

**Verification of
EVT 2012 Claimed Annual MWh Savings,
Coincident Summer and Winter Peak Savings
And Total Resource Benefit (TRB)**

Final Report

**Submitted to the
Department of Public Service**

by

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with Assistance from
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I. Introduction

On April 2, 2013, Vermont Energy Investment Corporation (VEIC), operating under an order of appointment by the Public Service Board (“PSB”) as Efficiency Vermont (“EVT”) to provide energy efficiency services in Vermont, submitted its "Year 2012 Preliminary Savings Claim" for calendar year 2012 activities. The Department of Public Service ("DPS" or "Department"), is required by the PSB to undertake a review to verify the energy, coincident peak, and Total Resource Benefit ("TRB") savings claimed by EVT for purposes of certifying achieved savings toward VEIC’s performance goals. To complete this review, the Department contracted the services of West Hill Energy and Computing, who conducted the verification with assistance from Cx Associates, Energy Resource Solutions (ERS), GDS Associates and Lexicon Energy Consultants.

The savings verification (SV) process is a paper review intended to identify errors in calculation, assumptions and methodology made by EVT in their savings claim. It is not designed nor intended to meet the level of rigor for impact evaluation required in many jurisdictions. For retrofit projects, a determination is also made as to whether savings are realistic in terms of pre-installation consumption. Project by project preliminary findings were provided to EVT as the project reports were completed. EVT provided comments on the preliminary reports for consideration by the Department and its contracted verification team.

This process helped facilitate agreement between the Department and EVT and EVT has indicated it accepts all of the adjustments to the 2012 claimed savings recommended by the Department in this report. Since the parties are in agreement on the magnitude of the adjustment, project by project issues and resolutions are only briefly described in the main report. Detailed discussion of the individual projects reviewed and the review outcomes are provided in Appendix A.

The DPS thanks the many staff members at Efficiency Vermont who coordinated the verification review, in particular Pierre Van Der Merwe, Bill Fischer, and Erik Brown.

The results of the Department’s verification indicate that EVT's 2012 energy savings claims are overstated by approximately 2.8%, or 3,171 gross annual MWh, and coincident peak savings are overstated by 2.3% or 572 winter kW and 1.8%, or 287 summer kW. The Department's findings are the result of numerous adjustments both upward and downward. The overstatement of savings for the overall portfolio is less than found in the 2011 program year, suggesting that EVT was more accurate in estimating savings during PY2012. For context, a comparison of the results from the FCM impact evaluation for PY2011, which includes direct measurement by evaluators, and savings verification for the same program year, based only on a paper review, show that the FCM portfolio-wide realization rate was 85% as compared to the SV realization rate of 94%.¹ However, the two evaluations are not directly equivalent as the C&I custom projects in the sample were not the same due to differences in the sampling methods.

¹ The FCM impact evaluation for PY2012 is currently in progress.

In addition to the analysis of gross energy and demand savings, this review also covers net energy and demand savings, TRB, MMBtu savings from fossil fuels, and water savings. Some of the Department's recommended energy adjustments have significant impacts on these other indicators. When EVT's savings are revised for the EVT 2012 annual report, all of the relevant indicators need to be re-calculated.

The above described recommended adjustments to EVT's savings claims is based on the review of EVT's entire portfolio, including review of a randomly selected sample of Commercial and Industrial (C&I) and multifamily projects and a comprehensive review of residential prescriptive measures. The sampling process was designed to ensure that the sample was weighted toward the larger projects that embody greater variability and more complex methods for calculating savings. Unlike prior years, in which a single sample of C&I custom projects was selected to be reviewed for Savings Verification (SV) and the Forward Capacity Market (FCM) evaluation, for PY2012 the approach was changed to select samples independently for SV and FCM. Separating the two samples allowed for the stratification by size to be based on the annual energy savings (kWh per year) rather than the coincident peak kW, which is a benefit as this variable is more closely related to EVT's goals. Since the projects under review are reasonably representative of EVT's 2012 activity, the DPS is applying a proportional adjustment to the Business Sector (C&I) savings that were not included in the sample. This sampling and adjustment method should reflect what would result from a comprehensive savings review of all C&I projects, if resources and time permitted that approach.

Since many of the residential initiatives are primarily prescriptive in nature, the Department's review of this sector consisted largely of verifying that the assumptions as compiled in EVT's Technical Reference Manual (TRM) were correctly applied. This validation process is easily conducted for the entire data set, obviating the need for random sampling. Custom residential initiatives are small in magnitude (less than 1% of total claimed savings) and the Department reviewed only the larger residential projects with higher savings.

