Final Report

Verification of

EVT 2010 Claimed Annual MWh Savings,

Coincident Summer and Winter Peak Savings

And Total Resource Benefit (TRB)

Department of Public Service

October 07, 2011

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I. Introduction

On March 16, 2011, Vermont Energy Investment Corporation (VEIC), operating under contract to the Public Service Board ("PSB") as Efficiency Vermont ("EVT"), submitted its "Year 2010 Preliminary Savings Claim" for calendar year 2010 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 Carole Welch, Cx Associates, GDS Associates and Lexicon Energy Consultants.

The verification process is a paper review intended to identify errors in calculation, assumptions and methodology made by EVT in their savings claim. For retrofit projects, a determination is also made as to whether savings are realistic in terms of pre-installation consumption. In a process modification from years past, 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 engineers. This process helped facilitate agreement between the Department and EVT on all of the project adjustments -- EVT has indicated it accepts all of the adjustments to the 2010 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 2010 be discussed more thoroughly through the ongoing DPS-EVT Technical Advisory Group (TAG) process. The Department has also identified several topics to be taken up in TAG process, as outlined in Section III. Since the parties are in agreement on the magnitude of the 2010 adjustment, the project by project issues and resolutions are only briefly described in the main report. Detailed discussion of the individual projects reviewed and the review outcomes are provided in Appendix A.

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

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The results of the Department's verification indicate that EVT's 2010 claimed energy savings claims are overstated by about 4.3%, or 4,555 gross annual MWh, and coincident peak savings are overstated by 4.6%, or 911winter kW and 7.6%, or 1,244 summer kW. The Department's findings are the result of numerous adjustments both upward and downward. The overstatement of savings for the overall portfolio is lower than found in the 2009 program year and reasonably consistent with the verification results prior to 2009.

In addition to the analysis of gross energy and demand savings, this review also covers net energy and demand savings, TRB, MMBtu savings from fossil fuels, and water savings. Some of the Department's recommended energy adjustments have significant impacts on these other indicators. When EVT's savings are revised for its 2010 annual report, all of the relevant indicators will 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 C&I projects and a comprehensive review of residential prescriptive measures. The sampling plan for the C&I projects is consistent with that undertaken for the Forward Capacity Market evaluation earlier this year, and the verification sample for program year 2010 will also be used for the FCM evaluation. 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. Since the projects under review are reasonably representative of EVT's 2010 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 agreed-upon 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 relatively small in magnitude and the Department reviewed the larger residential projects with higher savings.

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

Table 1: Adjustments by Program Group

	Energy Saved		Winter kW Reduction		Summer kW Reduction	
	EVT Gross Claimed MWh	Reali-zation rate	EVT Gross Claimed kW	Reali-zation Rate	EVT Gross Claimed kW	Realization Rate
C&I and Multifamily						
Retrofit	24,269	94.5%	3,663	89.9%	3,954	93.0%
NC/MOP	15,355	92.0%	2,182	89.1%	2,752	95.0%
Stipulated Lighting	13,462	98.1%	2,462	100.0%	2,690	92.7%
ILED Lighting	6,552	68.0%	1,047	70.9%	1,744	63.7%
Small Projects Not Sampled	1,696	100.0%	132	100.0%	138	100.0%
C&I Subtotal	61,334	92.0%	9,486	90.4%	11,277	89.0%
Residential						
Efficient Products	42,646	100.9%	9,911	100.0%	4,921	100.0%
Residential Retrofit/ Low Income Single Family	1,656	100.0%	338	100.0%	155	100.0%
Residential New Construction	597	100.0%	149	100.0%	111	100.0%
Residential Subtotal	44,899	100.8%	10,399	100.0%	5,187	100.0%
Portfolio Total	106,233	95.7%	19,839	95.4%	16,382	93.2%

The relative precision[1] for the realization rates associated with the energy savings (annual kWh) for the Business and Multifamily retrofit initiatives, and the Business and Multifamily New Construction and Market Opportunity initiatives is 6.4% and 4.3% at the 90% confidence level, respectively.

The remainder of this report is divided into four sections. Section II describes the sampling process and Section III covers the detailed project and measure-level issues that provide the basis for the adjustments shown in Table 1 above. In Section IV, we discuss specific issues with program year 2010 (PY10) projects and other concerns to be addressed on a prospective basis.

[1] Relative precision is a indicator of the variability of the estimator, in this case the realization rate, in relationship to the magnitude of the estimator. It is calculated at the 90% confidence level as 1.645 * standard deviation of the realization rate/mean realization rate.

II. Sampling

A. Overview

To review EVT's claimed savings from custom C&I and Multifamily projects, a random sample of projects was reviewed. The specifics of the sampling process were established based on the sampling strategies used in previous years. The sampling process utilized the same approach used for the SV09 sample. The guidelines for the SV10 sampling process are listed below.

- The primary sampling unit is the project. All measures associated with the project were reviewed.
- The primary sampling variable for establishing the size strata is the higher value of the kW peak reduction, either winter or summer with any stipulated savings subtracted.
- Sampling was conducted separately for two broad categories of initiatives, i.e., retrofit and MOP/new construction. Multifamily projects were included with the C&I projects.
- The sample size for each broad category of projects was set at a level designed to exceed the minimum required to estimate savings at the 80/10 confidence/precision level, based on an error ratio of 0.60.
- Projects with stipulated lighting measures only were excluded from the sample, except for those stipulated lighting measures and projects that fell into the "very large" stratum. Projects that included both stipulated and non stipulated measures were included when the non-stipulated savings were greater than 0.80 kW.
- The samples were checked to see if the lighting savings are roughly proportional to the initiatives as a whole.
- Stratification by project size was conducted, resulting in a total of five size strata for each of the two broad categories of projects.
- A census of the largest projects in the each broad category was reviewed.
- Weighting was done on the basis of the number of projects.
- The cut offs for the strata and sample sizes within each stratum were determined according to the methodology presented in the California Evaluation Framework.
- As was done for the SV08 and SV09 sample, projects with maximum kW reduction less than 0.80 kW were removed from the sampling frame.

The SV10 sample will also be used for PY10 FCM verification. It is possible some additional projects may be selected for the FCM evaluation. In the process of selecting the SV10 sample, all non-stipulated projects were assigned a random number and additional projects will be selected in the designated order, if necessary.

B. Summary of Projects

The first step in the sampling process was to determine the non-stipulated savings for retrofit and MOP/NC projects. [2] Projects with only stipulated savings were excluded from the sample. In addition, projects with less than 0.8 kW of savings account for a relatively small proportion of the savings and were not included in the sample. Including these projects would increase evaluation costs substantially without a commensurate improvement in the accuracy of the findings. Table 2 shows the number of projects in each of these three components and the total savings.

Table 2: Summary of Projects

Category	Number of Projects	MWh Savings	Higher KW Reduction
Retrofit	704	27,267	5,688
MOP/NC	501	15,376	3,332
Small & Stipulated Lighting[3]	2,407	14,215	218
Totals	3,612	61,309	9,238

The savings size cut offs for each stratum were calculated according to the methodology presented in the California Framework (Framework).[4] The Framework recommends applying an error ratio between .40 to .60 range for programs similar to EVT's. Experience from previous years verification reports suggest the actual error ratio is likely to be substantially lower than this recommendation. For SV10 sampling, an error ratio of 0.60 was used to allow some leeway for year-to-year variations in the verification results.

Using the Framework methodology, the number of projects selected from each stratum should be equal, with some exceptions. Examples of exceptions include fewer projects in a specific stratum than the selected sample size for each group or sampling a census in a single stratum. 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 initial sample included 49 retrofit and 48 MOP/NC projects.

[2] Savings for some measures were calculated using coincidence factors based upon a study of regional and local evaluation studies conducted by RLW Analytics. These measures were considered to be stipulated.

[3] Includes both small and stipulated savings. Stipulated savings were reviewed to ensure measures savings adhered to agreed values.

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

C. Sampling Results

An overview of the sample is shown below in Table 3. The sample custom projects account for about 35% of total energy savings and the maximum kW reduction.

Table 3: Overview of the Sample

Program	Total # of Projects	Total MWh Savings	Total Max KW Reduction	Sample # of Projects	Sample MWh Savings	Sample Max kW Reduction
Retrofit	704	27,267	5,688	49	9,651	2,058
MOP/NC	501	15,376	3,332	48	5,685	1,203
Small & Stipulated Lighting	2,407	14,215	218	0	0	0
Totals	3,612	56,858	9,238	97	15,336	3,261

The distribution of sampled projects in terms of the size of the projects is presented below in Table 4. This analysis shows that projects vary in size from small increases in kW to a 350 kW reduction. The strata reflect a reasonable grouping of projects by size.

Table 4: Distribution of Sample by Project Size[5]

Program Group	Size Stratum	# of Projects	Min (Higher KW Reduction)	Max (Higher KW Reduction)	Mean (Higher KW Reduction)	Initial Sample Size
Retrofit	0	1332	0	31.045	1.892	0
Retrofit	1	401	0.801	3.655	1.86	7
Retrofit	2	160	3.7	8.6	5.793	8
Retrofit	3	80	8.619	21.674	13.757	7
Retrofit	4	44	21.927	42.78	28.509	8
Retrofit	5	2017	44.312	208.112	87.399	19
Subtotal Retrofit		4034	0	208.112	2.867	49
MOP/NC	0	1075	-3.451	46.921	1.011	0
MOP/NC	1	260	0.806	3.281	1.789	7
MOP/NC	2	118	3.301	7.224	4.75	8
MOP/NC	3	65	7.24	13.639	9.8	7
MOP/NC	4	40	13.68	26.02	18.017	8
MOP/NC	5	18	26.41	133.776	52.7	18
Subtotal MOP/NC		1576	-3.451	133.776	2.157	48

[5] Stratum 0 for both Retrofit and MOP/NC includes both small projects and projects that were entirely stipulated lighting.

Table 5 compares the mean and median project KW reduction for the sample and the population. This analysis does not reveal any substantial discrepancies between the population and the sample.

Table 5: Comparison of Sample and Population

Program Group	Size Stratum	Sample Mean kWh	Population Mean kWh	Sample Mean Max KW	Population Mean Max KW
Retrofit	1	7,259	8,170	2.083	1.860
Retrofit	2	84,633	26,555	6.236	5.793
Retrofit	3	59,043	74,424	13.136	13.757
Retrofit	4	116,768	130,618	30.177	28.509
Retrofit	5	398,704	423,219	87.399	87.399
MOP/NC	1	6,689	7,379	1.590	1.789
MOP/NC	2	94,620	24,383	4.868	4.750
MOP/NC	3	30,267	42,997	8.550	9.800
MOP/NC	4	63,877	77,417	18.120	18.017
MOP/NC	5	230,992	260,485	52.700	52.700

The next table shows the distribution of savings by end use for the three groups. The top stratum for both groups was removed from this analysis, since all of these projects were reviewed. Thus, the percentage of savings in Table 6 reflects only the lower tiers (strata 1 through 4 for both broad program categories).

Table 6: Comparison of Sample and Population by End Use

	Retrofit		MOP/NC	
	Sample % of kW Peak Reduction	Population % of kW Peak Reduction	Sample % of kW Peak Reduction	Population % of kW Peak Reduction
HVAC	9.6%	4.4%	23.0%	19.0%
Lighting	71.0%	69.7%	31.0%	36.7%
Other End Uses	19.4%	25.9%	46.1%	44.2%

The sample was also checked to verify that it represented the variety of market tracks offered by EVT. The sample includes projects in fourteen of the tracks in the BEF, BNC and multifamily market initiatives.

D. *Post Hoc* Stratification for ILED Projects

The ILED initiative was implemented by EVT to promote the use of innovative LED technology in commercial establishments. It was operated as a turnkey operation, with the participating installers locating the potential applications and installing the measures. Just prior to the start of the 2010 verification process, EVT identified an issue with the delivery of the ILED initiative and conducted a study of installation rates for these products - this Quality Control report was provided to the DPS near the end of the verification process and is included as Appendix B to this report. The DPS reviewed EVT's study and concluded that the methods applied were sufficient to provide a more accurate picture of the implementation of this initiative than would be provided by a paper review even though the study only quantified in service rates. EVT's study provided an estimate of the number of products installed as compared to the number of products claimed. The DPS has accepted the findings of this study and applied the in-service rate of 71% to the energy and peak demand reduction for all ILED projects. As the sample was selected before the Department became aware of EVT's study, there were a number of ILED projects included in the custom C&I sample. Under these circumstances, *post hoc* stratification was conducted and the ILED projects were moved into a separate sampling group. The results of this re-stratification are presented in the table below.

Table 7: Case Weights by Stratum

Program Group	Size Stratum	Total # of Projects	# of Projects in Sample	Expansion Weight
Retrofit	1	302	4	75.500
Retrofit	2	132	8	20.000
Retrofit	3	72	6	11.429
Retrofit	4	41	8	5.500
Retrofit	5	18	18	1.000
MOP/NC	1	257	7	36.714
MOP/NC	2	118	8	14.750
MOP/NC	3	65	7	9.286
MOP/NC	4	40	8	5.000
MOP/NC	5	18	18	1.000
ILED	None	563	5	N/A

III. Project and Measure-Specific Adjustments

A. Commercial & Industrial Business Sector Projects

The random sample consisted of 92 Commercial and Industrial (C&I) and multifamily projects covering the range of EVT initiatives in those sectors. The Department's adjustments are based on fifty-four of the selected C&I and multifamily projects, i.e., issues were found with the savings claimed in over half of the selected projects. Many adjustments were relatively small in magnitude. Overall, the number of projects with substantial issues was similar to 2009 and lower than found in previous verifications. As has been the case in previous years, there were more substantive issues associated with the estimation of the peak demand savings than with annual energy estimates.

	Total # of Projects[6]	# of Projects in Sample	# of Projects with Project-Specific Adjustments	# Projects with kWh Adjustments >±5%
NC/MOP	498	44	26	12
Retrofit	565	48	28	11
Totals	708	92	54	23

Table 8: Summary of Adjusted Projects

In the SV09 verification process, revisions were made to the assumptions used to calculate the cooling bonus, i.e., additional cooling savings due to the reduction in waste heat from lighting measures in C&I applications. These updates were added to the TRM and implemented for prescriptive measures. However, savings for many PY2010 custom projects were calculated using the earlier values of 1.34 for demand savings and 1.12 for energy savings. These factors were updated to 1.175 for demand savings and 1.062 for energy savings (for retrofit projects). Further adjustments will need to be made for 2011 to update the coincidence factor for commercial air conditioning based on a recent study of HVAC load profiles conducted by the Northeast Energy Efficiency Partnership (NEEP).

[6] There were 767 projects with the maximum coincident peak reduction less than 0.8 kW. These projects were considered to be too small to evaluate and were not included in the sample or in this table. An additional 1,223 projects had at least one stipulated lighting measure; some of these projects may also have non-stipulated measures and be included in the table above. The stipulated lighting projects were also omitted from this table since the subgroup of lighting projects was not sampled for the 2010 verification.

Tables 9 and 10 provide a brief summary of the projects in the sample where the savings were adjusted and either the energy or the summer peak savings were revised by 5% or more. Realization rates by project as well as the project stratum and reason for adjustment are provided in Table 9 for C&I retrofit projects. Table 10 provides the same information for C&I New Construction and Market Opportunity projects in the sample. A detailed project report for each project is in Appendix A.

Table 9: Realization Rates for C&I Retrofit Projects

Project ID	Title	Size	RR kWh	RR kWWin	RR kWSum	Reason for Adjustment
387151	Barton Academy & Graded School - newlight	2	0.952	0.746	0.877	Cooling bonus revisions and misapplication
386393	Ben & Jerry's - Saint Albans - Freezer Doors	5	1.242	1.302	1.299	DPS used pre-install metering to establish baseline
382422	Burlington International Airport - Chiller & DDC Upgrade	5	0.695	0.000	0.700	Double counting of savings, incorrect inputs
383199	GE Healthcare - Data Center Cooling	3	0.451	0.460	0.441	Baseline assumes no cycling
386091	Lake Champlain Chocolate - Distribution Center - newLIGHT	4	0.868	0.981	0.862	Incorrect baseline
387626	Magnan, Mark - Magnan Bros Dairy - Clothes Washer	1	1.067	0.841	1.122	Use of residential rather than commercial load profile
388798	Neville Companies - 30 Kimball - common area - Lighting Plus	1	0.961	1.000	0.877	Cooling bonus revision
385032	Precision Contract Manufacturing - PCM - Lighting Retrofit Contr	4	0.904	1.000	1.000	Assumptions inconsistent with documentation
389641	Rutland High School / Stafford Tech - Lighting Plus - Phase 2	3	0.948	.969	0.903	Assumptions inconsistent with documentation
388125	Ryegate Associates - Newlight	4	0.511	0.498	0.542	Assumptions inconsistent with documentation
375023	Sugarbush - Snowgun Replacement	5	0.705	0.639	N/A	Assumptions inconsistent with documentation
383274	Vermont Butter & Cheese - Refrigeration	5	0.986	0.953	0.705	Assumptions inconsistent with documentation; errors in calculations
230080	Via Cheese - Wastewater Lagoon	5	1.743	0.871	0.871	Interpretation of metered data was incorrect

Table 10: Realization Rates for C&I New Construction and MOP Projects

Project ID	Title	Size	RR kWh	RR kWWin	RR kWSum	Reason for Adjustment
381551	Austine School For The Deaf - Brattleboro - Lighting, HVAC	5	1.136	1.106	0.384	Insufficient documentation of equipment and assumptions
337278	CCV - Winooski - New Construction	5	0.981	0.826	0.897	Cooling bonus revisions
378745	Hartford, Town Of - Quechee - WWTF	3	0.915	0.917	0.841	Rounding and cooling bonus
382361	Husky Injection Molding Systems - Cooling Water Upgrade - Ph. 3	5	1.016	1.065	1.140	Interactive effects not accounted for; methods required revision
384514	Husky Injection Molding Systems - Process Efficiency 2	3	1.000	0.122	0.122	Insufficient support for assumptions
351973	Jasper Hill Farm - Humidification	4	0.351	0.351	0.353	Insufficient documentation of equipment and assumptions
379381	Jay Peak - Snow Guns	5	0.256	0.302	N/A	Snow production overstated
373146	Jay Peak Ice Rink - New Construction	5	0.367	0.936	0.787	Insufficient documentation; baseline assumptions erroneous
390315	Jay Peak Resort - Snowmaking 2010	5	0.577	0.692	N/A	Snow production overstated; assumptions were revised
341473	Norwich Inn - Addition - New Construction	5	1.192	1.594	1.039	Baseline not documented
394285	Pyle, Mike - M & J Dairy - Rx Lighting 1	3	0.713	0.607	2.321	Insufficient documentation of assumptions
386602	Tomlinson's Store - Rx Refrigeration 3	2	0.726	0.782	0.478	Interactive effects not accounted for
376173	Velan Valve - Compressed Air	5	1.000	1.248	1.133	Peak kW updated based on metered data
379778	VSAC - Server Virtualization - Phase 1	2	0.500	0.500	0.500	Baseline is standard practice
376220	VSB - Castleton State College - Leavenworth - New Construction	2	0.849	1.000	0.878	Interactive effects not accounted for

B. Residential Initiatives

The DPS concentrated its review on the major components of EVT's portfolio. The Efficient Products Program accounts for 95% of EVT's claimed energy savings in the residential sector, with all of the remaining initiatives (Low Income Single Family, Home Performance, and the Vermont Energy Star Homes) accounting for the remaining 5% (and about 2% of the total portfolio savings). Thus, the Department's review was focused on the Efficient Product Program.

1. Efficient Products Program

While the Department does not recommend any adjustments to the Efficient Products Program at this time, this review identified the need to adjust the residential air conditioning measures in the TRM. EVT based the annual hours of use and the summer peak coincidence factor on the study conducted by RLW for NEEP in 2008.[7] However, EVT appears to have selected incorrect values from the report.

EVT's summer peak coincidence factor of 0.276 reflects the ISO-NE "Seasonal Peak performance hours" (the hours corresponding to ISO-NE system peaks) rather than the "On-Peak performance hours" (1:00 to 5:00 PM, June through August). EVT's summer peak demand savings are defined as the savings during the ISO-NE On-Peak performance hours. In addition, the value selected by EVT is based on 2007 weather data rather than the longer-term TMY2 weather data. It is common practice to use weather normalized savings whenever it is reasonable to do so.[8] The correct summer peak coincidence factor is 0.119. In addition, the annual hours of use should also be changed from 166 to 141 to reflect TMY2 weather data.[9]

Since these measures account for only 0.07% of the energy savings and 0.7% of the summer peak savings for the Efficient Products Program, the Department has not made an adjustment at this time. This issue will be referred to TAG to ensure that the TRM is corrected.

[7] 2007 ROOM AC Savings Analysis.xls, RLW Final Report, Coincidence Factor Study, Residential Room Air Conditioners, June 2008

[8] The Department consistently uses TMY2 or TMY3 weather data in its analysis to ensure that savings are based on longer-term weather patterns rather than possible anomalies within a specific metering period.

[9] RLW, 2008. Table i-2, Burlington, TMY2 Weather, On-Peak CF and FLEH (full load hours

IV. Issues to be Addressed Prospectively

1. Documentation

The Department found the documentation for numerous projects to be inadequate. All projects need to have adequate documentation to verify that measures were actually installed and to determine whether the savings are reasonable. Project-level documentation should include, at a minimum, copies of contractor invoices, receipts and/or inspection forms, detailed specifications of the baseline and efficient equipment, clear identification of other assumptions used in the analysis and the source of the values used, and a description of the methods used to calculate savings.

Project documentation initially provided to the Department often consisted of a screening file that does not include the specifics of the savings calculations. For one project, 6014-H505, no documentation was provided by EVT. Many project files did not include specific details of the installed or baseline equipment or the savings calculations. Consequently, the Department was unable to reproduce EVT's savings estimates for many projects. In the verification review process, the DPS used the information supplied by EVT to estimate savings, supplemented with publicly-available data if necessary and appropriate.

Project documentation has been an ongoing issue with the review of EVT savings claims and future deficiencies could result in a denial of the claimed savings. The Department will adjust for actual discrepancies identified through the FCM site visits as part of the FCM review.

2. EP Commercial Lighting

The assumed hours of operation for commercial CFL's sold through the Efficient Products program is not well supported. These assumptions should be reviewed through the TAG process to ascertain if better information is now available.

3. Specialty CFLs

Specialty CFL have become a significant portion of the screw-based CFL sold through the Efficient Products Program. EVT's data indicates that these products now account for approximately 50% of the total kWh for the screw based bulbs. The DPS would like additional information on the specific products that are in this category and the program mechanisms that are accounting for this high percentage.

4. Upstream HVAC

EVT established a process to prevent double counting of Tier II AC equipment that received upstream distributor incentives and could also possibly receive a customer rebate. The process involves matching specific equipment receiving end-user incentives to the upstream projects by make and model numbers at the end of the program year. The rationale for this approach was that EVT would not know the final purchaser of this equipment and that matching the equipment information was the most feasible approach.

The Department found that EVT diligently implemented this strategy in 2009. However, the Department is concerned that double counting across years could still be a potential issue. Project 6014-6439 in the 2010 savings claim contained a large number of HVAC units receiving rebates at a location that had installed HVAC units through the Upstream HVAC initiative in 2009. In upstream project ID 376284, there were 85 units installed in the new hotel being built at Jay Peak. EVT has an active project at this site and has not yet claimed any savings. The savings claimed for the units in this hotel are 184,139 kWh/yr, more than twice the savings offset by in the 2009 adjustment.

