EVALUATION, MEASUREMENT AND VERIFICATION PLANS

for

Riverside Public Utilities

March 3, 2010

SUMMIT BLUE CONSULTING

A part of Navigant Consulting

www.navigantconsulting.com

Submitted to:

Contact name: Rebeccah Goldware
951.826.5788
RGoldware@RPUca.gov

Client: RPU Public Utilities
Address: 3900 Main Street
RPU, CA 92501

Submitted by:

Gary Cullen
Navigant Consulting, formerly Summit Blue Consulting, LLC
NW Regional Office, Portland/Vancouver
1104 Main Street, Suite M110
Vancouver, WA 98660

(360) 718-8392
gary.cullen@navigantconsulting.com

Prepared by: Gary Cullen, Katherine Johnson, Deborah Swarts

TABLE OF CONTENTS

1 INTRODUCTION

The City of Riverside Public Utilities (RPU) has a number of energy efficiency and renewable energy programs offered through its utility department. This report describes the Evaluation, Measurement, and Verification Plans for selected RPU energy efficiency incentive programs.

Two legislative bills (SB1037 and AB2021) were signed into law a year apart. SB1037 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 (signed September 29, 2005) 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 both an on-going assessment of what is occurring within the programs along with a comparison of how much possible savings are left within the POU service territory.

1.1 Evaluation Priorities

Evaluation priorities should be based on a combination of relative size of the savings achieved as well as the degree of uncertainty with *ex ante* estimates of the savings. HVAC and shell measures have the greatest level of *ex ante* energy savings estimate uncertainty because they are based on savings estimates derived from building simulation modeling with the building characteristics being an average across all vintages and home sizes. The *ex ante* energy savings for lighting are stronger since wattages are fixed by lamp type. The greatest uncertainty with lighting is hours of operation. Based on this combination of the amount of achieved savings and *ex ante* energy savings uncertainty, it is recommended that RPU conduct the following E, M&V activities in Program Years 2008-2009.

1. A limited process evaluation of RPU's residential and commercial program offerings to ensure consistency in database tracking given the overlap in several program elements. The evaluation should consist of the following elements:
    a. A review of the database tracking system to streamline program reporting and enhance comparisons between and among programs.
    b. Residential customer surveys to determine free ridership, identify overall customer satisfaction, areas for improvement and validate the installation rates claimed by the program.
    c. A review of the measures targeted in its program portfolio to determine their cost-effectiveness and identify alternatives.
2. An impact evaluation of the residential Power Tree program and the overall non-residential program.

1.2 General Utility Background Information

Riverside is the largest city in the Inland Empire Metropolitan Area of Southern California, and is approximately 60 miles east of Los Angeles and 12 miles southwest of San Bernardino. As of 2008, Riverside had an estimated population of 311,575.

The RPU service territory has a semi-arid Mediterranean climate with hot, dry summers and mild, relatively wet winters. Temperatures in the summer can exceed 95°F but with low humidity. In the winter, high temperatures may not rise above 55°F during rainy days. The city is located in Climate Zone 10. Table 1 provides basic climate information for Riverside.

Table 1: Temperature Reference Points for RPU

Base Temperature	65F
Heating Degree Days (HDD)	1,678
Cooling Degree Days (CDD)	1,456

1.3 Energy Efficiency Programs Offered

RPU has developed a portfolio of programs for its residential and small commercial customers to encourage energy conservation and to meet its long-term reduction goals. These program offerings are summarized below.

Current Residential Efficiency Programs:

- **Cool Cash -Air Conditioning Rebates for New or Replacement Units**: Offers incentives for replacement or installation of central HVAC units and/or room units with high efficiency equipment. The incentive is intended to close the gap in cost between standard HVAC equipment and high efficiency equipment. Incentive amounts are based on the unit's rating - Seasonal Energy Efficiency Ratio (SEER) as defined by California Title 24 codes.

- **Energy Star® - Appliance Rebates**: Rebates to customers who purchase qualifying appliances. This does not include home electronics.

- **Refrigerator Purchase Rebate:** Provides incentives for the purchase of new high efficiency Energy Star® rated refrigerators that use 20 percent to 50 percent less electricity than standard units of comparable size.

- **Cool Returns- Refrigerator/Freezer Recycling:** This program provides for recycling of old operating inefficient refrigerators and/or stand-alone freezers that are picked up and transported to a recycling facility for processing.

- **Tree Power- Shade Tree Planting for Cooling Efficiency**: Incentives for residential customers to plant shade trees around their home to help save on summer cooling costs. Customers receive

rebates of up to $25 per tree for the purchase of up to five trees annually. In addition, every March a free Shade Tree Coupon comes on the back of the March bill. The coupon can be redeemed for one tree worth up to $25.

- **Pool Saver Swimming Pool Pump Incentive**: This program offers swimming pool owners a $5 credit on their monthly electric bill for setting their pool pump timers to operate at off-peak hours.

- **Online Home Energy Analysis**: Generates an analysis of home energy that identifies energy efficiency measures and savings. Customers complete the survey online and can view the results instantly. The web also provides conservation information.

- **Weatherization Incentive Rebate**: This program is a whole house approach to improving the energy efficiency of residential homes by providing rebates on attic insulation, duct insulation, duct testing/sealing, window replacement, window shading, whole house fans, programmable thermostats, and evaporative coolers.

These residential programs are available to RPU residential electric customers applicable. However, if the applicant is a tenant or renter, the property owner must also sign the application. Table 2 summarizes the rebate amounts available to RPU's residential customers.

