Measurement & Verification Load Impact Study for NCPA SB5X Miscellaneous Rebate Programs

Study ID: NCP0001.10

FINAL REPORT

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TABLE OF CONTENTS

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1. Executive Summary

This study was conducted at the request of Northern California Power Agency (NCPA) and the California Energy Commission (CEC). The study was managed by NCPA. It was funded by Senate Bill 5X (SB5X) and is available online at www.calmac.org. This report provides Measurement and Verification (M&V) load impact study results for the NCPA SB5X Miscellaneous Rebate Programs implemented by Lodi, Lompoc, Modesto Irrigation District (MID), Roseville Electric, Turlock Irrigation District (TID), and Santa Clara (Silicon Valley Power). The programs realized peak kW and kWh savings by paying incentives to customers for installing high efficiency miscellaneous measures. The programs provided 1,726 incentives for 68,698 measures from 2001 through 2003 with $246,519 SB5X funds administered by NCPA.[1]

Ex ante program savings are summarized in **Table 1.1**, and ex post savings are summarized in **Table 1.2**. The ex ante program savings were 921,903 kWh/yr and 427 kW. The M&V gross ex post program savings are 454,806 ± 24,239 kWh/yr and 240 ± 29 kW at the 90 percent confidence level. The net ex post program savings are 387,196 ± 19,339 kWh per year and 182 ± 20 kW at the 90 percent confidence level. The net ex post lifecycle savings are 5,064,053 ± 290,760 kWh. The average effective useful lifetime for all miscellaneous measures is 13.08 years.

Table 1.1 Ex Ante Savings for NCPA SB5X Miscellaneous Programs

NCPA Utility	Rebates	Qty.	Ex Ante Savings kWh/yr	Ex Ante Savings kW	Ex Ante Net-to-Gross Ratio kWh/y	Ex Ante Net-to-Gross Ratio kW	Ex Ante Savings kWh/y	Ex Ante Savings kW
Roseville - Vender Misers	56	115	212,900	19.3	1	1	212,900	19.3
MID – Res ESW	310	44872	98,718	179.5	1	1	98,718	179.5
MID - Comm SS	19	16243	51,978	65.0	1	1	51,978	65.0
MID – Res SS	99	5881	12,938	23.5	1	1	12,938	23.5
MID – Res WHF	23	24	6,600	12.0	1	1	6,600	12.0
MID – Refrig.	704	704	371,893	80.4	1	1	371,893	80.4
Lompoc - Kits	500	500	36,850	13.0	1	1	36,850	13.0
Lompoc - WB Pad	1	1	900	0.3	1	1	900	0.3
Lodi – Win. Film	9	9	900	0.6	1	1	900	0.6
TID – Win. Film	1	34	5,376	5.6	1	1	5,376	5.6
SVP-Plug Sensors	2	315	122,850	28.05	1	1	122,850	28.1
Total	**1,726**	**68,698**	**921,903**	**427**	**1.00**	**1.00**	**921,903**	**427**

Ex post kWh savings are based on billing data analyses, sub-metered data, engineering analyses, and previously published M&V studies. The net-to-gross ratio is calculated based on decision maker surveys regarding whether or not the unit would have been installed without rebates from the programs. The average net-to-gross ratio is 85 percent indicating approximately 15 percent of measures would have been purchased anyway without the program.[3] The net realization rates are

[1] MID, TID, and Lodi reported 441 rebates for approximately 67,000 ft^2 of window film.

[3] The net-to-gross ratios reflect what customers would have done in the absence of the program (see Section 3).

0.42 for kWh and kW savings. The M&V savings and realization rates are lower than anticipated due to missing measures and lower baselines, lower savings, and lower net-to-gross ratios.

Table 1.2 M&V Ex Post Savings for NCPA SB5X Miscellaneous Programs

NCPA Utility	Qty.	M&V Gross Ex Post Savings kWh/y	M&V Gross Ex Post Savings kW	Net-to-Gross Ratio kWh/y	Net-to-Gross Ratio kW	M&V Net Ex Post Savings kWh/y	M&V Net Ex Post Savings kW	Net Realization Rate kWh/y	Net Realization Rate kW
Roseville - Vender Misers	115	178,710	11.5	0.96	0.96	171,562	11.0	0.81	0.57
MID – Res ESW	44872	98,718	134.6	0.65	0.65	64,167	87.5	0.65	0.49
MID – Comm SS	16243	43,856	24.4	0.96	0.96	42,102	23.4	0.81	0.36
MID – Res SS	5881	9,410	4.1	0.48	0.48	4,517	2.0	0.35	0.08
MID – Res WHF	24	4,872	4.8	0.66	0.66	3,216	3.2	0.49	0.26
MID – Refrig.	704	46,464	9.9	0.80	0.80	37,171	7.9	0.10	0.10
Lompoc – Kits	500	33,500	11.5	0.80	0.80	26,800	9.2	0.73	0.71
Lompoc – WB Pad	1	270	0.1	0.80	0.80	216	0.1	0.24	0.24
Lodi – Win. Film	9	635	0.2	0.96	0.96	610	0.2	0.68	0.36
TID – Win. Film	34	4,516	2.1	0.96	0.96	4,335	2.0	0.81	0.36
SVP-Plug Sensors	85	33,856	36.6	0.96	0.96	32,501	35.1	0.26	1.25
Total	**68,468**	**454,806**	**239.8**	**0.85**	**0.76**	**387,196**	**181.6**	**0.42**	**0.42**
Roseville - Vender Misers	115	178,710	11.5	0.96	0.96	171,562	11.0	0.81	0.57

The M&V study provides average gross savings per unit and net-to-gross ratios. The gross savings are based on billing analyses, engineering analyses, and previous studies. Participant telephone surveys were used to evaluate program performance criteria and net-to-gross ratios.

Section 2 presents the M&V approach and results, field measurement methodology, and M&V findings. **Section 3** presents participant survey results and the methodology used to develop net-to-gross ratios for kWh and kW savings. **Section 4** presents the M&V methodology used for the sample design, statistical analysis, database, baseline, and program evaluation savings estimates. **Appendix A** provides the Decision-Maker Survey.

2. M&V Approach and Results for Miscellaneous

The measurement and verification approach for the study was based on the *International Performance Measurement & Verification Protocols* (IPMVP) defined **Table 2.1**.[4] Ex post energy and peak demand savings were determined using IPMVP Option A (i.e., partially measured retrofit isolation), Option B (i.e., retrofit isolation), and Option C (whole facility billing regression analysis). Billing data, PRISM, sub-metered data, engineering analyses, and previously published M&V studies were used to develop baseline energy use and gross energy and peak demand savings.

Table 2.1 IPMVP M&V Options

M&V Option	How Savings are Calculated	Typical Applications
Option A. Partially Measured Retrofit Isolation Savings are determined by partial field measurement of energy use of system(s) to which a measure was applied, separate from facility energy use. Measurements may be either short-term or continuous. Partial measurement means that some but not all parameters may be stipulated, if total impact of possible stipulation errors is not significant to resultant savings. Careful review of measure design and installation will ensure that stipulated values fairly represent the probable actual value.	Engineering calculations using short term or continuous post-retrofit measurements or stipulations.	Pre- and post-retrofit values are measured with a kW meter and operating hours are based on interviews with occupants or stipulated values.
Option B. Retrofit Isolation Savings are determined by field measurement of the energy use of the systems to which the measure was applied; separate from the energy use of the rest of the facility. Short-term or continuous measurements are taken throughout the post-retrofit period.	Engineering calculations using short term or continuous measurements	Electricity use is measured with kW meters. Hours of operation are measured with motor loggers.
Option C. Whole Facility Savings are determined by measuring energy use (and production) at the whole facility level. Short-term or continuous measurements are taken throughout the post-retrofit period. Continuous measurements are based on whole-facility billing data.	Analysis of whole facility utility meter or sub-meter data using techniques from simple comparison to regression analysis or conditional demand analysis.	Energy management program affecting many systems in a building. Utility meters measure energy use for 12-month base year and throughout post-retrofit period.
Option D. Calibrated Simulation Savings are determined through simulation of the energy use of components or the whole facility. Simulation routines must be demonstrated to adequately model actual energy performance measured in the facility. This option usually requires considerable skill in calibrated simulation.	Energy use simulation, calibrated with hourly or monthly utility billing data and/or end-use metering.	Project affecting systems in a building but where pre or post year data are unavailable. Utility billing meters measure pre- or post-retrofit energy use. Savings are determined by simulation using a model calibrated with utility billing data.