Without on-site verification, it is not possible to know for certain whether savings have already been claimed for these units. The unit serial numbers from the 2009 project were recorded by the DPS as part of the 2009 FCM verification. When the site visit occurs for the 2010 FCM verification, the Department should be able to verify that the units are new installations. The Department requests that EVT continue to work to ensure that the systems designed to avoid double counting are effective.

5. Server Virtualization and IT technology

The Department would like to introduce IT technology in general and server virtualization as a stand-alone measure as a new TAG item. The Department adjusted a server virtualization project by 50% based on information that this technology is now a baseline practice for server replacement in larger organizations. Virtualized servers are less expensive to purchase and install than an equivalent number of stand-alone servers in an organization that has a large data center. The extent and circumstances that this technology needs support from EVT should be defined through the TAG process.

A more general conversation about the evolution of IT technology and how to characterize measures in this market segment is also warranted. New products are developed in released in a very short time span and technology quickly becomes obsolete. This rapid change may require frequent updates to assumptions regarding the savings generated from IT investments. The Department and EVT should discuss how to best work within this market.

6. Performance Contracting Review

As stated in the 2009 report there are numerous implications to the third-party performance contracting model that EVT is pursuing. On the positive side, it has the potential to increase the number of qualified firms providing efficiency services in Vermont. If EVT applies a sufficient level of oversight when public benefit incentives are helping to fund the improvements, this becomes a likely outcome. On the other hand, if EVT relies solely on the expertise provided by the performance contractor, there is a potential that the market will not perform as well.

In the case of third party performance contracting projects, EVT's acts as an advocate for the customer to ensure that the savings being claimed by the performance contractor are accurately calculated and is fully attributable to the performance contractor’s actions. The recent issues with the ILED initiative raises some concerns as to the reliability of the current delivery of savings through the performance contracting model. The Department requests that EVT continue to monitor the status of the performance contracting model and work to insure that the issues found in the ILED and other performance contracting initiatives are addressed.

Appendix A

All projects listed alphabetically by title

Review Engineer: Energy & Resource Solutions
Date submitted to West Hill Energy: 9/7/2011
Date finalized by West Hill Energy: 9/7/2011

EVT Project ID Number: 381551
Project Name: Austine School for the Deaf - Brattleboro - Lighting, HVAC
Sample Group (Size): 5
Type of Project (NC/MOP, Retrofit): NC/MOP

The following table presents only the measures for which the Department of Public Service (DPS) calculated savings that differed from Efficiency Vermont (EVT).

Measure ID	Description	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
2349113	Custom space heat efficiency	149,511	37.910	0.200	207,213	42.23	0.00
2349114	Custom air conditioning	45,552	0.219	10.499	14,585	0.00	4.11
2349115	Replace space heater, propane	1,562	0.628	0.003	1,562	0.628	0.003
Total:		196,625	38.757	10.702	223,360	42.86	4.11

Measure ID	Description	Resource Type	Resource Units	EVT Claimed Resource Change	DPS Verified Resource Change
2349115	Replace space heater, propane	Propane	MMBtu	198.810	198.810

There was not enough information provided to either prove or disprove the reported savings for Measure 2349115, which consisted of replacing an oil-fired furnace with an infrared heater. Therefore, there were no changes made to the EVT savings results. This report only includes measures 2349113 and 2349114, for which evaluators arrived at savings that were different than those claimed by EVT.

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   This project consisted of installing new Daikin variable refrigerant air-to-air heat pumps. The existing electric baseboard heaters were considered the baseline for the heat pumps during the heating season. However, the facility did not have air conditioning or ventilation prior to the project completion, and code efficiency air-to-air heat pumps were therefore the baseline for the installed heat pumps during the cooling season.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   No, EVT did not meter for this project.

3. Is this project correctly characterized as MOP, NC, or retrofit?

EVT calculated savings for the custom space-heat efficiency measure (2349113) as a retrofit measure; the as-built energy usage of the heat pumps during the heating season was subtracted from the energy used by the existing electric baseboard heaters. In contrast, the custom air-conditioning measure (2349114) was characterized as a market opportunity, and savings were calculated to be the difference between the installed energy usage and the energy usage of a code efficiency air-to-air heat pump system during the cooling season. The DPS finds it unusual to use two baselines for the installation of a single system. However, as project documents indicated that there was no explicit need to remove the electric baseboard heaters, it is reasonable to use the same baseline characterizations as EVT.

4. Define the baseline for each measure.

Measure ID	**Description of EVT Baseline**	**Description of DPS Baseline**	**Reason for DPS Change**
2349113	Electric baseboard heaters; the energy demand is not included in the project file	Electric baseboard heaters; the energy demand was calculated from billing data	Measure savings could not be recreated from the project documents, so billing data was used to determine the baseline heating demand.
2349114	Code efficiency air-to-air heat pumps	Code efficiency air-to-air heat pumps	No change

5. Define the efficiency upgrade.

Measure ID	**Description of EVT Efficient Upgrade**	**Description of DPS Efficient Upgrade**	**Reason for DPS Change**
2349113	Install three 10-ton, three 8-ton, and three 6-ton Daikin VRV heat pumps (model RXYQ-P)	Install three 12-ton, three 8-ton, and three 6-ton Daikin VRV heat pumps (model RXYQ-M)	Project documentation indicated that the installed units are as indicated in the DPS column.
2349114	Install three 10-ton, three 8-ton, and three 6-ton Daikin VRV heat pumps (model RXYQ-P)	Install three 12-ton, three 8-ton, and three 6-ton Daikin VRV heat pumps (model RXYQ-M)	Project documentation indicated that the installed units are as indicated in the DPS column.

The DPS was unable to obtain invoices that list the model numbers of the heat pumps that were installed. There were documents that indicated that the overall system was increased from 60 tons to 80 tons (ReasonforDaikinUpsizing.pdf, Project Overview.doc), but again, there was no evidence of what was actually installed. The only document that showed the complete model numbers indicated that RXYQ-M units were installed as listed in the DPS column of the table above (Daikin VRV Energy Calc Report.pdf). EVT used RXYQ-P efficiency data for calculations.

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

Measure 2349113: Custom Space Heat Efficiency

The DPS was unable to recreate the heating savings listed in the CAT, but the DPS analysis method appears to be consistent with that of EVT. Several versions of archived EVT bin analyses used electric baseboard heat as the measure baseline. The DPS also used electric baseboard heat as the baseline, as there was no need to replace the existing heating system.

Bin analysis was used to calculate the energy savings. The DPS used TMY3 weather data from nearby Springfield, Vermont, to determine the number of hours in each temperature bin. EVT did not provide the source of the weather data used in calculations. EVT assumed that the heat pumps would be in heating mode when the wet-bulb temperature (WBT) is less than 50°F. In contrast, the DPS determined the bin hours according to dry-bulb temperature (DBT). Because manufacturer efficiency data for the heat pumps cooling mode is dependent upon DBT, bin hours were determined by DBT for cooling-mode savings (measure 2349114). Using DBT bins for both heating and cooling savings (measures 2349113 and 2349114, respectively) eliminates the possibility of counting heating savings when the unit is in cooling mode, and vice versa. The DPS assumed that the heat pumps would be in heating mode when DBT is less than 50°F.

Manufacturer data was used to determine the power draw of the as-built heat pumps at each temperature bin. The power draw was multiplied by the bin hours and the average percent heating load (calculated from utility data as described below) to determine the as-built kWh in each temperature bin. The total annual energy usage was the sum of each bin's calculated kWh. Baseline energy usage was determined using the average heating load (calculated from billing data as described below) and the EVT assumed COP of 1.0 for electric baseboard heaters.

Billing data was used to determine the average system loading as follows:

- The average summer and winter kW and kWh were calculated from 7 years of utility data.
- As there was no existing air-conditioning or ventilation equipment at the facility, the heating load was calculated to be the difference between the average summer and winter electric usage.

The average baseline heating load was calculated using the EVT assumption that the electric strip heaters operate with a 1.0 COP. It was assumed that the as-built heating load is equal to the baseline heating load. The average percent-load of the as-built heating system was calculated to be the average heating load divided by the total as-built heating capacity (determined from manufacturer data).

The energy savings was calculated to be the as-built annual energy usage subtracted from the baseline annual energy usage. The kWh savings was divided by the total bin heating hours to determine the winter peak kW savings. As the heat pumps do not operate in heating mode during summer peak periods, this measure does not yield any summer peak savings.

Measure 2349114: Custom Air Conditioning

Like the methodology employed for measure 2349113, bin analysis was used to calculate the energy savings. The DPS used TMY3 weather data from nearby Springfield, Vermont, to determine the number of hours in each dry-bulb temperature bin. EVT did not provide the source of the weather data used in calculations. EVT assumed that the heat pumps would be in cooling mode when DBT is greater than 50°F, but no justification was provided to support this assumption. Due to the facility type and building usage, the DPS assumed that the heat pumps would be in cooling mode when DBT is greater than 70°F. Manufacturer data was used to determine the power draw of the as-built heat pumps at each temperature bin. The power draw was multiplied by the bin hours and the to calculate the as-built kWh in each temperature bin. The total annual energy usage was the sum of each bin's calculated kWh.

Baseline energy usage was determined using the VT code baseline EER for air-to-air heat pumps and a standard part-load efficiency curve from eQUEST. The baseline efficiency curve varied the heat pump performance based on the DBT and WBT. The power draw of the baseline heat pumps was calculated for each temperature bin using the part-load efficiency and unit size. The power draw was multiplied by the bin hours to calculate the baseline kWh in each temperature bin. The total annual energy usage was the sum of each bin's calculated kWh. The energy savings was calculated to be the as-built annual energy usage subtracted from the baseline annual energy usage.

The summer peak kW was calculated for both the as-built and baseline units as follows:

> Summer peak kW = ISO-NE peak coincidence factor * Sum(kW demand in temperature bin * Bin hours in peak demand period) / Sum(Bin hours in peak demand period)

The peak demand kW savings was calculated to be the difference between the baseline and as-built peak kW demand. As the heat pumps do not operate in cooling mode during winter peak periods, this measure does not yield any winter peak savings.

7. Check if there are issues with any of the following:

____ Free ridership

____Spillover

____ Act 250 status

__X_ Hours of use/uptime

____ Commissioning adjustment

____ Cooling bonus/heating penalty

__X_ Load profile

____ MMBtu savings

____ Water savings

____ O&M savings

Preparation for FCM Verification

1. Which ISO option is recommended for forward capacity market (FCM) verification (Options A through D)?

   Option B metering is recommended.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- AustineSchoo381551ERS6TonCoolAnalV2.xls
- AustineSchoo381551ERS8TonCoolAnal V2.xls
- AustineSchoo381551ERS12TonCoolAnal V2.xls
- AustineSchoo381551ERSHeatAnal V2.xls

Review Engineer: Nathan Throop, Energy & Resource Solutions
Date submitted to West Hill Energy: 7/29/2011
Date finalized by West Hill Energy: 8/29/2011

EVT Project ID Number: 222413
Project Name: Barry Callebaut - LPA2
Sample Group (Size): 5
Type of Project (NC/MOP, Retrofit): Retrofit

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	**Description**	**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**
1959968	Custom refrigeration	153,170	16.852	18.061	206,083	31.687	18.033
1959969	Custom refrigeration	151,114	29.203	6.626	118,239	16.773	11.293
Total:		304,284	46.054	24.686	324,322	48.460	29.326

Measurement and Verification (M&V) Approach

1. Brief summary of the project.

   Add liquid pressure amplifiers to refrigeration banks 1 and 2. Liquid pressure amplifiers are small refrigerant pumps that raise liquid line pressure to increase system efficiency.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   EVT recorded 2-weeks of pre-installation and 2-weeks of post-installation compressor and condenser power data. The issue with the data is that the refrigeration load is very dependent on production levels and the production data was given on a monthly interval. The regressions with the power data and the ambient air condition have a significant amount of uncertainty because production levels are varying at an unknown amount over the pre- and post-installation logging periods. This results in a high level of uncertainty in the extrapolated annual energy estimates for the pre- and post-installation data. Also the power consumption of the new liquid amplifiers was not metered.

3. Is this project correctly characterized as MOP, NC or retrofit? If not or unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   Yes, the project is correctly characterized as a retrofit.

4. Define the baseline for each measure.

   The EVT and DPS baseline was no low pressure amplifiers in the refrigerant loop.

5. Define the efficiency upgrade.

   The EVT and DPS efficient case included the installation of low pressure amplifiers in the refrigeration loop.

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

   The DPS calculated the savings using the same methodology as EVT with the difference being that EVT had omitted some data when the power draw on the system was zero and did not account for that in the annual use calculation. Also, DPS used NOAA weather data for Burlington VT to regress the power data and TMY3 weather data for Burlington to extrapolate over the year.

   The DPS used the average power draw over the peak demand periods to quantify the peak demand savings. It was unclear how EVT calculated the peak demands.

   The analysis was corrected for production levels. The average production over the metered period and the average production over the entire year were used to normalize the model. DPS used the same factors as EVT. There is uncertainty in these factors because the production data is monthly and the metered period started and ended mid month.

   The post case use includes the energy consumed by the LPA pumps. The use of these pumps was estimated to be proportional to the load.

   The table below summarizes the DPS calculation of energy and demand savings for Bank 1.

				Bank1 pre	Bank1 post				
			slope	45.29107	31.865199				
			intercept	0.463117	0.181169				
			data correction for time at 0	6.17%	9.26%				
			Production correction	113%	129%				
TMY3				Bank 1					
DBT (F)	all hours	summer peak hours	winter peak hours	pre kW	post kW	savings kW	savings kWh	summer peak kWh	winter peak kWh
100	2	2		96.80	58.30	38	77	76.98847	0
95	9	5		94.35	57.25	37	334	185.52	0
90	22	12		91.90	56.19	36	786	428.5649	0
85	80	34		89.46	55.13	34	2,746	1166.999	0
80	240	97		87.01	54.08	33	7,904	3194.526	0
75	430	90		84.56	53.02	32	13,563	2838.871	0
70	651	69		82.12	51.96	30	19,629	2080.541	0
65	797	55		79.67	50.91	29	22,924	1581.939	0
60	727	2		77.22	49.85	27	19,900	54.74455	0
55	685	2	2	74.78	48.79	26	17,798	51.96406	51.96406
50	706		2	72.33	47.74	25	17,362	0	49.18357
45	631		4	69.88	46.68	23	14,640	0	92.80616
40	716		14	67.43	45.62	22	15,617	0	305.3581
35	651		13	64.99	44.57	20	13,294	0	265.4736
30	699		23	62.54	43.51	19	13,303	0	437.7085
25	562		24	60.09	42.45	18	9,914	0	423.3734
20	419		17	57.65	41.40	16	6,809	0	276.2553
15	261		7	55.20	40.34	15	3,878	0	104.0205
10	182		12	52.75	39.28	13	2,452	0	161.6379
5	138		3	50.31	38.23	12	1,667	0	36.23874
0	89		3	47.86	37.17	11	951	0	32.068
-5	37			45.41	36.11	9	344	0	0
-10	18			42.97	35.06	8	142	0	0
-15	6			40.52	34.00	7	39	0	0
-20	2			38.07	32.94	5	10	0	0
Total	8760	368	124				206,083	11,661	2,236
						Demand Savings kW	23.53	31.69	18.03

The table below summarizes the DPS calculation of energy and demand savings for Bank 2.

				Bank pre	Bank2 post				
			slope	79.320293	61.552384				
			intercept	0.4498962	0.299183				
	data correction for time at 0			0	0				
		Production correction		110%	129%				
TMY3				Bank 2					
DBT (F)	all hours	summer peak hours	winter peak hours	pre kW	post kW	savings kW	savings kWh	summer peak kWh	winter peak kWh
100	2	2		137.21	117.70	20	39	39.0105	0
95	9	5		134.72	115.78	19	171	94.73643	0
90	22	12		132.24	113.85	18	405	220.6719	0
85	80	34		129.76	111.93	18	1,427	606.2662	0
80	240	97		127.28	110.00	17	4,146	1675.519	0
75	430	90		124.79	108.08	17	7,188	1504.389	0
70	651	69		122.31	106.15	16	10,519	1114.865	0
65	797	55		119.83	104.23	16	12,433	857.9727	0
60	727	2		117.34	102.30	15	10,935	30.08308	0
55	685	2	2	114.86	100.38	14	9,921	28.96715	28.96715
50	706		2	112.38	98.45	14	9,831	0	27.85123
45	631		4	109.90	96.53	13	8,435	0	53.4706
40	716		14	107.41	94.60	13	9,172	0	179.3356
35	651		13	104.93	92.68	12	7,976	0	159.2724
30	699		23	102.45	90.75	12	8,174	0	268.9564
25	562		24	99.96	88.83	11	6,258	0	267.2591
20	419		17	97.48	86.90	11	4,432	0	179.8231
15	261		7	95.00	84.98	10	2,615	0	70.13907
10	182		12	92.52	83.05	9	1,722	0	113.5428
5	138		3	90.03	81.13	9	1,229	0	26.71182
0	89		3	87.55	79.20	8	743	0	25.03793
-5	37			85.07	77.28	8	288	0	0
-10	18			82.58	75.35	7	130	0	0
-15	6			80.10	73.43	7	40	0	0
-20	2			77.62	71.50	6	12	0	0
Total	8760	368	124				118,239	6,172	1,400
					Demand Savings kW		13.50	16.77	11.29

7. Check if issues with any of the following:

    ____ Freeridership

    ____Spillover

    ____ Act 250 Status

    ____ Hours of use/uptime

    ____ Commissioning Adjustment

    ____ Cooling Bonus/Heating Penalty

___x_ Load Profile

____ MMBtu Savings

____ Water Savings

____ O&M Savings

Briefly explain the issue(s).

The load profile has a significant amount of uncertainty due to lack of production data.

Preparation for FCM Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   Option B
2. If critical documentation is missing, list additional information needed to verify savings to FCM standards.

   Having daily production data for each of the two banks would greatly improve the uncertainty.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- BarryCalleba222413ERSAnalV0.xls

Attachments:

Metering Plan, sampling worksheet, supplemental work papers and files

Review Engineer: Emily Cross, Cx Associates
Date submitted to West Hill Energy: August 1, 2011
Date finalized by West Hill Energy: August 12, 2011

EVT Project ID Number: 386393
Project Name: Ben & Jerry's – Saint Albans – Freezer Doors
Sample Group (Size): 5
Type of Project (NC/MOP, Retrofit): Retrofit

The Efficiency Vermont (EVT) and Department of Public Service (DPS) verified savings are shown in the table below.

Measure ID	Description	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
2349221	Custom refrigeration 8 ft x 8 ft door, low use	259,581	28.782	28.782	321,584	37.307	37.231
2349222	Custom refrigeration 8 ft x 8 ft door, high use	259,698	28.795	28.795	322,042	37.382	37.306
2349223	Custom refrigeration 8 ft x 16 ft door	261,927	29.042	29.042	326,254	38.070	37.994
Total		781,206	86.618	86.618	969,880	112.758	112.532

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   This project included replacement of three freezer doors (a total of 256 sq ft) leading from a cooler space (high-stage ammonia refrigeration loop, +40°F space) to a freezer space (-35°F booster loop) in an ice cream storage and distribution center. The existing doors (two 8 ft x 8 ft, and one 8 ft x 16 ft) had an R value of 1 and the replacement doors have an R value of 3.5. The door replacement enabled the removal of a significant electrical load due to defrost-related equipment, which was no longer needed with the new doors, including heating tape, a door heater, and a blower. In addition to the removal of this direct electrical load, significant cooler refrigeration system electrical savings were realized from the removal of the defrost waste-heat cooling load on the cooler system (40°F space, "high-stage" refrigeration loop).

   Also included in the project were new automatic door motors that allow the doors between the cooler and freezer to open and close more quickly. This reduces infiltration of the warmer cooler air into the freezer space, thereby reducing the refrigeration load on the freezer refrigeration system (-35°F refrigeration loop), with resulting electrical savings attributable to the faster motors.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   Yes, EVT pre-metered the electrical load on all three door heater defrost systems before installation of the new doors. EVT also used annual average door counts available from the customer's door count device in their savings calculations for reduced infiltration.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not, or if it cannot be determined, please explain and identify any additional information needed to ascertain the correct project characterization.

   Yes, this project is correctly characterized as a retrofit.

4. Define the baseline for each measure. (Use tables provided below, if appropriate.)

   The baseline for this retrofit project was the existing equipment, as follows:

<table>
<tr><th>Measure ID</th><th>Description of EVT Baseline</th><th>EVT Baseline kW*</th><th>Description of DPS Baseline</th><th>DPS Baseline kW</th><th>Reason for DPS Change</th></tr>
<tr><td>2349221</td><td rowspan="3">R=1 doors between the cooler and the freezer

Direct equipment loads:
Door heater kW
Blower kW
Door heater tape kW
Old door motor kW

Indirect loads:
Refrigeration system kW related to:

Waste heat loads of all equipment (attributed to cooler)

Infiltration loads due to slower motors (attributed to freezer)</td><td>26.440</td><td>Same</td><td>38.307</td><td rowspan="3">Direct loads: The DPS analysis used the average kW from the EVT meter data to calculate the average direct electrical load during ISO NE winter and summer periods.

Indirect loads: The DPS analysis used a higher refrigeration system kW/ton efficiency than EVT, based on the Cascade report, for the average annual loads shown in that report.</td></tr>
<tr><td>2349222</td><td>27.633</td><td>Same</td><td>40.485</td></tr>
<tr><td>2349223</td><td>31.877</td><td>Same</td><td>48.273</td></tr>
</table>

* Based on the EVT calculation spreadsheet

5. Define the efficiency upgrade.

   The efficiency upgrade for this retrofit project included:

   - Installation of improved R value doors (R=3.5)/removal of defrost equipment
   - Faster door motors

Measure ID	Description of EVT Efficient Upgrade	EVT Efficient kW*	Description of DPS Efficient Upgrade	DPS Efficient kW	Reason for DPS Change
2349221	High-speed roll-up freezer door with insulated panel (R=3.5), thermal break, 8 ft x 8 ft	0.575	High-speed roll-up freezer door with insulated panel (R=3.5), thermal break, 8 ft x 8 ft	1.038	Indirect loads: The DPS analysis used a higher refrigeration system kW/ton efficiency than EVT, based on the Cascade report average annual loads.
2349222	High-speed roll-up freezer door with insulated panel (R=3.5), thermal break, 8 ft x 8 ft	1.748	High-speed roll-up freezer door with insulated panel (R=3.5), thermal break, 8 ft x 8 ft	3.141	
2349223	High-speed roll-up freezer door with insulated panel (R=3.5), thermal break, 16 ft x 8 ft	5.628	High-speed roll-up freezer door with insulated panel (R=3.5), thermal break, 16 ft x 8 ft	10.241	

* Based on the EVT calculation spreadsheet

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

   General

   The DPS savings calculations were based on the EVT pre-retrofit meter data and average annual refrigeration loads as reported in the Cascade report[1]. The primary differences between the EVT inputs and the DPS inputs are discussed below.

