

**Report to the Energy Efficiency Utility**

**Contract Administrator**

**Verification of**

**EVT's 2007 Claimed Annual MWh Savings,  
Coincident Summer and Winter Peak Savings  
And Total Resource Benefit (TRB)**

**Department of Public Service**

June 19, 2008

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**DPS Verification of  
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**I. Introduction**

On March 1, 2008, Efficiency Vermont ("EVT") submitted its "Year 2007 Preliminary Annual Report and Annual Energy Savings Claim" for calendar year 2007 activities operating as the statewide energy efficiency utility ("EEU"). As provided for in the contract between Efficiency Vermont and the Vermont Public Service Board ("PSB"), the Department undertook a review of EVT's 2007 activities, verifying the energy savings, coincident peak savings and Total Resource Benefit ("TRB") amounts claimed by EVT. This report made to Michael Wickenden, Contract Administrator for the PSB, summarizes the results of that review.

The DPS provided preliminary findings to EVT and the Contract Administrator on May 30, 2008. On June 6, 2008, Efficiency Vermont provided a response to the DPS preliminary findings on items where the DPS recommended an adjustment to the 2007 savings claim. Agreement on savings adjustments was reached for all of the items identified in the DPS preliminary findings.

EVT has indicated it accepts all of the adjustments to the 2007 claimed savings recommended by the Department in this report. In some cases, EVT does not completely agree with the Department's rationale or methodology for the adjustment, and requests that the measure characterizations for 2008 be discussed more thoroughly through the ongoing DPS-EVT TAG process. The Department has also identified several topics to be taken up in TAG process, as outlined in Section III, Issues to be Addressed on a Prospective Basis. Since the parties are in agreement on the magnitude of the 2007 adjustment, the issues and resolutions are briefly described. For more detail about the adjustments, please refer to the Department's May 30, 2008 preliminary findings and EVT's June 6, 2008 response.

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The Department appreciates Efficiency Vermont's position as a leading actor in the state's efforts to improve efficiency. Given the immediacy of climate change, the recent spikes in fossil fuel prices and the increased interest in energy efficiency among all segments of the population, Efficiency Vermont's skill and experience in promoting efficiency is acutely needed.

The results of the Department's verification suggest that the 2007 energy savings claims are overstated by about 2.8%, or 2,183 gross annual MWh, and coincident peak savings are overstated by 4.2%, or 521 winter kW and 5.2%, or 579 summer kW. This

result is a substantial improvement over the 2005 and 2006 verifications. The Department has noted the improvement in EVT's documentation and the positive impacts of EVT's quality control (QC) process. Many of the types of issues previously identified by the Department were flagged and addressed through internal QC.

While continuing in-depth review of the calculation of energy savings, the Department also expanded the focus of the verification of EVT's 2007 claimed saving to encompass a more detailed assessment of the coincident peak demand savings. The verification produced high realization rates for the winter and summer coincident peak that are the net effect of numerous adjustments in both directions. A systematic error with the screening of lighting measures was a major source of error. As EVT and Department move toward more consistent and detailed evaluation of demand savings, the Department expects that these issues will be resolved and the variability in the demand savings will be reduced.

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 energy adjustments also have significant impacts on these other indicators. A few adjustments are targeted primarily at these other indicators, often MMBtu adjustments, or for example, a TRB adjustment related to the overstatement of water savings. When EVT's savings are revised for its 2007 annual report, all of the relevant indicators will be re-calculated.

Similar to the process undertaken for previous verifications, the Department is basing its recommendations on the review of a random sample of C&I projects. This 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. Since the projects under review are reasonably representative of EVT's 2007 activity, the DPS is applying a proportional adjustment to the C&I savings. This sampling and adjustment method should reflect what would otherwise 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 agreed-upon savings as compiled in EVT's Technical Reference Manual (TRM) were correctly applied. This validation process could be easily conducted for the entire data set, obviating the need for random sampling. The remaining initiatives are relatively small in magnitude and the Department primarily reviewed the larger projects with higher savings.

The adjustments recommended in this analysis relate both to individual projects and to methods and tools applying to whole categories of projects. In the C&I sector, the adjustments are distributed throughout the smaller and larger projects. For example, in the BEF initiative, there were a total of thirteen adjustments, evenly divided among the three upper sampling strata. Only the stratum with the smallest projects had no adjustments. The same general pattern holds for the BNC, with one adjustment found in the lowest stratum.

The random sample consisted of 92 C&I projects covering the range of EVT initiatives in this sector. The Department is recommending adjustments based on twenty-six of these projects. The remaining projects fall into three categories: 1) no problems were identified, 2) the problems were such that the Department concluded they could be addressed on a prospective basis or 3) there was insufficient documentation to determine if the savings estimates are reasonable. In addition, ten multifamily projects were reviewed,

including the two largest projects and eight randomly selected from the remaining projects. Adjustments were made to two of the projects and a realization rate was calculated for this sample. The sampling and adjustment process is described in more detail under “Sampling Methodology.”

**Table 1: Summary of Adjusted Projects**

	Total # of Projects	# of Projects in Sample	# of Projects with Project-Specific Adjustments
BNC	383	20	6
BEF Custom	124	39	18
BEF Prescriptive <sup>1</sup>	657	33	0
Multifamily	124	10	2
Totals	1,062	102	26

The adjustments to gross annual savings and coincident peak reductions for all initiatives are summarized in Table 2. The relative precision for the realization rates associated with the custom Business Existing Facility (BEF), prescriptive BEF, Business New Construction (BNC) and multifamily projects is 6.3%, 5.9%, 5.9% and 13.3% at the 90% confidence level, respectively.<sup>2</sup>

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<sup>1</sup> The sampling for the BEF prescriptive track was done at the measure level and 34 measures in 32 projects were selected.

<sup>2</sup> The relative precision is calculated for the higher of the winter or summer peak reduction by project, which was the sampling variable.

**Table 2: Adjustments by Initiative**

	# of Projects	Energy Saved		Winter kW Reduction		Summer kW Reduction	
		MWh Adjust-ment	% Adj	kW Adjust-ment	% Adj	kW Adjust-ment	% Adj
<b>C&amp;I</b>							
BEF Top 10	10	409	4.2%	164	13.2%	74	6.1%
BEF Custom	351	1,450	10.3%	205	9.4%	209	9.9%
BEF Pres Top 4	4	0	0.0%	1	7.0%	0	0.3%
BEF Prescriptive	653	0	0.0%	-40	-15.6%	-34	-9.7%
BNC Top 5	5	98	3.1%	71	14.8%	177	27.2%
BNC	115	109	2.3%	73	11.2%	117	10.8%
Subtotal	1138	2,065	6.2%	475	9.8%	543	10.0%
<b>Residential</b>							
Multifamily RNC/REB	121	21	0.6%	18	3.5%	2	0.5%
LISF/REM		77	2.8%	28	4.6%	2	1.1%
EP		20	0.1%	0	0.0%	31	0.6%
RNC Single Family		0	0.0%	0	0.0%	0	0.0%
Subtotal		118	0.3%	46	0.6%	36	0.6%
Totals		2,183	2.8%	521	4.2%	579	5.2%

The DPS thanks the many staff members at Efficiency Vermont who coordinated the verification review process this year, in particular, Bill Fischer and Erik Brown. The remainder of this report is divided into four sections. Section II briefly describes project and measure-level issues that provide the basis for the adjustments shown in Table 2 above. In Section III, we discuss specific issues with program year 2007 (PY07) projects and other concerns to be addressed on a prospective basis. The final section describes the sampling methodology in more detail.

## II. Project- and Measure-Level Adjustments

### A. Cross-Program Adjustments

#### 1. Coincident Peak Demand Reductions

EVT's screening tool automatically adjusts the coincident peak demand reductions (both summer and winter) proportionally according to the relationship between the actual hours of use and the hours of operation used as the underlying foundation of the load profile. In addition, EVT's CAT tool adjusts the maximum KW load reduction for lighting measures installed in air conditioned areas or in refrigerated areas to account for the waste

heat factor. For the air conditioned areas, this adjustment (cooling bonus) only applies to the summer coincident peak, and the higher maximum KW load is offset by modified load profiles that reduce the winter coincident peak accordingly.

