

**Verification of  
EVT 2013 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 1, 2014, 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 2013 Preliminary Savings Claim" for calendar year 2013 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. This review process is substantially less rigorous than standard impact evaluations required in many jurisdictions.<sup>1</sup> Given the limited budget and time frame for the SV process, there is no opportunity to conduct site visits or direct measurement. However, it is sometimes possible to assess whether savings are realistic in comparison to pre-installation consumption for retrofit projects with large expected savings.

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 2013 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 Bill Fischer, Eric Brown and Erik Brown.

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The results of the Department's verification indicate that EVT's 2013 energy savings claims are overstated by approximately 2.8%, or 2,625 gross annual MWh, and coincident peak savings are overstated by 3.5% or 646 winter kW and 1.3%, or 146 summer kW. The Department's findings are the result of numerous adjustments both upward and downward.

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.

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<sup>1</sup> For example, verification through paper review without on-site visits (as conducted for the current annual savings verification process) is not listed as an acceptable approach for measurement and verification in the *California Energy Efficiency Evaluation Protocols* (prepared by TecMarket Works, et al., April 2006, Chapter on M&V Protocol).

When EVT's savings are revised for the EVT 2013 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.

As was done for program year 2010, the sampling process was developed to meet the requirements of the Forward Capacity Market (FCM).<sup>2</sup> Due to the time constraints of the savings verification process, the SV sample is a subset of the FCM sample. Since the projects under review are reasonably representative of EVT's 2013 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.

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<sup>2</sup> For PY 2013, the FCM impact evaluation covers EVT's total C&I custom portfolio. In comparison, the evaluation strategy for PY 2012 only included evaluating the largest C&I projects, and the sampling plan from PY2010 was used to define the stratification approach used in the PY2012 evaluation. Since the sampling plan had to be redone for PY2013, the DPS evaluation team took advantage of the synergies created by using the same sample for both SV and FCM.

**Table 1: Electric 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	21,102	97.4%	3,379	97.0%	1,892	98.2%
NC/MOP	19,051	94.8%	3,081	93.3%	1,868	99.9%
Upstream	8,404	93.1%	1,317	93.7%	1,429	94.8%
Stipulated Measures	6,097	98.1%	868	97.9%	1,281	98.0%
Unregulated Fuels	37	100.0%	17	100.0%	0.009	100.0%
C&I Subtotal	54,690	95.4%	8,661	92.7%	6,469	97.9%
Residential						
Efficient Products	34,907	100.0%	9,405	100.0%	4,884	100.0%
Residential Retrofit/Low Income Single Family	1,386	93.4%	273	92.4%	151	92.4%
Home Performance with Energy Star <sup>3</sup>	364	100.0%	186	100.0%	5	100.0%
Residential New Construction	758	97.0%	199	100.0%	75	100.0%
Upstream	34	100.0%	4	100.0%	0	100.0%
Residential Subtotal	37,449	99.7%	10,006	99.8%	10,021	99.8%
Portfolio Total	92,139	97.2%	18,729	96.5%	11,587	98.7%

The relative precision<sup>4</sup> 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 11.3% and 3.5% at the 90% confidence level, respectively. Overall, for the portfolio as a whole, the relative precision is 2.7%.

Provided in the table below is the MMBtu savings and associated realization rates by program group.

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<sup>3</sup> EVT adjusted the HPwES savings to reflect realizations rates established from the results of the Vermont Home Performance with Energy Star evaluation of PY2008-2010 projects.

<sup>4</sup> 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 \* standard deviation of the realization rate/mean realization rate.

**Table 2: MMBtu Adjustments by Program Group**

	Energy Saved	
	EVT Gross Claimed MMBtu	Realization Rate
C&I and Multifamily		
Retrofit	56,243	101.4%
NC/MOP	48,070	96.6%
Upstream	(5,158)	96.2%
Stipulated Measures	(4,185)	98.1%
Unregulated Fuels	3,169	48.4%
C&I Subtotal	98,138	97.7%
Residential		
Efficient Products	(3,580)	100.0%
Residential Retrofit/Low Income Single Family	(64)	100.0%
Home Performance with Energy Star	22,798	100.0%
Residential New Construction	7,686	100.0%
Upstream	0	100.0%
Residential Subtotal	26,840	100.0%
Portfolio Total	124,978	98.2%

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 site-level issues that provide the basis for the adjustments made to the C&I sample of projects. Section IV discussed the adjustments made to other components of EVT’s portfolio. Section V covers specific issues with program year 2013 (PY2013) 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, the verification method is restricted to a paper of a sample of the custom C&I projects and comparison of prescriptive savings to the TRM for the rest of EVT's portfolio. Other common verification methods, such as direct measurement, participant surveys and on-site verification, cannot be carried out within the available time frame. 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 for large retrofit projects.

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, the sampling for SV was designed to meet the FCM impact evaluation requirements. EVT's portfolio is divided into nine components:

- C&I and Multifamily Custom Retrofit Projects
- C&I and Multifamily Custom New Construction/MOP Projects
- C&I Stipulated Lighting Projects
- C&I Upstream Initiatives
- C&I Unregulated Fuels
- Residential Efficient Products Savings
- Residential Retrofit/Low Income Single Family
- Residential New Construction
- Residential Upstream

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

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

These projects account for 39% of the total C&I and Multifamily sector savings and 23% of EVT's total portfolio savings for PY2013. 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 were reviewed.

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

These projects account for 35% of the total C&I and Multifamily sector savings and 23% of EVT's total portfolio savings for PY2013. 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. C&I Stipulated Lighting

These projects account for 11% of the total C&I and Multifamily sector savings and 7% total portfolio savings for PY2013. These projects consist of standard lighting projects using coincidence factors that were determined through an independent evaluation conducted for the Northeast Energy Efficiency Partnership. Stipulated lighting projects are included in a number of EVT initiatives, covering retrofit, market opportunity (MOP) and new construction.