   Pre-Retrofit Meter Data Analysis

   The DPS analysis included filtering on ISO NE summer and winter periods (weekday non-holiday, 1 to 5 p.m. in summer, and 5 to 7 p.m. in winter) for use in calculations of ISO summer and winter peak kW savings. The DPS kW was similar to the EVT kW.

[1] *Energy Analysis Report: Ammonia Refrigeration System, Ben and Jerry's, St. Albans, VT*, 2008, Cascade Energy Engineering.

Waste Heat/Cooling Bonus Calculations

The EVT kW/ton is lower than the DPS kW/ton, resulting in a higher estimate of the cooling bonus savings.

The specific DPS calculation methodologies for kW savings are as follows:

$$kW_{.savings} = kW_{.baseline} - kW_{.efficient}$$ (for each of ISO NE summer and winter)

where,

$$kW_{.baseline} = kW_{.direct\ kW.baseline} + kW_{.indirect\ kW.baseline}$$

and

$$kW_{.efficient} = kW_{.direct\ kW.efficient} + kW_{.indirect\ kW.efficient}$$

The direct and indirect loads are broken down as described below:

$$kW_{.direct.kW.baseline} = kW_{.defrost\ heater} + kW_{.blower\&tape} + kW_{.door\ motors}$$

$$kW_{.direct.kW.efficient} = kW_{.new\ blower} + kW_{.new\ door\ motors}$$

Indirect electrical kW (cooling bonus for waste heat and infiltration) are as follows:

$$kW_{.indirect.kW.baseline} = kW_{.+40°F.defrost\ equip\ waste\ heat} + kW_{.-35°F.slow\ motor\ infiltration}$$

$$kW_{.indirect.kW.efficient} = kW_{.+40°F.blower\ waste\ heat} + kW_{.-35°F.fast\ motor\ infiltration}$$

The energy savings were calculated in a similar method, as described below:

$$kWh_{.savings} = kWh_{.baseline} - kWh_{.efficient}$$

where,

$$kWh_{.baseline} = kWh_{.direct.kWh.baseline} + kWh_{.indirect.kWh.baseline}$$

and

$$kWh_{.efficient} = kWh_{.direct.kWh.efficient} + kWh_{.indirect.kWh.efficient}$$

The direct and indirect components for kWh calculations are the same as for the kW calculations above and the DPS hours of operation are the same as the hours used in the EVT analysis.

$$h_{.defrost.system} = 8568 \text{ annual hours}$$

$$h_{.door.usage} = 6120 \text{ annual hours}$$

where the defrost system operates 8568 hours per year (= 51 weeks*24 hours*7 days), and the doors are in use 6120 hours per year (= 51 weeks*24 hours*5 days).

7. Check if issues with any of the following:

    ____ Free ridership

    ____ Spillover

    ____ Act 250 Status

    ____ Hours of use/uptime

    ____ Commissioning adjustment

    _X__ Cooling bonus/heating penalty

    ____ Load profile

    ____ MMBtu savings

    ____ Water savings

    ____ O&M savings

    Briefly explain the issue(s).

    As described in the calculations section above, the assumptions used by EVT in determining the efficiency of the refrigeration system for waste heat rejection savings calculations were not aligned with the report prepared by Cascade Energy Engineering. The report showed relatively low average compressor usage in the range of 5% to 33% of max loading for the 40°F and -35°F compressors respectively, whereas EVT assumed an average 75% loading for each system. The EVT assumption resulted in higher refrigeration system efficiency and therefore lower waste-heat rejection electrical savings than the DPS analysis, when the electric heaters and other defrost equipment were removed.

    The DPS calculated cooling bonus factor based on the documented (underloaded) systems is approximately 1.45. This is within the range of TRM cooling bonuses for smaller refrigeration systems (the TRM refrigeration cooling bonus is in the range of 1.2 to 1.5) and is based on project specific refrigeration load data from a third-party energy contractor (Cascade).

Preparation for FCM Verification

1. Which ISO option is recommended for forward capacity market (FCM) verification? (Options A through D)

    Option B is recommended for the direct electrical load removal (EVT has stated they are already planning for this).

    Option A is recommended for cooling bonus verification (see discussion below).

2. If critical documentation is missing, list additional information needed to verify savings to FCM standards.

    Post-metering of any remaining defrost equipment is required to confirm the efficient kW and savings to ISO NE FCM standards.

In order to assess the cooling bonus to FCM standards it would be necessary to interview the customer and request documentation demonstrating whether the study conducted by Cascade Energy Engineering (from 2008) was still representative of the refrigeration loads and system efficiency at the time of the door retrofit in 2010. Measurements of refrigeration system electrical usage in the post case may provide limits on the cooling bonus, but they would not be sufficient for calculating the cooling bonus to ISO NE standards. As such, customer interview and data requests are recommended in lieu of metering for cooling bonus verification.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- B+J St Albans Freezer Doors DPS adjustments v2.xlsb
- B+J refrig summary_CascadeReport2008 DPS.pdf
- Freezer Door Electrical Load 24 hr load shapes B+J Freezer.xlsb

Additional Notes/Discussion

The infiltration rate of 100 fpm used in the EVT infiltration-related savings calculations for the faster door motors has a strong impact on savings for that measure. The value of 100 fpm was selected by EVT as a conservative estimate in the lower third of the *ASHRAE Handbook*[2] range of 60 fpm to 300 fpm for infiltration rates through door openings; however, there is no project specific basis for this number. As it is difficult to quantify the infiltration rate accurately, even with in situ measurements on-site, the 100 fpm value has been accepted as a conservative estimate for the purpose of calculating energy savings for verification.

[2] *2010 ASHRAE Handbook*—Refrigeration, p. 24.6.

Review Engineer: Lexicon Energy Consulting
Date submitted to West Hill Energy: 9/8/11
Date finalized by West Hill Energy: 9/9/2011

EVT Project ID Number: 370695
Project Name: Bennington College – VAPA Studio Lighting
Sample Group (Size): 3
Type of Project (NC/MOP, Retrofit): NC/MOP

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
1912403	New T5 high-bay	17100	2.850	2.850	17100	2.850	2.850
1912404	New T5 high-bay	1664	0.190	0.190	1664	0.190	0.190
1912406	Occupancy sensors	14256	2.376	2.376	14256	2.376	2.376
1912407	Occupancy sensors	1728	0.288	0.288	2592	0.432	0.432
1912408	Daylighting	12139	0.000	4.320	12139	0.000	4.320
Total:		46888	5.704	10.024	47751	5.848	10.168

Note: The space is not cooled, so there is no cooling bonus for any of the lighting measures.

Measure ID	Description	Resource Type	Resource Units	EVT Claimed Resource Change	DPS Verified Resource Change
1912403	New T5 high-bay	Wood	MMBtu	-21.240	-21.240
1912404	New T5 high-bay	Wood	MMBtu	-2.070	-2.070
1912406	Occupancy sensors	Wood	MMBtu	-17.710	-17.710
1912407	Occupancy sensors	Wood	MMBtu	-2.150	-2.293
1912408	Daylighting	Wood	MMBtu	-15.080	-15.080

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   This is a retrofit lighting project in studios and mezzanine, including new fixtures, occupancy sensors, and daylighting.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   No.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   Yes, this project was correctly characterized as retrofit.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

Measure ID	**Description of EVT Baseline**	**EVT Baseline kW**	**Description of DPS Baseline**	**DPS Baseline kW**	**Reason for DPS Change**
1912403	No change	No change	No change	No change	
1912404	No change	No change	No change	No change	
1912406	No change	No change	No change	No change	
1912407	T5 high-bay 4L-F54HO	240 w/fixture	T5 High-Bay 6L-F54HO	360 w/fixture	See note below*
1912408	No change	No change	No change	No change	

*In the document named, "TechnicalPeerReviewandSign-offChecklist_fillable," there is a note that says that inspection revealed that only 6 lamp fixtures were installed. EVT's savings calculation for Measure 1912407, which is for the installation of occupancy sensors, used a baseline of 4 lamp fixtures without occupancy sensors. DPS revised the savings calculation to represent the installed 6 lamp fixtures.

5. Define the efficiency upgrade.

Measure ID	**Description of EVT Efficient Upgrade**	**EVT Efficient kW**	**Description of DPS Efficient Upgrade**	**DPS Efficient kW**
1912403	No change	No change	No change	No change
1912404	No change	No change	No change	No change
1912406	No change	No change	No change	No change
1912407	Occupancy sensors installed on 4L fixtures		Occupancy sensors installed on 6L fixtures	
1912408	No change	No change	No change	No change

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

   For measure 19122407 for occupancy sensors, EVT based their savings estimate on 4L fixtures, whereas 6L fixtures were actually installed.

   kWwin or sum = 0.15 * 8 fixtures * 360 W/ 1000 = 0.432 kW and kWh savings = 0.432 * 6000 hours = 2592 kWh

7. Check if issues with any of the following:

   ____ Free ridership
   ____Spillover
   ____ Act 250 status
   ____ Hours of use/uptime
   ____ Commissioning adjustment
   _X__ Cooling bonus/heating penalty
   ____ Load profile
   ____ MMBtu savings
   ____ Water savings
   ____ O&M savings

Preparation for Forward Capacity Market (FCM) Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   Option B, Retrofit Isolation/Metered Equipment, is recommended.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- CAT10a_3C875_dpsrev.xls

Attachments

Metering Plan, sampling worksheet, supplemental work papers, and files.

Review Engineer: Energy & Resource Solutions
Date submitted to West Hill Energy: July 22, 2011
Date finalized by West Hill Energy: August 3, 2011

EVT Project ID Number: 382422
Project Name: Burlington International Airport - Chiller & DDC Upgrade
Sample Group (Size): 5
Type of Project (NC/MOP, Retrofit): Retrofit

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
2321537	Motor, ODP 5 hp	385	0.002	0.115	102	0	0.038
2321538	Motor, ODP 15 hp	534	0.003	0.16	148	0	0.055
2321539	Motor, ODP 20 hp	712	0.004	0.214	195	0	0.073
2321540	Water chilling system	210801	1.32	63.195	164,663	0	78.360
2321541	Custom air conditioning	23526	0.397	19	0	0	0.000
2321543	Variable frequency drive (VFD) motor control	20775	0.35	16.778	17,393	0	6.010
2321544	VFD motor control	27699	0.467	22.37	23,293	0	8.064
2321545	VFD motor control	14046	0.237	11.344	1,772	0	0.629
Total		298479	2.781	133.176	207,565	0	93.229

Measurement and Verification (M&V) Approach

1. This project consists of measures associated with the installation of a new water-cooled chilled-water plant.
2. There is no metered data for this project.
3. The project is characterized as a retrofit. This is not correct, as this project is part of a major renovation and the existing equipment was at the end of its useful life. The correct project characterization is a market opportunity (MOP).
4. Define the baseline for each measure. (Use tables provided below if appropriate.)

Measure ID	Description of EVT Baseline	Description of DPS Baseline	Reason for DPS Change
2321537	Two 5 hp standard efficiency motors that operate at 75% load	Two 5 hp standard efficiency motors that operate according the modeled load on the cooling tower	Interactive savings were calculated using the modeled cooling load
2321538	One 15 hp standard efficiency motor that operates at 75% load	One 15 hp standard efficiency motor that operates according the modeled load on the evaporator loop	Interactive savings were calculated using the modeled cooling load
2321539	One 20 hp standard efficiency motor that operates at 75% load	One 20 hp standard efficiency motor that operates according the modeled load on the condenser loop	Interactive savings were calculated using the modeled cooling load
2321540	Code efficiency air-cooled chiller	Code efficiency air-cooled chiller	No change
2321541	Condenser-water and chilled-water pumps to support a 10°F delta T over condenser and evaporator loops	Condenser-water and chilled-water pumps to support a 14°F delta T over condenser and evaporator loops	The condenser water and chilled water flows demand did not change as a result of the 14°F delta T
2321543	One 15 hp constant-speed chilled-water pump that operates at full load	One 15 hp constant-speed chilled-water pump that operates at full load	No change
2321544	One 20 hp constant-speed condenser pump that operates at full load	One 20 hp constant-speed condenser pump that operates at full load	No change
2321545	Two 5 hp constant-speed cooling tower fans that operate at full load 100% of the time	Two 5 hp constant-speed cooling tower fans that cycle according to cooling-tower load	Standard practice would cycle the fans according to load

5. Define the Efficiency upgrade.

   The findings for each measure are detailed below. A table identifying the measure and the savings calculated by EVT and DPS are presented for each, followed by a discussion of the issues with the EVT calculation and description of the modified DPS calculation.

Measure ID	Description	EVT kWh	DPS kWh	EVT kW	DPS kW
2321537	VFD on cooling tower fans	385	102	0.115	0.038
2321538	VFD on chilled-water pump	534	148	0.160	0.055
2321539	VFD on condenser pump	712	195	0.214	0.073

Issue with EVT Calculation

The calculation uses 75% load for 2694 hours. The actual loading is lower than 75%, based on the system demand.

DPS calculation Adjustment

Savings was calculated from the post-case modeled use, which indicated that the motor loading was less than 75%.

Measure ID	Description	EVT kWh	DPS kWh	EVT kW	DPS kW
2321540	New water-cooled chiller vs. code air-cooled chiller	210,801	164,663	63.195	78.360

Issue with EVT Calculation:

Condenser pump and cooling-tower energy was not included in post-case calculations. In addition, the baseline 1.41 kW per ton was held constant for all temperature bins, even though all systems become more efficient at cooler temperatures. It was unclear what weather data was used in the EVT calculation.

DPS Calculation Adjustment:

Condenser pump and cooling-tower fan energy was added to post-case calculations. Additionally, chiller performance was modified as a function of outdoor air temperature. The weather data was changed to TMY3 weather data for Burlington, Vermont.

Measure ID	Description	EVT kWh	DPS kWh	EVT kW	DPS kW
2321541	Reduced pumping energy on condenser and chilled water for increasing delta T	23,526	0	19.000	0.000

Issue with EVT Calculation:

The program calculations claimed savings for reducing the condenser-water pump and chilled-water pump by 5 hp at 100% load for 3000 annual hours. Savings was claimed for having a 14°F delta T instead of a 10°F delta T. This calculation is unreasonable because it significantly over estimates the pumping energy that would be reduced by this measure. Additionally, EVT has already claimed savings for VFDs on these pumps in measures 2321543 and 2321544.

DPS Calculation Adjustment:

There was evidence in the commissioning report that the chilled-water pump and condenser-water pump flows did not change from what was assumed in the baseline. Also, since savings were already claimed in measures 2321543 and 2321544, they were eliminated for this measure.

Measure ID	Description	EVT kWh	DPS kWh	EVT kW	DPS kW
2321543	VFD chilled-water pump	20,775	17,393	16.778	6.010

Issue with EVT Calculation:

According to program documentation, this measure was implemented on a primary loop chilled-water system. EVT analysis did not account for the need to maintain a minimum flow through the evaporator.

DPS Calculation Adjustment:

The calculation was modified so that the post-case pump maintains a minimum speed of 50%. The DPS has calculated savings for this measure, but believes that these savings are optimistic.

Measure ID	Description	EVT kWh	DPS kWh	EVT kW	DPS kW
2321544	VFD condenser pumps	27,699	23,293	22.370	8.064

Issue with EVT Calculation: Variable condenser flow is complicated because reducing the flow can negatively impact the chiller performance. Also, there is a minimum flow that must be maintained. The EVT claimed savings did not account for these.

DPS Calculation Adjustment: The calculation was modified so that the post-case has a minimum condenser-water pump speed of 50%. The DPS has calculated savings for this measure, but believes that these savings are optimistic. The effect on the chiller performance was not calculated for this measure due to lack of available information.

Measure ID	Description	EVT kWh	DPS kWh	EVT kW	DPS kW
2321545	VFD cooling tower	14,046	1,772	11.344	0.629

Issue with EVT Calculation

The EVT baseline assumed that one 10 hp cooling tower fan ran at constant speed without cycling. However, program documentation indicates that two 5 hp fans were installed and should therefore be the measure baseline. The two 5 hp fans would cycle with demand.

DPS Calculation Adjustment

Program documentation indicates there are two 5 hp cooling tower fans. The baseline calculation was modified to have the two constant-speed 5 hp fans cycle based on load.

6. Saving Calculations

Savings were calculated using bin analysis. The bins were grouped on 2°F wet-bulb temperature and included the average dry-bulb temperature. The loading on the chiller was assumed to be 100% in the hottest temperature bin and 0% when the outside air is at or below 60°F. A linear profile was used between these two load conditions. There is no data to support this assumption, but the DPS used the same loading profile as EVT. The EVT post-case calculation assumed that the speed of all three VFDs (chilled-water pump, condenser-water pump, and cooling tower fans) followed the same linear profile, assuming 100% in the hottest bin and 0% when the outside temperature was 60°F. The DPS modified the VFD calculation for the chilled-water pump and condenser-water pump by limiting the minimum speed to 50%. This was done to account for the evaporative chiller's minimum flow requirement. The DPS post-case calculation for the cooling tower fan VFD measure used the same loading profile as EVT, but divided the baseline energy consumption in half under the assumption that when the cooling tower load is below 50% one fan operates at full speed, and when the cooling tower load is above 50% one fan operates at full speed and the other fan cycles on and off according to the load.

EVT calculated the savings for measure 2321541, custom air conditioning, by assuming a 14°F delta T instead of a 10°F delta T. Based on the chiller's full-load capacity of 220 tons, a new condenser water flow was calculated. The required pumping hp was calculated for both the baseline and post-case flows. The post-case flow was rounded up to the next motor size, which inflated the savings and resulted in a 5 hp fully loaded pump that operates for 3000 hours per year. The DPS believes that these saving do not exist because the commissioning report indicates the flows were not reduced.

7. Check if there are issues with any of the following:

____ Free ridership

____Spillover

____ Act 250 status

____ Hours of use/uptime

__X__ Commissioning adjustment

____ Cooling bonus/heating penalty

__X__ Load profile

____ MMBtu savings

____ Water savings

____ O&M savings

Briefly explain the issues.

The DPS has identified and described issues with the measures listed in Section 4 of this report.

Furthermore, there is no data to support the chilled-water loading profile used in the analysis. There is also not information on how the VFDs for the chilled water and condenser water are controlled and therefore the loading profile of the pumps has a significant amount of uncertainty.

There is no evidence that Measure 2321541 was implemented. There was information in the commissioning report that the flow was set to the baseline condition which leads the DPS to believe that the measure was not implemented.

Preparation for Forward Capacity Market (FCM) Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   Option B metering is recommended.

2. If critical documentation is missing, list additional information needed to verify savings to FCM standards.

   - Chiller model number and specifications
   - Pumping control algorithms
   - Post-metered data for:
     - Chilled-water pump power
     - Condenser water pump power
     - Cooling tower fan power
     - Chiller power
     - Chiller cooling load (tons)

Documentation

List all supplemental work papers and files used in the calculation of savings.

- Chiller Plant Analysis_Waterside ERS edits.xls

Attachments

Metering Plan, sampling worksheet, supplemental work papers, and files.

Review Engineer: GDS Associates
Date submitted to West Hill Energy: July 20, 2011
Date finalized by West Hill Energy: July 29, 2011, Revised October 4, 2011

EVT Project ID Number: 337278
Project Name: CCV - Winooski - New Construction
Sample Group (Size): 5
Type of Project (NC/MOP, Retrofit): NC/MOP

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
2287094	Lighting system, interior power density reduction	495	0.052	0.180	469	0.039	0.156
2287095	Lighting system, interior power density reduction	2188	0.178	0.618	2070	0.133	0.535
2287096	Lighting system, interior power density reduction	15	0.001	0.004	14	0.001	0.004
2287097	Lighting system, interior power density reduction	292	0.375	1.304	276	0.279	1.127
2287098	Lighting system, interior power density reduction	14	0.018	0.062	13	0.013	0.054
2287099	Lighting system, interior power density reduction	289	0.024	0.082	274	0.018	0.071
2287100	Lighting system, interior power density reduction	548	0.045	0.155	518	0.033	0.134
2287101	Lighting system, interior power density reduction	-53	-0.004	-0.015	-50	-0.003	-0.013
2287102	Lighting system, interior power density reduction	111	0.009	0.031	105	0.007	0.027
2287103	Lighting system, interior power density reduction	73	0.006	0.021	69	0.004	0.018
2287104	Lighting system, interior power density reduction	-76	-0.006	-0.022	-72	-0.005	-0.019
2287105	Lighting system, interior power density reduction	1806	0.147	0.510	1709	0.109	0.441
2287106	Lighting system, interior power density reduction	482	0.039	0.136	456	0.029	0.118
2287107	Lighting system, interior power density reduction	-1814	-0.148	-0.513	-1717	-0.110	-0.443
2287108	Lighting system, interior power density reduction	-13	-0.017	-0.058	-12	-0.012	-0.050
2287109	Lighting system, interior power density reduction	11806	0.960	3.337	11171	0.715	2.886
2287110	Lighting system, interior power density reduction	-1811	-0.110	-0.384	-1713	-0.082	-0.332
2287111	Lighting system, interior	9	0.011	0.038	8	0.008	0.033

	power density reduction						
2287112	Lighting system, interior power density reduction	1074	0.087	0.304	1016	0.065	0.263
2287113	Lighting system, interior power density reduction	848	0.069	0.240	802	0.051	0.207
2287114	Lighting system, interior power density reduction	-477	-0.039	-0.135	-452	-0.029	-0.117
2287115	Lighting system, interior power density reduction	1572	0.128	0.444	1487	0.095	0.384
2287116	Lighting system, interior power density reduction	10403	0.846	2.940	9843	0.630	2.543
2287117	Lighting system, interior power density reduction	609	0.050	0.172	576	0.037	0.149
2287118	Lighting system, interior power density reduction	1931	0.157	0.546	1827	0.117	0.472
2287119	Lighting system, interior power density reduction	-1187	-0.097	-0.336	-1124	-0.072	-0.290
2287120	Lighting system, interior power density reduction	-8	-0.011	-0.038	-8	-0.008	-0.033
2287121	Lighting system, interior power density reduction	13	0.016	0.057	12	0.012	0.049
2287122	Lighting system, interior power density reduction	992	0.081	0.280	938	0.060	0.242
2287123	Lighting system, interior power density reduction	-328	-0.027	-0.093	-311	-0.020	-0.080
2287124	Lighting system, interior power density reduction	16024	1.303	4.529	15162	0.971	3.917
2287125	Lighting system, interior power density reduction	497	0.040	0.140	470	0.030	0.121
2287126	Lighting system, interior power density reduction	1783	0.145	0.504	1687	0.108	0.436
2287127	Lighting system, interior power density reduction	376	0.031	0.106	355	0.023	0.092
2287128	Lighting system, interior power density reduction	-1217	-0.099	-0.344	-1151	-0.074	-0.297
2287129	Lighting system, interior power density reduction	603	0.049	0.170	570	0.036	0.147
2287130	Lighting system, interior power density reduction	26	0.034	0.117	25	0.025	0.101
2287131	Lighting system, interior power density reduction	335	0.027	0.095	317	0.020	0.082
2287132	Lighting system, interior power density reduction	1178	0.096	0.333	1114	0.071	0.288
2287133	Lighting system, interior power density reduction	172	0.014	0.048	162	0.010	0.042
2287134	Lighting system, interior power density reduction	15855	1.289	4.481	15002	0.960	3.876
2287135	Lighting system, interior power density reduction	1693	0.138	0.478	1602	0.103	0.414
2287136	Lighting system, interior power density reduction	720	0.059	0.203	681	0.044	0.176
2287137	Lighting system, interior power density reduction	-21	-0.027	-0.094	-20	-0.020	-0.081
2287138	Lighting system, interior power density reduction	419	0.034	0.118	396	0.025	0.102