Table 2: Summary of Rebate Amounts for Residential Programs

Qualified Products	Rating	Rebate
Central Air Conditioning Units & Heat Pumps	14 SEER or greater	Energy Star rated 10% of purchase price (up to $750)
Programmable Thermostat		$25 each (limit 2)
Refrigerator	At Least 14 Cubic Feet	$200 Rebate
Room Air Conditioner		$50 Rebate
Dishwasher		$50 Rebate
Clothes Washer		$75 Rebate
Weatherization Rebate Amounts		
Conservation Measure	**Minimum Rating**	**Rebate**
Attic Insulation*	R-19	10 ¢ per sq. ft.
	R-30+	15 ¢ per sq. ft.
Exterior Wall Insulation*	R-13+	5¢ per sq. ft
*Rebates will be calculated for nearest R-value		
Window Replacement	Energy Star® rated	$1.00 per sq. ft.
Door Replacement	Energy Star® rated	$1.00 per sq. ft.
Whole House Fans	Installation will not count towards purchase price	$200
Solar-Powered Attic Fan	Installation will not count towards purchase price	$200 (limit 2)

A summary of RPU's commercial programs are summarized below. Table 3 summarizes the rebate amounts available to RPU's commercial customers.

Current Commercial Customer Programs:

- **Air Conditioning Rebate for Replacement and/or New Units:** Offers incentives for replacement or installation of HVAC units with high efficiency equipment. The incentive is intended to close the gap in cost between new standard HVAC equipment and high efficiency equipment. Incentive amounts are based on the unit's rating - Seasonal Energy Efficiency Ratio (SEER) as defined by California Title 24 codes.

- **New Construction**: Offers non-residential customers technical assistance during the design and planning stages of pre-construction of facility additions to maximize their energy efficiency and energy savings by exceeding California's Title 24 state standards.

- **Custom Energy Efficiency Technology Grant Program**: Supports businesses, non-profit organizations, educational institutions or groups of customers working in collaboration in research, development, and effective use of innovative energy technologies. Grant funding supports projects related to the efficient and innovative use of energy that are not covered under our existing non-residential programs.

- **Energy Efficiency Incentives for Lighting**: Offers incentives for replacing older inefficient lighting with high efficiency units. The incentive is offered to close the gap between standard lighting equipment and high-efficiency equipment.

- **Technical Assistance Program**: Offers all non-residential customers a comprehensive energy audit using a software program designed specifically for businesses. Demand Rate and Time-of-Use customers can receive the services of a technical assistance consultant in addition to the audit.

- **Energy Management Systems Assistance Program:** Provides incentives for energy management system upgrades for non-residential customers. RPU offers cost sharing incentives to assist the customer in technology purchases that provide energy savings. The incentive is the cost sharing of 1/2 of the project based on overall customer load.

- **Tree Power- Shade Tree Planting for Cooling Efficiency**: Provides incentives to non-residential customers to plant shade trees around their business or organization to help save on summer cooling costs. Customers receive a rebate check from RPU for up to $25 per tree toward their cost to purchase up to five trees annually.

- **Energy Education Campaign** - Residential, Business: Energy information is provided to all residential and business classes; small and large commercials customers on energy conservation and demand reduction. Onsite energy audits are also available.

- **Thermal Energy Storage and Feasibility Study Incentives**: Incentives are provided to close the gap in cost between standard HVAC equipment and new cooling technologies such as thermal energy storage. The incentive amount of $200 per kilowatt is based on the on-peak kilowatt demand savings. Funding for 50 percent or up to $5,000 is also available for a study to analyze the feasibility of installing a system. A feasibility study is required prior to a customer entering into the agreement development phase of the program.

- **Customer Directed Funding**: Customers who enter into multi-year, energy service agreements with RPU can direct a portion of their Public Benefit funds directly to their specific needs. Customer directed funds could be used for a variety of energy conservation and assistance programs that promote renewable resources, and research and development.

- **Auto Meter Reading**: This program provides a tool to non-residential customers that monitor the electric load on 15-minute intervals. The program allows non-residential customers the ability to view, via the internet, usage patterns.

- **Efficient Motors:** Incentives for the replacement or purchase of new premium motors.

- **Performance Based Incentives**: Provide rebates to those customers who can demonstrate a kWh savings based on an energy efficiency measures implemented in their business that is not already provided through a standard rebate program.

Table 3: Summary of Rebate Amounts for Commercial Programs

Qualified Products	Rating	Rebate
Heat Pumps, Package A/C & Chiller Systems	Energy Star	$100/ton
Refrigerator	14-35 cubic feet	$100 Rebate
Refrigerator/ Freezers	36+ cu bic feet	$200 Rebate
Commercial Clothes Washer		$75 Rebate
Room Air Conditioner		$50 Rebate
Dishwashers		$50 Rebate
Lighting Retrofits/Installation		$.05 per kWh of the calculated energy savings for one year. Rebate amount cannot exceed 25% of the lighting product/lighting equipment cost.
Premium Motors		Incentives range from $35 to $630, with a maximum rebate of $25,000 per customer account.
Efficient Construction (new or retrofit)		RPU incentives can cover up to 50% of the owner's cost for energy efficiency measures or $150,000 (whichever is less).
Energy Management Systems (EMS) Incentives Based on Aggregated kWh load	7 Million and over	$25,000
	2.5 to 6.9 Million	$15,000
	Below 2.5 Million	$5,000

RPU is adding the following new energy efficiency programs to be initiated in the PY2009-10:

- Residential and Small Business HVAC Tune-Ups
- Residential CFL Direct Mail
- High Intensity Discharge (HID) lamp Change-out
- LED Security Wall-packs
- Small Business Direct Install – Lighting
- Demand Response Programs
- Vending Misers

2 PROCESS EVALUATION

2.1 Background and Objectives

The Navigant Consulting team (NCI) completed a process evaluation of RPU's efficiency programs that consisted of the following activities:

- A review of the database tracking system to streamline program reporting and enhance comparison between and among programs.
- A review of the measures targeted in RPU's residential portfolio to determine cost-effectiveness and identify potential alternative measures.

The scope of this process evaluation included:

- Reviewing marketing materials developed to promote both residential and commercial programs,
- Reviewing the databases used to track RPU's residential energy efficiency programs,
- Completing staff interviews with key program management
- Assessing the measures currently included in RPU's energy efficiency portfolio, and
- Identifying alternative measures for RPU to consider offering to its residential customers.