[4] See *International Performance Measurement & Verification Protocols*, DOE/GO-102000-1132, October 2000.

2.1 M&V Findings

M&V findings and load impacts are provided for vending misers, Energy Star windows, solar sun screens, whole house fans, conservation kits, water heater mattress pads, solar window film, and plug load sensors.

2.1.1 Findings for Vending Misers

The vending miser measures accounted for 23.1 percent of total ex ante kWh savings and savings and 4.5 percent of total ex ante kW savings for the SB5X Miscellaneous Programs. Vending misers reduce energy use in vending machines by using a passive infrared sensor to power down a vending machine when the area surrounding it is unoccupied and automatically re-powers the machine when the area is reoccupied. The vending miser controller uses fuzzy logic to learn from the habits of the building occupants, and modifies the time-out period accordingly. An optional Sensor Repeater allows the control of a bank of vending machines with a single sensor, minimizing installation time and visual impact. Additionally, vending misers monitor the ambient temperature while the vending machine is powered down. Using this information, vending misers automatically power up the vending machine at appropriate intervals, independent of occupancy, to ensure that the vended product stays cold. Vending misers also monitor electrical current used by the vending machine. This ensures that vending misers will never power down a vending machine while the compressor is running, so a high head pressure start never occurs. In addition, the current sensor also ensures that every time the vending machine is powered up, the cooling cycle is run to completion before again powering down the vending machine.

Load impacts for vending misers are based on a study from the University of Illinois at Urbana-Champaign showing average savings of 1,554 ± 88 kWh/year and 0.1 ± 0.01 kW for vending misers.[5] The ex ante savings per vending miser were 1,600 kWh/year and 0.1 kW. The gross ex post savings per measure are 1,544 ± 88 kWh/yr and 0.1 ± 0.01 kW. The Roseville Electric database reported incentives for 115 vending misers at 58 sites. The vender miser program ex ante savings are 212,900 kWh/year and 19.29 kW. The ex post savings are 178,710 ± 10.186 kWh/yr and 11.5 ± 0.7 kW. An evaluation study by Foster-Miller, Inc., found an effective useful lifetime for the vending miser of 13 years.[6] Based on findings from Foster-Miller a 13 year EUL is used for this study.

[5] Luo, J. 2003. Express Efficiency 2004-05 Workbook. 2-MeasureableEEActivities, Vending Machine Controller, San Francisco, Calif: Pacific Gas and Electric Company (PG&E). Taguchi, H., Jeong Lee, H., Pansare, P., Gentry, T. 2002. *The Vending Miser: A Pilot Study of Its Use at the University of Illinois at Urbana-Champaign.* Urbana-Champaign, Ill.: University of Illinois. The Illinois study had the most conservative savings of 39 studies.
[6] Foster-Miller, Inc. 2000. *Vending Machine Engineering Evaluation and Test Report*. Waltham, MA.: Foster-Miller, Inc.

2.1.2 Findings for Residential Energy Star Windows

The Energy Star window measures accounted for 10.7 percent of total ex ante kWh savings and savings and 42 percent of total ex ante kW savings for the SB5X Miscellaneous Programs. Billing data were collected from 12 sites in MID. These data were used as inputs for the PRInceton Scorekeeping Method (PRISM) to develop pre- and post-retrofit Normalized Annual Consumption (NAC) kWh values and energy savings as shown in **Table 2.2**.[7] Peak kW savings are based on the peak demand-to-energy ratio times the estimated kWh savings using the following equation.[8]

Eq. 1 $$\text{kW Savings}_{unit} = \frac{0.001172\ \text{kW}}{\text{kWh}} \times \text{kWh Savings}_{\text{unit}}$$

Where,

$PDER_i$ = Peak demand-to-energy ratio is 0.001172 kW/kWh.

The ex ante savings per square foot of residential Energy Star windows were 2.2 kWh/yr-ft^2 and 0.004 kW/ft^2. The ex post savings per square foot are 2.2 ± 0.4 kWh/yr-ft^2 and 0.003 ± 0.0006 kW/ft^2. The *2001 DEER Update Study* provides average unit savings per square foot of 2 ± 0.12 kWh/yr-ft^2 and 0.002 ± 0.0001 kW/ft^2.[9] The MID tracking database reported 44,872 square feet of Energy Star windows. The MID Energy Star Window program ex ante savings are 98,718 kWh/year and 179 kW. The ex post savings are 98,718 ± 19,744 kWh/yr and 134.6 ± 26.9 kW. The net to gross ratio is 0.65 and the effective useful lifetime (EUL) is 20 years.[10]

Table 2.2 MID Baseline Cooling and M&V Savings for Residential Energy Star Windows

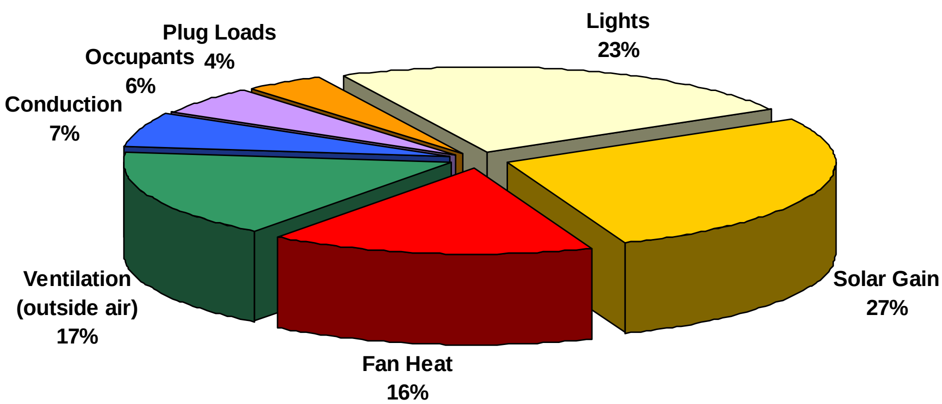
Site	Pre-Retrofit NAC (kWh/yr)	Post-Retrofit NAC (kWh/yr)	Affected Window Area ft^2	Ex Ante Savings kWh/yr	Ex Ante Savings kW	M&V Savings kWh/yr	M&V Savings kW	IPMVP Option
1	7,224	6,473	71	156	0.284	751	0.880	C
2	3,040	2,738	169	372	0.676	301	0.353	C
3	4,848	4,535	45	99	0.180	313	0.367	C
4	8,963	9,159	150	330	0.600	-196	-0.230	C
5	12,975	13,574	145	319	0.580	-599	-0.702	C
6	5,436	6,033	101	222	0.404	-597	-0.700	C
7	9,903	10,178	24	53	0.096	-275	-0.322	C
8	12,203	10,741	190	418	0.760	1,462	1.714	C
9	5,452	3,525	205	451	0.820	1,928	2.260	C
10	6,880	6,908	403	887	1.612	-28	-0.033	C
11	13,977	13,864	184	405	0.736	114	0.133	C
12	9,086	8,119	178	392	0.712	968	1.134	C
Average	**8,332**	**7,987**	**155**	**342**	**0.622**	**345**	**0.404**	
Ave/ft^2				**2.2**	**0.004**	**2.2**	**0.003**	

[7] Fels, M., Kissock, K., Marean, M., Reynolds, C. 1995. *PRISM Advanced Version 1.0 User's Guide*. Princeton, New Jersey. Princeton University, Center for Energy and Environmental Studies.
[8] SCE Energy-Efficiency Potential Study, prepared by XENERGY, Inc., Oakland, CA, prepared for Southern California Edison Company, 1992.
[9] Energy and peak demand savings are based on the 2001 DEER Update Study, page 6-54, Double-pane medium low-E coating windows, prepared by XENERGY, Inc., prepared for the CEC, Contract 300-99-008, August 2001.
[10] The net-to-gross ratio and effective useful lifetime (EUL) are taken from the *Energy Efficiency Policy Manual*, Chapter 4, page 22, prepared by the California Public Utilities Commission, 2001.

2.1.3 Findings for Commercial Solar Sun Screens

The commercial solar sun screen measures accounted for 5.6 percent of total ex ante kWh savings and savings and 15.2 percent of total ex ante kW savings for the SB5X Miscellaneous Programs. The ex ante unit savings per square foot for commercial solar sunscreens were 3.2 kWh/yr-ft^2 and 0.004 kW/ft^2. Average commercial building loads for a typical office building in California are shown on **Figure 2.1**. Solar heat gains represent the largest building load at 27%.