2287139	Lighting system, interior power density reduction	-1149	-0.093	-0.325	-1087	-0.070	-0.281
2287140	Lighting system, interior power density reduction	598	0.049	0.169	566	0.036	0.146
2287141	Lighting system, interior power density reduction	16	0.020	0.070	15	0.015	0.060
2287142	Lighting system, interior power density reduction	1145	0.093	0.323	1083	0.069	0.280
2287143	Lighting system, interior power density reduction	33	0.003	0.009	31	0.002	0.008
2287144	Lighting system, interior power density reduction	-58	-0.030	-0.104	-55	-0.022	-0.090
2287145	Lighting system, interior power density reduction	1624	0.132	0.459	1536	0.098	0.397
2287153	Occupancy sensors	418	0.044	0.152	396	0.033	0.132
2287154	Occupancy sensors	760	0.062	0.215	719	0.046	0.186
2287155	Occupancy sensors	144	0.012	0.041	136	0.009	0.035
2287156	Occupancy sensors	4	0.005	0.017	4	0.004	0.015
2287157	Occupancy sensors	92	0.008	0.026	87	0.006	0.023
2287158	Occupancy sensors	133	0.011	0.038	126	0.008	0.033
2287159	Occupancy sensors	636	0.052	0.180	601	0.038	0.155
2287160	Occupancy sensors	216	0.018	0.061	204	0.013	0.053
2287161	Dimming controls and ballasts	202	0.016	0.057	191	0.012	0.049
2287162	Occupancy sensors	144	0.012	0.041	136	0.009	0.035
2287163	Occupancy sensors	862	0.070	0.244	816	0.052	0.211
2287164	Occupancy sensors	216	0.018	0.061	204	0.013	0.053
2287165	Occupancy sensors	1589	0.129	0.449	1503	0.096	0.388
2287166	Occupancy sensors	10	0.013	0.044	9	0.009	0.038
2287167	Occupancy sensors	5704	0.464	1.612	5397	0.345	1.394
2287168	Dimming controls and ballasts	346	0.021	0.073	327	0.016	0.063
2287169	Occupancy sensors	231	0.019	0.065	218	0.014	0.056
2287170	Occupancy sensors	133	0.011	0.038	126	0.008	0.033
2287171	Occupancy sensors	744	0.061	0.210	704	0.045	0.182
2287172	Occupancy sensors	575	0.047	0.162	544	0.035	0.140
2287173	Occupancy sensors	4085	0.332	1.154	3865	0.247	0.999
2287174	Occupancy sensors	295	0.024	0.083	279	0.018	0.072
2287175	Occupancy sensors	1185	0.096	0.335	1122	0.072	0.290
2287176	Occupancy sensors	1564	0.127	0.442	1479	0.095	0.382
2287177	Occupancy sensors	2	0.003	0.009	2	0.002	0.008
2287178	Occupancy sensors	231	0.019	0.065	218	0.014	0.056
2287179	Occupancy sensors	323	0.026	0.091	306	0.020	0.079
2287180	Occupancy sensors	5763	0.469	1.629	5453	0.349	1.409
2287181	Occupancy sensors	144	0.012	0.041	136	0.009	0.035
2287182	Occupancy sensors	898	0.073	0.254	850	0.054	0.219
2287183	Occupancy sensors	251	0.020	0.071	238	0.015	0.061
2287184	Occupancy sensors	1500	0.122	0.424	1419	0.091	0.367
2287185	Occupancy sensors	402	0.033	0.114	381	0.024	0.098
2287186	Occupancy sensors	10	0.013	0.046	10	0.010	0.040
2287187	Occupancy sensors	277	0.023	0.078	262	0.017	0.068
2287188	Occupancy sensors	323	0.026	0.091	306	0.020	0.079
2287189	Occupancy sensors	5611	0.456	1.586	5309	0.340	1.372
2287190	Occupancy sensors	862	0.070	0.244	816	0.052	0.211

2287191	Occupancy sensors	323	0.026	0.091	306	0.020	0.079
2287192	Occupancy sensors	8	0.010	0.035	7	0.007	0.030
2287193	Occupancy sensors	251	0.020	0.071	238	0.015	0.061
2287194	Occupancy sensors	1456	0.118	0.411	1377	0.088	0.356
2287195	Occupancy sensors	402	0.033	0.114	381	0.024	0.098
2287196	Occupancy sensors	277	0.023	0.078	262	0.017	0.068
2287197	Occupancy sensors	323	0.026	0.091	306	0.020	0.079
2287198	Occupancy sensors	399	0.032	0.113	377	0.024	0.097
2287199	Water chilling system	93383	0.093	4.455	93383	0.093	4.455
2287200	Water chilling system	93383	0.093	4.455	93383	0.093	4.455
2287201	Motor, TEFC 30 HP	466	0.000	0.233	466	0.000	0.233
2287202	Motor, ODP 30 HP	1192	0.197	0.182	1192	0.197	0.182
2287203	Motor, ODP 15 HP	720	0.119	0.110	720	0.119	0.110
2287204	Motor, ODP 15 HP	397	0.000	0.397	397	0.000	0.397
2287205	Motor, ODP 5 HP	408	0.143	0.000	408	0.143	0.000
2287206	Motor, ODP 1.5 HP	105	0.017	0.016	105	0.017	0.016
2287207	Motor, ODP 3 HP	236	0.039	0.036	236	0.039	0.036
2287208	Motor, ODP 1.5 HP	105	0.017	0.016	105	0.017	0.016
2287209	Motor, ODP 1.5 HP	105	0.017	0.016	105	0.017	0.016
2287210	Variable frequency drive (VFD) motor control	6436	0.120	0.080	6436	0.120	0.080
2287211	VFD, standardized	1501	0.260	0.106	1501	0.260	0.106
2287212	VFD, standardized	3003	0.519	0.213	3003	0.519	0.213
2287213	VFD, standardized	1001	0.173	0.071	1001	0.173	0.071
2287214	VFD, standardized	1001	0.173	0.071	1001	0.173	0.071
2287215	HVAC economizer	7172	2.394	0.000	7172	2.394	0.000
Total		321,383	13.840	43.362	315,427	11.426	38.916

Measure ID	Description	Resource Type	Resource Units	EVT Claimed Resource Change	DPS Verified Resource Change
2287094	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.550	0.510
2287095	Lighting system, interior power density reduction	Natural Gas	MMBtu	-2.440	2.255
2287096	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.020	0.015
2287097	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.330	0.301
2287098	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.020	0.014
2287099	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.320	0.298
2287100	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.610	0.564
2287101	Lighting system, interior power density reduction	Natural Gas	MMBtu	0.060	-0.055
2287102	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.120	0.114
2287103	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.080	0.075
2287104	Lighting system, interior power density reduction	Natural Gas	MMBtu	0.080	-0.079
2287105	Lighting system, interior power density reduction	Natural Gas	MMBtu	-2.010	1.861
2287106	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.540	0.497
2287107	Lighting system, interior power density reduction	Natural Gas	MMBtu	2.020	-1.870
2287108	Lighting system, interior power density reduction	Natural Gas	MMBtu	0.010	-0.013
2287109	Lighting system, interior power density reduction	Natural Gas	MMBtu	-13.140	12.168
2287110	Lighting system, interior power density reduction	Natural Gas	MMBtu	2.020	-1.866
2287111	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.010	0.009
2287112	Lighting system, interior power density reduction	Natural Gas	MMBtu	-1.200	1.107
2287113	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.940	0.874
2287114	Lighting system, interior power density reduction	Natural Gas	MMBtu	0.530	-0.492
2287115	Lighting system, interior power density reduction	Natural Gas	MMBtu	-1.750	1.620
2287116	Lighting system, interior power density reduction	Natural Gas	MMBtu	-11.580	10.722
2287117	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.680	0.628
2287118	Lighting system, interior power density reduction	Natural Gas	MMBtu	-2.150	1.990

2287119	Lighting system, interior power density reduction	Natural Gas	MMBtu	1.320	-1.224
2287120	Lighting system, interior power density reduction	Natural Gas	MMBtu	0.010	-0.009
2287121	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.010	0.013
2287122	Lighting system, interior power density reduction	Natural Gas	MMBtu	-1.100	1.022
2287123	Lighting system, interior power density reduction	Natural Gas	MMBtu	0.370	-0.338
2287124	Lighting system, interior power density reduction	Natural Gas	MMBtu	-17.840	16.516
2287125	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.550	0.512
2287126	Lighting system, interior power density reduction	Natural Gas	MMBtu	-1.990	1.838
2287127	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.420	0.387
2287128	Lighting system, interior power density reduction	Natural Gas	MMBtu	1.350	-1.254
2287129	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.670	0.621
2287130	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.030	0.027
2287131	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.370	0.346
2287132	Lighting system, interior power density reduction	Natural Gas	MMBtu	-1.310	1.214
2287133	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.190	0.177
2287134	Lighting system, interior power density reduction	Natural Gas	MMBtu	-17.650	16.342
2287135	Lighting system, interior power density reduction	Natural Gas	MMBtu	-1.880	1.745
2287136	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.800	0.742
2287137	Lighting system, interior power density reduction	Natural Gas	MMBtu	0.020	-0.022
2287138	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.470	0.431
2287139	Lighting system, interior power density reduction	Natural Gas	MMBtu	1.280	-1.184
2287140	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.670	0.616
2287141	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.020	0.016
2287142	Lighting system, interior power density reduction	Natural Gas	MMBtu	-1.270	1.180
2287143	Lighting system, interior power density reduction	Natural Gas	MMBtu	-0.040	0.034
2287144	Lighting system, interior power density reduction	Natural Gas	MMBtu	0.060	-0.060
2287145	Lighting system, interior power density reduction	Natural Gas	MMBtu	-1.810	1.673
2287153	Occupancy sensors	Natural Gas	MMBtu	-0.470	0.000

2287154	Occupancy sensors	Natural Gas	MMBtu	-0.850	0.000
2287155	Occupancy sensors	Natural Gas	MMBtu	-0.160	0.000
2287156	Occupancy sensors	Natural Gas	MMBtu	-0.0043	0.000
2287157	Occupancy sensors	Natural Gas	MMBtu	-0.100	0.000
2287158	Occupancy sensors	Natural Gas	MMBtu	-0.150	0.000
2287159	Occupancy sensors	Natural Gas	MMBtu	-0.710	0.000
2287160	Occupancy sensors	Natural Gas	MMBtu	-0.240	0.431
2287161	Dimming controls and ballasts	Natural Gas	MMBtu	-0.230	0.783
2287162	Occupancy sensors	Natural Gas	MMBtu	-0.160	0.148
2287163	Occupancy sensors	Natural Gas	MMBtu	-0.960	0.004
2287164	Occupancy sensors	Natural Gas	MMBtu	-0.240	0.095
2287165	Occupancy sensors	Natural Gas	MMBtu	-1.770	0.137
2287166	Occupancy sensors	Natural Gas	MMBtu	-0.010	0.655
2287167	Occupancy sensors	Natural Gas	MMBtu	-6.350	0.222
2287168	Dimming controls and ballasts	Natural Gas	MMBtu	-0.390	0.209
2287169	Occupancy sensors	Natural Gas	MMBtu	-0.260	0.148
2287170	Occupancy sensors	Natural Gas	MMBtu	-0.150	0.888
2287171	Occupancy sensors	Natural Gas	MMBtu	-0.830	0.222
2287172	Occupancy sensors	Natural Gas	MMBtu	-0.640	1.638
2287173	Occupancy sensors	Natural Gas	MMBtu	-4.550	0.010
2287174	Occupancy sensors	Natural Gas	MMBtu	-0.330	5.879
2287175	Occupancy sensors	Natural Gas	MMBtu	-1.320	0.357
2287176	Occupancy sensors	Natural Gas	MMBtu	-1.740	0.238
2287177	Occupancy sensors	Natural Gas	MMBtu	-0.0022	0.137
2287178	Occupancy sensors	Natural Gas	MMBtu	-0.260	0.767
2287179	Occupancy sensors	Natural Gas	MMBtu	-0.360	0.592
2287180	Occupancy sensors	Natural Gas	MMBtu	-6.420	4.210
2287181	Occupancy sensors	Natural Gas	MMBtu	-0.160	0.304
2287182	Occupancy sensors	Natural Gas	MMBtu	-1.000	1.222
2287183	Occupancy sensors	Natural Gas	MMBtu	-0.280	1.612
2287184	Occupancy sensors	Natural Gas	MMBtu	-1.670	0.002
2287185	Occupancy sensors	Natural Gas	MMBtu	-0.450	0.238
2287186	Occupancy sensors	Natural Gas	MMBtu	-0.010	0.333
2287187	Occupancy sensors	Natural Gas	MMBtu	-0.310	5.940
2287188	Occupancy sensors	Natural Gas	MMBtu	-0.360	0.148
2287189	Occupancy sensors	Natural Gas	MMBtu	-6.250	0.926
2287190	Occupancy sensors	Natural Gas	MMBtu	-0.960	0.259
2287191	Occupancy sensors	Natural Gas	MMBtu	-0.360	1.546
2287192	Occupancy sensors	Natural Gas	MMBtu	-0.010	0.415
2287193	Occupancy sensors	Natural Gas	MMBtu	-0.280	0.011
2287194	Occupancy sensors	Natural Gas	MMBtu	-1.620	0.286
2287195	Occupancy sensors	Natural Gas	MMBtu	-0.450	0.333
2287196	Occupancy sensors	Natural Gas	MMBtu	-0.310	5.783
2287197	Occupancy sensors	Natural Gas	MMBtu	-0.360	0.888
2287198	Occupancy sensors	Natural Gas	MMBtu	-0.440	0.333

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   The Community College of Vermont's new building in Winooski is five stories, totaling 60,000 square feet, and is made up of classrooms and offices. The building will be LEED-certified. Energy efficiency measures include measures in lighting, HVAC, motors, and controls.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   EVT did not meter this project. CCV obtains energy consumption information on installed systems through an energy information-management system. As part of EVT's Core Performance Program, this information may have been or is actively being shared with EVT. EVT provide metering guidelines to CCV as part of this program but it is not clear what, if any, of these guidelines were implemented or whether additional metering was performed as part of the LEED certification process.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   Yes, this project is correctly classified as NC/MOP

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

   - Measures 2287094 – 2287152: Baseline lighting power density
   - Measures 2287053 – 2287198: Lighting fixtures operating at full estimated run hours without the use of occupancy sensors.
   - Measures 2287199 – 2287200: Baseline efficiency chiller, 82.2 ton, 9.56 SEER/EER
   - Measures 2287201 – 2287209: Baseline efficiency motors
   - Measures 2287210 – 2287214: No VFD controls on boiler circulation pump or on supply side fans.
   - Measures 2287215: No HVAC economizers

5. Define the efficiency upgrade.

   - Measures 2287094 – 2287152: Installed, reduced lighting power density
   - Measures 2287053 – 2287198: Lighting fixtures operating at reduced run hours with the use of occupancy sensors.
   - Measures 2287199 – 2287200: Higher efficiency chiller, 82.2 ton, 10.1 SEER/EER
   - Measures 2287201 – 2287209: Higher efficiency motors
   - Measures 2287210 – 2287214: VFD controls on boiler circulation pump and supply side fans.
   - Measures 2287215: HVAC economizers

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

   Lighting: (measures 2287094 – 2287198)

   The method used, both by EVT and DPS, to estimate peak kW reduction and kWh savings was taken out of the Vermont TRM manual SV_2010, page 91. EVT's method deviates slightly from the TRM in that a coincidence factor is also applied to calculate winter and summer demand reduction savings. The specific modified equations from this page are as follows:

Energy Savings

$$\Delta kWh = kW_{save} \times HOURS \times WHF_e$$

Demand Savings

$$\Delta kW = kW_{save} \times WHF_d \times \text{Coincidence Factor}$$

$$kW_{save} = (WSF_{base} - WSF_{effic}) \times SF/1000$$

The primary difference between DPS and EVT is the WHF. DPS used an updated WHF for summer, winter and energy. These updated WHF values produced reduced estimates for saved kW and kWh and have been verified by DPS in Table 1 in this report. DPS also identified an error in the EVT calculation for winter kW demand estimates. We discovered that EVT used the summer WHF for winter demand.

When calculating savings associated with occupancy sensor controls, EVT used a reduction factor that ranged from 0.1 to 0.3 depending on location. This factor was applied to both kW and kWh savings from the equations above.

HVAC: (measures 2287199 – 2287200)

The method used, both by EVT and DPS, to estimate peak kW reduction and kWh savings was taken out of the Vermont TRM manual SV_2010, page 34. DPS made no changes to these two measures.

Motors: (measures 2287201 – 2287209)

The method used, both by EVT and DPS, to estimate peak kW reduction and kWh savings was taken out of the Vermont TRM manual SV_2010, page 17. DPS made no changes to these measures.

VFD: (measures 2287201 – 2287209)

EVT used a combination of proprietary Excel-based estimating tools and the Vermont TRM manual SV_2010, page 23, to estimate peak kW reduction and kWh. DPS made no changes to these measures.

7. Check if there are issues with any of the following:

____ Free ridership

____ Spillover

____ Act 250 status

____ Hours of use/uptime

____ Commissioning adjustment

____ Cooling bonus/heating penalty

____ Load profile

__X_ MMBtu savings

____ Water savings

____ O&M savings

Briefly explain the issue(s).

Because the MMBtu heating penalty factor has been updated, the heating penalty in the CAT tool is no longer accurate. Using the new MMBtu heating penalty, DPS has estimated the new values for each of the installed efficiency upgrades. The calculation for this value can be found in GDS analysis tool.

Preparation for FCM Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   Option C: Whole Facility/Regression

2. If critical documentation is missing, list additional information needed to verify savings to FCM standards.

Documentation

1. List all supplemental work papers and files used in the calculation of savings.
   - CAT10a_4C045.xls
   - Hydronic_Heating_Circ_Pump_VFD_v061017_4C045.xls
   - Waterside Economizer.xls
   - 2803-Complete SPEC Package 02-04-09.pdf
   - 2803-Mechanical Binder 01-26-09.pdf
   - TRM User Manual_SV 2010.doc
   - CCVWinooski337278GDSAnalV1.xls

Attachments

Supplemental work papers and files.

Review Engineer: Energy & Resource Solutions
Date submitted to West Hill Energy: 8/16/11
Date finalized by West Hill Energy:

EVT Project ID Number: 378571
Project Name: Fulflex Incorporated - Various Measures
Sample Group (Size): 5
Type of Project (NC/MOP, Retrofit): Retrofit

The following table presents only the measures for which the Department of Public Service (DPS) calculated savings that differed from Efficiency Vermont (EVT).

Measure ID	Description	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
1962445	Compressed air, compressor	189345	20.245	20.245	259354	30.771	34.067
1962446	Compressed air, Air Dryer	39549	4.370	4.370	14029	2.192	1.472
1962447	Compressed air, air treatment	9902	1.534	1.534	8225	1.278	0.869
1962448	Compressed air, distribution	12377	1.587	1.587	10559	1.640	1.115

There are no Other Resource Savings associated with the measures included in this report.

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   This project consists of three large measures, each of which can be subdivided in many submeasures. The primary measures are: Lighting & Controls, Compressed Air, and Dust Collection System Upgrades. The majority of the lighting savings are for new super T8 high-bay fixtures. The compressed air system was upgraded with a new VFD compressor and new dryer. There are also savings for reducing the operating pressure of the compressors. There are several dust-collection systems that were affected by this project. Gates were added at the pickups and VFDs were installed on the fans. Some of the systems were consolidated allowing several of the baseline systems to be turned off.

   DPS calculations agreed with the savings calculated by EVT for the lighting and dust-collection system upgrades. Therefore, this report only addresses the compressed air system measures.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   Power was logged on the three pre-existing air compressors for a period of 1 week before the new compressor was installed. No post-installation metering was performed.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   Yes.

4. Define the baseline for each measure.

   The DPS used the logged compressor data and manufacturer's kW vs. flow specifications to calculate the load profile for the compressed air measures while the DPS used typical profiles. EVT's calculation method is only able to incorporate two compressors in the analysis. The actual system has three compressors. There is a significant amount of inaccuracy in the EVT calculation since EVT could not capture all three compressors in their analysis. The logged data indicated that the compressed air system is always energized. EVT's calculation did not capture the weekend operation.

5. Define the efficiency upgrade.

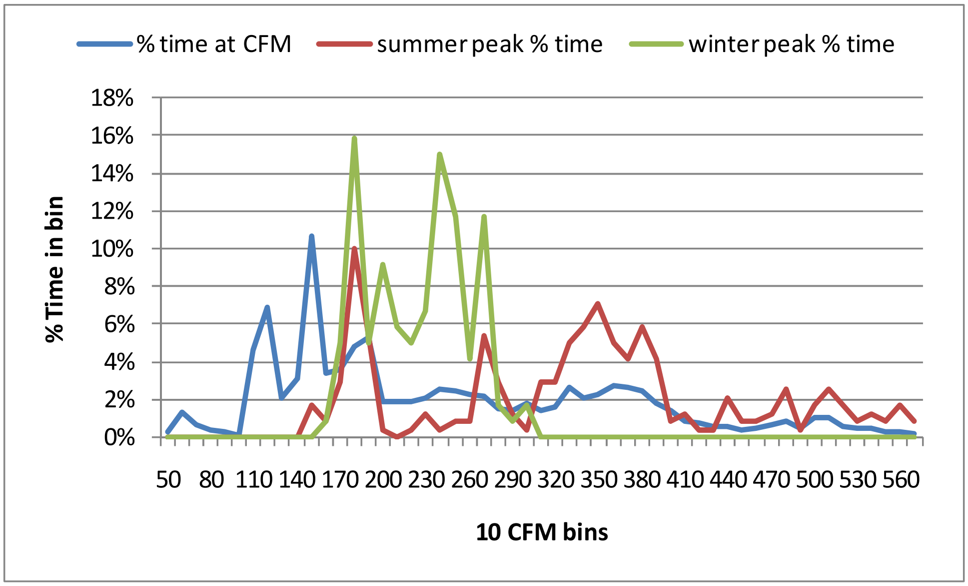
   The DPS used the same efficiency upgrades as EVT for the compressed air measures with the exception of the compressor load profiles. The load profile that the DPS used was based on the logged data while EVT used typical profiles.