2.2 Document Review and Staff Interviews

The NCI team interviewed the RPU staff who is most familiar with overall program operations and activities. The program staff reported that RPU has been offering residential energy efficiency programs since 1998 and commercial programs since 2000. Since then, these programs have been "tweaked" to enhance overall program operations. The qualifying criteria have also been changed to meet new Title 24 standards for its weatherization programs, as well as new standards for its Energy Star programs.

Over the past decade, the program tracking system has also been standardized. Now, program files are stored in a central location that is easily accessible to all program staff.

RPU has developed an inspection and review process for both its residential and commercial programs, which is discussed more fully in the program flow section (See Section 2.1.3).

This review also examined the current marketing materials developed to promote the program to both residential and commercial customers. These materials include the program website, mailers, flyers, and brochures. The programs are also promoted in the annual reports and at community events.

Both the residential and commercial programs are customer-driven, and this is reflected in the marketing materials and approach. The materials are directed at encouraging customers to participate in the program. The website also includes the rebate forms available for download. The customers must complete the forms in order to qualify for the rebate.

The commercial customers are encouraged to contact a RPU account manager to learn more about the program. The marketing materials provide additional information on how to contact the utility staff and details regarding program participation requirements.

2.3 Tracking Systems Review

During PY 2008-2009, RPU claimed more than 16 GWh of gross annual energy savings. As shown in Table 4, claimed energy savings from both the residential and non-residential sectors is about the same. Overall, the largest levels of claimed gross annual energy savings come from residential and non-residential lighting, non-residential custom, and residential shade trees.

Table 4: Energy Efficiency Program Results for PY 2008-09

Sector	Category	Sub-Category	Participants	Net kWh Savings	Net kW Savings	Net Annual kWh Savings as % of Sector	Net Annual kWh Savings as % of Total
Residential	Res Shell	Envelope and Tune-ups	1,301	171,732	154.0	2.1%	1.1%
Residential	Res Shell	Ceiling R-0 to R-30 Insulation-Batts	148	77,197	41.9	1.0%	0.5%
Residential	Res Shell	Wall Blown-in R0 to R13 Insulation-Batts	25	8,280	3.7	0.1%	0.1%
Residential	Res Shell	Windows	575	4,140	10.1	0.1%	0.0%
Residential	Res Refrigeration	Refrigerator: Top Mount Freezer	739	51,434	8.9	0.6%	0.3%
Residential	Res Refrigeration	Refrigerator: Side Mount Freezer	738	57,859	10.0	0.7%	0.4%
Residential	Res Refrigeration	Low-Income Refrigerator Replacement	79	51,950	0.0	0.6%	0.3%
Residential	Res Refrigeration	Refrigerator Recycling	358	557,334	85.9	7.0%	3.5%
Residential	Res Pool Pump	Pool Pumps	39	20,280	3.2	0.3%	0.1%
Residential	Res Lighting	CFL: Screw-In (<=15W)	86,000	2,201,600	412.8	**27.5%**	13.7%
Residential	Res Lighting	CFL: Screw-In (16-24W)	86,000	2,683,200	481.6	**33.5%**	16.7%
Residential	Res Dishwashers	Energy Star Dishwashers	760	14,592	4.3	0.2%	0.1%
Residential	Res Cooling	Attic Fans	54	6,912	13.0	0.1%	0.0%
Residential	Res Cooling	14 SEER (11.99 EER)- Split System	871	20,207	30.0	0.3%	0.1%
Residential	Res Cooling	15 SEER (12.72 EER) - Split System	416	23,296	29.0	0.3%	0.1%
Residential	Res Cooling	16 SEER (11.61 EER) - Split System	31	570	4.2	0.0%	0.0%
Residential	Res Cooling	Energy Star Room Air Conditioners	115	9,752	15.1	0.1%	0.1%
Residential	Res Cooling	Programmable Thermostats	172	-26,419	0.0	-0.3%	-0.2%
Residential	Res Cooling	Shade Trees	12,749	2,019,442	591.6	**25.2%**	12.6%
Residential	Res Cooling	Whole House Fans	155	-372	0.5	0.0%	0.0%
Residential	Res Clothes Washers	Energy Star Clothes Washers	789	18,305	7.6	0.2%	0.1%
Residential	Other	Education Programs	93	29,611	0.0	0.4%	0.2%
TOTAL				**8,000,903**	**1,907.4**		**49.8%**
Commercial	Non-Res Lighting	T-8 Linear Fluor Lamps with Electronic Ballast	4,813	3,850,400	770.1	**49.0%**	24.0%
Commercial	Non-Res Cooling	>=300 tons Centrifugal Water Cooled Chiller	1,430	337,989	165.1	4.3%	2.1%
Commercial	Non-Res Cooling	150-299 tons Centrifugal Water Cooled Chiller	200	42,832	21.1	0.5%	0.3%
Commercial	Non-Res Cooling	Packaged terminal air-conditioner (> 15k)	141	31,584	16.9	0.4%	0.2%
Commercial	Non-Res Cooling	Packaged terminal air-conditioner (7-15k)	27	9,439	5.0	0.1%	0.1%
Commercial	Non-Res Cooling	Packaged terminal air-conditioner (< 7k)	18	7,459	3.9	0.1%	0.0%
Commercial	Non Res Comprehensive		4,472	3,577,768	715.6	45.5%	22.3%
TOTAL				**7,857,472**	**1,697.5**		**48.9%**
Water Pumping	Other		171,666	196,386	0.0		**1.2%**
GRAND TOTAL				**16,054,761**	**3,604.9**		**100.0%**

Figure 1 illustrates the distribution by category of claimed energy savings within the residential sector. Over 60% of all residential sector claimed savings is from CFLs followed by shade trees at 25%.