The scaling of savings is not necessarily appropriate as an across-the-board reduction since the impact of longer hours on the coincident peak savings depends on many site-specific factors. For example, a manufacturing facility that operates more than 3,200 hours per year (5 days a week, 12 hours a day) would be in operation during all of the peak hours (5:00 to 7:00 PM on weekdays in December and January and 12:00 to 5:00 PM weekdays during the summer months). Consequently, running more hours would not result in an increased probability that the equipment would be running during the peak hours.

Adjusting to correct the issues above creates another discrepancy. For lighting measures with the cooling bonus, the connected load is increased by 34% (custom measures) to ensure that the energy savings are correctly calculated. When the actual hours of operation are higher than the assumed hours used in the load profile, the screening tool then increases the coincident peak, but not to exceed the value of the connected load reduction. However, since the connected load has been increased to account for the cooling bonus, the winter coincident peak reduction could be up to 34% greater than the actual connected load reduction.

The Department has identified specific measures to be corrected both for the overstatement of maximum kW load for lighting measures with the cooling bonus and for the scaling of the coincident peak reductions (where appropriate). The Department's recommended adjustments are summarized in Table 3 below. Negative values indicate a reduction in the claimed savings. These adjustments result in an increase in peak savings for the BEF prescriptive track, mostly due to the lower hours of use assumed for these projects. The adjustments for both the BEF custom and BNC initiatives result in a net reduction in the coincident peak savings.

**Table 3: Coincident Peak Corrections**

Market Sector	Stratum	Winter Coincident Peak Reduction			Summer Coincident Peak Reduction		
		EVT Claim (KW)	DPS Revised Savings (KW)	DPS Adjust-ment (KW)	EVT Claim (KW)	DPS Revised Savings (KW)	DPS Adjust-ment (KW)
BEF Custom	1	4.05	3.24	-0.812	6.08	4.86	-1.22
BEF Custom	2	19.00	17.49	-1.514	19.00	18.03	-0.97
BEF Custom	3	149.46	98.13	-51.332	175.14	142.86	-32.28
BEF Custom	4	529.48	444.30	-85.181	620.03	545.84	-74.19
BNC	1	1.23	1.02	-0.217	0.88	0.82	-0.06
BNC	2	19.39	15.60	-3.790	30.92	25.60	-5.31
BNC	3	8.53	7.08	-1.455	8.02	6.66	-1.36
BNC	4	248.81	180.42	-68.393	288.79	215.75	-73.05
Prescriptive	1	1.07	1.25	-0.181	1.97	2.02	0.05
Prescriptive	2	9.72	14.77	-5.052	15.41	20.08	4.67
Prescriptive	3	29.18	34.43	-5.247	45.60	47.53	1.93
Prescriptive	4	14.81	13.39	1.417	23.22	23.08	-0.14

**B. Business Existing Facilities: Custom**

**1. Snowmaking**

**a) Snowmaking Rebuild**

Project ID: J00000285378

MAS 90 Project: 6012-8269

Stratum 3

EVT provided assistance to rebuild 50 out of an existing inventory of 100 Ratnik Baby Snow Giant snow guns. The ski area planned to use these guns when they needed to make snow and conditions would not allow the use of the more efficient tower guns they had previously purchased. EVT provided an incentive that covered half of the cost of the snow gun retrofit. The Department is concerned about the high degree of uncertainty associated with numerous aspects of this project, as mentioned below.

- The efficiency attained by retrofitting this snow making equipment is in the same range as the efficiency of other snow guns that EVT considers baseline

equipment. The installed snow guns are far less efficient than the high efficiency fan and tower guns available on the market.

- Since only half of the guns were rebuilt, it is likely that some of the inefficient guns will be used when conditions require it.
- EVT was involved in commissioning a third-party report, and it projected a one year payback for this measure versus a 5.2 years payback if the resort upgraded to efficient snow guns. There is no evidence that other efficient options, such as portable fan guns, were considered.
- It appears that EVT is providing incentives for a measure that results in baseline operation. The resulting increase in investment payback period to move to a more efficient unit discourages investment, possibly leading to an overall, longer term increase in energy consumption.
- While EVT contends that the ski area requires these particular guns for specialty applications, EVT's savings claim assumes the guns will be used for 157 hours per year, almost as much as the 200 to 250 hours often cited by ski areas as a standard amount of service hours for an individual gun.
- EVT has also applied the 10% freeridership rate that is stipulated for snow making pumping, piping and fan gun projects rather than the 50% freeridership rate applied to the air water tower guns. Considering the low investment and potential short payback period (less than one year), it seems that the higher 50% rate should apply.

In addition, EVT could not provide any written documentation that they were involved in this project prior to its completion.

The Department has adjusted EVT's savings to reflect 90 hours of operation per year and the 50% free rider factor, resulting in a reduction of 213,347 gross annual kWh and 32.823 winter coincident peak KW. This adjustment includes the change in the free rider factor.

**b) Snow Making 2007**

EVT Project ID: J00000268577

MAS 90 Project: 6012-7877

Strata 4

This project involved the installation of 52 low e guns and 102 fan guns in order to upgrade the snow making system such that the ski area could make more snow in less time. EVT considered the resort's production schedule in the process of reviewing the savings for this project. The Department is pleased to see that EVT is beginning to analyze snowmaking using more of a whole system approach and encourages EVT to expand on this approach to continue to provide robust analysis.

However, this project was categorized as a retrofit; it is clear that the ski area's goal is to make more snow earlier in the year. As was explicitly stated on a ski industry web site, this project was not done simply to retrofit old inefficient equipment but also had major operational goals that could not be met with the existing equipment. In addition, the baseline equipment cannot be used for expanding snow making in the early winter season due to the high compressed air requirements. Thus, the baseline equipment is inadequate

and would not satisfy the production goals. This situation clearly indicates that these projects are not truly retrofit, but rather market opportunity, thus the baseline equipment should be the standard snow guns currently available on the market.

The Department revised the baseline to reflect the average performance of available air/water guns excluding the K2000/K3000 guns. This baseline change decreases energy savings by 513,840 kWh/yr, and the winter coincident peak savings by 79.05 KW.

**c) Snowmaking 2006**

EVT Project ID: J00000224723

MAS 90 Project: 6012-5727

Stratum 3

This ski area installed eight new fan guns to replace thirteen old fan guns and to reduce the use of existing air/water mixing guns (primarily Ratnik and Royal Rogers guns). Three of the older fan guns were in working condition. Savings are based on replacing air/water guns with the eight new fan guns, which are expected to be in use 200 hours per gun per year.

The Department agrees with EVT's position that little or no savings can be claimed from replacing dead or dying fan guns with new fan guns with similar performance. EVT did not fully account for the new fan gun capacity that will replace existing fan gun capacity as the savings are based on the assumption that the fan guns will replace air/water guns. While EVT reduced the expected hours of operation from 250 to 200 hours, the analysis did not explicitly take into account that at least three of the new guns were replacing existing fan guns.

The DPS has reduced the savings claim by 22% to account for the fan gun capacity that replaces existing fan guns. This adjustment results in lowering energy savings by 14,879 kWh/yr and winter coincident peak savings by 7.15 KW.

## **2. Lighting**

**a) Wholesale Distributor**

EVT Project ID: J00000220083

MAS 90 Project: 5016-6012

Stratum 4

Measures: All Occupancy Controls Measures

EVT assisted in retrofitting all of the lighting in this large warehouse facility. Previously lighting was uncontrolled and operating throughout the year. This inefficient lighting was replaced with high-bay T5 and Super T8 fluorescent fixtures and many of the fixtures were equipped with occupancy sensors set to shut the fixture down after 20 minutes of inactivity. EVT assumed the occupancy sensor strategy would reduce the fixture operating hours by 30% during normal operating hours. The strategy of combining efficient lighting and occupancy sensor in a warehouse facility is proving highly effective and resulted in a projected reduction of almost 3 gigawatt hours.