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

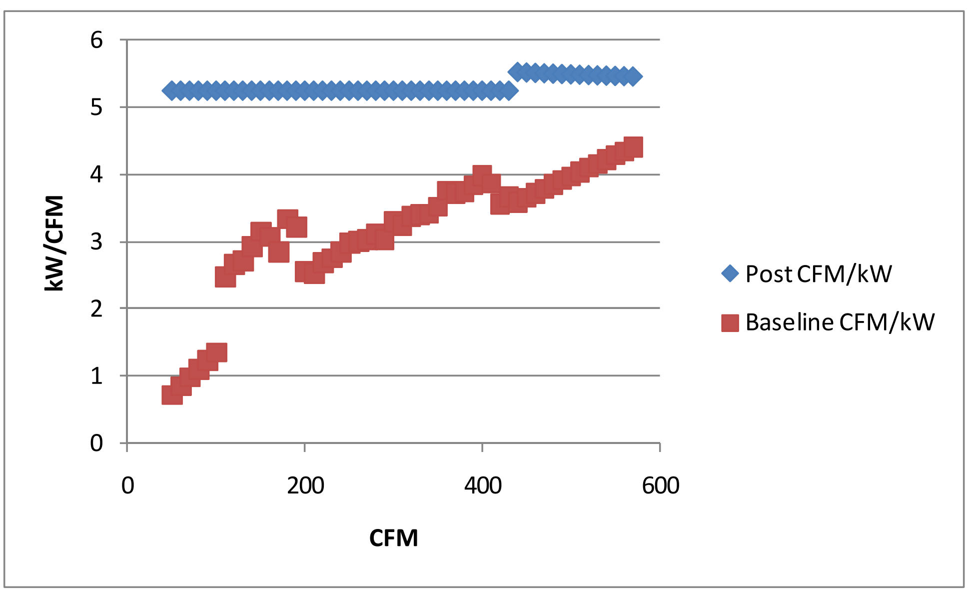
   As mentioned previously, the EVT measure calculations for the lighting and dust-collection measures seemed reasonable based on the information available and therefore the DPS did not modify the calculations for these measures. The DPS did calculate savings for the compressed air measures because the EVT calculations did not take all of the compressors in the system into account and did not fully utilize the logged compressor data.

   Measure 1962445, Compressed Air Compressor

   EVT used typical compressor loading curves to determine measure impacts. The DPS used logged power data provided by EVT and the manufacturer's performance data for each of the three compressors to calculate the compressed air load (flow in CFM) during the logged period. The flow data was binned into CFM bins (one bin per every ten CFM) and the percent time in each bin was calculated. The percent time in each flow bin during the winter and summer peak hours was also calculated in order to determine the peak demand savings. The logged data was for one week and the DPS analysis assumes this week is a typical week for the entire year. The load profile that the DPS calculated is presented in the following plot.



The performance as a whole system was calculated for each bin. The post-case assumes that the VFD compressor is used as the trim machine and that the other existing compressors are controlled so that they are fully loaded when they operate. This is the same assumption as EVT though this may not be how the system actually operates. This would require a controller to turn the non-VFD machines on and off as needed. There was no mention of this type of control in the documentation. Without this type of sequencing control the post performance would not be as efficient as modeled in the analysis. The following plot presents the DPS's modeled performance for the pre- and post-case.



It should also be noted that EVT's compressed air tool only allows for two compressors and the actual system has three. The loading in EVT's calculations did not correlate with the logged data. The DPS calculation assumed that the VFD machine would operate as the trim compressor at all times including weekend operation. This differed from EVT's calculation, as they assumed no change in the weekend operation and did not model any weekend operation. The third compressor in the system, the one EVT did not model, was operating over the weekend in the logged baseline data.

Measure 1962446 Compressed Air Dryer

The DPS used the load profile from the metered data to calculate the savings for the compressed air dryer using the same calculation method as EVT, the difference being the % time at each CFM bin. The DPS also used the peak demand loading profiles from the data to calculate the peak demand savings for the summer and winter peak demand savings.

Measures 1962447 and 1962448, Compressed Air Treatment and Compressed Air Distribution

These two measures calculate savings for reducing the compressed air outlet pressure at the compressors. The DPS used the ideal gas laws to calculate the theoretical energy required at each pressure based on polytropic expansion. This was then translated to a percent power reduction and applied to the expected energy use of the compressor when supplying 110 psig compressed air. The DPS calculations for this measure assumed that the baseline energy use was the same as the as-built compressor energy from Measure 1962445 and that the pressure reduction resulted in a percent decrease in annual energy use, as per the table below. The following table presents the savings calculation for the two pressure reduction measures.

	PSIG	$(PSIA/PATM)^{0.286}$	% Power Reduction	Use kWh	Savings kWh
Baseline	110	1.8432		405,397	
Filter	106	1.8261	2.03%	397,172	8,225
Distribution	101	1.8041	2.66%	386,613	10,559
Total			4.63%	386,613	18,784

7. Check if there are issues with any of the following:

____ Free ridership

____Spillover

____ Act 250 status

____ Hours of use/uptime

____ Commissioning adjustment

____ Cooling bonus/heating penalty

__X_ Load profile

____ MMBtu savings

____ Water savings

____ O&M savings

Preparation for Forward Capacity Market (FCM) Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   Option B metering is recommended.

   If critical documentation is missing, list additional information needed to verify savings to FCM standards.

   Post-metered power for the following equipment:

   - All three compressed air compressors
   - New compressed air dryer
   - Seven dust-collection systems (slitting, Menzel #2 Hoods, Menzel Floor, Calendar, Compounds, Bunbury Mixer, FMP Mills)

   Verify that dust-collection systems (Menzel #1 Hoods and Calendar floor) no longer operate.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- FulflexIncor378571ERSRptV2.doc
- FulflexIncor378571ERSAnalV1.xls

Attachments

Metering Plan, sampling worksheet, supplemental work papers, and files.

Review Engineer: Jacque Heger/ERS
Date submitted to West Hill Energy: July 21, 2011
Date finalized by West Hill Energy: 9/1/11

EVT Project ID Number: 383199
Project Name: GE Healthcare – Data Center Cooling
Sample Group (Size): 3
Type of Project (NC/MOP, Retrofit): Retrofit

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
1928588	Data center cooling system upgrade	122,793	15.32	10.72	55,410	7.04	4.73
Total		122,793	15.32	10.72	55,410	7.04	4.73

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   The data center cooling system was upgraded. One 5-ton York air handling unit was installed to introduce outside air and replace an existing 20-ton Liebert unit. New dedicated supply and return ducting in the ceiling was installed to allow cooling in hot/cold aisle setup attached directly to the new equipment being installed. Air containment curtains and single-direction diffusers that can direct the cold air immediately to the front of the racks were installed. An inline power vent fan was installed in the new return duct to vent to the building exterior.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   No, EVT did not meter this project. However, one of the EVT calculation spreadsheets uses a kW measurement to calculate the baseline energy draw. As there is no other measured data, it is assumed that the kW reading was a spot measurement.

3. Is this project correctly characterized as MOP, NC or retrofit?

   This project is correctly characterized as a retrofit.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

Measure ID	Description of EVT Baseline	EVT Baseline kW	Description of DPS Baseline	DPS Baseline kW	Reason for DPS Change
1928588	One 20-ton Liebert unit operates at full load for 8760 annual hours.	16.608	One 20-ton Liebert unit operates at full load for 4380 annual hours.	16.608	It is unreasonable to assume that the baseline unit did not cycle according to load.

5. Define the efficiency upgrade.

Measure ID	Description of EVT Efficient Upgrade	Description of DPS Efficient Upgrade	Reason for DPS Change
1928588	One 5-ton York AHU replaced one 20-ton Liebert unit; the new York unit is capable of economizing when outdoor air temperature (OAT) is below 60°F, and runs at full load when OAT is greater than 60°F; a power vent was installed to exhaust hot air rather than recirculate it.	One 5-ton York AHU replaced one 20-ton Liebert unit; the new York unit is capable of economizing when OAT is below 60°F, and 75% EFLH when OAT is greater than or equal to 60°F; a power vent was installed to exhaust hot air rather than recirculate it.	It is unreasonable to assume that the new AHU will not cycle according to load.

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

Measure 1928588: Data center cooling upgrade

According to project documentation, the baseline data center cooling system consisted of one 20-ton Liebert unit and one Mr. Slim unit. The connected general computing room was also served by one 20-ton Liebert unit and one Mr. Slim unit. Only the 20-ton Liebert serving the data center was removed during the system upgrade; the other three air-conditioning units remained at the facility. EVT assumed that the remaining Liebert unit and two Mr. Slim units would not be affected by the cooling system upgrade. The DPS is skeptical about this assumption, but as there is no pre- or post-case metered data, there is no way to prove that the remaining three units were affected by the upgrade.

EVT did not have any logged data to calculate the actual building load. Instead, it was assumed that the baseline 20-ton Liebert unit operated at full load for 8760 annual hours. The DPS found this assumption unreasonable, and therefore used a 50% equivalent full-load hours multiplier in the baseline.

The post-case AHU is capable of economizing. EVT assumed that the unit could economize whenever OAT was less than 60F. The DPS used this assumption in verification calculations as there was no logged data to prove or disprove it. Manufacturer data was used to determine the kW consumption of the York unit in cooling mode. EVT added the energy demand of the compressor fan and air handler fan to the power consumption calculated from the manufacturer full-load capacity and EER. However, the DPS removed the fan power from the calculation, as it is already accounted for in the manufacturer's efficiency rating.

The installed power vent was assumed to reduce the cooling load by exhausting hot air from the server bank rather than recirculating it. The EVT calculation spreadsheet indicated that the power vent would only operate when the outside air damper is at least 50% open. EVT assumed that the power vent would operate 75% of the time, and the DPS used the same assumption, as there was no evidence to support a change.

The DPS energy savings was calculated as follows:

> Annual kWh savings = (Baseline full-load Liebert kW * 8760 hours * 50%) – (As-built full-load York kW + Power vent kW) * (TMY3 hours when OAT >= 06°F * 75%) – (As-built supply fan kW + Power vent kW) * TMY3 hours when OAT < 06°F)

The resulting energy savings represents a 76% energy use reduction from the baseline. The DPS finds this result very optimistic, but can make no further assumptions without logged data.

TMY3 weather data was used to determine the bin hours during the winter and summer peak periods. The DPS demand savings was determined by first calculating the summer and winter kWh savings during peak hours (using the method described above), and then dividing the result by the total number of peak hours.

7. Check if there are issues with any of the following:

____ Free ridership

____ Spillover

____ Act 250 Status

__X_ Hours of use/uptime

____ Commissioning adjustment

____ Cooling bonus/heating penalty

__X_ Load profile

____ MMBtu savings

____ Water savings

____ O&M savings

Preparation for FCM Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

Option B metering is recommended.

Documentation

1. List all supplemental work papers and files used in the calculation of savings.

   ERS-Data Center Outside Air calc.xls

Review Engineer: GDS Associates
Date submitted to West Hill Energy: 7/15/2011
Date finalized by West Hill Energy: 8/5/2011

EVT Project ID Number: 378745
Project Name: Hartford, Town of – Quechee – WWTF
Sample Group (Size): 3
Type of Project (NC/MOP, Retrofit): NC/MOP

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	**Description**	**Efficiency Vermont (EVT) Claimed kWh**	**EVT Claimed Winter Peak kW**	**EVT Claimed Summer Peak kW**	**Department of Public Service (DPS) Verified kWh**	**DPS Verified Winter Peak kW**	**DPS Verified Summer Peak kW**
2347795	New super T8 indirect	12771	1.817	3.469	12153	1.817	3.042
2347796	Exit signs, LED	235	0.024	0.032	223	0.024	0.028
2347797	Exit signs, LED	78	0.008	0.011	74	0.008	0.009
2347798	New super T8 industrial/strip	3802	0.745	1.423	3618	0.745	1.247
2347801	New super T8 troffer/wrap	23	0.005	0.007	23	0.005	0.007
2347803	New super T8 troffer/wrap	23	0.005	0.007	23	0.005	0.007
2347805	New super T8 troffer/wrap	70	0.015	0.022	70	0.015	0.022
2347806	New super T8 vapor-proof	1199	0.262	0.374	153	0.034	0.048
2347807	New super T8 indirect	47	0.010	0.014	47	0.010	0.014
2347808	Exit signs, LED	70	0.008	0.008	70	0.008	0.008
2347810	Compact fluorescent interior fixture	100	0.022	0.031	100	0.022	0.031
2347811	New super T8 indirect	845	0.185	0.263	84	0.018	0.026
2347813	Exit signs, LED	19	0.008	0.008	70	0.008	0.008
2347814	New super T8 troffer/wrap	139	0.030	0.043	139	0.030	0.043
2347816	New super T8 indirect	47	0.010	0.014	47	0.010	0.014
2347819	New super T8 industrial/strip	93	0.020	0.029	93	0.020	0.029
2347820	Motor, ODP 25 hp	2712	0.588	0.588	2712	0.588	0.588
2347826	Motor, ODP 7.5 hp	939	0.204	0.204	939	0.204	0.204
2347827	Motor, TEFC 5 hp	317	0.034	0.034	316	0.034	0.034
2347828	Motor, TEFC 50 hp	3422	0.371	0.371	3422	0.371	0.371
2347829	Motor, TEFC 2 hp	205	0.022	0.022	205	0.022	0.022
2347831	Motor, TEFC 1.5 hp	318	0.069	0.069	318	0.069	0.069
2347832	Motor, TEFC 7.5 hp	2899	0.314	0.314	2899	0.314	0.314
2347833	HRV ventilator, makeup heat oil	0	0.000	0.000	0	0.000	0.000
2347834	Replace boiler, fuel oil	0	0.000	0.000	0	0.000	0.000
Total:		30371	4.778	7.359	27,799	4.383	6.189

Measure ID	Description	Resource Type	Resource Units	EVT Claimed Resource Change	DPS Verified Resourc e Change
2347795	New super T8 indirect	Heating oil	MMBtu	-14.220	-13.163
2347796	Exit signs, LED	Heating oil	MMBtu	-0.260	-.0.242
2347797	Exit signs, LED	Heating oil	MMBtu	-0.090	-.081
2347798	New super T8 industrial/strip	Heating oil	MMBtu	-4.230	-3.918
2347801	New super T8 troffer/wrap	Heating oil	MMBtu	-0.030	-0.027
2347803	New super T8 troffer/wrap	Heating oil	MMBtu	-0.030	-0.027
2347805	New super T8 troffer/wrap	Heating oil	MMBtu	-0.090	-0.080
2347806	New super T8 vapor-proof	Heating oil	MMBtu	-1.490	-0.176
2347807	New super T8 indirect	Heating oil	MMBtu	-0.060	-0.053
2347808	Exit signs, LED	Heating oil	MMBtu	-0.090	-0.081
2347810	Compact fluorescent interior fixture	Heating oil	MMBtu	-0.120	-0.115
2347811	New super T8 indirect	Heating oil	MMBtu	-1.050	-0.096
2347813	Exit signs, LED	Heating oil	MMBtu	-0.020	-0.081
2347814	New super T8 troffer/wrap	Heating oil	MMBtu	-0.170	-0.160
2347816	New super T8 indirect	Heating oil	MMBtu	-0.060	-0.053
2347819	New super T8 industrial/strip	Heating oil	MMBtu	-0.120	-0.107
2347833	HRV ventilator, makeup heat oil	Heating oil	MMBtu	12.000	11.777
2347834	Replace boiler, fuel oil	Heating oil	MMBtu	120.01	120.011

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   The project is a gut rehabilitation of the wastewater treatment plant, including motor, HRV, lighting, and boilers.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   It was not metered.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   This project is correctly characterized as new construction; however, two of the lighting measures 2347795 (LE1) and 2347798 (LE4) are classified as retrofit.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

   The baseline kW for the measure was taken from the EVT analysis tool based on the existing technology. These values have been reviewed and are consistent with industry standards. HRV and boiler measure did not claim electric savings.

Measure ID	**Description of EVT Baseline**	**EVT Baseline kW**	**Description of DPS Baseline**	**DPS Baseline kW**	**Reason for DPS Change**
2347795	Mercury vapor 175 W (qty: 24; watts: 205)	4.920	Same	4.920	No change
2347796, 2347797, 2347808, 2347813	Exit sign CF 9W (qty: 6; watts: 11)	0.066	Same	0.066	No change
2347798	Inc 1L 150 W (qty: 26; watts: 150)	3.900	Same	3.900	No change
2347801, 2347803, 2347805, 2347807, 2347814, 2347816, 2347819	T8 2L-F32 w/ elec (qty: 19, watts: 59)	1.121	Same	1.121	No change
2347806	41% 200W, 59% 2-lamp T12 (qty: 6; watts: 134)	0.804	T8 2L-F32 w/elec (qty: 6, watts: 59)	0.354	Efficient HPT8 fixture uses a baseline of T8 w/elec ballast for MOP/NC not existing where LPD info is not provided
2347810	Inc 1L 100 W (qty: 1; watts: 100)	0.100	Same	0.100	No change
2347811	Inc 1L 150 W (base qty: 6; watts: 150)	0.900	T8 2L-F32 w/elec (qty: 6, watts: 59)	0.354	Efficient HPT8 fixture uses a baseline of T8 w/elec ballast for MOP/NC not existing where LPD info is not provided
2347820	ODP 1800 RPM 25 hp motor (qty 2; η 91.7%)	30.507	Same	30.507	No change
2347826	ODP 3600 RPM 7.5 hp motor (qty 2; η 87.5%)	9.591	Same	9.591	No change
2347827	TEFC 3600 RPM 5 hp motor (qty 1; η 87.5%)	3.197	Same	3.197	No change
2347828	TEFC 3600 RPM 50 hp motor (qty 2; η 92.4%)	60.552	Same	60.552	No change
2347829	TEFC 3600 RPM 2 hp motor (qty 1; η 92.4%)	1.332	Same	1.332	No change
2347831	TEFC 3600 RPM 1.5 hp motor (qty 4; η 82.52%)	4.069	Same	4.069	No change
2347832	TEFC 3600 RPM 7.5 hp motor (qty 2; η 88.5%)	9.483	Same	9.483	No change

Lighting Efficiency (Retrofit Lighting, Exit)

$$kW_{base} = Qty_{base} * Watt_{base} / 1000$$

Motors

$$kW_{base} = \text{Motor hp} * .746\ kW/hp * \text{Load Factor} / \eta_{base}$$

The motor controls' baseline efficiency was based on the Baseline Motor Efficiencies from the TRM.

HRV: Baseline is for the ventilation system without ERV

$$MMBtu_{base} = 1.08 * CFM * \Delta \text{Dry Bulb Temperature} / \eta_{base}$$

CFM for the ventilation is a constant 225.

ΔDry-bulb temperature is based on 68°F room temperature during heating season minus Bin Hour TM2 weather data used in the ERV tool

η_{base} Motor Eff is 86% with an assumed 2.5% loss factor

Boiler

$$MMBtu_{base} = \text{Heating Capacity} * 1466 / (1000 * \eta_{base})$$

5. Define the efficiency upgrade.

The efficient kW for the measure was taken from the EVT analysis tool for the efficient technology. These values have been reviewed and are consistent with industry standards. The lighting measures aside from the two retrofit measures, and the exit signs were not evaluated because no lighting power density information was provided. HRV and boiler measure did not claim electric savings.

Measure ID	**Description of EVT Efficient Upgrade**	**EVT Efficient kW**	**Description of DPS Efficient Upgrade**	**DPS Efficient kW**	**Reason for DPS Change**
2347795	Mercury vapor 175 W (qty: 24; watts: 205)	1.344	Same	1.344	No change
2347796, 2347797, 2347808, 2347813	Exit Sign CF 9W (qty: 6; watts: 11)	0.018	Same	0.018	No change
2347798	Inc 1L 150 W (qty: 26; watts: 150)	1.456	Same	1.456	No change
2347801, 2347803, 2347805, 2347807, 2347811, 2347814, 2347816, 2347819	HPT8 2L 32W troffer/wrap Lamp System with Low BF Ballast (qty: 25, watts: 49)	1.225	Same	1.225	No change
2347806	Agricultural vapor-Proof HPT8 Fixture - 2 Lamp (qty 6: watts: 48)	0.288	Same	0.288	No change

2347810	Interior CF 1L 26W Quad w/ elec (qty: 1, watts: 28)	0.028	Same	0.028	No change
2347820	ODP 1800 RPM 25 hp motor (qty 2; η 91.7%)	29.888	Same	29.888	No change
2347826	ODP 3600 RPM 7.5 hp motor (qty 2; η 87.5%)	9.377	Same	9.377	No change
2347827	TEFC 3600 RPM 5 hp motor (qty 1; η 87.5%)	3.161	Same	3.161	No change
2347828	TEFC 3600 RPM 50 hp motor (qty 2; η 92.4%)	60.161	Same	60.161	No change
2347829	TEFC 3600 RPM 2 hp motor (qty 1; η 92.4%)	1.309	Same	1.309	No change
2347831	TEFC 3600 RPM 1.5 hp motor (qty 4; η 82.52%)	3.996	Same	3.996	No change
2347832	TEFC 3600 RPM 7.5 hp motor (qty 2; η 88.5%)	9.152	Same	9.152	No change

Lighting Efficiency (Retrofit Lighting, Exit)

$$kW_{eff} = Qty_{eff} * Watt_{eff} / 1000$$

Motors

$$kW_{eff} = \text{Motor hp} * .746 \text{ kW/hp} * \text{Load Factor} / \eta_{eff}$$

The motor controls' efficient case met the new construction minimum efficient case from the TRM.

HRV: Efficient case is for the ventilation system with ERV

$$MMBtu_{eff} = 1.08 * CFM * \Delta\text{Dry Bulb Temperature} / \eta_{eff}$$

CFM for the ventilation is a constant 225.

ΔDry-bulb temperature is based on the 68°F room temperature during heating season minus the ERV exit air temperature based on 76% sensible effectiveness and Bin Hour TM2 weather data used in the ERV Tool.

η_{eff} Motor Eff is 86% with an assumed 2.5% loss factor.

Boiler

$$MMBtu_{eff} = \text{Heating Capacity} * 1466 / (1000 * \eta_{eff})$$

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

Lighting Efficiency

kW Savings = (kW_{base} – kW_{eff}) * Coincident Factor * ISR * WHF_d

kWh Savings = (kW_{base} – kW_{eff}) * Hours * ISR * WHF_e

Coincident Factor[1] $_{winter}$ = 50.8%

Coincident $Factor_{summer}$ = 72.4%

Coincident Factor = 100% for exit signs

DPS $WHF_{d\ summer}$ = 117.5%[2] for areas with mechanical cooling, EVT used 134%

DPS $WHF_{e\ winter}$ = 106.2%[3] for areas with mechanical cooling, EVT used 1.12%

DPS $MMBtu_{WH}$ = .0011503, EVT used .0012423

Note: 2347813 the EVT hours of 2323 hours was corrected to 8760 hours for this exit sign measure.

HRV measure savings are based on the same constants and equations as EVT, EVT rounded to the nearest integer and DPS rounded to the thousandth.

Boiler

$\Delta MMBtu_{eff} = MMBtu_{base} - MMBtu_{eff}$

7. Check if there are issues with any of the following:
   ____ Free ridership
   ____Spillover
   ____ Act 250 status
   __X_ Hours of use/uptime
   ____ Commissioning adjustment
   __X_ Cooling bonus/heating penalty
   ____ Load profile
   __X_ MMBtu savings
   ____ Water savings
   ____ O&M savings

Preparation for Forward Capacity Market (FCM) Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   Option A – Partially Measured Retrofit Isolation/Stipulated Measurement – is recommended.

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[1] Coincidence Factor is as defined in TRM User Manual No. 2009-60 for Commercial Indoor Lighting Loadshape
[2] Retrofit demand (kW) (kW factor * % of lighting kW savings) from Cooling Bonus Calculation revised Feb 1, 2011
[3] Retrofit demand (kWh) (kWh factor * % of lighting kWh savings) from Cooling Bonus Calculation revised Feb 1, 2011

Documentation

List all supplemental work papers and files used in the calculation of savings.