The adjustments to gross annual savings and coincident peak reductions for all initiatives are summarized in Table 1.

Table 1: Adjustments by Program Group

	Energy Saved		Winter kW Reduction		Summer kW Reduction	
	EVT Gross Claimed MWh	Realization rate	EVT Gross Claimed kW	Realization Rate	EVT Gross Claimed kW	Realization Rate
C&I and Multifamily						
Retrofit	24,643	93.5%	3,987	93.1%	3,218	99.5%
NC/MOP	45,615	96.8%	6,589	96.1%	6,337	95.2%
C&I Subtotal	70,258	95.7%	10,577	94.9%	9,555	96.6%
Residential						
Efficient Products	41,102	100.0%	13,056	100.1%	6,184	100.5%
Residential Retrofit/ Low Income Single Family	3,139	97.2%	726	94.2%	245	98.7%
Residential New Construction	795	96.6%	213	94.1%	77	106.5%
Residential Subtotal	45,036	99.7%	13,995	99.7%	6,506	100.5%

Portfolio Total	115,293	97.2%	24,572	97.7%	16,061	98.2%

The relative precision² of the realization rates associated with the energy savings (annual kWh) for the C&I and Multifamily retrofit initiatives, and the C&I and Multifamily New Construction and Market Opportunity initiatives is 24.7% and 15.3% at the 90% confidence level, respectively. The high values of the relative precision are due to the variability of realized savings from one project to the next and the smaller sample size required to fit the budgetary constraints. Overall, for the C&I portfolio as a whole, the relative precision is 6.0%.

The remainder of this report is divided into four sections. Section II describes the methods (including the sampling process) and Section III covers the detailed project and measure-level issues that provide the basis for the adjustments shown in Table 1 above. Section IV discusses specific issues with program year 2012 (PY2012) projects and other concerns to be addressed on a prospective basis.

II. Methods

A. Verification Process

Annual savings verification starts in mid-March, when EVT provides the list of projects and savings for the previous program year to the DPS, with the goal of completing the entire review and generating a final report by the beginning of July, a span of less than four months. EVT's entire portfolio is included in the review, which covers the energy savings, demand savings, other fuel savings or extra use and all other inputs into the total resource benefit (TRB) calculation. Given the short time frame and the scope of the work, there is insufficient time to conduct on-site verification or measurement or participant surveys of any type. Consequently, the verification review consists almost entirely of review of EVT's project files and program tracking database. On a case-by-case basis, and time permitting, participant billing data may be reviewed or the DPS Evaluation Team may contact a participant to request additional information.

In this context, it is necessary to prioritize and identify the key components of the portfolio requiring more intensive review. As discussed in detail in the sampling section, in PY2012 the sampling for savings verification (SV) was conducted independently of sampling for the Forward Capacity Market (FCM) evaluation. EVT's portfolio is divided into five primary components:

- Commercial and Industrial (C&I) and Multifamily Retrofit Projects
- Commercial and Industrial (C&I) and Multifamily New Construction/MOP Projects
- Residential Efficient Products Savings
- Residential Retrofit/Low Income Single Family
- Residential New Construction

The approach to each of these components is discussed briefly below.

² Relative precision indicates variability of the estimator, in this case the realization rate, in relationship to its magnitude. It is calculated at the 90% confidence level as $1.645 * \text{standard deviation of the realization rate} / \text{mean realization rate}$.

1. Commercial and Industrial (C&I) and Multifamily Retrofit Projects

These projects account for 35% of the total C&I and Multifamily sector savings and 21% of EVT's total portfolio savings for PY2012. These projects are varied, ranging from relatively simple lighting system to highly complex industrial processes. Due to the characteristics of the projects and their relative importance to EVT's portfolio, the DPS Evaluation Team selected a random sample of projects to review and applies the results to this component of the portfolio. The following section provides details of the sampling process.

The DPS Evaluation Team reviewed the project files to assess whether the savings estimates are reasonable. This process is almost entirely dependent on the information provided by EVT. In a few cases, billing data was reviewed or the participant was contacted by the DPS Evaluation Team to fill in missing information.

2. Commercial and Industrial (C&I) and Multifamily New Construction/MOP Projects

These projects account for 65% of the total C&I and Multifamily sector savings and 40% of EVT's total portfolio savings for PY2012. Similar to the retrofit category described above, these projects are varied, ranging from relatively simple lighting system to highly complex industrial processes. As with the retrofit projects in this sector, the DPS Evaluation Team selected a random sample of projects to review and applies the results to this component of the portfolio. The following section on sampling provides details of the sampling process.