For the FCM impact evaluation, these projects do not require metering, and constructing a separate stratum allows the evaluation team to develop an appropriate and cost efficient M&V process. As part of the FCM impact evaluation for PY2012, the DPS Evaluation Team has been in the process of conducting separate evaluation activities to estimate the in service rate and accuracy of the underlying assumptions for these projects. This evaluation component is expected to be completed by August, 2014. The information collected through phone surveys for the MOP projects was used to estimate the in service rate ISR for this subset of projects and measure level savings assumptions were compared to the TRM to the extent possible.

## 4. C&I Upstream Initiatives

These projects account for 15% of the total C&I and Multifamily sector savings and 9% total portfolio savings for PY2013. EVT's upstream initiatives are intended to promote energy efficiency through offering incentives to distributors. The distributors then offer efficient products at a discount to their customers. The upstream projects are typically the aggregated sales from a specific distributor. As these projects require different evaluation methods, they were verified separately from the other C&I projects.

There are two major upstream initiatives, one for lighting products and the other for heating, ventilation and air conditioning (HVAC) equipment. The savings are prescriptive, and verification consisted primarily of comparing the savings assumptions to the TRM.

One of the unintended consequences of the upstream approach is that it adds a separate layer to the installation process (the distributor) and thus, it becomes more difficult to verify the installation of the actual products. This topic is discussed further in Section V.B. below.

#### 5. C&I Unregulated Fuels

These projects account for a very small percentage of the EVT's claimed electric savings as they primarily result in unregulated fuel savings. A sample of these projects was reviewed as part of the TRB review component of SV.

#### 6. Residential Efficient Products

The Efficient Products Program (EP) accounts for 93% of EVT's claimed energy savings in the residential sector, 38% of EVT's total portfolio savings for PY2013. These measures are prescriptive and the verification process involved ensuring that EVT's claimed savings match the values specified in the TRM.

#### 7. Residential Retrofit/Low Income Single Family

These projects account for 4.7% of the total residential sector savings and 1.9% of EVT's total portfolio savings for PY2013. Many of these measures are prescriptive and were reviewed by comparing the claimed savings to the TRM. This group includes projects completed through the Home Performance with Energy star program.

#### 8. Residential New Construction

These projects account for 2% of the total residential sector savings and less than 1% of EVT's total portfolio savings for PY2012. These measures are largely prescriptive and were reviewed by comparing the claimed savings to the TRM.

#### 9. Residential Upstream

Projects in this category include measures for residential HVAC equipment. This is a small initiative that has savings of less than 1% of the residential sector savings. Verification consisted of comparing the claimed savings to the TRM.

### **B. Overview**

In SV for program years 2009 through 2011, a single sample was selected to be reviewed for SV and the FCM impact 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.

For PY 2013, the M&V conducted for the FCM impact evaluation will cover the entire C&I portfolio rather than only the largest projects. As was done for PY2012, the SV sample for PY 2013 will also be used for the FCM impact evaluation. This approach allows the DPS evaluation team to leverage the project review conducted for SV and facilitate the FCM evaluation.

Upper level stratification was conducted of EVT’s C&I portfolio. All measures were grouped into 5 major initiative categories. A summary of savings by programs is provided below.

**Table 3: Summary of C&I Projects**

	<b>Sites</b>	<b>EVT Program Reported MWh Savings</b>	<b>EVT Program Reported Winter Peak Savings</b>	<b>EVT Program Reported Summer Peak Savings</b>
Retrofit	687	21,102	3,379	1,892
New Construction /MOP	1,636	19,051	3,081	1,868
Upstream	350	8,404	1,317	1,429
Stipulated Lighting	863	6,097	868	1,281
Unregulated Fuels	116	37	18	1
Totals	3652	54,690	8,663	6,470

The remainder of this section outlines the sampling strategies using within each initiative category.

### **C. Sampling**

#### **1. Retrofit and NC/MOP Programs**

A same sampling process was used for sites in both the Retrofit and NC/MOP program types. The guidelines for the SV13 sampling process for the C&I projects are listed below.

- Sampling was conducted separately for two broad program types, i.e., retrofit and MOP/new construction. Multifamily projects were included with the C&I projects.
- The primary sampling unit was the program type/site ID. All measures associated with the site were reviewed. During the review of the program data, the DPS Evaluation Team found that many site ID’s had multiple projects, and sampling by site ID was adopted to allow the DPS evaluation team to consider all measures installed at the site and the potential for interactive effects among the measures.
- The primary variable for establishing the size strata was maximum of the winter and summer peak kW reduction.

- The sample size for each broad category of projects was not designed to meet a specific confidence/precision level.
- Stratification by size was conducted, resulting in four size strata for each of the two broad program types.
- A census of the sites with the highest savings in each broad category was reviewed. Sites in the smaller size strata were randomly selected.
- Expansion weights were calculated based on the number of completed site reviews.
- The cut offs for the strata were determined according to the methodology presented in the California Evaluation Framework.
- Sites with a maximum winter or summer kW reduction of 0.80 were removed from the sampling frame, as they are too small to verify and have little impact on the overall savings.
- Stipulated lighting projects were removed from the sample frame.

Summary of Sites

All of the sites 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 4 below shows the number of sites in each of these categories and the total savings.

**Table 4: Summary of C&I and Multifamily Projects**

	<b>Projects</b>	<b>EVT Program Reported Savings (MWh)</b>	<b>Percent of EVT C&amp;I Program Reported Savings</b>
Retrofit	687	21,102	53%
MOP/NC	1,636	19,051	47%
Totals	2,323	40,153	100%

Sampling was conducted separately for the retrofit and MOP/NC sites. The size cut offs for each stratum were calculated according to the methodology presented in the California Framework (Framework).<sup>5</sup> Sample sizes were established based on previous experience and the time and budget constraints specific to SV13. For the PY2013 FCM sample, the strata will remain the same and additional projects will be added to the sample.