- CAT10a_4F405.xls
- ERV Tool_v1a4_F405.xls
- Hartford,Tow378745GDSAnalV1.xlsx

Attachments

Metering Plan, sampling worksheet, supplemental work papers, and files.

Review Engineer: Jacque Heger/ERS
Date submitted to West Hill Energy: 7/25/2011
Date finalized by West Hill Energy: 8/31/11

EVT Project ID Number: 382361
Project Name: Husky Injection Molding Systems – Cooling Water Upgrade
Sample Group (Size): 5
Type of Project (NC/MOP, Retrofit): MOP

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
2347094	Premium efficiency motors on four 30 hp cooling tower fans	8,105	0.88	0.88	850	0.10	0.36
2347095	VFD on the 150 hp condenser water return pump	90,869	0.00	32.40	90,513	0.00	37.02
2347096	VFD on the 200 hp condenser water supply pump	307,238	32.55	43.00	393,374	42.83	51.46
2347097	VFD on each of the four 30 hp cooling tower fans	120,380	12.68	22.38	50,448	6.18	23.64
Total		526,592	46.11	98.66	535,185	49.10	112.49

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   This market opportunity project involved consolidating the cooling towers that serve the process-cooling chillers with the cooling towers that serve the comfort-cooling chillers. Each of the following four measures was included in the project:

   - Installing one new 30 hp premium efficiency fan motor in each of the four new cooling towers
   - Installing a VFD on the 150 hp condenser water return pump (this pump only handles the comfort-cooling load)
   - Installing a VFD on the 200 hp condenser water supply pump (this pump handles both the comfort-cooling load and the process-cooling load)
   - Installing a VFD on each of the four new 30 hp cooling tower fan motors

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   No, EVT did not meter for this project.

3. Is this project correctly characterized as MOP, NC, or retrofit?

   This project is correctly characterized as a market opportunity (MOP).

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

Measure ID	Description of EVT Baseline	Description of DPS Baseline	Reason for DPS Change
2347094	Standard efficiency motors on four 30 hp cooling tower fans; each fan motor operates at full load for 8700 annual hours, with a run factor of 75%	Standard efficiency motors on four 30 hp cooling tower fans; the variable frequency driven fan motors operate according to the load on the cooling towers	The number of fans operating and the load on each fan is adjusted according to the modeled cooling tower load
2347095	At part load the main 150 hp pump is turned off and a redundant 75 hp pump with a smaller impeller is used; the 75 hp pump is throttled to reduce the flow according to the load	At part load the main 150 hp pump is turned off and a redundant 75 hp pump with a smaller impeller is used; the 75 hp pump is throttled to reduce the flow according to the load	No change
2347096	At part load the main 200 hp pump is turned off and a redundant 100 hp pump with a smaller impeller is used; the 100 hp pump is throttled to reduce the flow according to the load	At part load the main 200 hp pump is turned off and a redundant 100 hp pump with a smaller impeller is used; the 100 hp pump is throttled to reduce the flow according to the load	No change
2347097	Each of the four 30 hp cooling tower fans can operate at 2/3 speed; the fans cycle on and the speed is adjusted from 2/3 speed to full speed as the load dictates	Each of the four 30 hp cooling tower fans can operate at 2/3 speed; the fans cycle on and the speed is adjusted from 2/3 speed to full speed as the load dictates	No change

5. Define the efficiency upgrade.

Measure ID	Description of EVT Efficient Upgrade	Description of DPS Efficient Upgrade	Reason for DPS Change
2347094	Premium efficiency motors on four 30 hp cooling tower fans; each fan motor operates at full load for 8700 annual hours, with a run factor of 75%	Premium efficiency motors on four 30 hp cooling tower fans; the fan motors operate according to the load on the cooling towers	The number of fans operating and the load on each fan is adjusted according to the modeled cooling tower load
2347095	VFD on the 150 hp condenser water return pump	VFD on the 150 hp condenser water return pump; the number of comfort-cooling hours is less than EVT projections	Project documentation indicates that the comfort-cooling chillers only operate from May to September when OAT > 55F
2347096	VFD on the 200 hp condenser water supply pump	VFD on the 200 hp condenser water supply pump; the number of comfort-cooling hours is less than EVT projections	Project documentation indicates that the comfort-cooling chillers only operate from May to September when OAT > 55F
2347097	VFD on each of the four 30 hp cooling tower fans; each cooling tower capacity is 625 tons	VFD on each of the four 30 hp cooling tower fans; the cooling tower capacity changes according to WBT	The cooling tower capacity changes according to WBT

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

   Cooling Load Model

   EVT used bin analysis to model the cooling system. It was unclear what weather data was used in the program calculations. The DPS used TMY3 weather data in all bin analysis calculations.

   A study previously conducted by Hallam was used by EVT to determine the comfort chiller load as it varied with outdoor air temperature (OAT). The study assumed that the comfort chillers are fully loaded when OAT is greater than 95°F, that the chillers are off when OAT is below 55°F, and that there is a linear load profile for the temperature bins between 55 and 95°F. With no logged data or chiller load information, the DPS assumed the same comfort chiller load profile as EVT.

   EVT calculations assumed that there are four 90-ton Multistack comfort chillers and three 210-ton Cimco comfort chillers operating at the facility. The project overview indicated that there are seven 90-ton Multistack modules at the facility, but there is no evidence that all seven units operate. Without further details, the DPS assumed that there are four 90-ton Multistack comfort chillers and three 210-ton Cimco comfort chillers operating at the facility. EVT assumed a constant process load of 421 tons during all facility operating hours. Without further information about the process's chilled-water usage, the DPS assumed the same constant 421-ton process load.

   EVT assumed that 3 gpm of flow is required per ton of cooling. The DPS deemed that assumption reasonable and had no justification for changing it.

   EVT calculated the power draw of each variable frequency driven motor using manufacturer data. The DPS reviewed these calculations and used them in all verification calculations.

   Measure 2347094: Premium Efficiency Cooling Tower Fan Motors

   EVT calculated the full load power draw of each 30 hp cooling tower fan motor as follows:

   $$\text{Fan kW} = \text{Fan motor hp} * 0.746 / \text{Fan motor efficiency}$$

   The baseline fan motors were assumed to be 92.4% efficient (the minimum allowed by code), while the proposed fan motors were assumed to be 93.6% efficient. It was assumed that all four cooling towers operated at full load for 75% of the facility's 8700 annual operating hours. Therefore, the measure savings were calculated for each of the four cooling tower fans as follows:

   $$\text{Annual kWh savings} = 8700 * 0.75 * (\text{Baseline fan kW} - \text{Proposed fan kW})$$

   The summer and winter demand savings was calculated for each of the four fans using a 95% coincidence factor as follows:

   $$\text{Demand kW savings} = (\text{Baseline fan kW} - \text{Proposed fan kW}) * 0.95$$

The DPS calculated the full-load fan power consumption using the same equation as EVT. However, DPS calculations accounted for the interactive effects of the entire cooling system by adjusting the number of cooling tower fans operating and the load on each fan according to the modeled cooling tower load (more details on the modeled cooling tower load can be found in the discussion for measure 2347097). Energy savings were calculated for each OAT bin as follows:

> Annual kWh savings = Number of cooling towers operating * Percent load on each fan motor * Hours in OAT bin * (Baseline fan kW – Proposed fan kW)

The total annual kWh savings was the sum of the savings calculated for each OAT bin. TMY3 data was filtered to determine the number of hours in each OAT bin during the summer and winter peak periods. The total peak kWh savings was calculated with the summer and winter peak hours, and the summer and winter demand kW savings were calculated by dividing the peak kWh by the number of peak hours.

Measure 2347095: VFD on the 150 hp Condenser Water Return Pump

As the condenser water return pump only serves the comfort chiller loop, the process chiller load was left out of both EVT and DPS calculations. It is unclear what weather data was used by EVT to determine the number of hours in each weather bin; however, project documentation indicated that the comfort chillers are only used from May to September. Additionally, the Hallam study indicated that the comfort chillers do not operate when OAT is less than 55°F. Therefore, the DPS determined the number of hours in each weather bin using TMY3 weather data above 55°F from May to September.

Assuming that the 150 hp pump could generate 4,700 gpm of flow, EVT calculated the percent flow required at each OAT bin by dividing the flow required (3 gpm/cooling ton) by 4,700 gpm. In contrast, the DPS first calculated the minimum flow required to the chiller(s). Because the number of operating compressors varies according to the load, the minimum flow required varies at each OAT bin (1.2 gpm/design ton). The DPS then calculated the percent flow required at each OAT bin to be the greater of the following:

- (3 gpm/cooling ton)/4700
- (1.2 gpm/design ton)/4700

The proposed pump kW was then determined based on the percent flow required and the verified VFD motor kW calculated by EVT

Code requires that hydronic systems larger than 25 tons be capable of automatically turning off half of the pump horsepower. Therefore, EVT assumed that the baseline system would be comprised of one 150 hp constant-speed pump and one 75 hp constant-speed pump. The smaller 75 hp pump (Taco KS1213B) would have a 9.51-inch impeller and generate 3,250 gpm of flow. EVT assumed that the 150 hp pump would only operate when the chiller load required greater than 3,250 gpm of flow. The DPS used manufacturer data to verify that the 75 hp pump with a 9.51-inch impeller is appropriate as the smaller pump. EVT calculated the throttled power draw of the baseline 75 hp pump at each OAT bin using a curve obtained from an IAC report for a plant audit performed at RockTenn. The DPS reviewed this methodology and deemed it appropriate for verification calculations.

Annual energy savings was calculated at each OAT bin for both the EVT and DPS analysis as follows:

kWh savings = Hours in bin * (Throttled pump kW – VFD pump kW)

The total annual kWh savings was the sum of the kWh savings for each OAT bin. EVT multiplied the total kWh savings by 8700/8760. There was no documentation of why this was done, but the DPS assumed that the remaining 60 hours are for equipment maintenance. Without the ability to verify the 8700/8760 multiplier with facility staff, the DPS multiplied the verified kWh savings by the same 8700/8760 ratio.

The DPS filtered TMY3 data to determine the number of hours in each OAT bin during the summer and winter peak periods. As comfort cooling is only used from May to September, there are no energy savings during the winter peak period. The DPS calculated the total summer peak kWh savings using the summer bin hours, and the summer demand kW savings was then calculated by dividing the peak kWh by the number of peak hours.

Measure 2347096: VFD on the 200 hp Condenser Water Supply Pump

As the condenser water supply pump serves both the comfort chiller and the process chiller, the total chiller load was calculated to be the sum of the two loads at each temperature bin. The same savings methodology was employed for this measure as was used for measure 2347095. As in measure 2347095, the key differences between EVT and DPS calculations include:

- The DPS used TMY3 weather data, while the EVT weather data source is unknown
- The DPS accounted for the minimum flow required by the chillers
- The DPS only used May to September weather data to calculate the bin hours for the comfort chillers
- Per the chiller load profile presented in the Hallam study, the DPS assumed that the comfort chillers are off when OAT is below 55°F

Unlike the EVT calculation methodology, the DPS savings calculations were separated into two scenarios: 1) when the facility requires comfort cooling, and 2) when the facility only requires process cooling. The required percent flow was calculated for each OAT bin for both scenarios.

The energy savings for each weather bin was calculated using the methodology described in the discussion for measure 2347095. EVT assumed that the baseline system would consist of one 200 hp constant-speed pump and one 100 hp constant-speed pump. The smaller 100 hp pump (Taco KS1213B) would have a 10.07-inch impeller and generate 4,300 gpm of flow. The DPS used manufacturer data to verify that this pump is appropriate as the smaller pump. Like the analysis for measure 2347095, annual energy savings was calculated at each OAT bin (with and without comfort cooling) for both the EVT and DPS analysis as follows:

kWh savings = Hours in bin * (Throttled pump kW – VFD pump kW)

The total annual kWh savings was the sum of the kWh savings for each OAT bin. Both the EVT and DPS total kWh savings was multiplied by the 8700/8760 ratio.

The DPS filtered TMY3 data to determine the number of hours in each OAT bin during the summer and winter peak periods. The DPS calculated the total peak kWh savings using the summer and winter peak bin hours. The summer and winter demand kW savings was then calculated by dividing the peak kWh by the number of peak hours.

The verified savings is larger than EVT's projected savings. This is because the verified operational hours of the comfort-cooling chillers are less than what was projected by EVT. Project documentation indicates that the comfort chillers only operate from May to September when OAT is greater than 55 F. When the DPS applied this operation schedule to the TMY3 weather data, the number of hours in which only the process chillers operate increased (compared to the EVT bin hours). As a result, the number of hours that the condenser-water supply pump can run at low speeds increased; increasing the hours that the pump can operate at slower speeds resulted in more savings than EVT projected.

Measure 2347097: VFD on Each of Four 30 hp Cooling Tower Fans

A total of four cooling towers serve the facility cooling load (comfort and process). The DPS calculated the cooling load both with and without comfort cooling as described in the discussion for measure 2347096. Project documentation indicated that each cooling tower has a design capacity of 625 tons, and that the maximum fan load is 85%. EVT used the cooling load to calculate the number and percent load of each cooling tower fan. However, EVT did not account for the effect that the outdoor air wet-bulb temperature has on each cooling tower's capacity. As the WBT drops, the cooling tower increases. The DPS used this relationship between the cooling tower capacity and WBT to calculate the actual percent fan speed required to meet the cooling load (both with and without comfort cooling).

Code requires that fan motors larger than 7.5 hp be capable of operating at 2/3 speed. Both EVT and the DPS calculated the baseline required fan power to meet the load, assuming that the fan motors could cycle on and operate at either 2/3 speed or full load.

Annual energy savings was calculated at each OAT bin (with and without comfort cooling) for both the EVT and DPS analysis as follows:

$$\text{kWh savings} = \text{Hours in bin} * (\text{Two-speed fan kW} - \text{VFD fan kW})$$

The total annual kWh savings was the sum of the kWh savings for each OAT bin. Both the EVT and DPS total kWh savings was multiplied by the 8700/8760 ratio.

The DPS filtered TMY3 data to determine the number of hours in each OAT bin during the summer and winter peak periods. The DPS calculated the total peak kWh savings using the summer and winter peak bin hours. The summer and winter demand kW savings was then calculated by dividing the peak kWh by the number of peak hours.

7. Check if there are issues with any of the following:

____ Free ridership

____ Spillover

____ Act 250 status

__X_ Hours of use/uptime

____ Commissioning adjustment

____ Cooling bonus/heating penalty

__X_ Load profile

____ MMBtu savings

____ Water savings

____ O&M savings

Preparation for Forward Capacity Market (FCM) Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   Option B metering is recommended.

2. If critical documentation is missing, list additional information needed to verify savings to FCM standards.

   None.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- ERS Chiller Pump Savings Calcs_PostInspection.xls

Additional Notes/Discussion

None.

Review Engineer: Jacque Heger/ERS
Date submitted to West Hill Energy: July 15, 2011
Date finalized by West Hill Energy: 8/31/2011

EVT Project ID Number: 384514
Project Name: Husky Injection Molding Systems – Process Efficiency 2
Sample Group (Size): 3
Type of Project (NC/MOP, Retrofit): MOP

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	**Description**	**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**
2290057	Process tooling upgrade	7,664	8.3	8.3	7,664	1.0	1.0
Total		7,664	8.3	8.3	7,664	1.0	1.0

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   This market opportunity project involved replacing the cutting tools in ten milling machines at Husky. The baseline process is called helical milling and the new process is called cavity drilling. “Cavity drilling” is the terminology used in the project overview, while “step drilling” is the terminology used in the EVT analysis spreadsheet. Each of the ten machines has four drill bits. The new cavity drill bits reduce the drilling time required for the process, thereby reducing the machine run time.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   Yes, EVT used a power meter to determine the energy consumption of the drilling machine prior to the tooling upgrade.

Is this project correctly characterized as MOP, NC or retrofit?

   This project is correctly characterized as a market opportunity (MOP). According to the project overview, the process drill bits need to be replaced every two years.

3. Define the baseline for each measure. (Use tables provided below if appropriate.)

Measure ID	Description of EVT Baseline	EVT Baseline kW	Description of DPS Baseline	DPS Baseline kW	Reason for DPS Change
2290057	Each machine uses helical drilling	7.664	Each machine uses helical drilling	7.664	No change

   EVT logged a drilling machine for thirteen days prior to the tooling upgrade. A weighted average was calculated for all logged occurrences greater than 5 kW. This average was assumed to be the drilling machine’s power draw during drilling.

4. Define the efficiency upgrade.

Measure ID	Description of EVT Efficient Upgrade	Description of DPS Efficient Upgrade	Reason for DPS Change
2290057	Replace helical drill bits with cavity or step drill bits on ten process drilling machines	Replace helical drill bits with cavity or step drill bits on ten process drilling machines	No change

It is proposed that the new cavity drill bits can drill holes in less time than the old helical drill bits, thereby reducing the number of hours the drilling machine operates.

5. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

Measure 2290057: Process tooling upgrade

There are four different process drilling options identified in the EVT Drill Savings Analysis spreadsheet: Spade Drill, Lux Process, Helical Milling, and Step Drill. Spade drill is identified as the old process, helical milling is identified as the interim process, and step drill is listed as the future process. The savings calculations can be replicated using helical drilling as the baseline and step drilling as the post case, but it is unclear why helical drilling is listed as the interim process and spade drill is listed as the old process. Without any other information, DPS must assume that EVT correctly classified helical drilling as the baseline and step drilling as the post case.

EVT logged a drilling machine for thirteen days prior to the tooling upgrade. A weighted average of all logged kW occurrences greater than 5 kW was assumed to be the drilling machine's power draw during drilling. The program savings methodology made the following assumptions:

- The machines require no energy when they are not drilling
- The tooling upgrade would not change the power consumption of the drilling machines

Energy savings was calculated as follows:

> Annual kWh saved = (Hours that the new drill bits reduced the annual drilling time by) * (Number of upgraded machines) * (power draw of the drilling machines during drilling)

No details were given as to how the demand savings was calculated.

Logged data shows periods with low power consumption (4 - 6 kW). The DPS believes that these periods were logged when the machine was idling. If this assumption is correct, it is possible that the installation of cavity drill bits would reduce the drilling time while increasing the idling time. However, without better information about the idle machine behavior we must use the EVT assumption that the post case machines are off when not drilling. Additionally, without post case logged data the DPS must assume that the power consumption of the machines is equal to the baseline power consumption.

The kW savings that results from the tooling upgrade is highly uncertain as there is no information describing when the drilling machines are used. The DPS therefore calculated the average kW savings by dividing the annual kWh savings by the annual drilling machine run hours. The machine run hours were calculated from logged data. There were a number of periods in which logged data indicated the machine was drawing between one and four kW. It was assumed that the drilling machine was off during these periods, but that another power draw (such as a cooling pump) was left on.

6. Check if issues with any of the following:

____ Freeridership

____Spillover

____ Act 250 Status

__x__ Hours of use/uptime

____ Commissioning Adjustment

____ Cooling Bonus/Heating Penalty

____ Load Profile

____ MMBtu Savings

____ Water Savings

____ O&M Savings

Preparation for Forward Capacity Market (FCM) Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   Option B metering.

2. If critical documentation is missing, list additional information needed to verify savings to FCM standards.

   None.

Documentation

1. List all supplemental work papers and files used in the calculation of savings.

   ERS kW-No.3.1816.xls

   ERS-Cavity Drill Savings Analysis (2).xls

Additional Notes/Discussion

None.

Review Engineer: Energy & Resource Solutions
Date submitted to West Hill Energy: 7/22/11
Date finalized by West Hill Energy: 8/9/11
EVT Project ID Number: 351973
Project Name: Jasper Hill Farm - Humidification
Sample Group (Size): 4
Type of Project (NC/MOP, Retrofit): Retrofit

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
2420665	Custom industrial process	10,671	4.293	0.023	4,719	1.898	0.010
2420666	Custom industrial process	33,490	13.472	0.071	10,585	4.258	0.022
2420667	Custom industrial process	10,671	4.293	0.023	3,964	1.595	0.008
Total:		54,832	22.057	0.116	19,268	7.751	0.041

Measure ID	Description	Resource Type	Resource Units	EVT Claimed Resource Change	DPS Verified Resource Change
2420665	Custom industrial process	Heating Oil	MMBTU	-3.000	-0.730
2420666	Custom industrial process	Heating Oil	MMBTU	-7.000	-1.643
2420667	Custom industrial process	Heating Oil	MMBTU	-3.000	-0.662

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   This project involved the replacement of electric steam humidifiers with ultrasonic humidifiers in three separate cheese aging cellars. Energy Recovery Ventilators were present in the base case and still remained for the as-built.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   No metering information was found within the project documentation.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   This project is correctly characterized as a retrofit. Components of the system were replaced, while the majority of the infrastructure was left as-is.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

   Description of EVT Baseline

   The existing steam humidification system with humidistat control is the project baseline. Each cheese vault has its own space requirements, depending on the type of cheese to be aged. Although model numbers were not stated spefically by EVT, an HTML page was found that indicated the baseline units were most likely 1.5 to 8 kW models manufactured by Reimers Electra Steam, Inc.

Description of DPS Baseline

As mentioned, specific baseline make and model information could not be found in the project documentation. Therefore, an appropriately sized Reimers Electra Steam unit (http://www.reimersinc.com/jr_spec.htm) was assumed for each baseline cellar based on the maximum expected moisture demand (lb of water per hour). Moisture demand was calculated using given space design conditions and Montpelier Airport TMY3 data. ERVs were ignored for sizing purposes, since a worst-case scenario for the space would involve a nonfunctioning ERV.

Measure ID	Description of EVT Baseline	EVT Baseline kW/(lb/h)	Description of DPS Baseline	DPS Baseline kW/(lb/h)	Reason for DPS Change
2420665	Electric steam humidifier – make/model unknown	Unknown	Assumption: Reimers Electra Steam, Inc, model AR 4	0.2857	A choice needed to be made for calculation purposes
2420666	Electric steam humidifier – make/model unknown	Unknown	Assumption: Reimers Electra Steam, Inc. model AR 8	0.2857	A choice needed to be made for calculation purposes
2420667	Electric steam humidifier – make/model unknown	Unknown	Assumption: Reimers Electra Steam, Inc. model AR 4	0.2857	A choice needed to be made for calculation purposes

5. Define the efficiency upgrade.

Description of EVT As-Built

Electric steam humidifiers were replaced with ultrasonic humidifiers in each of the three cellars considered. As-built make and model numbers were not made available in project files.

Description of DPS As-Built

Due to the lack of specific make and model information for the installed ultrasonic equipment, an appropriately sized Humidifirst unit (http://www.humidifirst.com/dt-models.html) was assumed as the as-built humidifier for each cellar based on the maximum expected moisture demand (lb of water per hour). Moisture demand was calculated using given space design conditions and Montpelier Airport TMY3 data. ERVs were ignored for sizing purposes, since a worst-case scenario for the space would involve a nonfunctioning ERV. Humidifirst is a reputable company, and product performance is similar to that of competitors as well as numbers referenced in the Ultrasonic Humidifier Federal Technology Alert (DOE/EE-0180) mentioned by EVT in project documents.