The process is the same as for the C&I retrofit projects. The DPS Evaluation Team reviewed the project files to assess whether the savings estimates are reasonable. This process is almost entirely dependent on the information provided by EVT. In a few cases, billing data was reviewed or the participant was contacted by the DPS Evaluation Team to fill in missing information.

3. Residential Efficient Products

The Efficient Products Program (EP) accounts for 91% of EVT's claimed energy savings in the residential sector, 36% of EVT's total portfolio savings for PY2012. The measures in these projects are prescriptive and the verification process only involved ensuring that EVT's claimed savings match the values specified in the TRM.

4. Residential Retrofit/Low Income Single Family

These projects account for 7% of the total residential sector savings and 3% of EVT's total portfolio savings for PY2012. Many of these measures, accounting for 83% of claimed savings, are also prescriptive and were reviewed by comparing the claimed savings to the TRM. For the remaining custom measures, accounting for less than 0.5% of total portfolio savings, only the largest projects were reviewed, and no adjustments were identified. As discussed previously, any savings associated with the Home Performance with ENERGY STAR® Program were adjusted based on the recently completed impact evaluation study, which constituted a more rigorous assessment of this program than possible during the course of savings verification.

5. Residential New Construction

These projects account for 7% of the total residential sector savings and 3% of EVT's total portfolio savings for PY2012. Similar to the Residential Retrofit/Low Income Single Family category, many of these measures, accounting for 55% of the savings, are also prescriptive and were reviewed by comparing the claimed savings to the TRM. The remaining custom measures, accounting for less than 0.5% of total portfolio savings, were not reviewed.

B. Sampling

1. Overview

In SV for program years 2009 through 2011 a single sample was selected to be reviewed for Savings Verification (SV) and the Forward Capacity Market (FCM) evaluation. This process was designed to leverage the DPS Evaluation Team's review of the projects during SV as preparation for the FCM evaluation.

For program years 2011 and 2012, the DPS and EVT modified the approach to the FCM sample. Rather than drawing a completely independent sample for these two program years, the FCM results from program year 2010 were applied for all size strata except the largest stratum in each of the two major program categories (new construction/market opportunity and retrofit). Only the largest projects were evaluated to FCM standards with EVT conducting the metering and the DPS evaluation team performing the analysis.

The SV sample for program year 2011 was the same as the FCM sample, i.e., the size strata were defined by the maximum kW reduction as established for program year 2010. However, given that the SV and FCM samples only overlap for the largest projects, a large part of the efficiency in reviewing the same sample of projects for the two evaluations was lost.

Consequently, the sampling strategy for PY2012 was changed to select samples independently for SV and FCM. Because of this, the primary sampling variable for SV12 was changed to annual energy savings (kWh per year) rather than kW, as this variable is more closely related to EVT's goals. Both stipulated and non-stipulated measures were included in the sample.³

The guidelines for the SV12 sampling process for the C&I projects are listed below for the reader's convenience.

- The primary sampling unit was the project. All measures associated with the project were reviewed. The DPS Evaluation Team reviewed an alternative strategy of sampling on the Site ID, and found that most sites were unique, suggesting that using the project as the primary sampling unit is a reasonable approach and is roughly equivalent to sampling by site.
- The primary variable for establishing the size strata was project energy savings (kwh).
- Sampling was conducted separately for two broad categories of initiatives, i.e., retrofit and MOP/new construction. Multifamily projects were included with the C&I projects.
- The sample size for each broad category of projects was not designed to meet a specific confidence/precision level.

³ "Stipulated" measures are lighting measures with standardized load profiles that have been evaluated to FCM standards.

- Stratification by project size was conducted, resulting in four size strata for each of the two broad categories of projects.
- A census of the largest projects in each broad category was reviewed. Projects in the smaller size strata were randomly selected.
- Expansion weights were calculated based on the number of completed project reviews.
- The cut offs for the strata were determined according to the methodology presented in the California Evaluation Framework.
- The smallest 5% of projects based on kwh were removed from the sampling frame.

2. Summary of Projects

All of the projects were separated into the two major categories of Retrofit and MOP/New Construction, based on the differing baselines used in assessing savings (previous equipment vs. code). Table 2 below shows the number of projects in each of these categories and the total savings.