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 23 retrofit and 23 MOP/NC sites. An overview of the sample is shown below in Table 5.

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<sup>5</sup> 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.

**Table 5: Overview of the Sample**

Program	Stratum	Total Number of Sites	Sites In Sample	Sample kwh Total	Population kwh Total
Retrofit	0	357	0	-	610,998
	1	246	5	25,630	2,670,961
	2	54	5	416,455	4,633,235
	3	22	5	940,592	6,032,830
	4	8	8	7,153,549	7,153,549
New Construction / MOP	0	1219	0	-	1,470,064
	1	293	5	65,603	2,829,552
	2	92	5	317,960	4,288,544
	3	24	5	1,309,645	5,604,190
	4	8	8	4,670,733	4,858,564
Totals		2323	50	14,900,166	40,152,485

The distribution of all sites in terms of size is presented below in Table 6. The size strata were defined by the higher value of the winter or summer kW; this value is referenced as “kW max” throughout the rest of this document. This analysis shows that sites vary in size from 0 kW to 413 kW max reductions. The strata reflect a reasonable grouping of sites by size.

**Table 6: Distribution of Sample by Size**

Program	Stratum	Total Number of Sites	Sites In Sample	Minimum kW Max Reduction	Maximum kW Max Reduction	Mean kW Max Reduction
Retrofit	0	357	0	0.000	0.783	0.147
	1	246	5	0.808	6.066	2.278
	2	54	5	6.398	33.376	14.845
	3	22	5	34.249	77.257	46.262
	4	8	8	108.908	233.751	165.457
NC/MOP	0	1219	0	0.000	0.795	0.176
	1	293	5	0.807	3.678	1.657
	2	92	5	3.678	14.487	7.041
	3	24	5	14.989	75.2	36.392
	4	8	8	75.400	413.427	162.775

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 sites), the DPS Evaluation Team analyzed the

distribution of savings by end use. Results are presented below in Table 7. The top stratum (the largest sites 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). This analysis shows that no major measures have been omitted from the sample. Industrial process projects are represented in the sample at a higher proportion than found in the population. Although there was no stratification on end uses, this outcome is reasonable as there tends to be greater variability among projects with industrial process measures.

**Table 7: 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	10%	7%	3%	9%
Lighting	37%	35%	25%	45%
Industrial Processes	29%	19%	24%	11%
Other	25%	39%	49%	34%

The expansion weights were developed based on the number of sites in the sample and in the population, by broad program category and by size stratum. The expansion weights are given in Table 8 below.

**Table 8: Expansion Weights by Stratum**

Program	Size Stratum	Total Number of Sites	Sites in Sample	Expansion Weight
Retrofit	1	246	5	49.20
	2	54	5	10.80
	3	22	5	4.40
	4	8	8	1.00
NC/MOP	1	293	5	58.60
	2	92	5	18.40
	3	24	5	4.80
	4	8	8	1.00

## 2. C&I Unregulated Fuels

A simple random sample was used to select projects to be reviewed as part of verification. Five projects were selected at random from all of the projects with total MMBtu savings greater than or equal to 50.

### 3. All Other Initiatives

Sampling was not conducted for the remainder of the initiatives.

#### **D. 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 Sites (both Retrofit and New Construction/MOP)

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 site number

$n$  is the total number of verified sites in the sample

$w_i$  is the expansion weight

$y_i$  is the verified savings for site  $i$

$x_i$  is the original claimed savings for site  $i$

The basis for these calculations and the method for calculating the variance are provided in *The California Evaluation Framework*.<sup>6</sup>

##### 2. C&I Upstream Projects

The realization rate was calculated by comparing the program report savings to the verified values calculated using TRM assumptions. For the Smartlights initiative, the in-service rate (ISR) from the phone survey conducted by the DPS evaluation team for the FCM impact evaluation was applied.

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<sup>6</sup> 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.

### 3. C&I Stipulated Lighting

Adjustments were made based on the results of a telephone survey completed as part of the FCM impact evaluation. The realization rate was calculated by comparing the adjusted savings to the program reported savings.

### 4. C&I Unregulated Fuels

The realization rate was calculated by comparing the adjusted savings to the program reported savings for the sample and applying the result to the population of unregulated fuel projects.

### 5. Residential Efficient Products

The realization rate was calculated by comparing the program report savings to the verified values calculated using TRM assumptions.

### 6. Residential Retrofit/Low Income Single Family (LISF)

Savings associated with the Home Performance with ENERGY STAR® Program were not adjusted as a global adjustment was made by EVT prior to finalizing the PY2013 savings claim. The realization rate (86% for electricity and 60% for unregulated fuels) found by the recently completed impact evaluation study of that program was applied to all projects in this program. In addition, the program reported savings from the efficiency kits distributed through the Residential Retrofit Program were adjusted. Calculation of the adjusted RR was thus completed as follows:

$$b = \frac{1.00 \times hp + nonhp + \Delta rx}{hp + nonhp}$$

where

$b$  is the realization rate (ratio estimator)

$hp$  is the total EVT claimed Home Performance savings

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

$\Delta rx$  is the total change in savings from correcting the ISR for the efficiency kits

As EVT had already made the 86% adjustment, the HPwES savings were not reduced further by the DPS.

### 7. Residential New Construction (RNC)

The RNC program is the smallest, with less than 1% of EVT's total program reported savings. Savings were verified by comparing the claimed savings to the TRM. The RR reflects the adjustments to all measures with discrepancies.

### III. Site-Specific Adjustments

As discussed above, a sample of C&I custom sites was selected for more detailed review, and the results of this analysis were applied to the entire population. This section provides an overview of these site-specific adjustments.

#### A. Commercial & Industrial and Multifamily Sites

The random sample consisted of 46 Commercial and Industrial (C&I) and multifamily sites covering the range of EVT initiatives in those sectors. The Department's adjustments are based on 24 of the selected sites, i.e., issues were found with the savings claimed in about half of the selected sites. Some adjustments were relatively small in magnitude.