Measure ID	Description of EVT Efficient Upgrade	EVT Efficient kW/(lb/h)	Description of DPS Efficient Upgrade	DPS Efficient kW/(lb/h)	Reason for DPS Change
2420665	Ultrasonic humidifier – make/model unknown	Unknown	Assumption: Humidifirst model DT-10	0.0226	A choice needed to be made for calculation purposes.
2420666	Two ultrasonic humidifiers – make/model unknown	Unknown	Assumption: Humidifirst model DT-20	0.0235	A choice needed to be made for calculation purposes.
2420667	Ultrasonic humidifier – make/model unknown	Unknown	Assumption: Humidifirst model DT-10	0.0226	A choice needed to be made for calculation purposes.

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

   - EVT savings calculation methodology was unclear. As the DPS could not recreate the values presented by EVT, a new analysis approach was derived as described below.
   - The DPS calculated the moisture demand (lb water per hour) for each cellar using space design conditions provided in project documentation and Montpelier Airport TMY3 data.
   - Appropriately sized equipment was assumed for both the baseline and as-built cases, based upon the maximum expected moisture demand. ERVs were ignored for sizing purposes, since a worst-case scenario for the space would involve a nonfunctioning ERV.
   - Atmospheric moisture content (grains per lb of dry air) was subtracted from that of the desired space set point, which was determined from the psychometric chart. A positive difference in moisture content indicates a need for humidification during that time period (referred to as humidification hours below). In other words, influx of ambient moisture alone would not be enough to meet space requirements.
   - Percentage of max load was calculated for each cellar's baseline and as-built equipment by dividing the calculated moisture demand by the equipment capacity (lb water per hour). This number was then multiplied by 50% to account for ERV moisture recovery.
   - Humidification hours were multiplied by the percentage of max load to establish equipment runtime hours.
   - Runtime hours were then multiplied by full load kW (from manufacturer specifications) to obtain the annual energy usage of as-built humidification equipment (kWh).
   - A cooling bonus kWh was added to the baseline humidification energy. For ambient temperatures above 50°F, the cooling bonus was computed as follows:

Cooling bonus = (Specific heat of water * Baseline full load capacity * 157°F * Runtime hours when OAT > 50°F) / (3412 * COP)

where,

- The specific heat of water = 1 Btu/lb F.
- 157°F is the temperature difference between the incoming domestic hot water (55°F) and the boiling point (212°F). This delta T represents the worst-case scenario as water evaporation is also a function of wet-bulb temperature and can happen at temperatures much lower than 212°F.
- The DPS used EVT's assumption that COP = 4.3.

- Energy savings was calculated as follows:

$$kWh_{annual\ savings} = kWh_{baseline} - kWh_{as-built}$$

- For ambient temperatures below 50°F, heating penalty was calculated as follows:

  Heating penalty = Specific heat of water * Baseline full load capacity * 157°F * Runtime hours when OAT < 50°F * / Boiler efficiency

- Both EVT and DPS assumed a boiler efficiency of 80%.
- Winter and summer peak kW calculations were made using the same methodology as EVT, as no utility data was supplied. The DPS did not modify the load shape, equivalent full-load hours, or summer/winter peak multipliers. These numbers are provided in the attached spreadsheet.

Please refer to the following MS Excel file for more analysis details:

- Jasper Hill Farm – Humidification.xls

EVT calculations are based strictly on psychometric analysis, whereas DPS calculations are based on a combination of psychometrics and equipment specifications of power demand per required capacity (kW per lb/h).

Preparation for FCM Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   Option B metering is recommended.

2. If critical documentation is missing, list additional information needed to verify savings to FCM standards.

   Baseline and as-built equipment specifications or at least make/model information.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- Jasper Hill Farm – Humidification.xls

Review Engineer: Sharon Jones, Lexicon Energy Consulting
Date submitted to West Hill Energy: 7/13/11
Date finalized by West Hill Energy: 8/31/11

EVT Project ID Number: 373146
Project Name: Jay Peak Ice Rink - New Construction
Sample Group (Size): 5
Type of Project (NC/MOP, Retrofit): NC/MOP

The following table presents only the measures for which the Department of Public Service (DPS) calculated savings that differed from Efficiency Vermont (EVT).

Measure ID	**Description**	**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**
2182481	Occupancy sensors	752	0.063	0.121	630	0.121	0.156
2182482	Occupancy sensors	371	0.031	0.060	330	0.063	0.082
2182483	Occupancy sensors	651	0.055	0.105	569	0.109	0.141
2182484	Occupancy sensors	3,471	0.293	0.559	2,179	0.418	0.541
2182485	Occupancy sensors	347	0.029	0.056	280	0.054	0.069
2182486	Lighting system, interior power density reduction	37,596	3.169	6.052	33,236	3.263	4.917
2182488	Motor, TEFC 2 HP	106	0.039	0	N/C	N/C	N/C
2182489	Motor, TEFC 7.5 HP	1,071	0.112	0.112	N/C	N/C	N/C
2182493	Motor, ODP 2 HP	253	0.023	0.021	N/C	N/C	N/C
2182495	Motor, ODP 2 HP	253	0.023	0.021	N/C	N/C	N/C
2182497	Motor, TEFC 10 HP	194	0.029	0.027	N/C	N/C	N/C
2182498	HRV ventilator, makeup heat propane	(8,609)	-1.062	-0.984	0	0	0
2182500	Custom refrigeration	70,765	0.142	6.784	70,765	(1.877)	38.520
2182501	Other uncategorized efficiency	226,676	0	44.651	0	0	0
2182502	Design assistance, general	-	0	0	N/C	N/C	N/C
2182503	Improve refrigeration	19,062	2.247	2.512	N/C	N/C	N/C

	controls						
2182504	HRV ventilator, makeup heat propane	(2,050)	-0.253	-0.234	0	0	0
2182505	Replace space heater, propane	-	0	0	N/C	N/C	N/C
2182506	Replace space heater, propane	-	0	0	N/C	N/C	N/C
Total		350,909	4.94	59.863	128,928	4.623	8.309

Measure ID	Description	Resource Type	Resource Units	EVT Claimed Resource Change	DPS Verified Resource Change
2182481	Occupancy sensors	Heating oil	MMBtu	-0.840	N/C
2182482	Occupancy sensors	Heating oil	MMBtu	-0.410	N/C
2182483	Occupancy sensors	Heating oil	MMBtu	-0.720	N/C
2182484	Occupancy sensors	Heating oil	MMBtu	-3.860	N/C
2182485	Occupancy sensors	Heating oil	MMBtu	-0.390	N/C
2182498	HRV ventilator, makeup heat propane	Propane	MMBtu	385.000	N/C
2182500	Custom refrigeration	Propane	MMBtu	1728.000	N/C
2182504	HRV ventilator, makeup heat propane	Propane	MMBtu	81.000	N/C
2182505	Replace space heater, propane	Propane	MMBtu	38.590	N/C
2182506	Replace space heater, propane	Propane	MMBtu	134.430	N/C

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   This project provided incremental savings for a new ice rink being constructed. Savings are calculated for the refrigeration system including heat recovery and a low-e ceiling as well as for an Infrared ice sensor. There are lighting power density savings and occupancy sensor savings. Additionally savings are claimed for several PEM motors, for ERV and for a dehumidification system.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   No.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   The project is correctly classified as new construction.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

Measure ID	**Description of EVT Baseline**	**EVT Baseline kW**	**Description of DPS Baseline**	**DPS Baseline kW**	**Reason for DPS Change**
2182481	Occupancy sensor tied to (4) 2L F28T5 and (5) 1L F28T5	0.416	Same	0.416	NA
2182482	Occupancy sensor actually controls (4) F32T8s and (3) 2L 13w wall sconces for a total of 206 watts.	0.205	Same	0.218	Use lighting technology table wattages
2182483	Occupancy sensor actually controls (4) 2l 13W wall sconces and (8) F32T8 for a total of 360 watts	0.360	Same	0.376	Use lighting technology table wattages
2182484	(20) 3L F32T8	1.920	Same	1.440	Use lighting technology table wattages
2182485	Controls (6) 2 lamp, F14 T5.	0.192	Same	0.1848	Using 30.8 W for 2 @ 14-W lamps. Without supporting documentation, 32W seems excessive. Consider that 2@28 use 48W and 2@17 use 37W. DPS estimates 30.8W/fixture (10% over nominal lamp wattage) as reasonable.
2182486	1.1 W/sq ft for sports arena	35.680	Same	35.680	NA
2182488	P-1 (B-1 circulator)	1.332	Same		
2182489	P-3 & 4 (vent. loop Circ#1 & 2)	4.689	Same		
2182493	EF-4 (rink ventilation air fan)	1.332	Same		
2182495	P-5 dehum coil circulator	1.332	Same		
2182497	Munters supply fan	6.251	Same		
2182498	No ERV	0.0	HV unit	1.310	If the ERV was not installed, a heating and ventilating unit would provide ventilation and use similar fan energy as the ERV.
2182500	Hermetic reciprocating chiller	98.450	Same	144.110	Average electric load during peak hours based on hourly output of building modeling
2182501	DX dehumidifier with rink maintained at 55F / 50% rh + additional load on ice if rink were maintained at 55°F/ 70% rh; dehumidification efficiency assumed at 0.919 kWh/lb	65.397	Dx dehumidifier with rink maintained at 55°F/50rh	20.725	See comments below this table.
2182502					
2182503	Maintain cold loop supply at 17F; IKS efficiency of 1.21 kW/ton	68.000	N/C	N/C	N/C

2182504	No ERV	0.0	HV unit	0.374	If the ERV was not installed, a heating and ventilating unit would provide ventilation and use similar fan energy as the ERV.
2182505			N/C	N/C	N/C
2182506			N/C	N/C	N/C

Measure 2182501 (Dehumidifier):

Baseline system appears to be as efficient as proposed system. Since the baseline power draw was calculated based on cooling OA to 55°F/55rh, it is inappropriate to also calculate an increase load on the ice system. Also, the ice sheet load reduction is figured year-round whereas dehumidification is not likely to be needed in winter. Third, the baseline dehumidifier efficiency of 0.919 kWh/lb is unsupportable. Fourth, the building model that calculates measure 2182500 may also be accounting for this measure, as EVT states that the model "includes using the energy recovery features of the ice refrigeration plant linked to AHU-1." (See file titled "08400-090812 EVT Answers.pdf".)

5. Define the efficiency upgrade.

Measure ID	**Description of EVT Efficient Upgrade**	**EVT Efficient kW**	**Description of DPS Efficient Upgrade**	**DPS Efficient kW**	**Reason for DPS Change**
2182481	Occupancy sensors	0.2912	Same	No direct change	Use RLW coincident factors and update cooling bonus
2182482	Occupancy sensors	0.1435	Same	No direct change	Use RLW coincident factors and update cooling bonus
2182483	Occupancy sensors	0.252	Same	No direct change	Use RLW coincident factors and update cooling bonus
2182484	Occupancy sensors	1.344	Same	No direct change	Use RLW coincident factors and update cooling bonus
2182485	Occupancy sensors	0.1344	Same	No direct change	Use RLW coincident factors and update cooling bonus
2182486	Lighting power density of 0.9 W/sf	29.441	Same	No direct change	Use RLW coincident factors and update cooling bonus
2182488	P-1 (B-1 circulator)	1.294	Same	N/C	N/A
2182489	P-3 & 4 (vent. loop circ#1 & 2)	4.576	Same	N/C	N/A
2182493	EF-4 (rink ventilation air fan)	1.294	Same	N/C	N/A
2182495	P-5 dehumidifier coil circulator	1.294	Same	N/C	N/A
2182497	Munters supply fan	6.203	Same	N/C	N/A
2182498	ERV	1.310	Same	1.310	N/C

2182500	Efficient refrigeration system includes: 1. IKS heat pump system. 2. Low-E ceiling, 3. Heat recovery options as described in Alternate Pricing M1-M4.	90.050	Same	126.870	Average electric load during peak hours based on hourly output of building modeling
2182501	Munters FreeDry desiccant dehumidifier with rink maintained at 55°F and 50% rh	20.725	Same	20.725	NA
2182502			N/C	N/C	N/A
2182503	Maintain cold loop supply at 20°F; IKS efficiency of 1.21 kW/ton	65.824	Same	65.824	NA
2182504	ERV	0.374	Same	0.374	NA
2182505			N/C	N/C	N/A
2182506			N/C	N/C	N/A

6. Check if there are issues with any of the following:

   ____ Free ridership

   ____ Spillover

   ____ Act 250 status

   ____ Hours of use/uptime

   For the lighting measures, the operating hours were changed from 5400 to 5045 to agree with the hours of lighting used in the hour-by-hour building simulation model.

   ____ Commissioning adjustment

   ____ Cooling bonus/heating penalty

   The cooling bonus was removed for the occupancy sensor measures since these areas are served by an ERV and are not air-conditioned.

   The cooling bonus for the lighting power density measure was updated to the May 2011 agreed-upon values of 1.056 for energy and 1.159 for summer demand.

   ____ Load profile

   For the occupancy sensor measures, the RLW coincident factors for summer and winter peak usage and OS off-time were used based on the university/school sector, which seemed the most representative of the sectors studied.

   For the lighting power density measure, the coincident factors for summer and winter peak usage are updated based on the university/school sector, which seemed the most representative of the sectors studied.

   ____ MMBtu savings

   ____ Water savings

   ____ O&M savings

Preparation for Forward Capacity Market (FCM) Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

We recommend Option A: Partially Measured Retrofit Isolation/Stipulated Measurement for the lighting measures, and Option B: Retrofit Isolation/Metered Equipment for the chillers and HVAC equipment.

The savings claim was based in part on building modeling, so Option D: Calibrated Simulation has been considered, but the original Equest model did not contain the largest measure. Therefore, even if the model could be calibrated to match actual usage (which is typically a time-consuming proposition), simulation may not be a suitable option.

2. If critical documentation is missing, list additional information needed to verify savings to FCM standards.

   More details are needed on the lighting fixtures and the Equest model (only copies of outputs are provided; input details are requested).

Documentation

List all supplemental work papers and files used in the calculation of savings.

- 090922 summary_UPDATED 20091001-sj.xls
- JayPeakIce.xlsx

Attachments

Metering Plan, sampling worksheet, supplemental work papers, and files.

Review Engineer: Lexicon Energy Consulting
Date submitted to West Hill Energy: 916/2011
Date finalized by West Hill Energy: 9/19/2011

EVT Project ID Number: 390315
Project Name: Jay Peak Resort – Snowmaking 2010
Sample Group (Size): 5
Type of Project (NC/MOP, Retrofit): NC/MOP

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
2350929	Efficient snowmaking tower guns	43,960	13.526	0.000	29,577	9.101	0.000
2350930	Snowmaking water distribution efficiency	39,242	12.074	0.000	17,276	8.359	0.000
2350931	Compressed air, snowmaking distribution	2,630	0.809	0.000	2630	0.809	0.000
Total		85,832	26.410	0.000	49,483	18.269	0.000
	Total revised measures	39,242	12.074	0.000	46,853	17.460	0.000

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   This project installed new snow guns on two trails and upsized compressed air and water pipes.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   No, EVT did not meter this project.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   The project is correctly characterized as MOP. The pipeline increases might reasonably be considered retrofit.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

Measure ID	Description of EVT Baseline	EVT Baseline kW	Description of DPS Baseline	DPS Baseline kW	Reason for DPS Change
2350929	Baby Ratnik Snow Giant X2	24.04	Same	16.170	Reduced estimate of snow production on Alligator Alley by approximately ½ brings the total snow production for the project in line with the mountain average. Without customer data to

					document snow production, only an assumption of average production is warranted.
2350930	10" water piping. Pre-retrofit was 8" but upsizing was required to make the low-energy snow guns viable.	21.05		14.575	Reduced flow rate to 1500 gpm to yield total water usage of 113 million gallons per year to agree with SnoMatic's report that Jay Peak converts 0.6 mg/acre on 188 acres.
2350931	10" Compressed air piping		Same		NA

5. Define the efficiency upgrade.

Measure ID	Description of EVT Efficient Upgrade	EVT Efficient kW	Description of DPS Efficient Upgrade	DPS Efficient kW	Reason for DPS Change
2350929	Efficient Snowmaking Tower Guns (HKD Focus SX4400)	10.511	Same	7.070	Revised estimate of snow production on Alligator Alley as described above.
2350930	12" Snowmaking Water Piping	8.98		6.216	Revise flow and pressure drop calculation as described above
2350931	12" Compressed air piping		Same		NA

Preparation for Forward Capacity Market (FCM) Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   Option A is probably the only viable method, as these improvements are not directly on electric equipment.

2. If critical documentation is missing, list additional information needed to verify savings to FCM standards.

   - Snowmaking logs
   - Compressor and pump operating logs
   - Pump curves

Documentation

List all supplemental work papers and files used in the calculation of savings.

- Snowmaking Jay Peak_2010.xls
- Jay_water and air line upgrade calcs.xls

Additional Notes/Discussion

- Snomatic report from '07:
- Jay Efficiency Analysis.doc

Attachments

Metering Plan, sampling worksheet, supplemental work papers, and files.

Review Engineer: Lexicon Energy Consulting
Date submitted to West Hill Energy: August 20, 2011
Date finalized by West Hill Energy: September 8, 2011

EVT Project ID Number: 379381
Project Name: Jay Peak – Snow Guns
Sample Group (Size): 5
Type of Project (NC/MOP, Retrofit): NC/MOP

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
1962950	Efficient snowmaking tower guns	130610	40.188	0.000	33,413	12.150	0.000
Total:		130610	40.188	0.000	33,413	12.150	0.000

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   This project provided a retroactive rebate to the customer for installing ten Rubis tower guns in a previous year.

   The savings compared the Rubis guns to HKDs and the HKDs to Ratnik Baby Snow Giants. The savings was done in two steps to allow two different depths of snow for the two calculations. However, the estimated savings as claimed uses the same depth of snow for both calculations.

   Although the project overview stated that the savings were figured as the difference between two savings calculations, in fact it seems that the claimed savings are the sum of the two calculations, with both assuming a 6-foot snow depth.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   No, EVT did not meter this project.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   This project was characterized as a MOP.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

   The customer explains that these guns provide twice the coverage at twice the depth, making them four times more productive than the average of 1.5 ac-ft/gun. This is difficult to accept, for if these ten guns are four times as productive as average, then forty guns must be one-quarter as productive as average, and eighty must be one-half as productive as average to maintain the average. The coverage (acre/gun) should be possible to substantiate, but the depth is more difficult. There is about 30 ft of natural snowfall at Jay. In the absence of data, it may not be feasible to for the customer to estimate the depth of snow provided by the snowmaking system with any degree of accuracy.

We have re-calculated the savings assuming a more modest two times the productivity of the Rubis guns and one-quarter times the productivity of the relocated Ratnik Baby Snow Giants so that the average is maintained.

We also revised the temperature distribution data to more nearly match the temperature distribution provided in the SnoMatic report.

Measure ID	**Description of EVT Baseline**	**EVT Baseline kW**	**Description of DPS Baseline**	**DPS Baseline kW**	**Reason for DPS Change**
1962950	The Rubis tower guns replace HKD tower guns and the HKDs replace Ratnik Baby Snow Giants.	67.430	Same snow guns but with snow production of 3 ac-ft per gun for the Rubis and 0.375 ac-ft per gun for the Ratnik Baby Snow Giants.	15.679	As explained in text above. .

5. Define the efficiency upgrade.

Measure ID	**Description of EVT Efficient Upgrade**	**EVT Efficient kW**	**Description of DPS Efficient Upgrade**	**DPS Efficient kW**	**Reason for DPS Change**
1962950	Rubis tower guns	27.243	Same	3.529	See baseline table for explanation of differences in snowmaking production and temperature distribution.

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

   Energy savings are figured based on the amount of water converted to snow and the relative efficacies of the baseline and installed snow guns. Savings are calculated by month and the peak demand savings is figured as the average demand savings during the months of December and January, implicitly assuming that snowmaking is equally likely in any given hour.

Preparation for Forward Capacity Market (FCM) Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   Option A or C is recommended; this equipment does not draw power directly, so usage must be inferred through either efficiency assumptions or from billing analysis. Although this is a MOP project, Option C billing analysis may be appropriate, perhaps adjusted for the expected difference between the pre-retrofit and baseline equipment.

2. If critical documentation is missing, list additional information needed to verify savings to FCM standards.

   Equipment performance data (e.g., gpm and cfm at a variety of temperatures) for each of the three snow guns included in this measure.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- SnowGuns Jay Peak_2step-EVTr1.xls
- SnowGuns Jay Peak_2step-DPSr1.xls

Attachments

Metering Plan, sampling worksheet, supplemental work papers, and files.

Review Engineer: Lexicon Energy Consulting
Date submitted to West Hill Energy: July 22, 2011
Date finalized by West Hill Energy: August 10, 2011

EVT Project ID Number: 381313
Project Name: JLS Magic, LLC - Various Measures
Sample Group (Size): 4
Type of Project (NC/MOP, Retrofit): Retrofit

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
1929481	Efficient snowmaking guns, other	0	0.000	0.000			
1929482	Variable frequency drive, snowmaking	15,300	34.000	0.000	15,300	6.854	0.000
Total:		15,300	34.000	0.000	15,300	6.854	0.000

The table below shows other verified resource savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	Resource Type	Resource Units	EVT Claimed Resource Change	DPS Verified Resource Change
1929481	Efficient snowmaking guns, other	Heating Oil	MMBtu	351.000	1,890

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   This project rebuilt nine snow guns; all savings are diesel.

   A VFD was installed on a snowmaking pump.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   No; there were spot measurements of pump amperage pre- and post-retrofit.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   Retrofit is appropriate as claimed.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

Measure ID	Description of EVT Baseline	EVT Baseline kW	Description of DPS Baseline	DPS Baseline kW	Reason for DPS Change
1929481	Old Snow Giants (7) and Baby Snow Giants (2) with total use of 4.5 ac-ft/yr for the 9 guns	14.47 gal diesel/hr	Same	99.27 gal diesel /hr	These 9 guns represent 13% of snow gun inventory so should presumably produce a similar percentage of snow. Total water use is 45 mg/yr or about 230 ac-ft snow/yr on 70 acres with 72 guns.
1929482	Constant-speed drive on snowmaking pump	293	Same	293 * 20% = 59.060	The pump would operate the same hours as the compressors, which are listed as 300 in Dec. and Jan. The probability of pump operation during any given hour is therefore 20% (300÷(24*62)).

5. Define the efficiency upgrade.

Measure ID	Description of EVT Efficient Upgrade	EVT Efficient kW	Description of DPS Efficient Upgrade	DPS Efficient kW	Reason for DPS Change
1929481	Rebuilt guns	6.26 gal diesel/hr		43.08 gal diesel / hr	Increased assumption of snow production per gun as explained above
1929482	Variable frequency drive, snowmaking	259	Same	259 * 20% = 52.206	20% is figured same as for baseline.

Preparation for Forward Capacity Market (FCM) Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   We recommend Option B – isolated equipment measurement. Calculations will rely heavily on availability of more detailed records.

2. If critical documentation is missing, list additional information needed to verify savings to FCM standards.

   Regarding the VFD measure: It was delightful and much appreciated to find a pump curve in the documentation. However, there was very little other information. Much of the value of a variable speed drive comes from the fact that it is variable, yet the savings were based on only two observations of current draw: one baseline and installed. There were no indications of the pressure or flow at the time of these observations. Neither was there any mention of how the VFD would be controlled. Is the VFD speed set manually or is it controlled to maintain a setpoint pressure?