Figure 2.1 Air Conditioning Loads in Commercial Buildings



The program maximum solar heat gain coefficient (SHGC) was 0.35 for sunscreens (see **Table 2.3**). Solar sunscreens can reduce solar heat transmission by 51.6% and save approximately 13.9% on cooling (i.e., 0.516 x 0.27 = 0.139). The engineering estimate of ex post energy savings for reflective window film are 13.9 ± 2.6% or 2.7 ± 0.5 kWh/yr-ft^2 (i.e., 0.139 x [EUI of 3.95 kWh/yr-ft^2] ÷ [20% window-to-floor area ratio] = 2.7 kWh/yr-ft^2). The engineering estimate of ex post kW savings are 0.0015 ± 0.0003 kW/ft^2 assuming 13.9 ± 2.6% savings, coincident demand factor of 0.85, and baseline of 1.3 kW/ton (i.e., 0.139 x 0.85 x 1.3 kW/ton ÷ [20% window-to-floor area ratio x 500 ft^2/ton]= 0.0015 kW/ft^2). The MID tracking database reported 16,243 square feet of solar sunscreens. The ex ante cooling savings for commercial sunscreens were 51,978 kWh per year and 65 kW. The ex post savings are 43,856 ± 8,122 kWh/yr and 24.4 ± 4.7 kW. The M&V gross realization rate is 0.84 ± 0.16 for kWh and 0.38 ± 0.07 for kW. The net to gross ratio is 0.96 and the effective useful lifetime is 10 years.[11]

Table 2.3 Solar Sunscreen Performance

Glass Type	Visible Light Transmission (%)	Solar Heat Transmission (%)	Solar Heat Gain Coefficient
Clear ¼ inch	89	83	0.84
Clear ¼ inch with Solar Sunscreens	61	40	0.35

[11] Ibid.

2.1.4 Findings for Residential Solar Sun Screens

The residential solar sun screen program measures accounted for 1.4 percent of the ex ante kWh savings and savings and 5.5 percent of the ex ante kW savings for the SB5X Miscellaneous Programs. Billing data were collected from 10 sites in MID. PRISM was used to develop pre- and post-retrofit NAC kWh values and energy savings (see **Table 2.4**). Peak kW savings are based on peak demand-to-energy ratio times the estimated kWh savings using the **Equation 1**.

The ex ante savings per square foot of residential sun screens were 2.2 kWh/yr-ft^2 and 0.004 kW/ft^2. The ex post savings per square foot are 1.6 ± 0.19 kWh/yr-ft^2 and 0.0007 ± 0.000145 kW/ft^2. The *2001 DEER Update Study* provides average unit savings per square foot of 1.7 ± 0.19 kWh/yr-ft^2 and 0.001 ± 0.0001 kW/ft^2.[12] The MID tracking database reported 5,881 square feet of residential sun screens. The MID Energy Residential Sun Screens program ex ante savings are 12,938 kWh/year and 23.5 kW. The ex post savings are 9,410 ± 1,117 kWh/yr and 4.1 ± 0.85 kW. The net to gross ratio is 0.48 and the effective useful lifetime is 10 years.[13]

Table 2.4 MID Baseline Cooling and M&V Savings for Residential Sun Screens

Site	Pre-Retrofit NAC (kWh/yr)	Post-Retrofit NAC (kWh/yr)	Affected Window Area ft^2	Ex Ante Savings kWh/yr	Ex Ante Savings kW	M&V Savings kWh/yr	M&V Savings kW	IPMVP Option
1	6,123	6,073	30	66	0.12	50	0.06	C
2	8,536	8,492	33	73	0.13	44	0.05	C
3	12,622	12,141	576	1,267	2.30	481	0.56	C
4	4,809	4,757	71	156	0.28	52	0.06	C
5	9,946	9,783	99	218	0.40	163	0.19	C
6	23,076	21,964	240	528	0.96	1,112	1.30	C
7	6,197	6,156	26	57	0.10	41	0.05	C
8	4,598	4,537	56	123	0.22	61	0.07	C
9	14,604	14,494	129	284	0.52	110	0.13	C
10	14,142	13,952	152	334	0.61	190	0.22	C
Average	**10,465**	**10,235**	**141**	**311**	**0.56**	**230**	**0.30**	
Ave/ft^2				**2.2**	**0.004**	**1.6**	**0.0007**	
90% CI						**0.1899**	**0.000145**	

2.1.5 Findings for Residential Whole House Fans (WHF)

The residential whole house fan measures accounted for 0.7 percent of total ex ante kWh savings and savings and 2.8 percent of total ex ante kW savings for the SB5X Miscellaneous Programs. Billing data were collected from 18 sites in MID. These data were used as inputs for PRISM to develop base cooling values. The cooling savings are based on the average percentage savings of 10.2 ± 5.6 percent from the 2001 DEER Update Study.[14] Baseline cooling and savings values for MID are summarized in **Table 2.5**. The unit ex ante savings per WHF were 275 kWh/yr and 0.5

[12] Energy and peak demand savings are based on the 2001 DEER Update Study, page 6-54, Double-pane medium low-E coating windows, prepared by XENERGY, Inc., prepared for the CEC, Contract 300-99-008, August 2001.
[13] The net-to-gross ratio and EUL are taken from the *Energy Efficiency Policy Manual*, Chapter 4, page 21-23, prepared by the California Public Utilities Commission, 2001.
[14] Energy and peak demand savings are based on the 2001 DEER Update Study, page 6-45, Whole House Fan, prepared by XENERGY, Inc., prepared for the California Energy Commission, Contract 300-99-008, August 2001.

kW. The ex post savings are 203 ± 65 kWh per year and 0.02 ± 0.006 kW. The MID tracking database reported 24 whole house fans. The ex ante cooling savings for whole house fans were 6,600 kWh per year and 12 kW. The ex post savings are 4,878 ± 1,554 kWh/yr and 0.45 ± 0.14 kW. The net to gross ratio is 0.66 and the effective useful lifetime is 15 years.[15]

Table 2.5 MID Baseline Cooling and M&V Savings for Whole House Fans

Site #	Pre-retrofit NACC (kWh/yr)	Ex Ante Savings kWh/yr	Ex Ante Savings kW	M&V Savings kWh/yr	M&V Savings kW	IPMVP Option
1	2,029	275	0.5	208	0.02	A, C
2	197	275	0.5	20	0.00	A, C
3	2,040	275	0.5	209	0.02	A, C
4	3,207	275	0.5	329	0.03	A, C
5	303	275	0.5	31	0.00	A, C
6	4,261	275	0.5	437	0.04	A, C
7	822	275	0.5	84	0.01	A, C
8	326	275	0.5	33	0.00	A, C
9	1,159	275	0.5	119	0.01	A, C
10	424	275	0.5	43	0.00	A, C
11	2,834	275	0.5	290	0.03	A, C
12	3,446	275	0.5	353	0.03	A, C
13	1,093	275	0.5	112	0.01	A, C
14	3,293	275	0.5	337	0.03	A, C
15	6,033	275	0.5	618	0.06	A, C
16	1,382	275	0.5	142	0.01	A, C
17	1,402	275	0.5	144	0.01	A, C
18	1,454	275	0.5	149	0.01	A, C
Average	**1,984**	**275**	**0.5**	**203**	**0.02**	
90% CI	**632**			**65**	**0.006**	

2.1.6 Findings for Energy Star Refrigerators

The MID Energy Star refrigerator rebate program accounted for 40.3 percent of total ex ante kWh savings and savings and 18.8 percent of total ex ante kW savings for the SB5X Miscellaneous Programs. Annual energy savings for Energy Star refrigerators are based on the *Qualifying List of Energy Star Refrigerators and NAECA Standards for Refrigerators* from 4.9 to 38.9 cubic feet. The Energy Star database included 355 new refrigerators and the annual energy consumption for each product was provided along with the corresponding NAECA standard product for each size and type (i.e., top-freezer, bottom-freezer, and side-by-side).[16] The peak demand savings are based on data logger measurements of Energy Star and NAECA standard units. The average measured refrigerator load factor was 0.000214 ± 0.00000414 kW/kWh. The average ex ante savings per Energy Star refrigerator were 528.3 ± 44.5 kWh/year and 0.11 ± 0.01 kW. The gross ex post savings per refrigerator were 66 ± 1.3 kWh/year and 0.014 ± 0.0003 kW. The MID database reported incentives for 704 Energy Star refrigerators. The MID refrigerator rebate program ex ante savings were 371,893 kWh/year and 80.4 kW. The ex post savings are 46,464 ± 899 kWh/yr and 9.9 ± 0.19 kW. The net to gross ratio is 0.80 and the effective useful lifetime is 12 years.[17] The ex post savings for MID are considerably lower than the ex ante savings. This is because MID assumed some old units were recycled and removed from the

[15] Ibid.
[16] Available online: http://www.energystar.gov/index.cfm?c=refrig.pr_refrigerators).
[17] Ibid.

secondary refrigerator market based on customer self reporting. The actual recycling of old units could not be verified. Therefore, no credit was give for recycled units. For future programs, we recommend smaller rebates for Energy Star refrigerators of $25 per unit, and recycling old units by a third-party contractor in order to receive credit for energy and peak demand savings from documented recycling of each unit including refrigerant, foam, plastic, metals, and other components.