**Table 9: Summary of Sites with Adjustments**

	Total # of Sites	# of Sites in Sample	# of Sites with Site-Specific Adjustments	# Sites with kWh or kW Summer Adjustments >+5%
NC/MOP	687	23	10	8
Retrofit	1,636	23	14	10
Totals	2,323	46	24	18

Table 10 and Table 11 below, provide a brief summary of the sites 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 site as well as the size stratum and reason for adjustment are provided in Table 10 for C&I and multifamily retrofit projects. Table 11 provides the same information for the C&I New Construction and Market Opportunity projects in the sample. A detailed report for each site with an adjustment is attached in Appendix A.

**Table 10: Realization Rates for C&I and Multifamily Retrofit Sites**

Site ID	Title	Size	RR kWh	RR kWWin	RR kWSum	Reason for Adjustment
15261	Glycol Loop Heat Exchanger	4	101%	91%	100%	Method required adjustment
6003351	Fleet Vehicle Timer	1	72%	125%	N/A	Efficient case mischaracterized, calculation error
18351	Old Brewery ECM HPP	4	100%	107%	107%	Method required adjustment
909781	Fleet Vehicle Timer	1	59%	0%	N/A	Efficient case mischaracterized, calculation error
6563371	Facility Lighting 2013	4	82%	101%	101%	Key inputs required adjustment
3368651	CAS and Dust Collection	3	102%	N/A	104%	Key inputs required adjustment, method required adjustment
577781	Heat Pump PTAC Units	2	87%	34%	101%	Key inputs required adjustment
12411	2013 Snowmaking	4	93%	97%	100%	Calculation error, key inputs required adjustment
201271	Lighting 4	2	99%	50%	70%	Calculation error, efficient case mischaracterized
414181	Fleet Vehicle Timer	1	59%	200%	N/A	Efficient case mischaracterized, calculation error

**Table 11: Realization Rates for C&I and Multifamily New Construction and MOP Sites**

Site ID	Title	Size	RR kWh	RR kWin	RR kWSum	Reason for Adjustment
5511852	Water Treatment Facility	4	97%	98%	95%	Key inputs required adjustment, calculation error, baseline mischaracterized, efficient case mischaracterized
2129342	Rx Lighting 2	1	81%	81%	81%	Key inputs required adjustment
7127612	Rx Lighting 1	1	124%	124%	124%	Baseline and Efficient Cases Mischaracterized
18352	Tollgate HVAC	3	103%	107%	107%	Method required adjustment, key input adjustment
3910362	Powder Packaging	4	98%	98%	98%	Baseline mischaracterized
912392	Chiller Upgrade and Lighting	1	80%	79%	80%	Method required adjustment, key inputs required adjustment
556822	Rx Lighting 3	3	100%	102%	102%	Method required adjustment
6794612	New Construction	3	57%	52%	84%	Method required adjustment, baseline and efficient case mischaracterized, key inputs required adjustment
12222	WWTP Improvements	3	91%	85%	100%	Key inputs required adjustment
201272	AHU - 7 & Boiler Room	2	84%	82%	134%	Calculation error, key inputs required adjustment, efficient case mischaracterized
466902	Mountain Upgrades 2013	4	101%	73%	21%	Efficient and baseline case mischaracterized, calculation error, method required adjustment
5079382	2013/2014 Snowmaking	4	46%	48%	N/A	Calculation error, key inputs required adjustment, method required adjustment
6727832	Rx Biomass - Brandon	2	91%	88%	86%	Key inputs required adjustment, baseline case mischaracterized
3473322	New Construction	4	97%	97%	97%	Baseline and efficient case mischaracterized, key inputs required adjustment, calculation error

## B. Unregulated Fuels

A sample of projects with savings greater than 50 MMBtu was selected to be reviewed as part of savings verification. Three projects were randomly selected from the CEED tracks and two were randomly selected from the unregulated fuels tracks. Due to the lack of sufficient documentation to calculate estimated savings for the sample of projects, limited analysis could be done on the unregulated fuels projects. Only one of the five sample projects (project id 418878) had enough documentation to review, resulting in a realization rate of 40%. The results of a DPS conducted impact evaluation of the unregulated fuel savings for EVT's HPwES program in 2013 was used to estimate a realization rate of 51% for the remaining projects. Both the HPwES and the projects in the sample achieved savings from shell efficiency improvements, so a similar realization rate is reasonable.

**Table 12: Summary Savings for Sampled Unregulated Fuel Projects**

Project ID	Title	EVT Claimed kWh	EVT Claimed Winter Peak kW	EVT Claimed Summer Peak kW	EVT Claimed Oil MMBtu	DPS Evaluated kWh	DPS Evaluated Winter Peak kW	DPS Evaluated Summer Peak kW	DPS Evaluated Oil MMBtu
422659	Project 1	2,849	0.776	0.513	163.8	2,849	0.776	0.513	83.9
424327	Project 2	298	0.161	0	59.4	298	0.161	0	30.4
428157	Project 3	597	0.322	0	118.9	597	0.322	0	60.9
430025	Project 4	259	0.140	0	51.5	259	0.140	0	26.4
418878	Project 5	-7866	-4.246	0	183.1	-4998	-2.697	0	77.3
Total		-3,863	-2.847	0.513	576.7	-995	-1.298	0.513	278.9

## IV. Adjustments due to Other Verification and QC Activities

Adjustments were also made based on other verification and QC activities, as described below:

- Comparison of EVT claimed savings to TRM assumptions at the measure level
- External evaluations of EVT's programs
- Additional evaluation activities conducted as part of the FCM impact evaluation
- EVT's QC activities

In comparison to the C&I custom site analysis, the realization rate was calculated using all of the relevant measures in the SV13 portfolio rather than selecting a sample and applying the realization rate from that sample to the program savings as a whole. In some cases, the adjustments are based on other evaluation or QC studies, which may have included sampling. However, no additional sampling was conducted as part of this verification.