This facility is a major distribution hub and is in use all hours of the year. However, the weekly schedule includes a minimal staffing and activity level from sometime on Saturday afternoon until 4PM on Sunday or approximately 24 hours. The 30% reduction in run time is a reasonable estimate during times of normal activity, but is likely an understatement during the 24 hours when the facility is not receiving and shipping goods. During this period it would be reasonable to expect the lighting to be switched off 80% of the time. Assuming a 30% reduction for six days a week and an 80% reduction on the seventh day results in an overall reduction in lighting run time of approximately 37%.

Electricity (kWh) savings for occupancy sensor measures placed on lights with continuous use in the pre-installation period should be increased by 23.8% or 121,804 kWh/yr. As this increase is entirely associated with off peak hours, the energy savings and not the coincident peak reductions should be adjusted.

**b) Manufacturing Lighting Retrofits**

Project ID: J00000219423 & J00000207593  
MAS 90 Project: 6012-4971& 6012-4154  
Stratum 4 & Stratum 3

In each of these projects, EVT assisted in retrofitting the lighting systems. Project 6012-4971 consisted of replacing 441 Metal Halide fixtures with an equivalent number of 4 lamp T5 HO. The company is a two shift printing operation and the lighting schedule while operating is from 6AM to 12 midnight. In project 6012-4154, EVT assisted in the replacement of 110 HPS fixtures with T5HO High Bays in the production area at this facility. The production area operates on average 12 hours per day 6 days per week. EVT has not documented yearly variation in operating hours due to vacations and planned shutdowns.

EVT, in each case, assumes that the company does not close for any holidays or vacation. It is common practice to base savings on 50 weeks a year allowing for one week of holidays and one week of vacation shutdown. Many businesses also shut down for a period of time in the summer or have a business cycle that requires increased hours for a portion of the year. Where possible, EVT should document operating schedules for lighting taking into account planned holidays, vacation schedule and any other periodic cycles that affect operating hours.

The DPS has made some assumptions for the facilities listed here to account for scheduled holidays and vacations. The Department has adjusted the energy savings as detailed in the table below. Fossil fuel savings should be reduced according to the reduction in the energy savings. No adjustment to the coincident peak savings is warranted.

**Table 4: Manufacturing Retrofit Lighting Adjustment**

MAS Project ID	Assumed Holidays and Vacation	EVT Hours of Operation	Revised Hours of Operation	EVT Annual kWh	Revised Annual kWh	Annual kWh Adjustment
6012-4971	10	4680	4500	443,734	426,667	17,067
6012-4154	10	3744	3624	164,106	158,847	5,259

### 3. Plastic Injection Molding Machines

#### a) Injection Molding Project #1

EVT Project ID: J00000267868

MAS 90 Project: 6013-7862

Stratum 1

This company installed a 100-ton electric injection molding machine (IMM). EVT calculated savings by comparing measurements from a baseline hydraulic IMM to those from an energy-efficient electric IMM, incorporating an estimated 85% uptime. However, the kW data from metering, by itself, does not provide sufficient information to accurately model savings. For example, critical information is missing for the electric machine, the metering of the electric machine included days during which the machine was not in use, and the metered data for the baseline machine contains zero values. Since the metered data still provides the best basis currently available for estimating savings, the Department adjusted the results to account for some of the discrepancies and revised the calculation of average energy efficient power draw accordingly.

Additionally, the savings calculation is based on full operation of a hydraulic machine and this assumption leads to an implicit 89% uptime for the electric machine. It is standard practice to base savings on the production of the energy efficient equipment. This approach requires reducing the hours of the electric machine to 85% and adjusting the baseline hours accordingly. The Department revised the runtime to 7,446 hours for the electric machine.

The Department reduced the claimed energy savings by 9% or 5,149 annual kWh and 0.588 kW for both winter and summer coincident peak demand.

#### b) Injection Molding Project #2

EVT Project ID: J00000226243

MAS 90 Project: 6013-6051

Stratum 2

This project involved the installation of one 390-ton all-electric injection molding machine (IMM). The savings calculation is based on metered data for both baseline and energy efficient (electric) machines. During the metering, the test machines ran a mold

with a 240-second cycle time. The savings calculation is based on 4-1/3 days of operation per week or 5,200 hours per year.

Customer-supplied data in the file provided information on downtime by machine. The average of all machines is about 50% while the most productive machines show 88% uptime. Since electric machines tend to be more productive than average, a reasonable assumption for uptime for the electric machine should be in the range of 70%. EVT appears to have deducted 208 hours from the operating schedule of the machine and the DPS assumes this deduction accounts for yearly holiday and vacation shutdowns. However, EVT does not seem to have realistically accounted for machine downtime.

The Departments reduced the claimed savings be reduced by 32,448 annual kWh, 3.71 winter peak kW and 5.20 summer peak kW, to account for 70% uptime.

**c) Injection Molding Project #3**

EVT Project ID: J00000240767

MAS 90 Project: 6013-7232

Stratum 2

This project involved the installation of a 500-ton electric IMM. EVT assumed that the machine would operate 5,944 hours per year in the 5 day a week, three shift facility or approximately 95% of the possible hours.

EVT has assumed an optimistic runtime for the new machine and failed to reduce operating hours at the facility for holidays and vacation time. This project was selected for a site visit where it was determined that the plant closed for 9 holidays and tried to schedule a vacation shutdown the first week of July. It was further reported that the electric machines were achieving an uptime of 90%. Applying this information to the hours of operation, assuming 12 shutdown days to account for holidays and an erratic one week vacation shutdown as well as a 90% uptime for the machine reduces the hours of operation to 5,357.

The Department modified the operating hours to account for both planned facility shutdowns and machine downtime, resulting in a downward adjustment of 13,781 kWh per year and 2.202 kW to both summer and winter coincident peak savings.

**4. Other Projects**

**a) Insulation**

Project ID: J00000268466

MAS 90 Project: 6012-7872

Measure: Insulation

Stratum 2

This project involved insulating an outside air cavity and ceiling area of a museum building. EVT assumed that the existing wall and ceiling area assemblies both had an R-value of 3 and also claimed substantial savings for the reduction of air infiltration on the assumption that the insulation would constrict the air flow.

The DPS found two issues with the calculations: 1) the R-value of the concrete was understated and 2) the air infiltration savings were not properly supported. Infiltration reduction is difficult to predict and a blower door test is the primary method of estimating savings. EVT did not directly measure the air changes and apparently based savings on professional judgment. Given that concrete construction is not common in Vermont and the characteristics of this type of construction are substantially different from more standard construction techniques, the Department believes it is particularly important to support professional judgment with direct measurement.

The savings should be reduced from the EVT claim of 38,413 kWh to 27,972 kWh and the coincident savings should be adjusted proportionally, representing a reduction of 10,441 gross annual kWh, 2.741 kW winter coincident peak, and .022 kW summer coincident peak.

**b) Transformers & Heating**

EVT Project ID: J00000227579

MAS 90 Project: 6012-6352

Stratum 3

Measure M00001010244 - Transformer measure

This project removed several old transformers from service. This building previously housed a heavy industrial customer. After being vacant for several years, it was converted to light industrial use. The original idea as proposed was to remove 7 old transformers and install one transformer appropriately sized for the new loads. The facility was sold and the new owner opted for an alternative strategy. Instead of eliminating all seven and replacing them with one new unit, three of the originals were re-circuited to serve the entire facility. EVT estimated savings from the re-circuiting of the transformers based on the recorded demand load over the period that the facility was vacant.

The energy savings are based on the lowest measured demand over several years of vacancy. However, it is quite possible that there was some electrical load in the building during this period. For instance the building was being marketed and security and exit lighting would have been in use. Savings would more reasonably be based on a standard 0.4% no load loss from the transformers, as is consistent with the worst-case scenario from the DOE Design Lines.

EVT also assumed a measure life of 10 years. Considering that the project resulted in the retrofitting of the older transformers rather than the installation of newer equipment a 10 year measure life is overly optimistic. The Department modified the assumptions to a shorter measure life (3 years) and savings based on expected 0.4% no-load losses for the eliminated transformers. These changes reduce the savings claim by 66,757 annual kWh and both the summer and winter coincident peak savings by 7.62 kW each.