Table 2: Summary of C&I and Multifamily Projects

	Projects	EVT Program Reported Savings (MWh)	Percent of EVT C&I Program Reported Savings
Retrofit	938	24,643	35%
MOP/NC	3,141	45,615	65%
Totals	4,079	70,258	100%

Sampling was conducted separately for the retrofit and MOP/NC projects. The savings size cut offs for each stratum were calculated according to the methodology presented in the California Framework (Framework).⁴ Sample sizes were established based on previous experience and the time and budget constraints specific to SV12.

Using the methods described in the Framework, the number of projects selected from each stratum should be equal, with some exceptions. An example of an exception is including a census of the largest projects even if the stratum contains fewer or more projects than required for the other strata. Once the strata and the sample sizes were defined, the specific projects were selected randomly. No adjustments were made to the methodology laid out in the California Framework.

The final sample included 30 retrofit and 20 MOP/NC projects. After sampling had been completed, the DPS Evaluation Team discovered an error made during efforts to pull together the sample during the truncated time period: approximately 114 projects in track 6014PRES were inadvertently omitted from the sample frame. These projects represent less than 1% of portfolio savings and the vast majority of the projects were in the group of very small projects excluded from the sampling. Given the small magnitude of the savings associated with these projects and tight timeline for SV12, the DPS evaluation team proceeded with the sample as drawn, rather than resample.

⁴ TecMarket Works, et. al. The California Evaluation Framework. Project Number: K2033910. Prepared for the California Public Utilities Commission and the Project Advisory Group. June, 2004. Pages 327 to 339 and 361 to 384.

An overview of the sample is shown below in Table 3. The sampled projects account for 27% of sector savings, 16% of EVT's total portfolio savings for PY2012. The review for all projects includes both stipulated and non-stipulated measures.

Table 3: Overview of the Sample

Program	Stratum	Total Number of Projects	Projects In Sample	Sample kwh Total	Population kwh Total
Retrofit	0	568	0	0	928,205
	1	241	5	96,048	5,891,655
	2	78	5	347,826	5,891,513
	3	36	5	784,270	5,842,384
	4	15	15	6,088,782	6,088,782
New Construction / MOP	0	1963	0	0	2,346,606
	1	937	3	17,145	11,069,058
	2	181	3	137,616	10,701,000
	3	49	3	436,679	10,390,056
	4	11	11	11,108,567	11,108,567
Totals		4,079	50	19,016,933	70,257,825

The distribution of all projects in terms of size is presented below in Table 4. This analysis shows that projects vary in size from small kWh extra use to 3,312 kWh reductions. The strata reflect a reasonable grouping of projects by size.

Table 4: Distribution of Sample by Project Size

Program	Stratum	Total Number of Projects	Projects In Sample	Minimum kwh	Maximum kwh	Mean kwh
Retrofit	0	444	0	1	10,083	3,085
	1	241	5	10,118	50,637	24,447
	2	78	5	51,643	109,322	75,532
	3	36	5	110,709	237,948	162,288
	4	15	15	248,908	975,450	405,919
NC/MOP	0	1,924	0	2	3,901	1,220
	1	902	3	3,906	32,762	12,272
	2	181	3	32,844	129,003	59,122
	3	49	3	130,120	472,104	212,042
	4	11	11	481,700	3,312,410	1,009,870

To understand the degree to which the measure mix of the selected sample matched the measure mix of the population (all C&I and Multifamily projects) the DPS Evaluation Team analyzed the

distribution of savings by end use. Results are presented below in Table 5. The top stratum (the largest projects in terms of EVT claimed savings) was removed from this analysis, as all of these projects were reviewed. Thus, the percentage of savings reflects only the lower tiers (strata 1 through 3 for both program categories). As can be seen, the sample has a higher proportion of industrial process and a lower proportion of lighting projects, particularly for retrofit.

Table 5: Comparison of Sample and Population Claimed Savings by End Use

End Use	Percentage of EVT Claimed kWh Savings			
	Retrofit		MOP/NC	
	Sample	Population	Sample	Population
HVAC	1%	1%	7%	7%
Lighting	23%	52%	43%	61%
Industrial Processes	51%	25%	26%	10%
Other	26%	22%	25%	22%

After the SV review and analysis had been completed, the DPS evaluators conducted an analysis to determine whether the difference in the percent of lighting projects between the sample and population may have created a bias. This analysis indicated that the difference in the realization rates between the lighting and non-lighting projects was not sufficiently large enough to introduce bias to the overall portfolio results.