2.1.7 Findings for Residential Conservation Kits

The residential conservation kits accounted for 4 percent of total ex ante kWh savings and savings and 3 percent of total ex ante kW savings for the SB5X Miscellaneous Programs. The kits included the following nine measures: 1) Refrigerator Thermometer; 2) Outlet Safety Cap; 3) Faucet Repair Kit; 4) V-type Weather Stripping; 5) Tub of Caulking; 6) LimeLite Night Light; 7) 22W CFL; 8) Garden Hose Nozzel with Positive Shut-off; and 9) Conservation Booklet. The unit ex ante savings per kit were 73.7 kWh/yr and 0.26 kW. The ex post unit savings are 67 ± 7.9 kWh/yr and 0.023 ± 0.0016 kW based on savings for only the 22W CFL lamps taken from the Measurement & Verification Report for NCPA SB5X Residential Compact Fluorescent Lamp Programs. The Lompoc database reported 500 conservation kits. The ex ante savings for 500 kits were 36,850 kWh per year and 13 kW. The ex post savings are 33,500 ± 3,946 kWh/yr and 11.5 ± 0.8 kW. The net to gross ratio is 0.80 and the effective useful lifetime is 8 years.[18]

2.1.8 Findings for Water Bed Mattress Pad

The Lompoc water bed mattress pad measures accounted for 0.1 percent of total ex ante kWh savings and savings and 0.1 percent of total ex ante kW savings for the SB5X Miscellaneous Programs. The ex ante savings were 900 kWh/yr and 0.3 kW. According to Home Energy Magazine, average energy consumption for a water bed is 900 kWh/yr and savings for mattress pads or insulating comforters are 30 percent.[19] Therefore, the ex post savings for the mattress pad are approximately 270 kWh/yr and 0.09 kW. The net to gross ratio is 0.80 and the effective useful lifetime is 5 years.[20]

2.1.9 Findings for Commercial Window Film

The Lodi and TID commercial window film rebate programs accounted for 0.7 percent of total ex ante kWh savings and savings and 1.3 percent of total ex ante kW savings for the SB5X Miscellaneous Programs. Average commercial building loads for a typical office building in California are shown on **Figure 2.1**. The assumed solar heat gain coefficient (SHGC) for window film is 0.45 (see **Table 2.6**). High performance window film can reduce solar heat transmission by 45.7% and save approximately 12.3% on cooling. The engineering estimate of ex post energy savings for reflective window film are 12.3% ± 2.3% or 2.4 ± 0.45 kWh/yr-ft^2 (i.e., 0.123 x [EUI of 3.95 kWh/yr-ft^2] ÷ [20% window-to-floor area ratio] = 2.8 kWh/yr-ft^2). The

[18] Ibid.
[19] Trends in Energy, Miscellaneous Water Under the Energy Bridge, Home Energy Magazine Online Mar/Apr 1999, http://homeenergy.org/archive/hem.dis.anl.gov/eehem/99/990304.html.
[20] Ibid.

engineering estimate of ex post kW savings are 0.0014 ± 0.00026 kW/ft^2 assuming 12.3% savings, coincident demand factor of 0.85, and baseline of 1.3 kW/ton (i.e., 0.123 x 0.85 x 1.3 kW/ton ÷ [20% window-to-floor area ratio x 500 ft^2/ton]= 0.0014 kW/ft^2).

The Lodi and TID tracking databases did not report square feet of reflective window film, nor did they provide ex ante savings on per square foot basis. Therefore, the savings for these programs will be based on the M&V gross realization rates for MID commercial sun screens of 0.84 ± 0.16 for kWh and 0.38 ± 0.07 for kW. The ex ante savings for 10 sites were 6,276 kWh per year and 6.22 kW. The ex post savings are 5,272 ± 824 kWh/yr and 2.36 ± 0.17 kW. The net to gross ratio is 0.96 and the effective useful lifetime is 10 years.[21]

Table 2.6 Reflective Window Film Performance

Glass Type	Visible Light Transmission (%)	Solar Heat Transmission (%)	Solar Heat Gain Coefficient
Clear ¼ inch	89	83	0.84
Clear ¼ inch with Solar Window Film	70	45	0.40

2.1.10 Findings for Commercial Plug Load Sensors

The commercial plug load sensors accounted for 13.3 percent of total ex ante kWh savings and savings and 6.6 percent of total ex ante kW savings for the SB5X Miscellaneous Programs. Silicon Valley Power provided incentives for 85 units at site #1 and 230 units at site #2 for a total of 315 units. M&V findings for the commercial plug load motion sensors are based on field verification of installed units and field measurements from ten (10) units installed in cubicles at a large high-technology office building located in Santa Clara, California. Measurements were made from February 7 through February 26, 2002. Pacific Science and Technology (PS&T) data loggers were used to obtain measurements of true RMS kilowatts (kW) and kilowatt-hours (kWh). M&V results for the ten cubicles are shown in **Table 2.7**. Pre- and post-retrofit field measurements for each plug load sensor are provided in **Figures 2.2** through **2.6**. The figures show a distinct reduction in energy use with sensor-controlled switched loads properly plugged into the sensors.[22] Savings are highest in cubicles where the occupant previously left their task lights on 24-hours per day (Data Logger I). Savings are lowest where occupants manually turned off their task lights and peripheral equipment prior to the plug load sensors being installed (Data Loggers J, M, O).

The ex ante unit savings were 390 kWh per year and 0.089 kW. The M&V ex post unit savings for plug load motion sensors are 398.3 ± 103 kWh per year and 0.043 kW ± 0.11 kW. The ex ante savings for 315 plug load sensors were 122,850 kWh/yr and 28.05 kW. Field verification found 85 units installed at site #1, but 230 units were not installed at site #2 and these units were not located at the site. Therefore, annual savings for 85 plug load sensors are 33,855 ± 8.729 kWh per year and 3.66 ± 0.95 kW. Plug load sensors must be installed as per manufacturer's

[21] Ibid.
[22] Pre- versus post kWh measurements are indicated by a break in the kWh data.

directions in order to achieve these savings.[23] The effective useful lifetime (EUL) of plug load motion sensors is 10 years.[24]

Table 2.7 Measured kW and kWh savings for Watt Stopper Plug Load Sensors

Plug Load Sensor	Pre kW	Pre kWh/yr	Post kW	Post kWh/yr	M&V Savings kW	M&V Savings kWh/yr
B	0.158	1,237	0.103	663	0.055	574
D	0.230	1,836	0.194	1,402	0.036	434
G	0.156	1,154	0.122	890	0.034	264
H	0.262	1,906	0.217	1,491	0.044	415
I	0.219	1,531	0.124	696	0.095	835
J	0.182	1,200	0.160	993	0.022	207
L	0.185	1,354	0.142	977	0.043	377
M	0.201	1,350	0.165	1,068	0.036	282
O	0.124	988	0.095	733	0.029	255
X	0.194	1,335	0.157	995	0.036	339
Average	**0.191**	**1,389**	**0.148**	**991**	**0.043**	**398**

