential HVAC Retrofit Impacts

RE utilizes savings estimates that are deemed energy savings per ton based on engineering calculations:

kW = Rated cooling output, kBtuh / EER

kWh = kW x 888 hrs/yr

The 888 hrs/yr was determined in the development of the alternative calculation method for the E3 calculator for climate zone 11 from CEC approved data within the MicroPas software.

Deemed savings used per measure:

	kW Reduction			kWh Savings		
Tons	14 SEER/ 11 EER	14 SEER/ 12 EER	15 SEER/ 12.5 EER	14 SEER/ 11 EER	14 SEER/ 12 EER	15 SEER/ 12.5 EER
2.0	0.188	0.344	0.413	194	355	426
2.5	0.235	0.430	0.516	242	444	533
3.0	0.281	0.516	0.619	291	533	639
3.5	0.328	0.602	0.722	339	622	746
4.0	0.375	0.688	0.826	387	710	852
5.0	0.469	0.860	1.032	484	888	1,066

These saving are based on comparing the high efficient system with the minimum efficiency standard of SEER 13 in Title 20 and a default 10 EER (also used in the E3 calculator); there is no minimum EER requirement in Title 20. The E3 calculator's alternative calculation is based on this calculation. The equations in the rebate database show RE is counting the savings of all air conditioners with a rating of SEER 15/ EER 12.5 or higher as the same savings. Also at this time, RE does not claim savings for the heating side of the heat pumps.

Even though this methodology is accepted and used in the E3 Calculator by all municipal utilities, engineering calculations are in disagreement with the Database for Energy Efficient Resources (DEER) savings for the air conditioning program. According to the DEER, the savings are less than the engineering calculations. The current DEER savings data is inconsistent. In some cases the less efficient units have better savings than the more efficient units. We recommend analyzing the updated DEER savings numbers when they are released.

3.3 Residential HVAC Retrofit Recommendations

1. Most contractors included a printout of the ARI web site showing the efficiency of the air conditioner they installed for the customer. RE should make this a requirement to make efficiency verification easier.
2. RE should analyze the updated DEER savings when they are available for consistency among efficiency levels.

4. Commercial Custom Program

The commercial custom program is a program that accepts energy efficiency projects that do not meet Roseville's prescriptive commercial programs. In FY 2007/2008, six different types of measures received energy efficiency incentives. Some of these projects were identified by RE energy audits or third party energy audits.

Measure	Number of Rebates	Summer Peak Reduction (kW)	Annual Savings (kWh)	kW % of Total	kWh % of Total
Air Compressors	2	15.4	69,720	2%	2%
By Pass	1	18.8	148,351	3%	3%
Chiller	2	307.6	2,716,439	46%	60%
Lighting	14	241.5	920,602	36%	20%
Pump	1	40.0	350,400	6%	8%
Transformer	1	40.2	350,784	6%	8%
Total	21	663.5	4,556,296	100%	100%

For this program, Summit Blue recommended Option A of the IPMVP M&V Options. They suggested that the methodology should consist of on-site verification of measure installation and review of the engineering calculations made for each measure installed.

Since twenty-one custom projects were installed, verification of sixteen randomly selected projects is required to achieve evaluation results that meet the statistical confidence of 90% +/- 10%. We reviewed all 21 applications, RE documentation of on-site verification and engineering calculations.

4.1 Commercial Custom Process

To make a reservation for a custom project, a commercial customer or a contractor for the customer must submit the following documents:

- Scope of work
- Estimation of total cost
- Timeline (including all phases of the project)
- Estimated savings base on contractor or internal company expertise

To approve the reservation, RE completes the following steps:

- Pre-inspects the site to verify the existing fixtures or equipment.
- Reviews the proposal to ensure that all proper documentation is included
- Hires third party consultant to review the project for savings accuracy
- Run cost effectiveness tests using the E3 calculator and the NPV calculator
- If the project is a simple change out of equipment with deemed savings or an efficiency rating, such as lighting, no third party engineering evaluation is done.

After completion of the project, RE must complete and/or review the following documentation:

- Post inspection
- Copies of the invoice
- Product cut sheets
- Process the rebate.

The above process is tracked in the commercial rebate database. The database includes the customer information, project description, completion date, inspection dates and the calculated savings. We found no missing information when reviewing the hard copies of the applications or in the database.

4.2 Commercial Custom Impact Evaluation

For the fiscal year 2008, RE processed 14 custom lighting rebates. This accounts for 36% of the kW reduction and 20% of the kWh savings for the custom program. RE staff uses the "M&V Report for NCPA SB5X Commercial & Industrial Lighting" (produced by Robert Mowris) Appendix A: Lighting Peak kW Savings for the existing fixtures and the manufacturer's data for the proposed fixtures. RE staff suggest that these savings are based upon PG&E work papers. The kW savings are calculated by subtracting the proposed kW from the existing kW. This difference is multiplied by the hours of operation to calculate the kWh savings.

The SB5X report was completed in 2003 so we suggest RE should use the updated PG&E work papers or the DEER database for determining peak watts for the existing lighting fixtures. Also RE should compare the manufacturer's data with other sources such as the PG&E work papers or DEER database to validate the manufacturer's data. The numbers should be the same or very close.

RE processed 7 non-lighting rebates and they account for 54% of the kW reduction and 80% of the kWh savings.

When RE receives a proposal for a complicated project they send the proposal to a third party engineering company to review it. The engineering company will accept the savings estimate, reject it and provide their own estimate or provide a range of savings. The engineering company will send the results of their review to RE so they can use the savings numbers to determine the cost effectiveness of the project. Per interviews with RE program managers, if the engineering company provides a range of savings RE uses the lower limit of the range to be conservative.

The chiller change out project shows considerable kWh savings in relationship to the kW reduction. In reviewing this project, we found that the engineering company did not show the hours of operation in their analysis. This led us to question the savings for this project. In a short interview with the customer's engineering staff, we verified the hours of operation and method of estimation. With our questions answered we confirmed the

savings. We recommend that the engineering company show all the relevant information in the report they send back to RE.

RE did not use the third party engineering company to evaluate the savings for the transformer upgrade. Transformers have efficiency ratings so this project was treated as a lighting change out.

RE does a pre and post inspection for every custom project.

4.3 Commercial Custom Recommendations

1. Recommend putting custom lighting with other lighting projects in the rebate database instead of including them in the custom section. This was suggested by one of the RE staff because some of the database reports were confusing. In our review of the database reports we agree.
2. For non-lighting rebates, it would be beneficial to have the third party engineering company participate with RE in the pre and post inspections to verify name plate data, hours of operation and other information provided in the proposal. At this time the engineering company uses the data from the customer's project proposal as prepared by the customer's engineers.
3. In reviewing documentation of the chiller change out, the engineering company did not include the hours of operation. RE should require that consultants include all there assumptions in their analysis reports.
4. Some projects are sub-metered. Morrison Energy Services was unable to gather this metered data for use in this analysis. We recommend RE collect the hourly consumption data for these custom projects and include it with the application documents. This will allow RE to follow up and better analyze the project. The data will also be available for third party analysis.
5. To encourage continued participation in this custom program we recommend RE provide support for the customers to identify projects through energy audits of their facilities.