The components of EVT's portfolio that were verified using these methods are the following: stipulated lighting, upstream initiatives, fleet engine block heaters, and all of the residential initiatives.

### A. Stipulated Lighting

The DPS Evaluation Team has been in the process of conducting separate evaluation activities to estimate the in service rate and accuracy of the underlying assumptions for these projects. This component of the FCM evaluation includes a participant phone survey and an on-site survey. The data collection has been collected and analysis is currently in progress. This evaluation component is expected to be completed in August, 2014.

The information collected through phone surveys for the prescriptive MOP projects was used to estimate the in service rate (ISR) for these projects. EVT MOP participants were randomly selected for the phone survey, using a stratified sample design. The analysis of the telephone data for the retrofit projects has not yet been completed, and the evaluation of the new construction projects will be based entirely on site visits. Consequently, there was insufficient data available to make an adjustment to retrofit and new construction projects at this time.

An analysis of the results from the telephone survey indicates that the ISR for MOP projects is 94%. While the 94% is the best available data at the time of this report, the DPS evaluation team expects that this value will be modified for the FCM impact evaluation as the analysis of the on site survey is completed. A brief review of measure level savings assumptions was conducted and EVT's savings values were compared to the TRM to the extent possible. The primary goal of this review was to verify that EVT was consistently and correctly applying a 98% ISR to prescriptive MOP projects. The results of this review indicated that EVT is applying a 98% ISR for some projects and 100% for others. Due to time and budgetary constraints, the evaluation team was unable to delve deeper into the specifics of how the ISR is being applied. An ISR of 94% was applied to the prescriptive MOP projects. Adjustments were not made to account for an ISR applied by EVT as a review indicates it is not being consistently applied.

The similar approach was used for the upstream initiatives, Smartlights and HVAC equipment replacement. The savings are prescriptive, and part of the verification process consisted of comparing the savings assumptions to the TRM. The specific adjustments are described below.

## B. Upstream Initiatives

### 1. Smartlights

As part of the FCM evaluation, the DPS evaluation team conducted a telephone survey of 76 commercial and 47 residential randomly selected homeowners and businesses who purchased lighting products and received the Smartlight discount from the distributors. The purpose of this survey was to estimate the ISR for Smartlight installations.

The energy savings formula and the claimed kWh savings were used to calculate EVT's wattage reduction by measure type. For most of the lamps the wattage reduction was as identified in the TRM and therefore the only adjustment to the savings was the ISR.

As part of the 2012 FCM evaluation, a telephone survey of Smartlight participants was conducted. The revised ISR that resulted from this survey were applied to the 2013 Smartlight measures. The table below provides a comparison of the TRM in service rates by measure type and the DPS verified in-service rate.

**Table 13: Smartlights ISR Adjustment**

Measure Description	EVT ISR	DPS ISR
LED - Residential	0.870	0.760
LED - Commercial	0.898	0.850
Reduced Wattage CFL	0.900	0.850
Reduced Wattage MH	0.900	0.850
Reduced Wattage T5	0.900	0.850
Reduced Wattage T8	0.900	0.850

For CFL and T8 lamp measures, the calculated lighting wattage was not as stipulated in the TRM. For these lamps, the evaluated savings were calculated using the DPS revised ISR and the wattage reduction identified in the TRM.

### 2. HVAC Equipment Replacement

In previous FCM impact evaluations, the DPS evaluation team has selected random samples of HVAC equipment replacement participants and verified the ISR. These evaluation activities indicate that the ISR for these units is 100%. Consequently, no further efforts were devoted to this aspect of the HVAC initiative.

Comparison to the TRM assumptions uncovered many discrepancies. It was not possible to determine the source(s) of the differences. However, this result is consistent with recent FCM impact evaluations. It appears that EVT's method of applying the TRM assumptions to these measures produces highly erratic results. The adjustments are summarized in Table 14.

**Table 14: Upstream HVAC Adjustments**

Upstream Category	EVT Claimed kWh	EVT Claimed Winter kW	EVT Claimed Summer kW	DPS Evaluated kWh Total	DPS Evaluated Winter kW	DPS Evaluated Summer kW
HVAC	230,774	24	37	151,866	24	28

### C. Residential Initiatives

The DPS concentrated its review on the major components of EVT's portfolio. The Efficient Products Program accounts for 93% of EVT's claimed energy savings in the residential sector, with all of the remaining initiatives (Low Income Single Family, Home Performance, Residential New Construction, and Upstream) accounting for the remaining 7% (approximately 3% of total portfolio savings). Thus, the Department's review focused most intensively on the Efficient Product Program.

#### 1. Efficient Products Program

Energy and demand savings were found to match to the TRM values for almost all entries in EVT's database and only a few discrepancies were found. The measures and per unit savings by measure can be found in Table 15. Upon adjusting these measures to match the TRM values, the total energy savings increased by 6.186 MWh and the kW savings for winter and summer increased by 1.98 kW and 0.52 kW, respectively.

**Table 15: Efficient Products Winter and Summer kW Adjustments**

Measure ID	Measure Description	EVT Per Unit			TRM per Unit		
		kWh	kW Winter	kW Summer	kWh	kW Winter	kW Summer
LFHCNFFX	Compact fluorescent interior fixture, ceiling fan	114.7	0.060	0.118	111.0	0.048	0.013
LFHRDLED	LED Recessed Surface or Pendant Downlight Rx	138.3	0.018	0.035	145.6	0.020	0.037

In addition, energy savings and kW savings from the EVT database for the efficient television category do not match the TRM values. This discrepancy is due to the use of 2012 TRM categories and values, rather than the 2013 TRM categories. The 2012 TRM only refers to LCD or Plasma televisions, while the 2013 TRM is based on ENERGY STAR 6.0 ratings. The difference in categories made it difficult to quantify the adjustment. Given that these measures have an extremely limited contribution to EVT's portfolio, the DPS evaluators did not make any adjustments to these measures.