Figure 2.2 Logger B and D Plug Load Motion Sensor Field Measurements

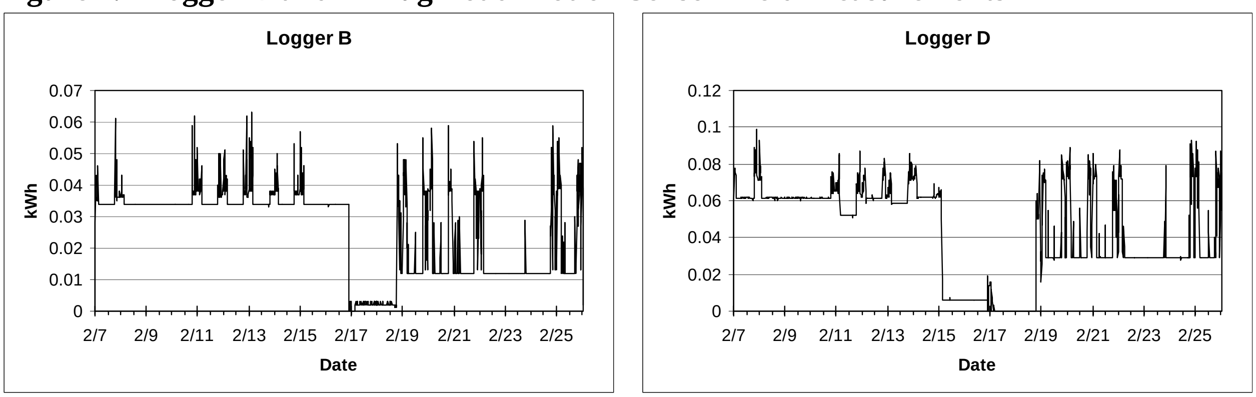
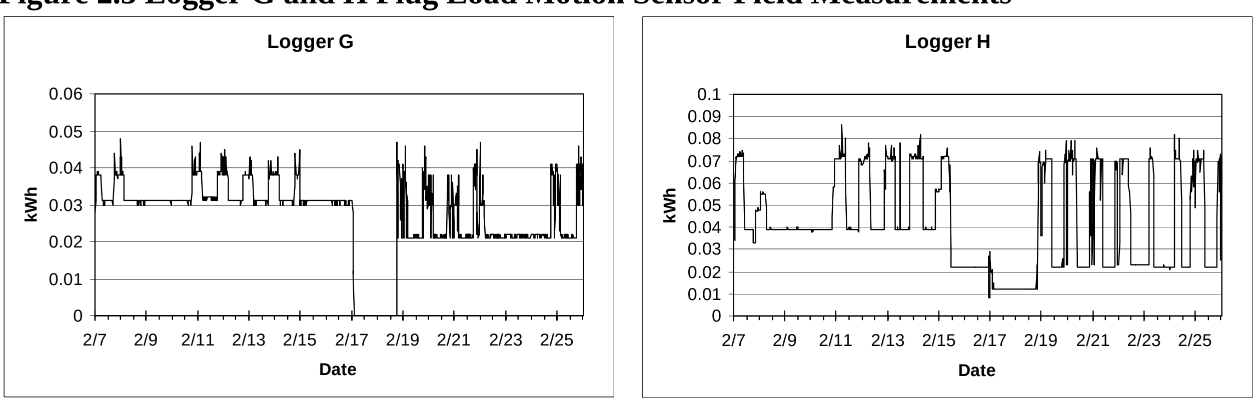


Figure 2.3 Logger G and H Plug Load Motion Sensor Field Measurements



[23] As per manufacturer's instructions, computers must be plugged into non-switching sockets and monitors, lights, and other peripheral equipment must be plugged into the sensor-controlled switching sockets.
[24] The effective useful lifetime (EUL) for plug load sensors is taken from the *Energy Efficiency Policy Manual*, Chapter 4, page 22, prepared by the California Public Utilities Commission, 2001.

Figure 2.4 Logger I and J Plug Load Motion Sensor Field Measurements

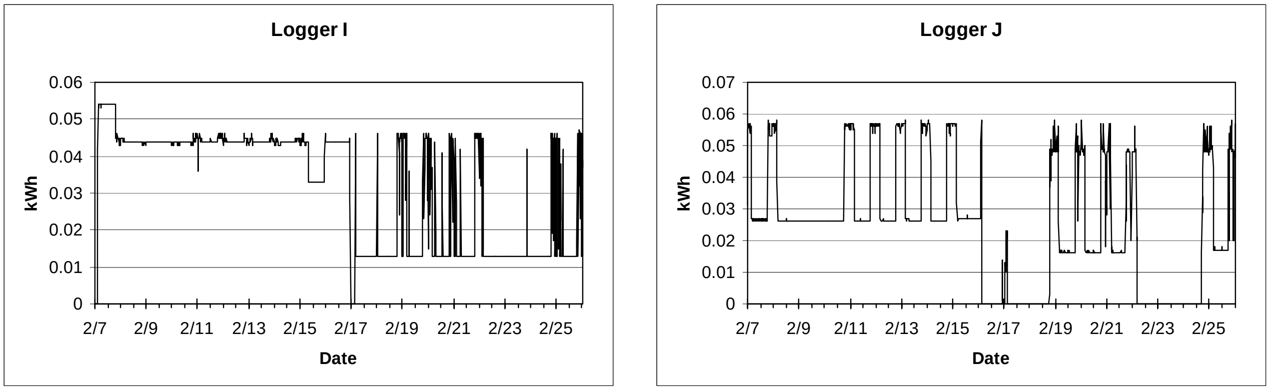


Figure 2.5 Logger L and M Plug Load Motion Sensor Field Measurements

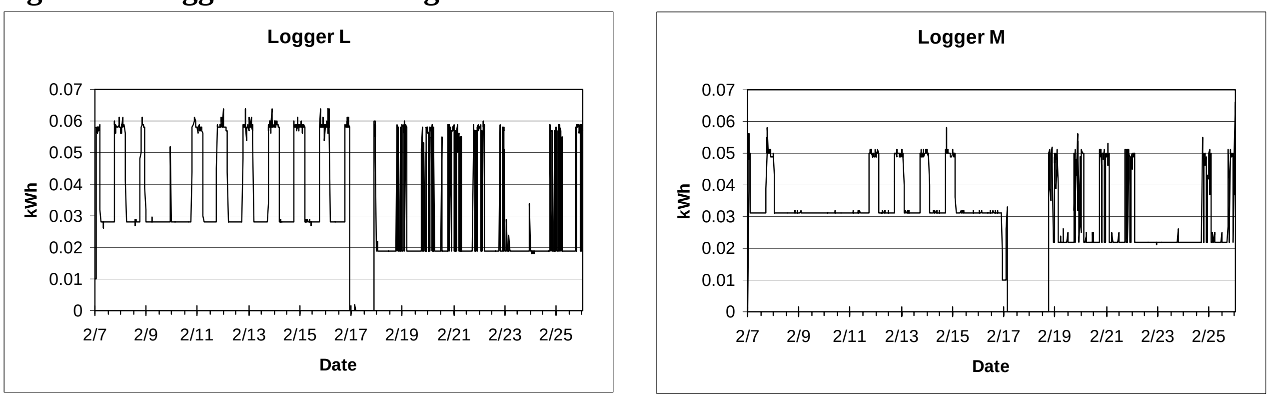
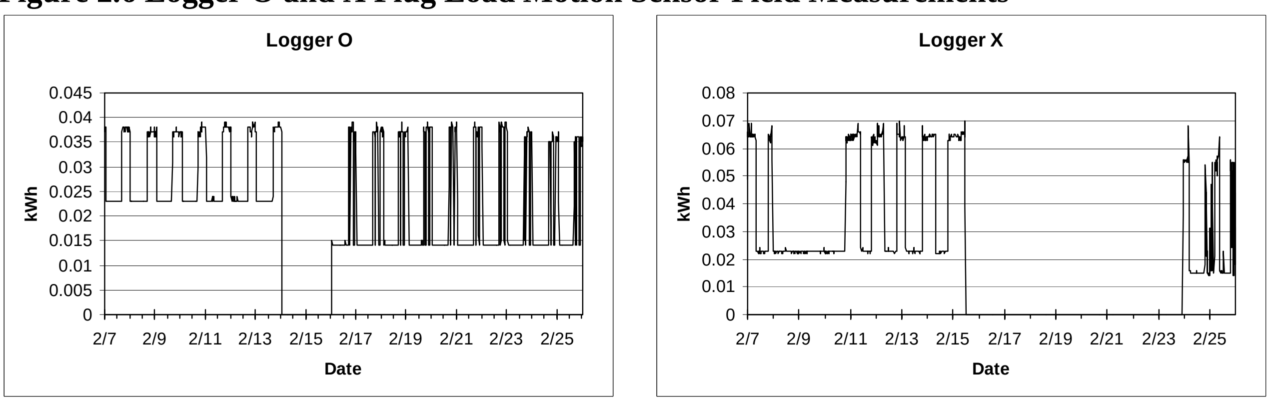


Figure 2.6 Logger O and X Plug Load Motion Sensor Field Measurements



3. Participant Survey Results

This study used participant surveys to estimate the net-to-gross ratios for kWh and peak kW savings. Participant surveys were completed for 24 participants in three NCPA utility service areas. This sample size exceeded the M&V plan of 20 sites.