Figure 1: RPU's Residential Energy Program Claimed Gross Energy Savings Shares

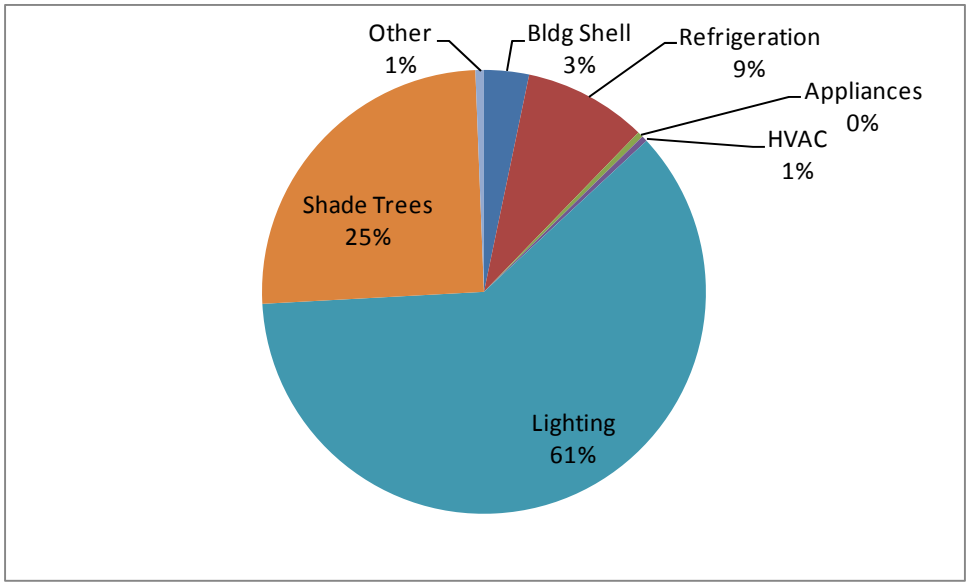
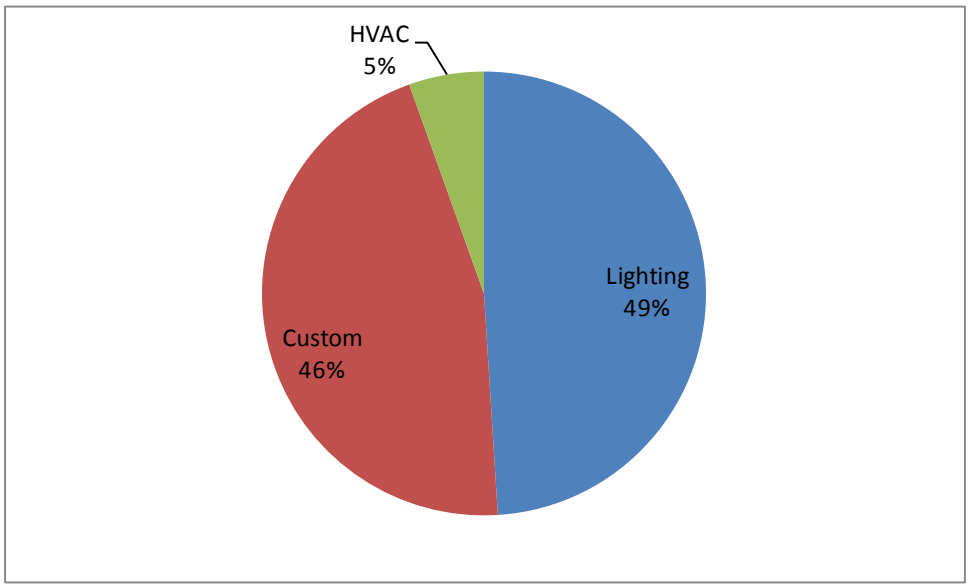


Figure 2 illustrates the distribution by category of claimed energy savings within the non-residential sector. Here, 49% of claimed savings comes from lighting and 46% from Custom. Claimed savings from other non-residential program offerings are very small.

Figure 2: RPU's Commercial Energy Program Claimed Gross Energy Savings Shares



2.4 Process Flow

Figure 3 and Figure 4 illustrate the program flows for the residential and commercial programs; respectively. In the residential program, the customer purchases the qualifying equipment and then mails in the appropriate documentation to RPU. If the rebate is less than $500, the customer receives a bill credit on the next bill. For amounts more than $500, the customer will be issued a check within six to eight weeks.

Approximately 10 percent of the residential installations are inspected; however, these inspections are scheduled based on "customer availability." If the customer is not available, RPU may schedule drive-bys (particularly for the Tree Power program) for observation. Follow-up surveys are also sent to customers to measure their overall satisfaction with the program. According to the staff, most customers are satisfied with the program.

The process for commercial customers is quite different. For all retrofit installations, the customer contacts the RPU account manager to schedule a pre-inspection. The account manager then assists the customer through the process and develops specifications for vendors. After the installation is complete, for all jobs, the account manager completes a final inspection and then processes the rebate checks.