**c) Process Cooling System Upgrade**

EVT Project ID: J00000227093

MAS 90 Project: 6012-6218

Stratum 3

This project installed a new cutting oil cooling system with an evaporative fluid cooler and Heat Exchanger to provide process cooling water at about 85F, eliminating the need to run a Thermatrol open belt-drive air-cooled chiller with a 50 hp compressor.

The Department modified the estimation of savings associated with the cooling tower and with the pumping. For the cooling tower, the scope of work indicates a cooling load of approximately 50 tons or 600,000 Btu/hr and the measured energy use of the pre-retrofit system would seem to corroborate this load. However, the electric usage of the proposed system is based on an average cooling load of about 100,000 Btu/hr. The savings from pumping seem to be based primarily on reducing the differential pressure required of the circulating oil pump(s) with an added benefit of increased pumping efficiency. Specific gravity should have been included in the calculation.

Revising the cooling tower model for a 600 MBH tower and including specific gravity in the pumping calculation reduces the savings from 342,434 kWh/yr to 298,864 kWh/yr, for a net reduction of 43,570 annual kWh and 4.65 kW for both the summer and winter coincident peak.

**d) Dust Collector**

EVT Project ID: J00000273168

MAS 90 Job: 6013-8011

Stratum 1

This project involved a new dust collector for a wood/foam cutting operation, resulting in the installation of a premium efficiency motor and VFD on a Donaldson-Torit DF03-24 with a 30 hp blower motor. Blast gates were used to control the vacuum as needed. The VFD is to slow the motor down when less vacuum is needed. The savings calculation uses a manufacturer's fan curve and estimates the savings based on riding the curve in the base case; the efficient case is based on maintaining minimal pressure based on the required flow. Fan efficiency versus cfm is expected to remain the same at different frequencies.

Typically the VFD on a system such as this would maintain a constant pressure differential. Thus, the static pressure of the fan would be set and would not vary as a function of flow, as EVT assumed. Also, the fan efficiency would not be a constant function of cfm but rather would vary with frequency. The Department revised the energy savings to account for variable fan efficiency and constant 10" total static pressure.

There are no demand savings claimed for the VFD measure, which seems to be excessively conservative. The Department estimated the average demand savings and applied the coincident peak factor of 0.95.

The Department decreased the claimed energy savings by 8,604 kWh/yr, and increased the coincident peak demand savings by 3.113 kW for both summer and winter.

**e) Elementary School**

Initiative: BEF  
EVT Project ID: J00000210114  
MAS 90 Job: 6012-1573  
Stratum 2  
Measures: M00001076077

This project includes a fuel switching measure for switching out the school's 30 year old electric cooking equipment with Energy Star propane cooking equipment, as well as lighting and other efficiency upgrades. EVT bases its analysis on metered data from a day where the school prepared brown bagged lunches instead of using the cooking equipment. The school used 223 kWh less energy that day and 23 kW less demand because of the reduced kitchen load.

EVT assumed that on a regular day with cooking equipment in use, the dishwasher would use about 50 kWh and 20% of the demand, and that the rest of the energy and capacity savings is from the cooking equipment. There is no mention of exhaust fan use, which would also be expected in a school kitchen. Furthermore, EVT's calculation assumed the school kitchen is in operation 200 days per year of school in their analysis, whereas there are 175 days in the VT school year and a certain number of the 175 days are half days with brown bag lunches.

Since the winter coincident peak occurs from 5:00 PM to 7:00 PM, there should be no coincident winter peak hours of operation for this measure. Likewise, given that the school's kitchen is closed for most of the summer and lunch clean up is likely to be completed by 2:00 PM, there is probably not much overlap with the summer hours of coincident peak (1:00 to 5:00).

The DPS adjusted EVT's savings based on the assumption that there is indeed an exhaust fan in the kitchen and that it was not in use the day of the metering. The DPS further adjusted EVT's savings to account for the school's operational schedule. In aggregate, the adjustment result in a reduction of 5,450 annual kWh, 10.267 winter peak KW and 12.842 summer peak KW.

**f) Lumber - CAS**

EVT Project ID: J00000254167  
MAS 90 Job: 6013-7544  
Stratum 2  
Measures: M00001022948, M00001022949, M00001022950

This lumber company recently had a significant electric rate increase and pursued this project in an effort to reduce their usage enough to move into a more favorable rate category. They installed a new, more efficient air compressor, started using gas-driven air compressors on Fridays, installed a new humidistat-controlled twin-tower desiccant dryer, and reduced compressed air leakage. A brief description of the methods used is given below.

- The savings for the new air compressor were calculated by measuring the power to the existing compressor for 2 weeks and developing a load profile from the kW measurements.

- The analysis of the gas-fired compressor was based on the average load that the new electric compressor would otherwise be expected to draw.
- The dryer savings were estimated from the reduced purging at part-load and on hours when the outside air has a sufficiently low dewpoint that no drying would be necessary.
- The savings from the leakage reduction was estimated as a percentage of compress air consumption.

There are a number of small discrepancies in the analysis for this project that affect each of the four measures listed above. Metering data were used to estimate the savings for the new air compressors. The metering period incorporated startup and shutdown for each of three days, representing reduced time rather than reduced energy use during these metering intervals. Because a modulating compressor is so inefficient at low loads, these six points (out of 118) accounted for about 20% of the savings. However, there are no real savings during these periods.

The analysis of the gas-fired compressor did not account for the increased gas use of running a gas compressor on Fridays. There are no representations of MMBtu additional use in the CAT tool or in the database, although the Project Overview lists 49 MMBtu per year. The Department recalculated the MMBtu impacts and concluded that the additional gas use will be about 66 MMBtu per year.

The calculation for the dryer is based on the erroneous assumption that the dewpoint does not change with pressure, leading to the conclusion that there will be no need to purge moisture from the compressed air whenever the outside air dewpoint is less than 10 °F.

In addition, when the Department recalculated the savings from the efficient compressor, it revised the compressor load, which affects the savings associated with the leakage reduction. These changes resulted in an energy savings be reduction of 10,149 annual kWh, and 1.937 and 3.255 kW of winter and summer coincident peak, respectively. The Department estimates the increased gas consumption to be 66 MMBtu per year.

**g) Efficient Washing Machines**

EVT Project ID: J00000216679

MAS 90 Job: 6013-4747

Stratum 1

EVT claimed savings for the installation of an efficient washer in a shared laundry. The baseline modified energy factor (MEF) of .817 and the water factor (WF) of 13.3, used to calculate savings, represented a 1995 federal standard. The federal standard that applied at the time of the project required manufacturers to produce machines with an MEF of 1.26 beginning January 1, 2007. However, since the machine was purchased for this project in March of 2007, the previous federal minimum of 1.04 MEF and 11 WF is what would reasonably be available on the market at the time. The DPS also assumed that the baseline should be slightly higher than federal standards to more accurately reflect what would be purchased outside of the program. In this case, an MEF of 1.1 and a WF of 11 seem appropriate.

Correcting for the MEF and WF reduces the energy savings to 381 annual kWh, a reduction of 347 kWh, 0.052 winter peak kW and 0.147 summer peak kW, with a corresponding reduction in water savings of 2.08 ccf/yr.

**h) High School - VFD's**

EVT Project ID: J00000287774

MAS 90 Project: 6012-8341

Stratum 2

EVT assisted with efficiency upgrades to reduce the energy use of the HVAC systems at the school. Time clocks were installed on seven motors and VFDs were installed on eight pumps and fans. The fuel savings for the time clocks were based on avoiding heating the full flow of ventilation air up to 75°F when the space is unoccupied and the outdoor air temperature is below the balance point of the building.

EVT's analysis assumes a constant indoor temperature throughout the unoccupied and occupied periods. It seems reasonable to assume some setback during the unoccupied hours and the Department recommends using 67°F as a reasonable estimate. The electric savings for the VFD measures assumes load factors of 75% while the time clock measures assume a load factor of 80%. In the absence of more detailed information, 65% would be a more reasonable assumption.