As an additional check to ensure the sample is representative, the DPS evaluation team also conducted a comparison of the percentage of savings by track between the sample and population. Within the population, the tracks 6012CNIR and 6014CUST account for more than 50% of total EVT claimed savings. Similarly, over half of the EVT claimed savings within the sample are attributable to projects in these tracks. Within the population six tracks accounted for 98% of EVT claimed savings; the sample contains projects from all six of these tracks.

The expansion weights were developed based on the number of projects in the sample and in the population, by broad program category and by size stratum. The expansion weights are given in Table 6 below.

Table 6: Expansion Weights by Stratum

Program	Size Stratum	Total Number of Projects	Projects in Sample	Expansion Weight
Retrofit	1	241	5	48.20
	2	78	5	15.60
	3	36	5	7.20
	4	15	15	1.00
NC/MOP	1	902	3	312.33
	2	181	3	60.33
	3	49	3	16.33
	4	11	11	1.00

C. Calculation of the Realization Rates

The realization rates were calculated for each of the components described above and then applied to the whole portfolio based on the relative contribution of each component to the total portfolio savings. The calculation of the realization rate for each portfolio category is discussed below.

1. Commercial and Industrial (C&I) and Multifamily Projects (both Retrofit and New Construction/MOP)

These programs account for about 60% of EVT's total program reported energy savings for PY2012. The realization rate (RR) is the ratio of verified energy savings to the program's reported savings. The RR represents the percentage of program-estimated savings that is actually achieved based on the results of the evaluation M&V analysis. The RR was calculated as follows:

$$b = \frac{\sum_{i=1}^n w_i y_i}{\sum_{i=1}^n w_i x_i}$$

where,

b is the realization rate (ratio estimator)

i represents the project number

n is the total number of verified projects in the sample

w_i is the expansion weight

y_i is the verified savings for project i

x_i is the original claimed savings for project i

The basis for these calculations and the method for calculating the variance are provided in *The California Evaluation Framework*.⁵

2. Residential Efficient Products

These residential EP measures in aggregate account for 36% of EVT's total program reported energy savings for PY2012. No discrepancies between EVT's claimed savings and the TRM were found for the energy (kWh) savings or demand (kw) savings, and the realization rate was set to 100%.

3. Residential Retrofit/Low Income Single Family (LISF)

The residential retrofit components of EVT's portfolio contribute about 3% to EVT's total program reported savings. Review of the six largest projects in this category found no discrepancies with the TRM in terms of energy (kWh) savings and only minor discrepancies in demand savings. As discussed previously, any savings associated with the Home Performance with ENERGY STAR® Program were adjusted based on the realization rate (86%) found by the recently completed impact evaluation study of that program. Calculation of the adjusted RR was thus completed as follows:

⁵ TecMarket Works, et. al. *The California Evaluation Framework*. Project Number: K2033910. Prepared for the California Public Utilities Commission and the Project Advisory Group, June, 2004, 327 to 339 and 361 to 384.

$$b = \frac{0.86 \times hp + nonhp + \Delta rx}{hp + nonhp}$$

where,

\underline{b} is the realization rate (ratio estimator)

hp is the total EVT claimed Home Performance savings in the LISF category

$nonhp$ is the remainder of total EVT claimed savings in the LISF category

Δrx is the total change in prescriptive savings from correcting discrepancies found between EVT's calculations and the TRM; this variable is zero for the kWh

4. Residential New Construction (RNC)

The RNC program is the smallest, with less than 1% of EVT's total program reported savings. Through an analysis of the six largest projects, some discrepancies between the TRM and EVT reported savings were identified. These were primarily associated with measure code LFHRDLED, LED Recessed Surface or Pendant Downlight. The realization rate was calculated based on all items with these measure codes.

III. Project and Measure-Specific Adjustments

A. Commercial & Industrial and Multifamily Projects

The random sample consisted of 50 Commercial and Industrial (C&I) and multifamily projects covering the range of EVT initiatives in those sectors. The Department's adjustments are based on 33 of the selected projects, i.e., issues were found with the savings claimed in two thirds of the selected projects. Many adjustments were relatively small in magnitude.