Figure 3: Process Flow for RPU's Residential Programs

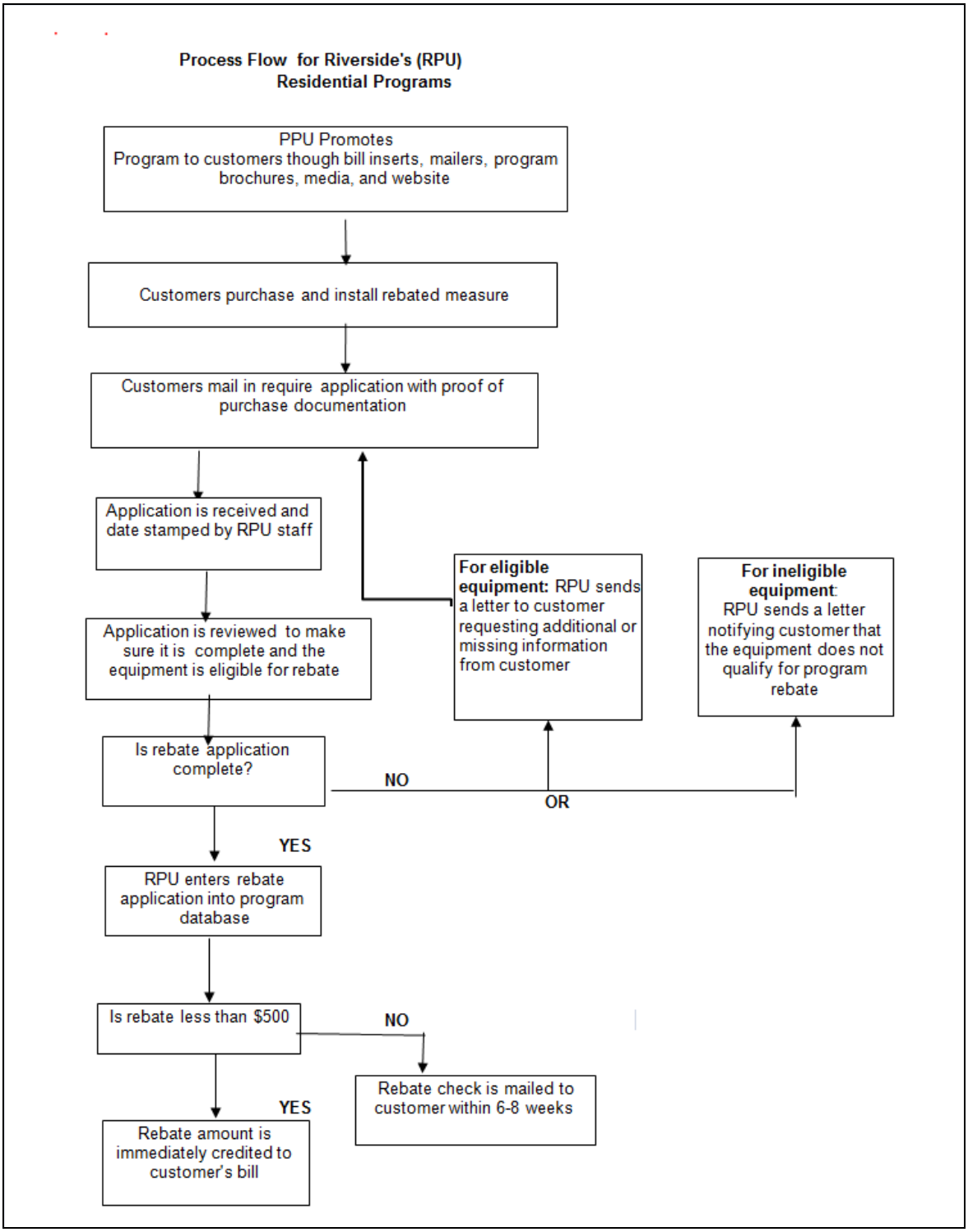
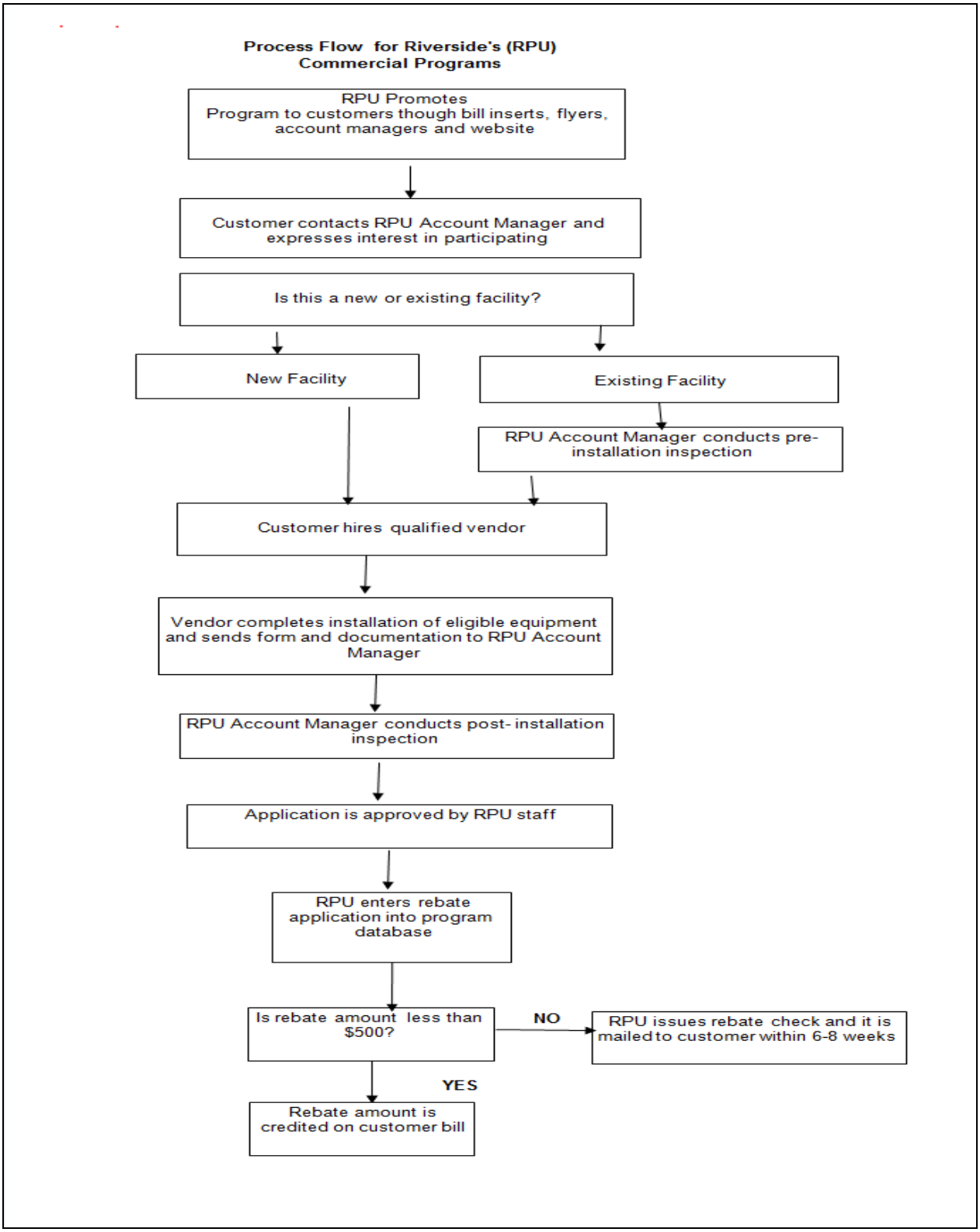


Figure 4: Process Flow for RPU's Commercial Programs



2.5 Process Evaluation Recommendations

Based on the findings from this limited process evaluation, the NCI team has developed the following recommendations. These findings and recommendations are grouped by topic.