## 2. Home Performance Program

Prior to SV13, members of the DPS Evaluation Team were engaged to complete a separate impact evaluation of EVT's Home Performance with ENERGY STAR® Program.<sup>7</sup> 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 Home Performance with ENERGY STAR® savings should reflect these impact evaluation results. EVT made a number of improvements to program performance in 2012. Although it is not possible to quantify the results of these changes without further impact evaluation, the DPS and EVT have agreed to apply a realization rate of 60% for unregulated fuels and 86% for electric in acknowledgement of EVT's efforts to improve the program savings. EVT applied these realization rates to PY 2013 projects prior to finalizing the savings claim. Therefore, no further adjustments were required.

## 3. Residential Retrofit Program

During PY 2013, EVT distributed free efficiency kits to residential households. These savings were claimed under the Residential Retrofit Program. These measures are listed in the TRM and the ISR for 2013 was 75%.

As part of EVT's QC process, residential customers were provided with postcards to identify which items were installed; in addition, a phone survey was conducted. These QC activities were intended to assess the validity of the 75% ISR.

The DPS evaluation team reviewed the material provided by EVT and determined that the ISR for the items provided in the kits should be adjusted downward to 49% resulting in a savings reduction of 90,886 kWh, 21 kW of winter peak and 12 kW summer peak. The revised ISR is based on the telephone survey results due to the numerous issues identified with the postcards, as discussed below.

### *Postcard Responses*

Postcards with survey questions were included in the efficiency kits and participants who returned the postcards were entered into a drawing for \$100 gift card. The process for entering the drawing is described on the postcard as follows:

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<sup>7</sup> "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

“All you have to do is...

1. PICK YOUR SAVINGS TARGET (\$61, \$491 or even over \$850 a year.\* Think of what you will do with the money you will save!
2. CHOOSE THE STEPS you’ll take to reach you energy savings goal.
3. RETURN THIS SURVEY for a chance to win \$100!\*\* (Pre-paid envelope included)

....

\* All savings targets shown are annual estimates of potential dollar savings. Your actual savings will vary.

\*\* For more information ....”

While these postcards and the drawing for the \$100 gift card may be a reasonable marketing strategy, it is highly problematic to use the returned postcards to estimate the ISR. Three critical concerns are discussed below:

1. There is likely to be self-selection bias as those participants who returned the postcard may well be more interested in efficiency and more likely to install the measures.
2. The whole construction of the survey questions on the postcard clearly demonstrates that EVT is encouraging participants to take action to improve energy efficiency and participants may be more likely to make socially desirable responses and overstate their actual efficiency actions.
3. Participants may be under the impression, however incorrect, that survey answers indicating the adoption of efficiency actions will improve their chances of winning the prize.

Self-selection bias suggests that the participants who return postcards are not representative of the population of Vermont residents who received the efficiency kits. Socially desirable responses and potential motivation to overstate efficiency actions to improve the chances of winning the prize suggest that those who return the postcards may not be providing accurate responses with a bias toward overstating efficiency installations.

#### *Integrating Phone Survey and Postcard Responses*

Normally, there is no information available to assess the impacts of these effects on the survey results. However, EVT’s combination of postcard and telephone surveys provides an opportunity to investigate these potential sources of bias.

**Table 16: Comparison of Data Collection Methods for the Efficiency Kits**

Type of Survey	Number of Responses	Postcard ISR	Telephone ISR
Postcards	365	85%	
Telephone	28		49%
Overlap with Postcards	9	92%	61%
Telephone only	19		44%

The sample size for the telephone survey and the number of respondents who both returned the postcard and completed the telephone survey are quite small, and thus, it is not possible to come to definitive conclusions. However, these results point to some possible insights into the issues discussed above.

- Comparing the results for participants who responded to both the postcard and telephone surveys, the large difference in the ISR based on the postcard responses (92%) and the telephone responses (61%) suggests that the installation rates from the postcard surveys are substantially overstated.
- The large gap between the ISR for respondents who answered only the telephone survey (44%) and those who responded to both surveys (61%) suggests that there is a difference between the postcard responses and the overall population of participants who received the efficiency kits.

The most defensible approach is to apply the ISR from the telephone responses for postcard responses to the portion of the population that returned the postcards and use the ISR from the telephone only survey responses for the remainder of the population. Given the small sample size for the overlap between the postcard and telephone survey respondents, the best alternative is to apply the ISR from the telephone survey overall (49%).

#### 4. Residential New Construction Program

For prescriptive measures several 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 17. Upon adjusting these measures to match the TRM values, the total energy savings decreased by 22.8 MWh.

**Table 17: Residential New Construction Adjustments**

Measure ID	Measure Description	EVT Per Unit	TRM per Unit	Percent Adjustment
		kWh	kWh	kWh
LFHCEFIX	Compact fluorescent exterior fixture	57.8	45.2	78.2%
LFHCNREC	Compact fluorescent interior fixture, recessed can	32	25	78.1%
LFHCNSUR	Compact fluorescent interior fixture, surface mount	56.3	48.7	86.5%
LFHGENFT	Generic linear fluorescent tube fixture	120.8	96	79.5%

#### D. Other Adjustments

One other adjustment was made to the portfolio, as discussed below. This adjustment was made for all projects with the measure and was implemented by subtracting the amount of the adjustment from

the program reported C&I savings outside of the other adjustments made through the realization rates.

### 1. Fleet Engine Block Heater Timers

The verification of the savings for this measure is based on EVT’s QC efforts, which were reviewed by the DPS evaluation team and found to be sufficient for this purpose. EVT’s fleet engine block heater (EBH) timer program is carried out by subcontractors, who are responsible for installing the subsidized equipment promoted by the program. Because program design calls for direct installation of equipment, EVT based their initial savings claim on the assumption that 90% of timers would be in use, i.e., an in-service rate (ISR) of 0.9. Savings were also based on estimated an average block heater size of 1,500 Watts.