For the time clock measures, the Department would expect full peak demand savings in the winter and very little savings in the summer. The time clock would normally be set to turn equipment off at 4 pm and the summer peak is until 5 pm (1 hour out of 4). The time clock will only impact demand during the time school is in session, which is approximately one month out of three. Therefore, the summer peak savings would be  $\frac{1}{4} * \frac{1}{3}$ , or  $\frac{1}{12}$  of the connected load reduction for most of the time clock measures. There should be no summer peak demand savings for the gym or locker room as they run past 5 PM.

The Department decreased the MMBtu fuel savings for the time clock measures by 286 MMBtu per year to account for adjusting the setback temperature. The energy savings for the VFD's and time clocks are reduced by a total of 30,751 annual kWh to account for the lower load factors. The Department also adjusted the summer and winter peak demand savings as shown in the table below.

**Table 5: High School VFD Demand Adjustments**

		EVT Database			DPS Recommended			DPS Adjustment	
			Winter	Sum		Winter	Sum	Winter	Sum
Measure	Description	kW Load	kW	kW	kW Load	kW %	kW %	kW	kW
M00001126770	Tech center SF	1.82	1.09	0.08	1.63	100%	8%	<b>0.53</b>	<b>0.06</b>
M00001126771	Mini gym SF	3.04	1.82	0.13	2.71	100%	8%	<b>0.89</b>	<b>0.10</b>
M00001126772	Main gym	14.19	4.72	2.72	10.58	100%	0%	<b>5.85</b>	<b>-2.72</b>
M00001126773	Lockerroom SF	1.95	0.65	0.19	1.63	100%	0%	<b>0.98</b>	<b>-0.19</b>
M00001126775	Music room	3.04	1.82	1.69	2.71	100%	8%	<b>0.89</b>	<b>-1.46</b>
M00001126776	Auditorium	5.93	3.55	3.29	5.29	100%	8%	<b>1.73</b>	<b>-2.85</b>
	Total		16.40	9.27				<b>10.87</b>	<b>-7.06</b>

**i) Plant Chiller**

EVT Project ID: J00000233220

MAS 90 Job: 6013-7055

Stratum 2

This project installed a new high efficiency Trane 250 ton air cooled chiller replacing 3 older 40-ton chillers and relegating 3 @ 60-ton chillers to backup status. This chiller serves both HVAC loads and process loads. The winter coincident peak savings are estimated based on the cooling load profile.

In the savings calculation, the process load is assumed to operate 5 days a week but the AC load is assumed to be independent of the day of week. While the conduction component of the AC load is independent of day of week, the ventilation and internal loading components should be greatly reduced. The process load is figured at 24 hr/day, 5 days/wk, 52 wk/yr with an implicitly assumed uptime of 100%.

In addition, since the chiller operates year-around to satisfy the process loads, the cooling load profile would understate the winter coincident peak savings for this measure by a wide margin.

The Department's adjustment is a reduction to account for downtime and for reduced AC load on the weekends. Down-time of approximately 10-15% would be expected. Assuming the AC load would be reduced on the weekends by half results in approximately a 14% reduction in savings. Considering the cumulative affect of these two factors, the Department reduced the energy savings by 25% or 30,969 kWh/yr. The winter kW savings should be increased from 0.05 to 8.48 kW to more accurately reflect the savings from the process only load.

## **C. Business New Construction**

### **1. Assembly Plant/Office**

EVT Project ID: J00000230551

MAS 90 Job: 6014-6690

Stratum 3

Savings estimates for this Act 250 project were provided for the measures installed, including several RTUs, the heat recovery ventilation, the lighting (including daylighting controls and occupancy sensors), dual enthalpy economizer controls, and a “Kone EcoSpace” elevator. The Project Overview file indicated that a space-by-space LPD was performed and measures updated in the CAT tool.

Documentation in the on-site project file is insufficient to properly verify the savings associated with the efficient “Kone EcoSpace” elevator. The actual source for the estimates appears to be a vendor-provided calculation comparing the efficient elevator to a typical hydraulic option. While this document can be found in the project file, two such estimates are provided and the assumptions used to determine the savings are not transparent. In the absence of additional information, the DPS applied the lower of the two vendor estimates.

EVT specified some lighting fixtures as continuous use (8,760 hrs/yr). Given that this facility appears to have a one-shift operation, the Department reduced the hours of use to 3,000 hours of operation per year for selected applications.

The DPS reduced the annual energy savings for the Kone EcoSpace elevator from 4,817 kWh to 2,133 kWh, with a proportional adjustment to the demand savings. The DPS also reduced the energy savings claims for the continuous lighting by 6,875 annual kWh. The total reduction comes to 9,559 annual kWh, 9.907 winter KW and 10.452 summer KW.

### **2. Pharmacy**

EVT Project ID: J00000234367

MAS 90 Project: 6014-7063

Stratum 3

This project is a 14,600 SF new pharmacy that fell under Act 250 review. The resulting scope of improvements includes three RTUs, four economizers, and several lighting measures. Upon review of the project communications, background information, CAT tool, and master file, there does not appear to be a correlation between the total claimed project savings and the savings as calculated in EVT's LPD tool. EVT's documentation as detailed in the LPD tool supports lower savings than the claimed values.

The Department adjusted the savings to be consistent with the documentation provided by EVT. This adjustment results in a reduction of 7,911 gross annual kWh savings, 1.838 winter peak KW and 2.757 summer peak KW.

### **3. Commercial – Gut Rehab**

Initiative: Business New Construction

EVT Project ID: J00000209501

MAS 90 Project: 6014-4225

Stratum 3

Measures: M00001086664, M00001074781, M00001074779

EVT assisted with multiple efficiency measures including lighting, HVAC, motors and controls in this mixed-use commercial and multifamily building.

The mechanical ventilation savings occur by using two smaller systems to meet the ventilating needs of the mixed used building instead of one larger, over-sized system. For this measure, it is assumed that the base case and the efficient cases are both running 24/7. For capacity savings, EVT takes the 67,625 kWh savings and divides by 5,870 full load hours. The claimed winter and summer coincident peak reductions for this measure were 8.399 and 7.7824 kW, respectively. For the mechanical ventilation, the maximum kW reduction cannot be higher than the energy savings divided by the hours of operation, which are 8,760 for this system resulting in peak kW savings of 7.7197.

Motor timer controls savings result from installing timer controls to shut off the larger ventilating system at night and only running the smaller system. Given the operating schedule of the motor timer controls, the coincident peak savings should be zero since the system is assumed to be running at full capacity during the daytime and early evening hours.

Savings for the custom motor result from using a smaller, 5 hp fan most of the time to meet the A/C ventilating needs for this building instead of a 15 hp fan. According to the bin analysis, the system operates a total of 2665 hours, so at maximum the capacity savings should be the 22,638 kWh savings divided by 2665 hours resulting in capacity reduction for this measure of 8.495 kW instead of 22.638 kW. The bin analysis shows that approximately 39 hours require the use of the larger fan during the warm months. Those 39 hours are likely to occur during peak summer hours and the summer peak coincident savings should be adjusted accordingly.

The DPS adjusted the savings for this project downward by 5.974 winter coincident peak kW and 16.481 summer coincident peak KW. No adjustment is recommended for the energy savings.

### **4. VSB Helicopter Facility**

Initiative: BNC

EVT Project ID: J00000016135

MAS 90 Project: 6014-1604

Measure: M00000987345 Comprehensive Building Commissioning

Stratum 4

This project is a LEED Green building design project. Savings are based on TRACE building model of multiple efficient building systems. The assumptions appear reasonable for a building of this size and nature. It appears that EVT used significant internal review of this project and this project went through the process of commissioning.

For a project of this size, the DPS suggests that site energy bills be included in the electronic project files so as to demonstrate the order of magnitude of the savings as compared to the overall site energy usage. Also, custom modeling was used to determine kWh energy savings and the DPS suggests that the modeling should be used to determine the demand reduction as well. In the documentation of the modeling analysis, kWh savings were summarized from the TRACE modeling but not the kW capacity reduction.