- **Program Design and Marketing**: These programs are customer focused, and the burden for participation rests with the customer. This is especially true for the residential program. However, the participation rates for equipment-driven programs, such as the HVAC Tune-Ups and new equipment are low. This may be related to the fact that trade allies, contractors, retailers and installers are not included in the program recruitment. While this is less of a problem for the commercial program, both programs should be modified to focus on including the trade allies more proactively in program marketing and outreach.

- **Program Tracking**: The current program database is comprehensive, but it is not in a consistent format with the reporting requirements for the E3 calculator. RPU should consider aligning its program database tracking to more closely follow the E3 reporting requirements including participation, kWh savings, and kW demand reductions.

- **Residential Program Offerings:** RPU has developed its appliance rebate program to match Energy Star standards. This should be continued as specifications for qualifying equipment change from time to time. Furthermore, RPU staff should consider expanding its current list of qualifying to household "plug loads." Plug loads account for as much as 15 percent of total energy usage. Appendix A contains the most recent Energy Star ratings and specifications for household electronics.

- **Future Process Evaluation Activities**: Overall, RPU's programs are operating effectively. However, RPU should consider conducting a more comprehensive process evaluation for both its residential and commercial programs that would include:

    - Additional in-depth interviews with account managers, local vendors, and other trade allies (both participating and non-participating.) These surveys would focus on program satisfaction, barriers to program participation, and areas for program improvement.

    - Customer surveys with residential and commercial participants and non-participants to measure overall satisfaction, identify areas for program improvement, free ridership, free drivership and spillover.

3 IMPACT EVALUATION

The primary objectives of an impact analysis are to assess gross and net demand and energy savings and the cost-effectiveness of the installed energy efficient equipment. An impact evaluation verifies measure installations, identifies key energy assumptions and provides the research necessary to calculate defensible and accurate savings attributable to the program.

3.1 Impact Evaluation Research Issues and Objectives

The primary objectives of the impact analysis are to:

- Conduct a preliminary uncertainty analysis, identify, and rank those factors that contribute to overall uncertainty regarding program gross and net kW and kWh savings.
- Review engineering assumptions.
- Develop an analysis approach designed to minimize uncertainty of reported savings.
- Verify measure installations.
- Calculate verified gross demand and energy savings.
- Calculate net-to-gross factors, verified net demand, and energy savings.
- Assess program costs, including incremental costs associated with measures installed through the program.

3.2 Methods and Data Sources

A useful construct for thinking about the range of efficiency measures covered by the RPU Program is the International Performance Measurement and Verification Protocol (IPMVP). Table 5 presents a listing of 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. Our approach to selecting M&V strategies follows these guidelines.

Table 5: Overview of M&V Options

IPMVP M&V Option	Measure Performance Characteristics	Data Requirements
Option A: Engineering calculations using spot or short-term measurements, and/or historical data	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 multi-variate 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

Many of the energy saving estimates used by RPU in its planning and reporting are deemed saving values developed for all of the California Publically Owned Utilities (CPOU) and included in the CPOU version of the E3 benefit/cost calculator used for reporting to the California Energy Commission (CEC). For measures that utilize deemed energy savings estimates, Option A is the appropriate M&V option. The deemed saving estimates will be reviewed to insure correct values are used, but no field work involving metering or billing analysis will be needed. However, some form of installation verification will be needed; either on-site, by telephone, or through invoice reviews. The complexity of the project would determine the most appropriate approach.

More complex measures, especially those installed under the commercial advantage program, may need to employ some form of Option "B" although Option "A" may still be appropriate when deemed savings are available.

Three program areas provide the majority of PY 2008-2009 program savings:

- Residential HVAC – 13% of net annual kWh savings
- Residential and Non-residential Lighting – 54% of net annual kWh savings
- Non-residential Comprehensive – 22% of net annual kWh savings

3.2.1 Residential Programs

The residential HVAC program area is primarily comprised of the Tree Power program. About 25% of the claimed PY 2008-09 residential sector energy savings is from the Tree Power program. Although this

program is very popular with significant energy savings potential, there are high levels of uncertainty surround the underlying program assumptions. Tree mortality and the actual placement of the trees in relation to the building are the most uncertain program assumption variables. Because of the large amount of claimed energy savings and the high levels of uncertainty surrounding several underlying program assumptions, it is recommended that the Tree Power program be a high priority evaluation. Most of the remaining implemented residential measures are based on well defined deemed measure characteristics and can be considered lower priority.

SMUD has developed a tree benefits estimator that estimates the impacts of a utility shade tree program. The methodology includes assumptions regarding each trees' impact on direct shading benefits, impacts of indirect or evapotranspiration effect, heating penalty in winter months, tree growth rates and tree survival rates. Key variables include:

- Tree species (likely simplified into deciduous, conifer, and broad leaf evergreen)
- Age of the tree from the tree planting date
- Number of trees planted
- Climate zone
- Direction the tree faces (for trees planted next to buildings)
- Distance between the tree and the building that is being shaded
- Tree mortality

This estimator will be used to develop impacts from the program. The key variable information will be collected through on-site verification. A statistically representative sample of past participant trees will be drawn, the home addresses identified, and drive by verification and collection of variable data completed. A drive by approach is suggested in order to both minimize troubling RPU customers as well as maximizing the randomness of the sample drawn. Achieving sample representativeness at a 90% confidence level +/- 10% will require about 70 complete drive-by verifications.

A companion telephone survey is also recommended to be conducted with past program participants to estimate a net-to-gross factor. This sample would be drawn independently of the on-site verification sample. The survey instrument would be very short with the sample population goal being to achieve sample representativeness at a 90% confidence level +/- 10%. This will require about 70 completed telephone surveys.