Subsequent quality assurance activities undertaken by EVT found that a combination of factors (including frequent movement of trucks between different parking areas) had led to the much lower ISR of 0.6. Analysis of data on block heater wattage collected by the subcontractor found that the average size of block heaters in use among program participants was approximately 1,200 Watts. Both findings were communicated to the DPS evaluation team, and a revised savings algorithm proposed for inclusion in the TRM .<sup>8</sup>

The DPS evaluation team reviewed the QA sampling, data collected, and subsequent analysis and concurred with the changes proposed by EVT. These changes (reduction of the assumed ISR from 0.9 to 0.6 and the reduction of the assumed engine block heater size from 1,500 to 1,200 Watts ) are to be applied globally to all savings claimed for fleet engine block heater timers in program year 2013.

The combined effect of these changes to the default savings algorithms is a 20% reduction in claimed demand savings and a 47% reduction in claimed energy savings. Due to calculation error in the energy savings algorithm in TRM/Portfolio 85, energy savings for these measures were systematically understated compared to the expected value using the previous assumed block heater wattage and ISR. For this reason, the net change in claimed energy savings is a reduction of only 41%. A portfolio summary of measures, previous claim and corrected claim is given in Table 18 below.

**Table 18: Impact of Global Adjustment to Commercial Fleet EBH Timer Assumptions**

Description	Original Claim				Revised Claim			Percentage Adjustment		
	Qty	kWh	Winter Peak kW	Summer Peak kW	kWh	Winter Peak kW	Summer Peak kW	kWh	Winter Peak kW	Summer Peak kW
EBH Timer, Fleet - Single	681	715,731	344.246	0.000	424,107	183.456	0.000	-41%	-47%	0%
EBH Timer, Fleet - Multiple (4x single)	1	4,206	2.021	0.000	2,491	1.078	0.000	-41%	-47%	0%

<sup>8</sup> Commercial Fleet EBH Memo\_Final.docx, Engine Block Timer TRM Updated\_Final.docx sent 5/13/2014.

## 2. Agricultural Engine Block Heater Timers

As part of the FCM12 evaluation, a project comprised of 711 engine block heater timers that were installed at 278 farms around the state of Vermont was evaluated. These block heaters were offered via a variety of venues, and were often left for the farmer to install. A combination of telephone surveys and on-site metering was used to verify the savings for this project. The realization rates for this project were 10% for the kWh and 2% for the winter demand. This result was partly due to the lower ISR (about 52%), the lower than estimated wattage of the engine block heaters and the lower hours of use during the pre-installation period.

In PY2013, this measure was installed only as direct installation, i.e., the timers were installed at the farm by the EVT contractor. EVT conducted a telephone survey that suggested the ISR and average wattage of the engine block heaters were higher than found in the DPS survey. The DPS reviewed the supporting documentation from EVT, but was unable to fully assess the validity of the results. However, as the program implementation has been changed, the DPS acknowledges that the ISR is likely to be higher. Consequently, the DPS applied an ISR of 75%, an average wattage of 900W and hours of use of 6.6 per day from the DPS survey. The results are provided in Table 19.

**Table 19: Agricultural Block Heater Adjustments**

Measure Description	EVT Quantity	EVT Claimed kWh	EVT Claimed Winter Peak kW	EVT Claimed Summer Peak kW	DPS Verified kWh	DPS Verified Winter Peak kW	DPS Verified Summer Peak kW
Block Heater Timer	186	140,688	81.583	0.00	69,378	22.655	0.00

### E. Comparison to Other Evaluation Activities

Since program years 2007/2008, the DPS has been conducting two evaluations of EVT's savings: SV and the FCM impact evaluation. The SV process is started mid March and completed in early July of the same year (less than four months from start to completion). The FCM impact evaluation is started in May and completed in July of the following year (about 15 months in duration). Due to the time line and scope of work, SV is a paper review process. In contrast, the FCM evaluation is a more rigorous impact evaluation that includes direct measurement for the C&I custom projects.

Comparing the realization rates for these two types of verification activities provides some insights into the potential impacts of relying exclusively on a paper verification for SV. However, the comparison can only be conducted for winter and summer peak kW, as kWh is not required for the FCM impact evaluation and evaluators have not been consistently verifying the kWh for all projects in the sample. Consequently, the results shown in the table below may not be directly applicable to energy savings.

For the peak kW savings, the realization rates from SV and from FCM were compared for program years 2010, 2011 and 2012. For the FCM evaluation, all custom C&I projects were evaluated for PY 2010, but only the census strata of large projects were verified for PYs 2011 and 2012. In the table below, the realization rates for PY 2011 and 2012 include only the census strata in order to be able to make a more reliable comparison.

**Table 20: Comparison of Realization Rates from SV and FCM Evaluations**

	Winter kW Realization Rate			Summer kW Realization Rate		
	SV	FCM	Difference	SV	FCM	Difference
<b>PY 2012</b>						
Retrofit	82%	84%	-2%	86%	77%	9%
NC/MOP	89%	58%	31%	83%	72%	11%
<b>PY 2011</b>						
Retrofit	59%	37%	22%	87%	70%	17%
NC/MOP	76%	66%	10%	77%	60%	17%
<b>PY 2010</b>						
Retrofit	90%	71%	19%	93%	69%	24%
NC/MOP	89%	52%	37%	95%	69%	26%

This analysis indicates that the FCM impact evaluation consistently results in lower realization rates for the kW reduction. The SV realization rate was lower than the FCM in only one of the twelve comparisons, and the difference was quite small (2%). In all other cases, the FCM realization rate was lower, ranging from 9% to 27% lower.