The comprehensive building commissioning measure contains a typographical error in the energy savings between the file “ModelingAnalysisv2” which summarizes the findings of the TRACE modeling for this project, and the database tracker. After reviewing the proportion of the capacity reduction in the database tracker compared to the energy savings, it appears that the kW reductions were estimated from the incorrect energy savings, which necessitates adjustments to these values as well.

Correcting this error results in a decrease of 10,000 annual kWh, and 1.139 and 3.178 winter and summer KW coincident peak, respectively.

## **5. High School & Career Center**

EVT Project ID: J00000007499

MAS 90 Job: 6014-1447

Stratum 4

This project had been in process for well over five years. The project included a significant overhaul of an existing school, and construction of a school addition, including a separate mechanical building for a wood chip boiler plant. The estimated savings were calculated using the TRACE modeling software.

Many lighting measures were recommended and most of these were installed. Some installations were not completed properly and resulted in higher watts/square foot in gymnasium areas. EVT adjusted the estimated energy savings to reflect the actual installation.

Lighting occupancy sensors were also recommended and installed. The Department agrees with EVT's decision that the savings should not be claimed due to the fact that operating schedules in classrooms already ensure facility lighting is off when not in use. Contrary to this decision, some of the energy savings and all of the demand reduction for these measures were inadvertently included in the claimed savings. Daylighting measures were recommended but not installed. EVT removed the energy savings for these measures, but not the demand savings.

Thermal Shell measures add a small but significant amount to the savings. Air conditioning, heat recovery, and VFD's on motors make up the rest of the savings in this project. For air conditioning, the actual installed units were lower efficiency than the recommended ones, although the installed units did meet code. However, the savings for the air conditioning units were based on the proposed units rather than the installed ones. Since the actual units barely meet the code and only savings above the code are claimed, no savings would be expected from this measure.

The energy and demand savings were corrected to remove the measures that were either not installed or where the savings are already incorporated into the model. The load profile was also corrected from primarily air conditioning to a blended profile reflecting the variety of measures installed at this site.

The DPS recommended adjustments result in a decrease of 87,814 gross annual kWh and 106.74 summer peak kW, and an increase of 0.243 winter peak kW.

## **6. Supply House- Addition**

Initiative: BNC  
EVT Project ID: J00000232387  
MAS 90 Project: 6014-6894  
Stratum 2

This project is an addition including office, warehouse and showroom spaces. It consists of a number of lighting, occupancy sensor and HVAC measures. EVT uses the appropriate LPD Space-by-space method for determining energy savings and capacity. However, there seems to be some confusion in the documentation, and some of the units may be double counted in a fixture-to-fixture analysis as well. The notes in the file “CAT6b\_46894\_Master” indicate that some areas are air conditioned (offices and showroom and training room) and some are not (warehouse space and mezzanine) which makes sense, but has not been accounted for appropriately with the weighting factors for cooling bonus.

The savings for the lighting in this project should reflect the savings from the LPD tool and the A/C cooling bonus should be applied for the appropriate spaces. In addition, the savings for the 18 super T-8 fixtures in the showroom and 7 super T-8's in the training room were included in the space-by-space method, but then also entered as separate measures. In the future, EVT should add consistent supporting calculations and documentation to their CAT tool and database.

The Department has removed the measures associated with the warehouse LPD, and showroom and training room super T-8's, and reduced the savings for the office LPD measure by 3,458 annual kWh with the associated changes in the kW peak reductions, for a total reduction of 6,343 kWh and 0.759 winter peak kW, and an increase of 0.514 summer peak kW for the project.

## **7. Center – Expansion & Renovation**

EVT Project ID: J00000203006  
MAS 90 Project: 6014- 4028  
Stratum 4

This project consisted of the addition of over 32,000 ft<sup>2</sup> of space and the renovation of another 47,200 ft<sup>2</sup>, at a medical facility. At the owner's request, the contract was split into two parts, one for the chiller water system and one for the rest of the building, including lighting, HVAC, Envelope, and transformer efficiency. The project fell under Act 250 review.

This project is a highly complex with large system changes that impact one another. The participant installed an 800-ton high efficiency chiller to supplement the existing 300-ton unit, amongst a variety of other measures. The documentation as to what was pre-existing relative to free-cooling and economizers is unclear.

There are no capacity savings resulting from the efficient chiller system during the winter peak period since the efficient chiller system is only used for higher cooling loads that do not occur during the winter peak period. In addition, the DPS has concluded that the wrong load shapes were applied to calculate the winter and summer capacity savings. Correcting for these error results in a decrease of 6.215 winter kW and 2.712 summer kW. No adjustments were made to the energy savings.

## **D. Residential Multifamily**

### **1. Senior Housing**

Project ID: J00000217903

MAS 90 Project: 6018-4844

Stratum 2

EVT claimed savings for 47 porch lights at 12 hours per day and 4 common entry lights at 3 hours per day. A review of the blue prints indicated that the "porch" lights were on balconies off the dwelling units, which would be unlikely to be used 12 hours per day in an elderly housing facility. EVT explained that this reflects a data entry error; EVT should have reported 47 switched porch lights with 3 hour burn time, and 4 common entry lights with 12 hour burn time.

The total adjustment is a decrease of 5,792 gross annual kWh, 1.297 KW in the winter peak and 0.383 KW in the summer peak.

### **2. Apartments**

Project ID: J00000005309

MAS90 Project: 6017-1149

Stratum 4

This is a multifamily existing building project consisting of 101 units of affordable elderly housing. The major source of savings for this project is the space heat fuel switch. The building had both storage electric space heat and baseboard electric heat, and is on a commercial time-of-use rate. Peak hours are specified by the utility as sixteen consecutive hours between 6:00 AM and 11:00 PM on weekdays (Rate 61), with the remaining hours designated as off peak. The fuel switching savings for the baseboard and the storage heater are entered as two separate measures, since they have different load profiles.

Savings for the fuel switch were estimated from a billing analysis. The billing analysis did not incorporate weather data. The baseboard kW reduction takes into account that some of the kW draw at any given moment is likely to include electric devices in addition to the electric space heat. In contrast, the kW reduction for the storage heater assumes that the entire recorded highest kW draw is due to the storage space heaters.

The load profile applied to the storage electric space heat assumes most energy savings will occur during the winter peak hours. A small winter and summer coincident demand reduction are also associated with this measure.

For the demand savings estimated for the storage heater, the highest KW draw for the off peak hours was selected. However, a review of the billing records indicates that there continues to be some KW use even during the summer months when the electric space heat would not be operating. Consequently, it is reasonable to adjust the KW to account for this base load demand.

The second issue is related to the load profile selected for the electric storage heaters. These units are designed to operate during the utility off peak period, which runs from 11 PM to 6 AM. There should be no energy or demand savings during the on peak periods as defined for screening purposes. Table 6 below shows the assumptions used by EVT and the Department's recommended changes.

**Table 6: Comparison of Load Profiles for the Storage Electric Space Heat**

	EVT Load Profile	DPS Adjusted Load Profile
Winter On Peak kWh	76.7%	0.0%
Winter Off Peak kWh	21.5%	98.2%
Summer On Peak kWh	1.4%	0.0%
Summer Off Peak kWh	0.4%	1.8%
Winter Coincident Peak	2.8%	0.0%
Summer Coincident Peak	0.2%	0.0%

The Department decreased the demand savings for the storage space heat from 504 to 375 KW. In addition, the load profile for the storage heater was updated to remove all energy savings from the peak periods and eliminate the coincident peak savings in their entirety (a reduction of 14.1 KW from the winter peak and 1.0 from the summer peak). No adjustments to the total energy savings are warranted. EVT is requested to recalculate the TRB using these modified assumptions.

## **E. Other Residential Adjustments**

### **1. Efficient Products Program**

#### **a) Efficient Clothes Washer**

Project ID: J00000206861

EVT has been updating the claimed savings for efficient clothes washers on an annual basis, using data collected from the rebate forms regarding the fuel used for water heating and drying. The updated energy savings for 2007 is 223 for the period prior to May 1, 2007 and 189 kWh for the latter part of the year. However, for installations between May 1st and June 30th of 2007, EVT used 225 kWh, i.e., the value from program year 2006.