Table 7: Summary of Adjusted Projects

	Total # of Projects	# of Projects in Sample	# of Projects with Project-Specific Adjustments	# Projects with kWh or kW Summer Adjustments >+5%
NC/MOP	938	30	21	20
Retrofit	3,141	20	10	7
Totals	4,079	50	31	27

Tables 8 and 9, below, provide a brief summary of the projects in the sample where the savings were adjusted and either the energy or the summer peak savings were revised by 5% or more. Realization rates by project as well as the project stratum and reason for adjustment are provided in Table 8 for C&I and multifamily retrofit projects. Table 9 provides the same information for the C&I New Construction and Market Opportunity projects in the sample. A detailed report for each project with an adjustment is attached in Appendix A.

Table 8: Realization Rates for C&I and Multifamily Retrofit Projects

Project ID	Title	Size	RR kWh	RR kWWin	RR kWSum	Reason for Adjustment
405588	Allen & Brooks Associates, Inc. - NewLIGHT	1	108%	108%	108%	Key Inputs Required Adjustment
388840	Autumn Harp- Dry Cooler	2	108%	185%	110%	Key Inputs Required Adjustment, Calculation Error
392455	Burlington International Airport - Airside Upgrades	4	96%	96%	112%	Method Required Adjustment, Key Inputs Required Adjustment, Calculation Error
390818	Denecker Chevrolet - newlight	1	110%	61%	100%	Efficient Case Mischaracterized, Key Inputs Required Adjustment
403651	Fairlee, Town Of - Municipal Streetlighting Initiative	1	98%	137%	0%	Key Inputs Required Adjustment
397547	GE Aviation - Plant 2 - Air To Electric Sump Pumps	3	99%	92%	92%	Method Required Adjustment, Key Inputs Required Adjustment
396742	National Hanger Company - CASA Plan B	3	95%	157%	130%	Key Inputs Required Adjustment
398505	National Life Insurance - Parking Garage And Roadway LED	4	95%	90%	67%	Key Inputs Required Adjustment
405173	Norwich University - Various Measures - 2012	3	95%	95%	89%	Key Inputs Required Adjustment
398471	Rock Tenn Company - Vacuum Pump Efficiency	4	79%	79%	79%	Efficient Case Mischaracterized
405318	Rodeway Inn - South Burlington - Heat Pump PTAC Units	1	102%	97%	267%	Key Inputs Required Adjustment
414875	Shaw's - Derby Store# 431 - LED Case Lighting	2	94%	100%	100%	Key Inputs Required Adjustment
419065	Smugglers Notch Resort - 2012 Snow Guns	4	29%	42%	N/A	Baseline Mischaracterized
278267	Southwestern Vermont Health Care - Lighting 4	4	89%	94%	77%	Baseline Mischaracterized, Efficient Case Mischaracterized, Key Inputs Required Adjustment
403761	Stowe Mountain Resort - Snowguns 2011	4	65%	65%	0%	Baseline Mischaracterized, Calculation Error
415723	Stowe Mountain Resort - Snowguns 2012	4	79%	79%	N/A	Calculation Error
419865	Stratton Mountain Resort - Snowguns - 2012 - 2013	4	6%	10%	N/A	Method Required Adjustment
415015	Trapp Family Cooperative Housing - Units 4,7,11,25,26,27,28	3	78%	50%	58%	Calculation Error
259970	VSU - BGS - Statehouse - HVAC	4	66%	280%	103%	Key Inputs Required Adjustment, Method Required Adjustment
402093	VSU - BGS iLED - Various	4	47%	50%	35%	Key Inputs Required Adjustment

Table 9: Realization Rates for C&I and Multifamily New Construction and MOP Projects

Project ID	Title	Size	RR kWh	RR kWWin	RR kWSum	Reason for Adjustment
418224	Cabot Creamery Cooperative - New Cheese Warehouse	4	85%	51%	48%	Baseline Mischaracterized
409367	Discount Foods Of Rutland - Rx Lighting 3	1	182%	173%	137%	Key Inputs Required Adjustment
373630	Jay Peak - Hotel 2 - New Construction	4	72%	65%	46%	Baseline Mischaracterized, Method Required Adjustment, Key Inputs Required Adjustment
417976	Smartlight - CED South Burlington - 2012 - 05 - Part 2 - Sales	4	53%	69%	36%	Documentation, Key Inputs Required Adjustment, Method Required Adjustment
417966	Smartlight - CED Wilder - 2012 - 05 Sales	3	98%	89%	107%	Documentation, Key Inputs Required Adjustment, Method Required Adjustment
418400	Smartlight - GMES - West Lebanon, NH - 2012 - 05 Sales	2	64%	62%	67%	Documentation, Key Inputs Required Adjustment, Method Required Adjustment
416245	Windsor, Town of - Public Works Dept. - Pump Station Upgrade	3	101%	186%	115%	Key Inputs Required Adjustment, Baseline Mischaracterized, Clerical Error

B. Residential Initiatives

The DPS concentrated its review on the major components of EVT's portfolio. The Efficient Products Program accounts for 91% of EVT's claimed energy savings in the residential sector, with all of the remaining initiatives (Low Income Single Family, Home Performance, and the Vermont Energy Star Homes) accounting for the remaining 9% (approximately 3% of total portfolio savings). Thus, the Department's review focused most intensively on the Efficient Product Program.