3.1 Participant Survey Methodology

Participant surveys were used to develop net-to-gross ratios (NTGRs) for calculating net kW and kWh savings. The net-to-gross ratio is used to estimate the fraction of free riders who would have otherwise implemented efficiency upgrades in the absence of the program. Ten participant survey questions were used to assess net-to-gross ratios as shown in **Table 3.1**. The NTGR score for each completed participant survey is the average score based on answers to questions 2 through 10. No score was assigned to responses of “don’t know”, “refused to answer,” or “other.”

Table 3.1 Net-to-Gross Ratio Participant Survey Questions and Scoring

#	Question	Answer	Score
2	Did you understand the value of the program BEFORE or AFTER you installed the efficiency upgrades?	Before	1
		After	0
3	Did you install the lighting efficiency upgrade BEFORE or AFTER you heard about the Rebate Program?	Before	0
		After	1
4	On a scale from 0 to 10, with 0 being no influence at all and 10 being very influential, how much influence did the Utility or Rebate have on your decision to install the efficiency upgrades?	0 to 10	0=0, 10=1
5	If the rebates had not been available, how likely is it you would have done exactly the *same* thing. Please use a scale from 0 to 10, with 0 being not at all likely and 10 being very likely.	0 to 10	0=1, 10=0
6	What role did the Utility Program play in your decision to install the upgrades?	1 = Reminded	0.25
		2 = Speeded Up (i.e., early replacement)	0.5
		3 = Showed Benefits Didn’t Know Before	1
		4 = Clarified Benefits	0.75
		5 = No role	0
7	The Utility Program was nice but it was unnecessary to get the efficiency upgrades installed.	0 to 10	0=1, 10=0
8	The Utility Program was a critical factor in installing the efficiency upgrades.	0 to 10	0=0, 10=1
9	We would not have installed the efficiency upgrades without the Utility Program.	0 to 10	0=0, 10=1
10	If you had not received the [rebate or service] from the Utility, would you have installed upgrades?	Within 6 months	0
		< 1 year	0.125
		1 to 2 years	0.25
		2 to 3 years	0.5
		3 to 4 years	0.75
		4 or more years	1
		Never	1

3.2 Findings of the Participant Surveys

Findings of the participant surveys for each program are presented in **Table 3.2**. The weighted average net-to-gross ratio is 0.851 based on average participant survey results multiplied times gross ex post savings for each program divided by total gross ex post savings for all programs.[25]

[25] Participant survey results for programs with lower savings are weighted lower in terms of the total weighted average NTGR for all sites.

Programs where it was not possible to conduct participant surveys assume default values from the California Public Utilities Commission Energy Efficiency Policy Manual. [26]

Table 3.2 Findings of Participant Surveys for SB5X Miscellaneous Programs

NCPA Utility	Rebates	Completed Surveys	Gross Ex Post Program Savings kWh/yr	Gross Ex Post Program Savings kW	Weighting Factor	Actual Net-to-Gross Ratio	Weighted Net-to-Gross Ratio
Roseville - Vender Misers	115	n/a	178,710	11.5	0.393	0.96	0.377
MID - Res ESW	44872	5	98,718	134.6	0.217	0.65	0.141
MID - Comm SS	16243	n/a	43,856	24.4	0.096	0.96	0.093
MID - Res SS	5881	6	9,410	4.1	0.021	0.48	0.010
MID - Res WHF	24	5	4,872	4.8	0.011	0.66	0.007
MID – Refrig.	704	n/a	46,464	9.9	0.102	0.8	0.082
Lompoc - Kits	500	n/a	33,500	11.5	0.074	0.8	0.059
Lompoc - WB Pad	1	n/a	270	0.1	0.001	0.8	0.000
Lodi - Win. Film	9	n/a	635	0.2	0.001	0.96	0.001
TID - Win. Film	34	7	4,516	2.1	0.010	0.96	0.010
SVP-Plug Sensors	85	1	33,856	36.6	0.074	0.96	0.071
Total	**68,468**	**24**	**454,806**	**240**	**1.000**		**0.851**

4. M&V Methodology

The M&V methodology for the metering and participant survey tasks are discussed above in **Sections 2** and **3**. The M&V methodology for sample design, database tracking, baseline, and program evaluation savings estimates are discussed below.

4.1 Sample Design and Statistical Analysis

Statistical survey sampling methods were used to select a sample of customers or projects from each program population in order to evaluate load impacts.[27] Selecting participants for the sample was guided by the statistical sampling plan as well as input from NCPA utilities. Statistical analysis methods were used to analyze the data and extrapolate mean savings estimates from the sample sites to the population of all program participants and to evaluate the statistical precision of the results. Considering each NCPA utility program within a program category as a stratum, the sample mean within a program was calculated using **Equation 2**.

Eq. 2 $$\text{Mean Savings } = \bar{y}_h = \frac{1}{N_h}\sum_{k=1}^{n} y_k$$

Where,

$\bar{y}_h$ = M&V mean kW or kWh savings for stratum "h."

N_h = Number of measures or sites in stratum "h."

y_k = M&V kW or kWh savings estimate for measure "k."

[26] The NTGR factor represents the net program load impact divided by the gross program load impact. *Energy Efficiency Policy Manual*, Chapter 4, page 23, prepared by the California Public Utilities Commission, 2001.

[27] Cochran, William G. *Sampling Techniques*. New York: John Wiley & Sons, 1977, Kish, Leslie. *Survey Sampling*. New York: John Wiley & Sons, 1965. Thompson, Steven K. *Sampling*. New York: John Wiley & Sons, 1992.

The mean savings for each program category is based on the sample mean savings estimate across NCPA utility programs strata in the program category. The program category sample mean savings were calculated using **Equation 3**.

Eq. 3 Program Category Sample Mean $= \bar{y}_p = \sum_{h=1}^{L} W_h \bar{y}_h$

Where,

$\bar{y}_p =$ Program category sample mean savings estimate.

$W_h = \frac{N_h}{N_p} =$ Weighting factor across all strata.

$N_p =$ Total number of measures across all strata in program category.

The variance, s_h^2, of the sample mean for a utility program stratum within a program category was calculated using **Equation 4**.

Eq. 4 $$s_h^2 = \frac{\sum_{k=1}^{n} \left(y_k - \bar{y}_h\right)^2}{N_h - 1}$$

The coefficient of variation (Cv) provides a relative measure of the sample size required to satisfy the 90/10 criteria (or 80/20 criteria) for estimating the mean of the population. The sample Cv for the utility program stratum was calculated using **Equation 5**.

Eq. 5 Sample Coefficient of Variation $= Cv_h = \frac{s_h}{\bar{y}_h}$

Where,

$s_h = \sqrt{s_h^2}$ = Standard deviation of the sample mean savings in stratum "h."

The sample size necessary to obtain a desired level of relative precision for the utility program stratum mean savings estimate was calculated using **Equation 6**.

Eq. 6 Utility Program Stratum Sample Size $= n_h = \frac{t_o Cv_h^2}{r_h^2}$

Where,

$n_h =$ Sample size of the utility program stratum.

$r_h =$ Desired relative precision for the utility program stratum.

For small populations, the sample size was corrected using the finite population correction (FPC) equation as follows.[28]

[28] Cochran, William G. *Sampling Techniques*. New York: John Wiley & Sons, 1977, Kish, Leslie. *Survey Sampling*. New York: John Wiley & Sons, 1965. Thompson, Steven K. *Sampling*. New York: John Wiley & Sons, 1992.

Eq. 7 FPC Sample Size = $n_{FPC\,h} = \dfrac{n_h}{1+(n_h - 1)/N_h}$

Where,

$n_{FPC\,h}$ = Sample size for stratum with finite population correction.

The utility program stratum error bound of $\bar{y}_h$ as an estimator of the mean value at the 90% level of confidence was calculated using **Equation 8**.

Eq. 8 Stratum Error Bound $= Eb(\bar{y}_h) = t_o \dfrac{s_h}{\sqrt{n_h}}$

Where,

t_o = 1.645 at 90 percent level of confidence (1.28 at 80 percent confidence).

n_h = Number of units in sample in stratum h.

An unbiased estimate of the program category variance was calculated using **Equation 9**.

Eq. 9 $s_p^2 = \sum_{h=1}^{L} \dfrac{W_h^2 s_h^2}{n_h} - \sum_{h=1}^{L} \dfrac{W_h s_h^2}{N_p}$

Where,

s_p^2 = Variance of the program category mean savings estimate, $\bar{y}_p$.