The overstatement was applied to 1631 washers. The DPS reduced the gross energy savings by 19,786 kWh.

**b) EP Demand Savings for Air Conditioners**

The demand savings for Energy Star room air conditioners claimed by EVT do not match up to the TRM values. Adjusting for this error results in a decrease of 31.467 summer KW.

**Table 7: Efficient Products Demand Adjustments**

Name of Measure	Time Period	Quantity	Winter KW Reduction		Summer KW Reduction		DPS Adjustment	
			TRM	EVT Claimed	TRM	EVT Claimed	Winter KW	Summer KW
EStar Room A/C	5/1-6/30/07	545	0.000	0.000	0.060	0.106	0.0	24.907
EStar Room A/C	After 7/1/07	1,287	0.000	0.000	0.083	0.088	0.0	6.561
Totals								31.467

**2. Low Income Single Family and Residential Emerging Markets**

**a) Space Heat Fuel Switching**

Review of the largest fuel switch projects from 2007 indicates that EVT is primarily relying on billing analysis for the estimation of savings from fuel switches. EVT has developed a computer tool that automatically calculates the base load and estimates the energy used for electric space heating.

In general, the Department agrees with EVT’s emphasis on the review of billing data. Even when a heat loss calculation is necessary, comparing the results to billing records where possible is an important step in the estimation process. However, review of the 2007 fuel switching projects suggests that EVT is sometimes relying solely on a billing analysis where this approach alone is insufficient. In these cases the billing analysis was conducted through computerized analysis without careful consideration of the implications for the specific home.

The Department and EVT made an agreement on the methods to be used for estimating the savings for electric space heating fuel switching, and the first criteria is to determine whether the billing analysis can be a reliable predictor of savings over the next 30 years. In these cases, it seems clear that the billing analysis cannot be the sole method of determining reliable savings over the long run.

While the Department is not able to make an independent estimate of the savings without additional information, the Department assumes that these installations are in fact cost effective. Consequently, the Department has reduced the savings to the threshold level at which the measure passes the screening. For the project with the error in the billing analysis, the savings were corrected to be consistent with the billing data.

The adjustments to specific projects are listed in Table 8 below. The total adjustment results in a reduction of 22,704 gross annual kWh and 10.03 winter peak KW to EVT's claimed values for the Residential High Use initiative, and 16,503 kWh and 8.91 winter KW for the Low Income Single Family initiative. MMBtu additional use will need to be adjusted accordingly.

**Table 8: Residential Fuel Switching Adjustments**

Project ID	MAS 90 Job	MAS90 Project	EVT Claimed		DPS Allowed	DPS Adjustment	
			kWh/yr	KWWin	kWh/yr	kWh/yr	Winter KW
J00000228786	6036	6074	11,971	3.829	7,000	4,971	1.590
J00000233767	6036	6303	17,131	5.480	12,000	5,131	1.641
J00000280198	6036	6629	14,712	7.942	13,080	1,632	0.881
J00000283374	6036	6655	7,534	4.067	4,000	3,534	1.908
J00000285704	6036	6670	9,673	5.222	7,000	2,673	1.443
J00000288072	6036	6689	11,940	6.446	9,000	2,940	1.587
J00000284070*	6036	6660	12,278	6.628	10,455	1,823	0.984
J00000308374	6034	A948	16,101	8.692	11,000	5,101	2.754
J00000307389	6034	A894	10,944	5.908	5,700	5,244	2.831
J00000288701	6034	A687	12,158	6.563	6,000	6,158	3.324
Total RHU			85,239	39.613	62,535	22,704	10.034
Total LISF			39,203	21.163	22,700	16,503	8.909

\* This project (J00000284070) was found to have an error in the billing analysis.

**b) CFL Lamps**

The Department and EVT agreed that the savings for the direct install of CFL lamps could be claimed on a prescriptive basis rather than collected site-specific information for each bulb replaced. The prescriptive savings are based on the same data used to estimate savings for the Efficient Products program, with an adjustment to the in service rate.

EVT has applied the prescriptive savings to all lamps, regardless of the number of lamps installed in each home. This approach has resulted in claiming savings of more than 2,000 kWh for CFL's in some homes.

While the DPS agrees that it is acceptable to claim savings on a prescriptive basis the DPS maintains that there needs to be a cap on the number of claimed lamps per home. Otherwise, excessive savings are claimed for some homes. This issue has been raised previously for the Residential New Construction and Efficient Products initiatives. Both of these programs use prescriptive savings for lighting products and both have a cap on the savings per household. In addition, the 2005 verification report discusses the unrealistically high per household savings for some participants in the residential retrofit initiatives stemming from the method of claiming savings from multiple measures without regard to the overall effect (2005 Savings Verification Report, Section III.H.)

The DPS recommends that future savings be capped at a certain number of lamps in a single family home or dwelling unit. For purposes of this verification, the Department identified 84 participants who received more than fifteen lamps, reducing savings claimed by 38,235 kWh, 9.125 winter peak KW and 2.390 summer peak KW savings.

### **III. Issues to be Addressed on a Prospective Basis**

#### **A. Snowmaking**

EVT continues to work with Vermont's ski areas to improve the efficiency and expand the capabilities of their snowmaking operations and EVT's assistance is extremely valuable to this important segment of the Vermont economy. The Department commends EVT for its contribution to Vermont's economic well being. As the ski industry adapts to changing conditions, the Department recommends that EVT modify its strategy of estimating and claiming savings to reflect changing realities.

The Vermont ski areas face many challenges in a highly competitive industry. While competition and skier expectations are on the rise, climate change predictions suggest that natural snowfall is likely to decrease over time. These conditions emphasize the need to maintain and increase the ski area's capacity for making snow. The Vermont ski industry recognizes that they may be far more dependent on snow making operations as natural snow becomes less frequent and are expanding to snowmaking capabilities to meet the anticipated need.

In order to survive, ski areas believe they need to modernize their snowmaking equipment. According to the Vermont Ski Area Association ([www.skivermont.com](http://www.skivermont.com)), "Between 1994 and 1997, one Vermont ski area increased snowmaking coverage by 23% and saw skier visits increase by 29%. During the same time period, another similarly-sized Vermont ski area increased snowmaking coverage only 6% and saw skier visits decrease by 15%." The industry is very aware that being able to provide a quality product regardless of the weather is essential to its survival. This includes both expanding the area served by snow making, being able to produce more snow in existing areas and being able to respond to market demands such as the desire for terrain parks.

Additionally, awareness of the threat of climate change to the industry is not limited to Vermont. Ski areas throughout the country recognize that climate change poses unique challenges to their industry and the National Ski Area Association has committed to the Sustainable Slopes Charter. This industry-led initiative provides principles and strategies to lessen the environmental impact of all aspects of ski area operations and at least ten of Vermont's major ski areas are already committed to the Charter. As part of the Charter, ski areas commit to minimizing their energy consumption for snowmaking.

The ski industry clearly perceives that survival in a difficult environment will require more and more efficient snowmaking. In fact, a review of EVT's projects with the ski areas makes it quite obvious that the industry recognizes these needs and is pursuing these upgrades. These realities suggest that many snowmaking projects are likely to be market opportunities in that the ski areas are pursuing these upgrades for a variety of reasons beyond reducing energy consumption. Consequently, the Department would like to engage with EVT to discuss these issues and develop guidelines for properly characterizing these projects.

#### **B. Demand Savings for Occupancy Sensors**

The installation of occupancy sensors offers tremendous potential to save energy in a variety of applications. EVT's promotion of this strategy in warehouses, schools and

offices is providing significant savings and benefits to the State of Vermont. The wide range of applicability for these devices, however, increases the uncertainty associated with their demand savings. These savings would be driven by patterns of occupation that can vary significantly even within the same facility. The Department would like to consider the issues and challenges posed by this conundrum through the TAG process.