1. Efficient Products Program

Energy savings were found to match to the TRM values for all entries in EVT's database and only a few minor discrepancies were found with the winter and summer peak kW savings. The measures and per unit savings by measure can be found in Table . Upon adjusting these measures to match the TRM values, the total kW adjustment for winter and summer were increased by 17.04 kW and 32.37 kW, respectively.

Table 10: Efficient Products Winter and Summer kW Adjustments

Measure ID	Measure Description	EVT Per Unit		TRM per Unit		Percentage Adjustment	
		kW Winter	kW Summer	kW Winter	kW Summer	kW Winter	kW Summer
RFRESRT1	Energy Star CEE Tier 1 refrigerator, incremental cost	0.017	0.018	0.023	0.029	133%	161%
RFRESRT3	Energy Star CEE Tier 3 refrigerator, incremental cost	0.021	0.022	0.028	0.035	133%	161%
RFRESRRP	Energy star refrigerator	0.014	0.014	0.018	0.023	134%	162%
RFRFERPS	Freezer early retirement program, secondary	0.102	0.106	0.136	0.171	134%	161%
RFRERPS	Refrigerator early retirement program, secondary	0.148	0.154	0.197	0.248	134%	162%

2. Home Performance Program

Prior to SV12, members of the DPS Evaluation Team were engaged to complete a separate impact evaluation of EVT's Home Performance with ENERGY STAR® Program.⁶ This evaluation, the first comprehensive impact evaluation of EVT's residential retrofit programs, covered the 2008-2010 period and was intended to provide a benchmark for future program and evaluation activities. The evaluation used billing analysis and a participant survey to establish first year gross energy electric and unregulated fossil fuel savings and estimate the savings realization rate, i.e., the ratio of the evaluated gross savings to the HPwES program reported gross savings. Verified unregulated fossil fuel savings were estimated based on annualized consumption. All results were weather normalized as appropriate.

This rigorous impact evaluation found a realization rate of 86% +/- 12% for electric savings and 51% +/- 13% for fossil fuels. Because this impact evaluation represents a more in-depth evaluation of such projects than the short time frame of SV would permit, the DPS evaluation team applied the realization rate from the study to any Home Performance with ENERGY STAR® savings.

3. Residential New Construction Program

For prescriptive measures, which accounted for 55% of savings in this program area, only two minor discrepancies were found between EVT's tracking database and values prescribed in the TRM. The measures and per unit savings by measure can be found in Table . Upon adjusting these measures to match the TRM values, the total energy savings decreased by 27.2 MWh, and kW savings for winter and summer were decreased by 12.57 kW and increased by 5.05 kW, respectively.

⁶ "Efficiency Vermont's Home Performance with ENERGY STAR® Program Impact Evaluation Final Report," prepared for Vermont Department of Public Service by West Hill Energy and Computing with GDS Associates, June 2013

Table 11: Residential New Construction Adjustments

Measure ID	Measure Description	EVT Per Unit			TRM per Unit			Percentage Adjustment		
		kWh	kW Winter	kW Summer	kWh	kW Winter	kW Summer	kWh	kW Winter	kW Summer
CKLESWRP	Energy Star washer	237	0.034	0.026	95	0.010	0.014	40%	30%	53%
LFHRDLED	LED Recessed Surface or Pendant Downlight Rx	63	0.015	0.004	48	0.003	0.012	77%	21%	279%

IV. Ongoing Issues to be Handled on a Prospective Basis

A. Documentation

Adequate documentation for all projects is critical to verify that measures were actually installed and to determine whether the savings are reasonable. EVT has been working to improve documentation of projects and the DPS evaluation team noted progress from this effort, especially with respect to collection of invoices and the provision of inspection forms. Most projects included either copies of invoices for the installed equipment or an inspection form. In some cases there were also digital photos of the installation, which is an excellent method of documentation.