This result is not unexpected. Paper reviews are necessarily limited in scope and the evaluators do not have the opportunity to go on site to see how the efficient equipment is performing. In a number of cases, contacting the participant after the completion of the SV process had revealed that the equipment was no longer in service. These situations are discouraging and EVT has no control over the actions of their participants. However, a realistic estimate of the actual savings achieved by the programs need to take into account the actual operating conditions of the equipment.

## **V. Ongoing Issues to be Addressed on a Prospective Basis**

### **A. Improved Documentation**

Previous verification reports have identified inadequate documentation as an issue that creates an impediment to the completion and validity of the verification process. As a result, EVT was instructed by the Vermont Public Service Board (VPSB) to improve the documentation of projects. In this verification cycle, the DPS evaluation team found that the overall level of documentation was greatly improved. The PY 2013 projects in the sample included either copies of invoices for the installed equipment or an inspection form, which meets the minimal level of documentation requested by the DPS. Additionally, many more projects included pre and/or post metering that not only facilitates the review process but also increases the confidence in the results. There was also a higher incidence of projects with electrical and mechanical plans included in the project folders.

### **B. Verification of Savings Claimed for Upstream Measures**

EVT has increasingly been using a strategy of providing incentives for efficient technology at the market distributor level. Providing incentives to distributors is a potentially effective strategy of increasing the adoption of efficient technology in a cost effective manner. Unfortunately, this added layer makes it substantially more difficult to verify the savings.

First, distributors do not consistently collect information about the eventual installation and use of the product. In the case of lighting technology, such as high efficiency lamps, the product may be purchased directly by the end user and installed in the reported location, purchased and installed elsewhere, or purchased and put in storage for future replacement of existing lamps. Lamps may also be purchased by a contractor for installation at a customer's site or for future sales. In other words, the disposition and use of the product cannot be ascertained through the methods available during the verification process and this adds a high level of uncertainty to the savings claim.

The DPS evaluation team also noticed that EVT reduced the upstream HVAC savings substantially, as they found that a second downstream incentive was also paid for about 40% of the purchased units. Considering that EVT does not necessarily capture all of the units that apply for a second incentive due to the inherent difficulties in identifying the upstream units, 40% should be considered a floor for the percentage of units that have dual incentives. In the case of upstream lighting incentives, where there is not a unique serial number to track a product, the potential for dual incentives and double counting is even greater. An evaluation of the cost effectiveness of the upstream model is recommended to assess this issue.

In addition to the inherent difficulty in tracking the ultimate use of products promoted via upstream incentives, the manner in which data is currently captured in the program tracking data hinders the verification process. The current practice of aggregating quarterly sales volume for all lamps within a given category (e.g., LED screw and pin-based bulbs < 10W) makes comparison with distributor data (typically given by sale date, customer, and product number) extremely difficult. This disconnect between the measures reported by EVT and the information available from the distributors increases the uncertainty of verified savings.

### **C. Overreliance on the 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. Methodologies for many custom applications are now also documented in the TRM. While this provides a helpful reference for common values and assumptions, DPS evaluators note a tendency to cite 'TRM defaults' as justification even on custom project measures where site-specific data should be available. Savings estimates should reflect the best available information about the Vermont market and how specific technologies can be expected to operate in VT homes and businesses.

Assumptions need to have a real world basis and some, such as hours of use, vary wide from site to site. Custom projects involve a high level of customer engagement; as such it is expected EVT has the ability to obtain the site-specific information necessary to make savings estimates as accurate as possible. Future evaluation efforts should continue to test assumptions in the TRM.

### **D. Selective Application of Stipulated Load Profiles**

The DPS has agreed with EVT that the coincident factors for specific applications can be based on the facility coincident factors from results of the C&I Lighting Load Shape Project completed through the Northeast Energy Efficiency Partnership (NEEP).<sup>9</sup> This issue affects the winter and summer peak demand kW reduction; there is no impact on energy savings.

The methodology used in the NEEP study takes into account the variety of lighting uses and operating schedules in each facility type in order to produce average coincident demand reduction factors. In some facilities, EVT continues to apply the stipulated values selectively and applies a higher coincidence to lighting that is known to be operated 24/7. To apply these average factors to the majority of facility lighting, but utilize a different load profile (such as a flat 8760 hours profile when the lighting is expected to be in use 24/7) invalidates the application of average coincidence factors to the remaining measures.

Similarly, applying custom load shapes based on known facility schedules rather than using an appropriate stipulated load profile invalidates the average profile. While estimates may be more accurate for a particular project (if, for example, all lighting schedules are known), removing the facility from the pool of those evaluated using the stipulated profile means the remaining projects (to which the stipulated profile is applied) represent a sample of convenience, which introduces an unknown bias into the overall portfolio results.

Going forward, DPS evaluators are working with EVT to ensure that stipulated load profiles are applied consistently both within projects and across projects.

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<sup>9</sup> Kema. *C&I Lighting Load Shape Project FINAL Report*. July, 2011.

## **E. TRM Lighting Categories**

The TRM relies on grouping lighting measures into wattage categories to estimate savings for a range of lamp wattages. All lamps within a bin are assumed to have the same savings and implicitly there is an assumption that the baseline technology has the same efficacy. In some custom projects where these TRM assumptions were used, the implicit assumption does not result in the efficacy that would be expected as standard practice for the baseline technology.

For example, the assumed baseline efficacy was equivalent to standard incandescent technology for an LED exterior lighting installation. However, at the wattage and lumen requirement of the installation, a metal halide or high pressure sodium fixture would have been the likely market baseline. The LED exterior lighting products in this category extend from 30W to 75W and crosses a technology threshold where there is likely to be an increase in efficacy in the market baseline. If the baseline is unrealistically low for a portion of the measures in the category, the savings will be overestimated.

The TRM needs to accurately reflect savings from current market conditions in order for savings estimates to accurately represent program effects. The wattage bins for lighting products should be reviewed to ascertain where there may be unintended consequences relating to thresholds where the baseline technology would be expected to change.