3.2.2 Non-Residential Programs

Nearly 50% of the PY 2008-09 claimed energy savings are from non-residential programs with lighting and customized measures comprising over 90% of the non-residential total claimed energy savings. These savings estimates come from 36 different projects. It appears that the savings come from these 36 projects each represents a mix of these different measures. Therefore, non-residential programs should be considered as a whole from an evaluation perspective with a sample drawn from these 36 projects. The best evaluation strategy for these two programs is likely one that uses engineering calculations with a combination of metered data and stipulated performance parameters. On-site verification is one of the keys for evaluating these kinds of non-residential programs. Our experience has found that even lighting

projects, which often consists of deemed measures, have numerous errors regarding installed wattages, measure placement, and measure operating hour assumptions.

To keep costs reasonable, it is recommended that a sample population be drawn from the universe of projects sufficient to achieve a level of precision and confidence of 80% +/-20%. Using a universe of 36 projects, a sample of nine projects would be included in the regression analysis. Because of the variability among types of measures, it is recommended that the sample be drawn using a stratified random draw with the stratifications based both on the amount of claimed savings and the diversity of measures installed.

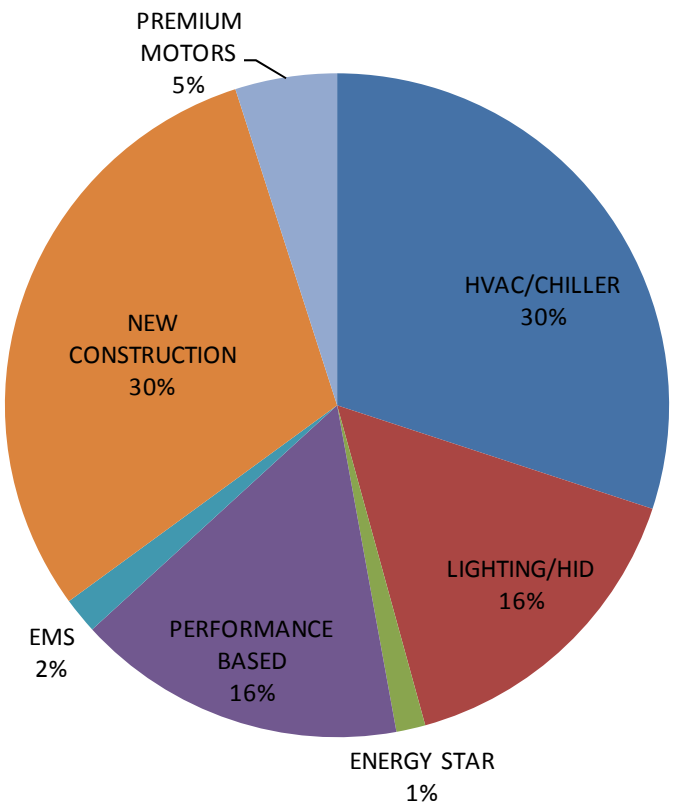
The program data supplied to NCI by RPU was for the 2008-2009 program year and but not include energy and demand savings values for some of the measures, so rebate amounts have been used as a proxy to estimate the relative impacts of measures. When actual sampling is performed, the actual applications for each project would need to be provided in order to perform the actual measure verification and savings analysis. Table 6 and Figure 5 provide an overview of the types of measures installed.

Table 6: Overview of Measures Installed During 2008-2009 Program Year

measure type	# of measures	% of measures	rebate	% of rebate
EMS	1	2.8%	$5,000.00	1.8%
HVAC/Chiller	11	30.6%	$85,685.00	30.1%
Lighting/HID	13	36.1%	$44,654.20	15.7%
Premium Motors	1	2.8%	$14,125.00	5.0%
Energy Star Appliances	6	16.7%	$4,050.00	1.4%
Performance Based	3	8.3%	$45,796.20	16.1%
New Construction	1	2.8%	$85,789.00	30.1%
total	**36**	**100%***	**$285,099.40**	**100%***

*Values shown may not add up to exactly 100% due to rounding.

Figure 5: July 2008-June 2009 Rebate Percentage by Measure Type



Application Review

Two full project applications were provided as examples for this evaluation plan and additional applications are expected to be similar. One application was for a lighting project and the other was for a new hydraulic pump system, which would be part of the performance based measure category. Although the invoices included with the applications were not itemized, the files contained complete descriptions of the retrofits and details of savings calculations. The lighting application did not specify the type of fixtures removed, however their wattage was included, along with details of the new fixtures, numbers of fixtures, and hours of operation. The hydraulic pump system file included plots of power consumption for the old and new hydraulic pump systems as well as invoices and a project description. Measured data, such as that shown in the plots, provides reliable baseline and post installation information that generally improves the accuracy of both initial savings estimates and impact evaluation calculations. The evaluation technique varies by the types of measures included in a project. Following are brief discussions by measure type.

EMS

Verification of energy management systems generally requires a combination of data logs from the system, specifications of the equipment controlled, and operational schedules. In addition, spot measurements and metering may be used to determine equipment power usage if equipment specifications are not adequate. In cases where the EMS controls a large percentage of the building loads

and no significant changes have occurred in equipment, billing analysis may be used to determine savings as part of an IPMVP Option C approach to verification.

HVAC/Chillers

HVAC measure verification can include multi-week logging of operation, which is correlated with outdoor air temperatures and TMY data. However, for prescriptive replacements of AC units such as those included in the RPU program, typically the IPMVP Option A approach is employed. A simple onsite inspection may be performed to confirm proper system operation, often including spot measurements of power consumption. This is used along with system specifications, Title 24 baselines, and operational hours to determine savings. These values can be compared to the deemed savings to determine if they are greater than the standard values.

Lighting/HID

Verification of lighting measures typically involves the IPMVP Option A method. If projects chosen for the sample do not involve any occupancy sensors or dimming controls, a simple count and calculation based on rated wattages will be used for verification. In order to accurately evaluate a typical lighting installation, all that is needed is a list of fixtures removed, fixtures installed, and operational hours. Standard wattages are available for most fixtures and can be used in a straightforward calculation of savings. If occupancy sensors are included in the project, standard usage reductions for the space type may be used to estimate savings. If there is reason to believe savings from sensors may be substantially higher than these standard values, lighting loggers can be employed over a period of three weeks to determine actual savings.