The Cv for the program category was calculated using **Equation 10**.

Eq. 10 Program Category Coefficient of Variation = $Cv_p = \dfrac{s_p}{\bar{y}_p}$

Where,

s_p = $\sqrt{s_p^2}$ = Standard deviation of the mean savings in the program category.

Statistical analysis was used to extrapolate M&V ex post kW and kWh savings at the sample level for a utility program (stratum) to the program category level and finally for the NCPA SB5X portfolio. This step included an assessment of the error bounds and relative precision of program-level kW and kWh savings as discussed above. The program category savings estimate was calculated as the sum of the number of measures for the utility program stratum times the M&V ex post sample mean savings estimate as shown in **Equation 11**.

Eq. 11 $\hat{Y}_p$ = M&V Gross Ex Post Program Category Savings $= \sum_{h=1}^{L} \left[\hat{X}_h \times AGRR_h\right]$

Where,

$\hat{Y}_p$ = M&V gross ex post program category savings (kW or kWh).

$\hat{X}_h$ = Ex ante program stratum “h” savings (kW or kWh).

$AGRR_h$ = M&V average gross realization rate for program stratum “h.” Defined as the sum of M&V savings for measures or sites in the random sample divided by ex ante savings for measures or sites in the random sample (kW or kWh).

The M&V Average Gross Realization Rates (AGRR) for kW and kWh savings were calculated using **Equation 12**.

Eq. 12 $$AGRR_h = \frac{\hat{Y}_h}{\hat{X}_h}$$

Where,

$AGRR_h$ = Average Gross Realization Rate for kW or kWh savings defined as the sum of M&V kW savings for measures in program stratum "h" divided by the ex ante kW savings.

$\hat{Y}_h$ = Ex post program stratum "h" savings (kW or kWh).

$\hat{X}_h$ = Ex ante program stratum "h" savings (kW or kWh).

The error bound for the program category is the square root of the sum of the squared error bounds for each of the utility program stratums and was calculated using **Equation 13**.[29]

Eq. 13 $$\hat{E}b(\bar{y}_p) = \sqrt{\sum_{i=1}^{m}\left[Eb(\bar{y}_h)\right]^2}$$

The AGRR is combined with the Net-to-Gross Ratio (NTGR) to develop the Net Realization Rate (NRR) relative to planning using **Equation 14**.

Eq. 14 $$NRR_h = NTGR_h \times AGRR_h$$

Where,

NRR_h = Net Realization Rate for kW or kWh savings in program stratum "h."

$NTGR_h$ = Net to Gross Ratio defined as the number of units that would not have been installed without the program divided by the total number of units installed through the program (kW or kWh).

Some statistics were calculated using other equations.[30]

The weighted sample coefficient of variation is 0.03 for kWh savings, the weighted Cv is 0.07 for kW savings, and the weighted participant survey coefficient of variation is 0.19. The kWh

[29] This result is a consequence of (a) the fact that the standard deviation of the difference between two statistically independent random variables (e.g., the standard savings of each program) is the square root of the sum of the squares of the standard deviations of each of the random variables, and (b) the error bound at the 90 percent level of confidence is 1.645 times the standard deviation. See Hall, N., Barata, S., Chernick, P., Jacobs, P., Keating, K., Kushler, M., Migdal, L., Nadel, S., Prahl, R., Reed, J., Vine, E., Waterbury, S., Wright, R. 2004. *The California Evaluation Framework*, Chapter 12: Uncertainty, pp. 280-306. San Francisco, Calif.: California Public Utilities Commission.

[30] Hall, N., Barata, S., Chernick, P., Jacobs, P., Keating, K., Kushler, M., Migdal, L., Nadel, S., Prahl, R., Reed, J., Vine, E., Waterbury, S., Wright, R. 2004. *The California Evaluation Framework*, San Francisco, Calif.: California Public Utilities Commission. Cochran, William G. *Sampling Techniques*. New York: John Wiley & Sons, 1977, Kish, Leslie. *Survey Sampling*. New York: John Wiley & Sons, 1965. Thompson, Steven K. *Sampling*. New York: John Wiley & Sons, 1992.

billing data sample included 40 sites. The field measurement and sub-metered data sample included 10 sites. All results in this report are presented at the 90/10 confidence level. Energy and peak demand savings for plug load sensors are based on sub-metered data.

4.2 Database

Data for the miscellaneous rebate programs was tracked and archived in the NCPA Tracking Database. Data for all programs of this type are summarized within the database for M&V sampling and reporting purposes. The tracking system data is based on reports provided by the respective utilities. The database includes general customer information, quantity and type of measures installed, make and model number, ex ante kW/kWh savings, and NCPA account number (if available). Tracking data was delivered electronically by utility program staff and entered into the database after the programs were completed.

4.3 Baseline

The baseline kWh values are based on billing data, PRISM analyses, and field measurements. The baseline kW values are based on metering results for a random sample of sites, deemed values from the 2001 DEER Update Study, engineering analyses, and previously published M&V studies (see **Section 2**).

4.4 Program Evaluation Savings Estimates

Gross ex post kWh savings are based on billing data analyses, engineering analyses, and previously published M&V studies. Energy savings for vender misers are based on sub-metered data from previously published M&V studies. Energy savings for Energy Star windows (ESW), sun screens, window film, and whole house fans are based on billing regression and engineering analyses using PRISM. Energy and peak demand savings for Energy Star refrigerators, conservation kits and water heater mattress pads are based on previously published M&V studies. Energy and peak demand savings for plug load sensors are based on sub-metered data. Net program evaluation savings are based on the participant decision-maker survey results that were analyzed to develop net-to-gross ratios for kWh and kW savings using methods described in **Section 3**. The gross and net savings estimates obtained at the participant level are extrapolated to the population of program participants using the methods described above.

Ex ante program savings are summarized in **Table 4.1**, and ex post savings are summarized in **Table 4.2**. The ex ante program savings are 921,903 kWh/yr and 427 kW. The gross ex post program savings are 454,806 ± 24,239 kWh/yr and 240 ± 29 kW at the 90 percent confidence level. The net ex post program savings are 387,196 ± 19,339 kWh per year and 182 ± 20 kW at the 90 percent confidence level. The net ex post lifecycle savings are 5,064,053 ± 290,760 kWh as shown in **Table 4.3**. The average effective useful lifetime for all miscellaneous measures is 13.08 years. The net-to-gross ratio is calculated based on decision maker surveys regarding whether or not the unit would have been installed without rebates from the programs (see **Section 3.2**). The net realization rates are 0.42 for kWh and kW savings. The M&V savings and realization rates are lower than anticipated due to missing measures and lower baselines, savings, and net-to-gross ratios.

Table 4.1 Ex Ante Savings for NCPA SB5X Miscellaneous Programs

NCPA Utility	Rebates	Qty.	Ex Ante Savings kWh/yr	Ex Ante Savings kW	Ex Ante Net-to-Gross Ratio kWh/y	Ex Ante Net-to-Gross Ratio kW	Ex Ante Savings kWh/y	Ex Ante Savings kW
Roseville - Vender Misers	56	115	212,900	19.3	1	1	212,900	19.3
MID – Res ESW	310	44872	98,718	179.5	1	1	98,718	179.5
MID - Comm SS	19	16243	51,978	65.0	1	1	51,978	65.0
MID – Res SS	99	5881	12,938	23.5	1	1	12,938	23.5
MID – Res WHF	23	24	6,600	12.0	1	1	6,600	12.0
MID – Refrig.	704	704	371,893	80.4	1	1	371,893	80.4
Lompoc – Kits	500	500	36,850	13.0	1	1	36,850	13.0
Lompoc - WB Pad	1	1	900	0.3	1	1	900	0.3
Lodi – Win. Film	9	9	900	0.6	1	1	900	0.6
TID – Win. Film	1	34	5,376	5.6	1	1	5,376	5.6
SVP-Plug Sensors	2	315	122,850	28.05	1	1	122,850	28.1
Total	**1,726**	**68,698**	**921,903**	**427**	**1.00**	**1.00**	**921,903**	**427**