Although there has been noticeable progress, there continues to be areas where the documentation is lacking. Two areas reviewers identified for improvement are the documentation of on-site inspections and the connection between tracking data and invoices.

While inspection forms were available for more projects than found in previous years, the quality of the information on the forms was noticeably lacking. In some cases, it appears that the inspection was a formality rather than a method of project documentation. For example, the inspection form was sometimes just a list of the measures with claimed savings and a signature at the bottom, *i.e.*, the inspector did not write notes or make any other indication on the form that the specific products were found on site. A more thorough cataloging of project information at this stage, for example collection of installed equipment model numbers, nameplate photos, etc., would greatly facilitate the verification process.

Similarly, the inability to connect invoice details to tracking data was problematic as it was not possible to identify the specific equipment that was purchased in the program level records. This disconnect between the invoices and tracking data limited our ability to conduct measure-level review for some projects. This issue was particularly problematic for upstream projects, such as Smartlights, where the incentive is provided to the distributor and invoices are used to support the

claimed savings. In these cases, the DPS evaluation team was not able to make a definite match between the installed products and the claimed savings. Inclusion of a model or serial number field in tracking data would streamline the verification of claimed quantities and facilitate verification of the assumptions and calculations used to estimate savings.

B. LED Smartlight End User Assumptions

In reviewing several Smartlight projects that were selected in the C&I and Multifamily sample, it came to the attention of the DPS Evaluation Team that the distribution of end users between the residential and commercial sectors appears to differ significantly from that assumed in the TRM (47.4% vs. 52.6% for residential vs. commercial). While the difficulty of tracking the ultimate use of products promoted via upstream incentives is understood, the data currently collected for this measure (customer name, address, etc.) provides sufficient detail to make an informed guess as to the nature of the installation location (commercial vs. residential). Collecting this additional detail via purchaser self-report would be a straightforward means to improve the current estimates and improve the accuracy of the savings calculation. This issue has been raised with EVT program staff and is referenced here for further discussion in TAG.

C. Updates to Technical Reference Manual

EVT's savings estimates rely heavily on assumptions documented in the Vermont Technical Reference Manual. It is appropriate to use these deemed savings for prescriptive and rebated measures where actual use of a product, such as a CFL, may not be known, and market studies provide suitable information concerning average use. However, it is also important that information in the TRM is updated to reflect changing market conditions and new information. Savings should reflect the best available information about both the Vermont market and how specific technologies can be expected to operate in VT homes and businesses.

Currently there are a number of areas where updates to the TRM are appropriate. Market characterization studies completed in late 2012 and early 2013 for the DPS,⁷ covering both the C&I and the residential markets respectively, should provide a basis for updating outdated assumptions currently contained within the TRM. For instance, in the C&I sector the baseline studies indicate improvements in the baseline for interior lighting and this finding is supported by studies from other jurisdictions. These reports should be carefully reviewed and the TRM should be updated to reflect the reports' findings.

In addition, the DPS evaluators continue to find errors in the TRM. As the document is so large and unwieldy, it is difficult to be confident that the information is accurate. Further review is needed to ensure that the TRM actually reflects the measure characterizations as understood and the DPS and EVT.

⁷ *2011 Vermont Market Characterization and Assessment Study Business Sector (Commercial and Industrial) Existing Buildings*, Navigant Consulting, Inc., October 2012.

2011 Vermont Market Characterization and Assessment Study Business Sector (Commercial and Industrial) New Construction and Major Renovation Buildings, Navigant Consulting, Inc., December 2012.

Vermont Single Family Existing Homes Onsite Report, Navigant Consulting, Inc., February 2013.

Vermont Residential New Construction Baseline Study Analysis of On-Site Audits, Navigant Consulting, Inc., February 2013.

D. Use of the Technical Reference Manual

Another, more global issue, is the expanded use of the TRM to measures that are not prescriptive. Methodologies for many custom applications are now also documented in the TRM. While the documentation is useful to provide a reference for common assumptions, it also has the potential to lead a cookie cutter mentality of estimating savings, without carefully considering site specific conditions and changes in the market.

Additionally, EVT's categorization of measures in the EVT tracking system often identifies measures that have TRM entries as "prescriptive" and EVT has argued that there is no need to verify them. However, assumptions need to have a real world basis and some, such as hours of use, can be very site specific. Future evaluation efforts should be carefully designed to test the assumptions in the TRM. Otherwise there is no basis for measuring the real, as opposed to the assumed, benefits of EVT's portfolio to Vermont ratepayers.