The provided lighting application involved the replacement of HID lights with six-lamp T5 HO fixtures with motion sensors. Since the application does not specify the type of HID fixtures removed, facility personnel would be asked about the old unit type. A 25% reduction in usage was assumed for the motion sensors, which is below the 45% standard allowance for a warehouse, such as the one listed in the application. Because of this, measurement of sensor operation would not be required, but discussions with facility personnel would be used to determine the reason for the low assumed savings. Adjustments to the motion sensor savings up to 45% would not require logging of operation.

Premium Motors

Premium motors are typically a prescriptive rebate measure, providing incentives based on purchased horsepower. These savings are based upon deemed values and onsite verification typically includes observing that the units are installed and operation. Operational hours and loading are discussed with facility personnel, but typically deemed values are used for savings. In rare cases, particularly with large motors, spot measurements and operational hours may be used as a part of IPMVP Option A for savings calculations.

Energy Star Appliances

Energy Star appliance savings are based upon deemed values. Since these are typically small measures, logging is rarely employed to determine savings, even if onsite verification is included. Instead onsite verification usually consists of simple verification of installation and operation of the new appliance. In addition, discussions with facility personnel are used to determine what appliances were previously installed and that they were removed and disposed of, rather than still being in use. However, since the Energy Star appliances made up only 1.4% of program rebates and use deemed savings values, they are unlikely to be included in the program sample for verification.

Performance Based

Performance based, or custom, project verification generally requires a combination of spot measurements, metering, and equipment specifications as in the IPMVP Options A and B approaches. Typically onsite spot measurements of power consumption of the affected equipment are combined with logging of power or current draw for between one and three weeks. If the facility tracks operation or production related to the affected equipment, these data logs could be used in conjunction with logged data to determine system power requirements. Production or operation can also be estimated from power consumption using equipment specifications. If logged data is available for the baseline system prior to the project installation, this can be compared to current usage if the system loads have not significantly changed. Otherwise the usage baseline can be calculated using equipment specifications for the old system based on current loading data. In the cases of production dependent measures, adjustments are made for any changes in production levels as well.

The provided application for a performance-based measure is for the replacement of a hydraulic pump system. Operation of both the old and new systems was logged as part of the initial verification, so savings values are expected to be accurate. However, onsite verification of this measure would still be likely to include logging of the system usage and spot measurements of power consumption as part of a IPMVP Option A and B approach to verification. This data would be compared to that provided with the application to determine if usage had changed since installation. The application provides only graphs and summarized data. If possible, the actual logs would be obtained for comparison to measured data. However, older data logs are frequently not available, and in this case the data in the application would be compared in as much detail as possible to new measurements. In addition, discussions with facility personnel would be used to determine overall hours of operation and any changes that have taken place since the retrofit. This would be used, along with any available operational logs to determine savings based upon current operation.

New Construction

Verification of comprehensive building efficiency generally requires billing analysis as in the IPMVP Option C or D approach. In the case of new construction, such as the measure included in the supplied database, billing data is typically compared to projected energy use based on modeling. It is also possible to meter individual measures and calculate their usage for comparison. Although this can provide the most accurate savings estimate, it is often not justified due to cost and time considerations. If the savings due to the comprehensive measures constitute a significant fraction of overall building use, billing analysis can typically be used to compare predicted use to actual savings.

3.3 Process and Impact Evaluation Report

The evaluation consultant will issue a final report to the utility summarizing the results from the process and impact evaluations and describing any recommendations that come from the evaluations. These recommendations will assist the Riverside Public Utilities in meeting the requirements with the AB2021 requirements.

4 ESTIMATED BUDGET

The budget to complete an impact evaluation that includes a telephone survey and on-site verification assessment of Tree Power participants and on-site evaluation of nine non-residential program participants includes consultant staff time to:

- Talk with RPU staff, gather all relevant project materials and review of those materials;
- Residential telephone survey;
- Residential drive-by verification survey;
- Non-residential on-site verification visits and in some cases short-term metering efforts;
- Development of the residential and non-residential measure realization rates;
- Development of the residential Shade Tree net-to-gross factor; and
- Creating a final DSM impact evaluation report.

Based on our experience with doing similar studies for a number of POUs in California, our estimate for a budget is $49,740. Table 7 provides detail for this budget.

Table 7: Riverside Impact Evaluation Proposed Budget

	Project		Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	-	
Personnel	**Function**	**Rate**	**Finalize Residential Tree Power Survey and Draw Sample**	**Conduct Residential Tree Power Survey and Perform Analysis of Results**	**Identify Non-Residential Evaluation Sample**	**Non-Residential On-Site Visits**	**Calculate Non-Residential Impacts**	**EM&V Report**	**Total Hours**	**Total**
Kevin Cooney	Principal	$240	0	0	0	0	0	2	2	$480
Gary Cullen	Project Manager	$175	4	8	4	0	8	32	56	$9,800
Deborah Swarts	Engineer	$150	0	0	4	16	40	16	76	$11,400
Jackie Goss	Engineer	$100	0	0	0	16	40	16	72	$7,200
Wayne Leonard	Engineer	$100	0	0	0	16	40	16	72	$7,200
Michelle Lewis	Analyst	$90	0	40	0	0	0	16	56	$5,040
Lakin Garth	Analyst	$90	4	40	0	0	0	16	60	$5,400
Administrative Staff	Admin	$65	0	4	0	0	0	4	8	$520
			8	92	8	48	128	118	402	$47,040
Other Direct Costs										
	Travel			$1,200		$1,200			-	$2,400
	Equipment					$300				$300
	Total Labor		$1,060	$8,860	$1,300	$5,600	$15,400	$14,820	-	$47,040
Total Cost by Task			**$1,060**	**$10,060**	**$1,300**	**$7,100**	**$15,400**	**$14,820**	**-**	**$49,740**