Table 4.2 M&V Ex Post Savings for NCPA SB5X Miscellaneous Programs

NCPA Utility	Qty.	M&V Gross Ex Post Savings kWh/y	M&V Gross Ex Post Savings kW	Net-to-Gross Ratio kWh/y	Net-to-Gross Ratio kW	M&V Net Ex Post Savings kWh/y	M&V Net Ex Post Savings kW	Net Realization Rate kWh/y	Net Realization Rate kW
Roseville - Vender Misers	115	178,710	11.5	0.96	0.96	171,562	11.0	0.81	0.57
MID – Res ESW	44872	98,718	134.6	0.65	0.65	64,167	87.5	0.65	0.49
MID – Comm SS	16243	43,856	24.4	0.96	0.96	42,102	23.4	0.81	0.36
MID - Res SS	5881	9,410	4.1	0.48	0.48	4,517	2.0	0.35	0.08
MID - Res WHF	24	4,872	4.8	0.66	0.66	3,216	3.2	0.49	0.26
MID – Refrig.	704	46,464	9.9	0.80	0.80	37,171	7.9	0.10	0.10
Lompoc – Kits	500	33,500	11.5	0.80	0.80	26,800	9.2	0.73	0.71
Lompoc – WB Pad	1	270	0.1	0.80	0.80	216	0.1	0.24	0.24
Lodi – Win. Film	9	635	0.2	0.96	0.96	610	0.2	0.68	0.36
TID – Win. Film	34	4,516	2.1	0.96	0.96	4,335	2.0	0.81	0.36
SVP-Plug Sensors	85	33,856	36.6	0.96	0.96	32,501	35.1	0.26	1.25
Total	**68,468**	**454,806**	**239.8**	**0.85**	**0.76**	**387,196**	**181.6**	**0.42**	**0.42**
Roseville - Vender Misers	115	178,710	11.5	0.96	0.96	171,562	11.0	0.81	0.57

Table 4.3 Ex Post Lifecycle Savings for NCPA SB5X Miscellaneous Programs

NCPA Utility	Qty.	M&V Net Ex Post Annual Savings kWh/yr	Effective Useful Lifetime	M&V Net Ex Post Lifecycle Savings kWh	90% CI kWh/yr
Roseville - Vender Misers	115	171,562	13	2,230,301	126,298
MID - Res ESW	44872	64,167	20	1,283,339	233,334
MID – Comm SS	16243	42,102	10	421,019	77,966
MID - Res SS	5881	4,517	10	45,166	5,363
MID - Res WHF	24	3,216	15	48,233	15,444
MID – Refrig.	704	37,171	12	446,054	8,635
Lompoc – Kits	500	26,800	8	214,400	25,280
Lompoc – WB Pad	1	216	5	1,080	108
Lodi - Win. Film	9	610	10	6,096	1,129
TID - Win. Film	34	4,335	10	43,352	8,028
SVP-Plug Sensors	85	32,501	10	325,013	84,048
Total	**68,468**	**387,196**	**13.08**	**5,064,053**	**290,760**

Note: The total 90% confidence interval (CI) kWh is the square root of the sum of the squares of the 90% CI for each program.

Appendix A: NCPA SB5X Decision-Maker Survey

Interview Instructions for Decision-Maker Survey

1. Purpose

The purpose of the Decision-Maker Survey is to obtain sufficient information to estimate the Net-to-Gross Ratio (NTGR).

2. Selection of Respondent

The **decision-maker** must be the person who decided to install or implement rebated measures.

3. Two Types of Sites

This survey will be used for two types of sites:

1. **On-Site M&V Only**. Sites that receive an on-site inspection for the M&V evaluation.
2. **Telephone Only**. Sites that only receive a telephone survey.

4. How to Start a Survey

Complete the following steps to start one of these surveys:

1. Review file information for the site (if available).
2. Make sure you understand what was installed prior to initiating the call or visit.
3. Contact the person and explain the purpose of the Survey. Tell them that the data provided by them will be kept strictly confidential and will not be shared with anyone.

NCPA SB5X DECISION-MAKER SURVEY

Customer Name:______________________________ Date: ____

Business Name: ______________________________ Contact: _____________________________________

Phone Number:_______________________________ City: ____

Start Call Time: ______________________________ End Call time:________________________________

Surveyor Initials: _____________________________ Survey Completed: Y NA R WB BN

Y = yes, NA = no answer, R = refused, WB = wrong business, BN = bad number

The purpose of the decision-maker survey is to obtain information necessary to calculate a net-to-gross ratio. You will need to interview the customer who was responsible for the decision to implement measures at the site. If this person is not available attempt to locate someone who is at least familiar with how that decision was made.

Introduction

Say: "Hello. My name is [**Anne**] and I am conducting a survey regarding the your participating in the energy efficiency programs funded with SB5X funds. Would you mind spending 5 minutes to answer a few questions?"

Begin Survey

1. When and how did you first learn about the Utility Program? [**Only ask this question once, for the first recommendation for each site.**]

   ____

   1 Didn't know there was a program (**Go to Q.3**)

2. Keeping that in mind, did you understand the value of the program BEFORE or AFTER you installed the efficiency upgrades? (**Circle One**)

   1 Before **2** After (**Go to Q.4**) **98** Don't Know **99** Refused to Answer

3. Did you install the high efficiency AC unit BEFORE or AFTER you heard about the Utility Rebate Program? (**Circle One**)

   1 Before **2** After **98** Don't Know **99** Refused to Answer

4. On a scale from 0 to 10, with 0 being no influence at all and 10 being very influential, how much influence did the Utility or Rebate have on your decision to install the efficiency upgrades?

   ___ Response (**0-10**) **98** Don't Know **99** Refused to Answer

5. If the rebates had not been available, how likely is it you would have done exactly the *same* thing. Please use a scale from 0 to 10, with 0 being not at all likely and 10 being very likely.

   ___ Response (**0-10**) **98** Don't Know **99** Refused to Answer

   Notes: ____

NCPA SB5X DECISION-MAKER SURVEY (Continued)

Special Instruction for Contradictory Responses: If [**Q.4 is 0,1,2** *and* **Q.5 is 0,1,2**] *or* [**Q.4 is 8,9,10** *and* **Q.5 is 8,9,10**]. Probe for the reason. However, it is important not to communicate a challenging attitude when posing the question. For example, say,

When you answered "8" for the question about the influence of the rebate or service, I interpreted that to mean that the Utility Program was important to your decision. Then, when you answered "8" for how likely you would be to take the same action *without* the rebate or service, it sounds like the Utility was *not* very important. I want to check to see if I understand your answers or if the questions may have been unclear.

If they volunteer a helpful answer at this point, respond by changing the appropriate answer. If not, follow up with something like: "Would you explain in your own words, the role the Utility Program played in your decision to take this action?

If possible translate their answer into responses for **Questions 4** and **5** and check these responses with the respondent for accuracy. If the answer doesn't allow you to decide what answer should be changed, write the answer down and continue the interview.

Answer: ____

6. What role did the Utility Program play in your decision to install the upgrades [**describe implemented recommendation**]? [Prompt by reading list if the respondent has trouble answering.]

   1 Reminded us of something we already knew
   2 Speeded up process of what we would have done anyway (i.e., early replacement)
   3 Showed us the benefits of this action that we didn't know before
   4 Clarified benefits that we were *somewhat* aware of before
   5 Recommendation had no role
   6 Other ____
   98 Don't Know
   99 Refused to Answer

Say: Here are some statements that may be more or less applicable for your home about the Utility Program [**or recommendation**]. Please assign a number between 0 and 10 to register how applicable it is. A 10 indicates that you fully agree, and 0 indicates that you completely disagree.

7. The Utility Program was nice but it was unnecessary to get the efficiency upgrades installed.

   ___ Response (**0-10**)   **98** Don't Know   **99** Refused to Answer

8. The Utility Program was a critical factor in installing the efficiency upgrades.

   ___ Response (**0-10**)   **98** Don't Know   **99** Refused to Answer

NCPA SB5X DECISION-MAKER SURVEY (Continued)

9. We would not have installed the efficiency upgrades without the Utility Program.

   ___ Response (**0-10**) **98** Don't Know **99** Refused to Answer

10. If you had not received the [rebate or service] from the Utility, would you have installed upgrades [**or other measures**]...

    1 ..within 6 months?

    2 ..6 months to 1 year?

    3 ..one to two years later?

    4 ..two to three years later?

    5 ..three to four years later?

    6 ..four or more years later?

    7 ..Never

    98 ..Don't Know - **Try less precise response, if still "don't know" use 98**

    8 ...less than one year?

    9 ...one year or more?

    99 ...Refused to Answer

    <u>Time relative to the installation date</u>. For customers with more than one measure ask if their response is the same. If not, obtain a response for each measure. Write answers in margins and enter answers on a new line in the Excel spreadsheet.

Repeat **Questions 2** through **10** for each installed measure or service.