### **C. Multifamily Electric Space Heat Fuel Switching**

Generally, converting large multifamily buildings from electric to fossil fuel space heat results in more potential electricity savings than any other residential electric measure. Given the magnitude of the savings, it is important that the methodology and calculations used to derive the savings be complete and appropriate. As discussed under Project ID: J00000005309, this includes accounting for weather variation by normalizing savings to local weather data. EVT should institute standard procedures to make sure that critical steps in the analysis of larger projects are not omitted.

### **D. Single Family Electric Space Heat Fuel Switching**

The Department and EVT have an agreement concerning the circumstances when it is appropriate to use bill history to estimate savings from a fuel switch as opposed to conducting a heat load analysis. Through this review it has become apparent that EVT is interpreting this agreement in a fashion that is inconsistent with the Department's understanding of the agreement. EVT appears to be using billing history when a heat load analysis is indicated and interpreting billing history in ways that the Department does not find well grounded. The Department and EVT need to revisit this issue in the TAG process to clarify the guidelines and ensure common understanding of a reasonable process.

### **E. Residential New Construction Lighting**

On average, EVT's claimed savings for residential new construction lighting measures appear to be reasonable at slightly less than 900 annual kWh per unit for single family homes. However, the Department notes that the 20% of the projects with the highest savings account for 43% of the total savings and average over 1,900 annual kWh per home. In these homes, an average of 21 lighting measures were installed. The Department is concerned that the per fixture savings are not reasonable at this level of penetration. The Department would like to discuss with EVT the ramifications of these findings and also hopes to gain a better understanding as to why the penetration of lighting measures is relatively low for roughly half of the program participants.

### **F. Injection Molding Machines**

All-electric injection molding machines (IMM) save considerable energy compared to hydraulic molding machines. In addition, they typically enjoy faster cycle time, greater reliability, easier maintainability, lower scrap production, and greater up-time. It is clear that energy savings over a hydraulic machine are significant, though certainly not the only advantage of the all-electric injection molding machines.

Under these circumstances, it is not surprising that purchasing electric injection molding machines is apparently gaining in popularity. Of the sixteen IMM projects since EVT began implementation in 2000, nine have been completed in the last two years. Assuming that this trend is likely to continue, there are a number of issues to consider in improving estimates for future years, as well as addressing concerns arising from the 2007 projects. (Four of the five injection molding projects fell into the verification sample for 2007.)

The Department has two primary concerns: 1) the definition of the baseline and knowledge of the current efficiency levels in the market and 2) the range of relevant engineering and measured inputs and the difficulty in accurately estimating the savings from these inputs. These topics should be explored further through the TAG process.

### **G. HVAC TRM Adjustments**

In the TRM (C&I electric HVAC measure), a 10% bonus is given to the capacity savings for small HVAC systems to adjust from the EER to the SEER (which is more commonly available for the small units). No such adjustment is made for the energy savings. The Department would like to revisit this issue and assess whether any modifications to the method should be considered.

### **H. Documentation of Hours of Use**

EVT has substantially improved the documentation of its projects over time. In the role of the review, the Department is in the position of questioning the assumptions and results and following the process of savings estimation through to the EVT's claims. The improved documentation facilitates this process. The projects overviews have turned out to be a highly useful tool in this endeavor.

In some cases, the Department still lacks sufficient information to adequately verify all of the savings and assumptions. One of the issues focused on in this round of verification is the accuracy of operating, facility and runtime schedules and assumptions. These critical inputs result in the yearly operating hour assumption that has a major impact in the savings estimate. Standardization of procedures to insure that critical questions concerning holiday and vacation shutdowns, yearly production cycles, machinery scheduling and downtime, etc. are routinely asked and consistent documentation would greatly facilitate the verification of the assumed hours of operation. The Department requests that EVT develop better more consistent procedures in this area.

## **IV. Sampling Methodology**

A stratified random sample was selected from EVT's 938 C&I and 124 residential MFB projects. Sampling was conducted by project and the strata were defined according to the higher of the winter or summer coincident peak reduction. The rationale and results of this sampling strategy were laid out in two memoranda dated March 31, 2008 and April

7, 2008. The samples were selected independently for the Business New Construction (BNC), custom and prescriptive projects within the BEF and for the residential MFB projects. The specifics of the sampling strategy are listed below.

- The allocation of the sample to BNC, custom BEF, prescriptive BEF and MFB was determined approximately in accordance with the total of the higher of the winter or summer coincident peak reduction (Higher KW), and then adjusted to ensure an adequate sample within each category.
- The sample was checked to see if the lighting savings are roughly proportional to the initiatives as a whole and to ensure that it included most of the market tracks represented in the total population of C&I projects.
- A census of the largest projects in the custom BEF, prescriptive BEF and BNC initiatives were reviewed.
- The cut offs for the strata and the sample sizes within each stratum were determined according to the methodology presented in the California Evaluation Framework.<sup>3</sup>

A couple of compromises were made in the sampling process for the BEF prescriptive track and the MFB projects. Sample sizes for the BEF prescriptive, BNC and MFB projects were increased to ensure an adequate sample size. For the BEF prescriptive track, the sampling was done at the measure level to mitigate the sampling issues found in previous years, i.e., that the project-level sampling resulted in a small sample size within each stratum and the sample tended to be skewed toward a single end use (generally lighting). This modified process produced a sample with a reasonable distribution of end uses on the first selection.

**Table 9: Summary of C&I Projects**

Program	# of Projects	MWh Savings	Higher KW Reduction	% of KW Reduction
BEF Custom	383	24,476	4,130	58%
BNC	124	7,910	1,863	26%
BEF Prescriptive	431	1,860	460	7%
Res MFB	124	3,662	652	9%
Totals	1,062	37,908	7,105	

The distribution of sampled projects in terms of the size of the projects is presented below in Table 10. This analysis shows that projects vary in size from 0.003 to 340 KW reduction. The strata reflect a reasonable grouping of projects by size. In the commercial sector, the sample projects and measures account for between 52% and 56% of total energy savings, the higher of the KW winter or KW summer reduction and the TRB. For the residential multifamily projects, the sample represents about 58% of the energy, 61% of the higher of the summer and winter demand savings and 49% of the TRB.

<sup>3</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 10: Distribution of Sample by Project Size**

	Strata	# of Projects	Min (Higher KW Reduction)	Max (Higher KW Reduction)	Mean (Higher KW Reduction)	# Projects in Sample
BNC	1	76	0.299	9.269	4.132	5
BNC	2	27	9.438	22.583	14.429	5
BNC	3	12	23.834	59.055	38.145	5
BNC	4	5	70.696	233.791	140.280	5
Subtotal BNC		120	0.229	233.791	15.523	20
BEF Custom	1	264	0.014	9.386	2.550	13
BEF Custom	2	59	9.568	23.542	15.073	13
BEF Custom	3	28	23.786	65.865	39.869	13
BEF Custom	4	10	72.272	340.073	145.148	10
Subtotal Custom		361	0.014	340.073	11.442	49
BEF Prescriptive <sup>4</sup>	1	619	0.003	2.457	0.398	10
BEF Prescriptive	2	24	2.591	5.823	3.910	10
BEF Prescriptive	3	10	6.089	9.466	7.455	10
BEF Prescriptive	4	4	10.150	14.199	11.904	4
Subtotal Prescrip		657	0.003	14.119	0.704	34
Res MFB	1	108	0.006	8.641	1.244	4
Res MFB	2	11	9.586	45.853	18.208	4
Res MFB	3	2	122.060	195.580	158.820	2
Subtotal MFB		121	0.006	195.580	5.390	10

The sample was also checked to verify that it represented the variety of market tracks offered by EVT. The sample includes projects in all eight of the tracks in the BEF and BNC market initiatives. For the multifamily projects, two of the five tracks are included in the sample, the low income retrofit and new construction initiatives. The remaining three tracks omitted from the sample are the low income rehab, and the market rate MFB retrofit and new construction initiatives. This outcome is likely to be related to the fact that the two large low income segments account for over 80% of the total KW savings for the MFB tracks.

Please refer to West Hill Energy's memoranda of March 31 and April 7, 2008 for more details on the sampling process.

<sup>4</sup> BEF Prescriptive was sampled on measures rather than projects. The "# of projects" and "# of projects in sample" columns contain the number of measures.