We have allowed the savings to stand because the claim is so small compared to the size of the pump. It should be easy to achieve these minimal savings with proper operation and we suspect the savings are greater but have no basis for increasing the estimate. However, if the reduced speed leads to reduced flow, the pump would need to operate additional hours to provide the total desired flow, obviating any savings. Indeed, given the high head required, any flow reduction would likely lead to INCREASED energy use.

Pre- and post-retrofit operating records of flow, pressure, and speed as well as a description of the control sequence is required.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- Snowmaking Savings Magic 7-22-11.xls

Attachments

Metering Plan, sampling worksheet, supplemental work papers, and files.

Review Engineer: CxAssociates
Date submitted to West Hill Energy: 8/1/2011
Date finalized by West Hill Energy: 8/31/2011

EVT Project ID Number: 386091
Project Name: Lake Champlain Chocolates – Distribution Center - Newlight
Sample Group (Size): 4
Type of Project (NC/MOP, Retrofit): Retrofit/New Construction – classification changed by DPS

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
2290063	Occupancy sensors	7,784.5	1.428	3.014	7,339.7	1.428	2.61
2290064	New T5 high-bay	4,351.8	0	1.281	3,115	0	0.84
2290065	New T5 high-bay	24,137.4	0	7.105	17,278	0	4.65
2290066	Occupancy sensors	9,146.8	0	2.692	8,196	0	2.33
2290067	Occupancy sensors	6,714.1	0	1.976	6,016	0	1.71
2290068	Unitary air conditioning system	4,848.5	0.102	3.636	4,848.5	0.102	3.636
2290069	Unitary air conditioning system	4,848.5	0.102	3.636	4,848.5	0.102	3.636
2290070	Unitary air conditioning system	9,697.0	0.102	3.636	8,928.9	0.09	3.35
2290071	Unitary air conditioning system	9,697.0	0.102	3.636	8,928.9	0.09	3.35
2290072	Unitary air conditioning system	9,697.0	0.102	3.636	8,928.9	0.09	3.35
2290073	Motor, ODP 7.5 hp	2,282.2	0	0.209	2,282.2	0	0.209
2290074	Motor, ODP 7.5 hp	1,141.1	0	0.104	1,141.1	0	0.104
2290075	Motor, ODP 7.5 hp	104.2	0	0.104	104.2	0	0.104
Total:		94,450	1.94	34.67	81,996	1.90	29.88

The table below shows other verified resource savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	Resource Type	Resource Units	EVT Claimed Resource Change	DPS Verified Resource Change
2290063	Occupancy sensors	Heating penalty	MMBtu	(8.7)	(5.9)
2290064	New T5 high-bay	Heating penalty	MMBtu	(4.8)	(2.48)
2290065	New T5 high-bay	Heating penalty	MMBtu	(27)	(13.77)
2290066	Occupancy sensors	Heating penalty	MMBtu	(10.2)	(6.9)
2290067	Occupancy sensors	Heating penalty	MMBtu	(7.5)	(5.07)
Total:		Heating penalty	MMBtu	(58.04)	(34.12)

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   The building was a major renovation where HVAC rooftop equipment was replaced throughout, lighting was replaced in 60% of the building, and motors and occupancy sensors were installed in other areas.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   As the customer was new to the building, there was no equipment to meter prior to the measure installation. EVT did not meter the project after the installation was completed.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   This project was claimed as a retrofit. However, according to an EVT memo dated November 14, 2008 from Erik Brown and Philip Mosenthal, a portion of this project falls into the category of New Construction (NC). The EVT memo states:

   "Projects will generally be classified as New Construction if they involve any of the following:

   - Construction of a new building
   - Construction of an addition of 500 square feet or more
   - Major rehabilitation of an existing building. Major rehabilitation is defined as stripping an existing building down to the building shell, and/or replacement of at least two building systems (HVAC, electrical, and/or building shell)."

   This project is a major rehabilitation of 30,591 square feet (packaging area) of an existing building with the replacement of two building systems, HVAC and lighting. According to the EVT documentation, the building shell was also upgraded with increased roof insulation, but the corresponding savings were not claimed in this project. DPS has classified this space as the ASHRAE 90.1 defined "Warehouse – medium bulk storage" for the lighting calculations. The process being performed in this space is a warehouse function of boxing up boxes of chocolate.

   The remaining area (approximately 20,000 square feet of warehouse and office space) remains as a retrofit, because the existing lighting was not replaced. These areas received new HVAC systems and the warehouse had occupancy sensors installed on a portion of the existing fixtures.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

   The packaging area was changed to an NC project as described in Item 6 below. The NC stipulation alters the lighting and HVAC baseline from existing conditions to Vermont code levels. These baseline changes are detailed in this section.

Lighting

The EVT baseline was the existing fixture wattage (430 watts/fixture) and the existing fixture count (70), which creates a LPD for this space of 0.984. According to the Vermont Code, the NC baseline for a Warehouse – Medium/bulk storage is 0.90.

HVAC

The EVT baseline reflected Retrofit HVAC equipment baseline values, which are lower than the New Construction Vermont Code baseline values (as stipulated in the TRM). The EER baseline value went from 9.9 to 10.10, creating a small decrease in HVAC equipment savings.

The lighting and HVAC changes are quantified in the following table:

Measure ID	Description of EVT Baseline	EVT Baseline kW	Description of DPS Baseline	DPS Baseline kW	Reason for DPS Change
2290064 & 65	MH 400W; calculated per unit wattage of 430; LPD 0.984	30.1	Vt Code Baseline for Warehouse lighting – Medium/bulky storage; LPD of 0.9	27.53	Change in project classification to NC
2290070	Unitary air conditioning system – baseline for RET = 9.9	24.24	Baseline for NC = 10.10	23.76	Change in project classification to NC
2290071	Unitary air conditioning system – baseline for RET = 9.9	24.24	Baseline for NC = 10.10	23.76	
2290072	Unitary air conditioning system – baseline for RET = 9.9	24.24	Baseline for NC = 10.10	23.76	

5. Define the efficiency upgrade.

All efficient measures remained the same as in the EVT documentation. The LPD was calculated for this analysis using the CAT inputs of the installed light fixtures. The LPD of the packaging area is 0.64 and the HVAC equipment has an EER of 13.20.

Measure ID	Description of EVT Efficient	EVT Efficient kW	Description of DPS Efficient	DPS Efficient kW	Reason for DPS Change
2290064 & 65	New T5 high-bay; LPD =0.64	19.56	Same as EVT	19.56	No change
2290066 & 67	Occupancy Sensors	Schedule based automatic control; 30% reduction	Same as EVT	Schedule based auto control; 30% reduction	No change
2290070	Unitary air conditioning system – EER 13.20	18.18	Same as EVT	18.18	No change
2290071	Unitary air conditioning system – EER 13.2	18.18	Same as EVT	18.18	No change
2290072	Unitary air conditioning system – EER 13.20	18.18	Same as EVT	18.18	No change

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

   This project was originally classified as a Retrofit and therefore calculated the lighting savings on a fixture replacement basis. Classifying the packaging area to be NC requires lighting fixtures for this area to be analyzed on a lighting power density (LPD) basis.

   The NC LPD calculation in this verification was performed in the EVT LPD Tool, using the CAT light fixture inputs and the packaging area square footage noted in the EVT project documentation. The LPD savings output from the EVT LPD tool is shown in the following table:

Total Building Area (sf)	Code Lighting Power Density	Actual Lighting Power Density	Annual Operating Hours	Total Watts Saved	Total Lighting kWh Saved
30,591	0.9	0.64	2,422	7,972	19,308

7. Check if issues with any of the following:

   ____ Free ridership

   ____Spillover

   ____ Act 250 status

   ____ Hours of use/uptime

   ____ Commissioning adjustment

   __x__ Cooling bonus/heating penalty

   ____ Load profile

   ____ MMBtu savings

   ____ Water savings

____ O&M savings

Briefly explain the issue(s).

Cooling bonus and heating penalty factors have changed for all projects in this verification analysis. The changes are shown in the following table:

	EVT Factors		**DPS Factors**	
	Cooling Bonus	**Heating Penalty (in MMBtu)**	**Cooling Bonus**	**Heating Penalty (in MMBtu)**
kW	1.34		1.159	
kWh	1.12	0.00124	1.056	(0.00084)

These factors are reflected in all of the lighting measure savings shown in Table 1 and 2. They are the only changes to the occupancy sensors on the existing fixtures, Measure 2290063 and the new occupancy sensors, Measures 2290066 and 2290067.

Preparation for FCM Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   Option A: Partially Measured Retrofit Isolation/Stipulated Measurement

2. If critical documentation is missing, list additional information needed to verify savings to FCM standards.

   Building plans listing square footage and building lighting layout.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- DPS_calculations.v2.xlsx
- LPD Tool_v2j_2H273.CxA.xlsx

Attachments

Metering Plan, sampling worksheet, supplemental work papers, and files.

Review Engineer: CxAssociates
Date submitted to West Hill Energy: 8/2/2011
Date finalized by West Hill Energy: 8/31/11

EVT Project ID Number: 387626
Project Name: Magnan, Mark - Magnan Bros Dairy - Clothes Washer
Sample Group (Size): 1
Type of Project (NC/MOP, Retrofit): Retrofit

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
2307276	Commercial efficient clothes washer	5996	0.868	0.651	6,396	0.73	0.73
Total:		5996	0.868	0.651	6,396	0.73	0.73

The table below shows other verified resource savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	Resource Type	Resource Units	EVT Claimed Resource Change	DPS Verified Resource Change
2307276	Commercial efficient clothes washer	Heating Oil	MMBtu	8.440	9.00

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   A dairy farm replaced its existing clothes washing machine with a CEE Tier III machine. The dryer was not replaced and is an electric machine. The facility washes clothes continuously 24/7/365 throughout the year.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   The project was not metered by EVT.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   This project is correctly characterized as a retrofit because the existing washing machine was replaced for energy efficiency reasons.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

   The baseline is the same as the EVT documentation except the amount the unit operates per day has been updated to reflect a conversation with the owner. According to the owner, their facility is operational around the clock and they use the machine 24 hours/day, reloading the machine as soon as it is done. This DPS estimated one half-hour between loads, to allow for unloading, reloading, and lag time between loads. The customer stated that the machine takes approximately 1 hour to complete a cycle. This equates to one full cycle (runtime and downtime) taking 1.5 hours and enabling the dairy to complete 16 loads in 24 hours.

Measure ID	Description of EVT Baseline	EVT Baseline kW*	Description of DPS Baseline	DPS Baseline kW*	Reason for DPS Change
2307276	15 loads/day for 12,754 kWh/year consumption	44.75	16 loads/day for 13,065 kWh/yr consumption	2.33	Discussion with the customer.

*The method with which EVT calculated the demand is quite different and cannot easily be compared to the method with which DPS calculated demand. The differences are described in detail in Item 6 below.

5. Define the efficiency upgrade.

   The efficient case has been updated as described in Item 4 above.

Measure ID	Description of EVT Efficient Upgrade	EVT Efficient kW*	Description of DPS Efficient Upgrade	DPS Efficient kW*	Reason for DPS Change
2307276	15 loads/day for 6,758 kWh/yr consumption	23.71	16 loads/day for 7,209 kWh/yr consumption	2.31	Discussion with the customer.

*The method with which EVT calculated the demand is quite different and cannot easily be compared to the method with which DPS calculated demand. The differences are described in detail in Item 6 below.

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

   The method for calculating demand savings (kW) was altered from the EVT documentation to reflect the actual annual hours of consumption. The EVT tool calculated the demand savings using the residential load profile coincidence factors of 3.3% in the Summer Coincident Peak period and 4.4% in the Winter Coincident Peak period. The EVT tool also assumes 304 hours/year runtime. In actuality, the unit operates considerably more during the peak periods and has considerably more annual operating hours than the residential profile reflects. The two methods of demand savings calculations are detailed below:

   EVT Demand Calculations

   The EVT savings calculation tool uses the residential load profile and defines the hours of operation to be 304 hours/year. The demand savings is then calculated as:

kW savings = energy savings / hours per year * coincident factor

	Summer	Winter
EVT demand savings	6396/304*0.033=0.651	6396/304*0.044=0.868

DPS Demand Calculations

The EVT coincidence factors and load profile do not represent a 24/7/365 continuous operation. Based on the estimated 1.5 hour/cycle washer cycle (including washing and downtime), the coincidence factors for winter and summer are 0.667 and the annual hours of operation are 8760. According to the manufacturer efficient factors (baseline = 1.29 and new equipment = 2.47), the more efficient washing machine enables the drying time per cycle to be reduced by 49%. This creates the following coincidence factors for this project:

DPS Coincidence Factor (Summer and Winter)	Baseline	Replacement
Clothes washer	66.67%	66.67%
Drying machine	66.67%	34.01%

DPS calculated the savings using CEE equipment (washer and dryer) consumption information documented in the EVT Clothes Washer calculation tool. This demand is shown in the table below:

DPS Demand	Baseline kW	Replacement kW
Clothes washer	0.1326	0.1137
Drying machine	2.1969	2.1969

Demand savings were calculated as:

kW savings = (Baseline kW * CF) – (Replacement kW * CF)

DPS Demand Savings	Summer & Winter kW
Clothes washer	0.013
Drying machine	0.717
Total	0.730

7. Check if there are issues with any of the following:

____ Free ridership

____Spillover

____ Act 250 status

____ Hours of use/uptime

____ Commissioning adjustment

____ Cooling bonus/heating penalty

__X_ Load profile

____ MMBtu savings

____ Water savings

____ O&M savings

Briefly explain the issue(s).

The EVT demand savings are calculated using the residential load profile, which does not apply to this project. The EVT demand calculations and the DPS modifications are described above in Item 6.

Preparation for Forward Capacity Market (FCM) Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   We recommend Option A: Partially Measured Retrofit Isolation/Stipulated Measurement.

2. If critical documentation is missing, list additional information needed to verify savings to FCM standards.

   None.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- Calc_2H719_MagnanMark_ClothesWasher.CxA.xlsx
- Magnan_coincidence_factor.xlsx

Attachments

Metering Plan, sampling worksheet, supplemental work papers, and files.

Review Engineer: GSD Associates
Date submitted to West Hill Energy: 7/20/2011
Date finalized by West Hill Energy: 7/29/2011

EVT Project ID Number: 344172
Project Name: North Country Hospital - New Construction
Sample Group (Size): 5
Type of Project (NC/MOP, Retrofit): NC/MOP

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
1911974	Comprehensive building-wide savings	283620	35.235	60.750	272715	34.512	59.504
Total:		283620	35.235	60.750	272715	34.512	59.504

The table below shows other verified resource savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	Resource Type	Resource Units	EVT Claimed Resource Change	DPS Verified Resource Change
1911974	Comprehensive building-wide savings	Heating Oil	MMBTU	636.000	504.959

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   This project is the construction of the North Country Medical Office Building. This building is a 32,000 ft^2 facility with offices, exam rooms and treatment rooms.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   No metering provided.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   This project is correctly characterized as New Construction.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

   The baseline for this project is an eQUEST Energy Model set at minimum efficiency requirements as defined in 2005 Vermont Guidelines for Energy Efficient Commercial Construction. The provided eQUEST baseline model was checked against the 2005 Vermont Guidelines for Energy Efficient Commercial Construction. The roof insulation eQUEST input was adjusted from 3" polyurethane (R18) to 4" polyurethane (R24) to achieve the Table 802.2(1) Building Envelope Requirements – Roofs, Insulation entirely above deck; U-0.040; R24 continuous insulation.

	EVT Baseline Provided, eQUEST Version 3.61	**EVT Baseline eQUEST Version 3.63**	**DPS adjusted Baseline eQUEST Version 3.63**
Annual consumption - MWh	623.70	617.83	611.304
Annual consumption – Btu	2299.1	2293.3	2192.447

5. Define the efficiency upgrade.

   The efficient case for this project is the provided As Designed eQUEST model. This model was loaded into eQUEST Version 3.63 to be able to compare the savings in the same version of the software.

	EVT Baseline Provided, eQUEST Version 3.61	**EVT Baseline eQUEST Version 3.63**	**DPS adjusted Baseline eQUEST Version 3.63**
Annual consumption - MWh	340.08	338.589	No change
Annual consumption - Btu	1662.8	1687.488	No change

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

   ΔkWh = Hourly load profile Baseline Annual Consumption – Design Annual Consumption

   ΔkW = Hourly load profile Baseline kW – Design kW as provided in eQUEST detailed output file.

   CF_{win} = 29%; CF_{sum} = 50%

   ΔMMBtu = Hourly load profile Baseline MMBtu – Design MMBtu as provided in eQUEST detailed output file.

7. Check if there are issues with any of the following:

   ____ Free ridership

   ____Spillover

   ____ Act 250 status

   ____ Hours of use/uptime

   ____ Commissioning adjustment

   ____ Cooling bonus/heating penalty

   ____ Load profile

   _X_ MMBtu savings

____ Water savings

____ O&M savings

Briefly explain the issue(s).

The adjustment to the base case for roof insulation changed the MMBtu savings for the measure.

Preparation for FCM Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

We recommend Option D: Calibrated Simulation.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- Cat10a_4C192.xls
- NorthCountry344172GDSAnalV1.xlsx
- Baseline and As Designed Consumption.pdf

Attachments

Supplemental work papers and files.

Review Engineer: GDS Associates
Date submitted to West Hill Energy: 7/20/2011
Date finalized by West Hill Energy: 8/31/11

EVT Project ID Number: 341473
Project Name: Norwich Inn - Addition - New Construction
Sample Group (Size): 5
Type of Project (NC/MOP, Retrofit): NC/MOP

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
1961074	Linear fluorescent T5	342	0.208	0.077	542	0.347	0.112
1961075	Compact fluorescent interior fixture	1014	0.618	0.228	1608	1.030	0.333
1961076	Custom lighting efficiency	185	0.000	0.419	176	0.113	0.368
1961077	Custom lighting efficiency	7	0.004	0.002	7	0.004	0.001
1961078	New super T8 troffer/wrap	68	0.042	0.015	65	0.042	0.013
1961079	New super T8 troffer/wrap	68	0.042	0.015	65	0.042	0.013
1961080	Compact fluorescent interior fixture	610	0.062	0.084	968	0.104	0.122
1961081	Linear fluorescent T8	1232	0.126	0.169	1172	0.126	0.148
1961082	Linear fluorescent T8	176	0.018	0.024	167	0.018	0.021
1961083	Compact fluorescent interior fixture	634	0.386	0.142	1005	0.644	0.208
1961084	Compact fluorescent interior fixture	493	0.300	0.111	781	0.501	0.162
1961085	Compact fluorescent exterior fixture	1823	0.457	0.024	1936	0.457	0.028
1961086	Compact fluorescent exterior fixture	781	0.196	0.010	830	0.196	0.012
1961087	Metal halide track lighting	7008	1.123	0.059	7442	1.123	0.070
1961088	Compact fluorescent interior fixture	362	0.048	0.018	573	0.080	0.026
1961089	New super T8 industrial/strip	47	0.006	0.002	45	0.006	0.002
1961090	New super T8 industrial/strip	31	0.004	0.002	30	0.004	0.001
1961091	New super T8 industrial/strip	78	0.010	0.004	74	0.010	0.003
1961092	New super T8 industrial/strip	137	0.014	0.019	130	0.014	0.016
1961093	Compact fluorescent interior fixture	60	0.008	0.003	96	0.013	0.004
1961094	New super T8 industrial/strip	67	0.009	0.003	64	0.009	0.003
1961095	New super T8 industrial/strip	156	0.021	0.008	149	0.021	0.007

1961096	New super T8 industrial/strip	31	0.008	0.003	30	0.008	0.003
1961097	Heat pump, air, Cool Choice tier 2 135-375 KBtu/hr	3533	0.074	3.566	3533	0.075	3.568
1961098	Heat pump, air, Cool Choice tier 2 65-135 KBtu/hr	810	0.017	0.817	812	0.017	0.82
1961099	Improved air conditioning controls	13221	0.000	29.227	-	-	-
Total:		32,972	3.804	35.051	-	-	-
Total Verified		19,753	3.801	5.824	22,300	5.004	6.064

* DPS cannot verify savings from improved air conditioning controls. See explanation in section 6.

The table below shows other verified resource savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	Resource Type	Resource Units	EVT Claimed Resource Change	DPS Verified Resource Change
1961074	Linear fluorescent T5	Heating oil	MMBtu	-0.38	-0.59
1961075	Compact fluorescent interior fixture	Heating oil	MMBtu	-1.13	-1.74
1961076	Custom lighting efficiency	Heating oil	MMBtu	-0.21	-0.19
1961077	Custom lighting efficiency	Heating oil	MMBtu	-0.01	-0.01
1961078	New super T8 troffer/wrap	Heating oil	MMBtu	-0.08	-0.07
1961079	New super T8 troffer/wrap	Heating oil	MMBtu	-0.08	-0.07
1961080	Compact fluorescent interior fixture	Heating oil	MMBtu	-0.68	-1.05
1961081	Linear fluorescent T8	Heating oil	MMBtu	-1.37	-1.27
1961082	Linear fluorescent T8	Heating oil	MMBtu	-0.2	-0.18
1961083	Compact fluorescent interior fixture	Heating oil	MMBtu	-0.71	-1.09
1961084	Compact fluorescent interior fixture	Heating oil	MMBtu	-0.55	-0.85
1961085	Compact fluorescent exterior fixture	Heating oil	MMBtu	0	0
1961086	Compact fluorescent exterior fixture	Heating oil	MMBtu	0	0
1961087	Metal halide track lighting	Heating oil	MMBtu	0	0
1961088	Compact fluorescent interior fixture	Heating oil	MMBtu	-0.4	-0.62
1961089	New super T8 industrial/strip	Heating oil	MMBtu	-0.05	-0.05
1961090	New super T8 industrial/strip	Heating oil	MMBtu	-0.03	-0.03
1961091	New super T8 industrial/strip	Heating oil	MMBtu	-0.09	-0.08
1961092	New super T8 industrial/strip	Heating oil	MMBtu	-0.15	-0.14
1961093	Compact fluorescent	Heating oil	MMBtu	-0.07	-0.10

	interior fixture				
1961094	New super T8 industrial/strip	Heating oil	MMBtu	-0.07	-0.07
1961095	New super T8 industrial/strip	Heating oil	MMBtu	-0.17	-0.16
1961096	New super T8 industrial/strip	Heating oil	MMBtu	-0.03	-0.03

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   Norwich Inn is a hotel that has installed new lighting fixtures, one 20-ton air-cooled HP, one 6-ton air-cooled HP, and automation controls that control lighting and AC. An addition was just put onto the hotel.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   EVT did not meter this project.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   This project is a combination of NC and retrofit. The AC energy savings used NC calculations and the lighting used retrofit calculations. The automation controls capture savings from the baseline of both the lighting and AC measures. It was not made clear to DPS which, if any, of the new lighting fixtures were installed in the new addition versus installed as retrofits in the original structure. DPS assumed that most of the lighting improvements were retrofits and that retrofit calculations were the proper approach to estimate savings.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

Measure ID	Description of EVT Baseline	EVT Baseline kW	Description of DPS Baseline	DPS Baseline kW	Reason for DPS Change
1961074	Inc 1L 75 W (base quantity: 22; watts: 75)	1.65	Inc 1L 75 W (base quantity: 22; watts: 75)	1.65	N/A
1961075	Inc 1L 100 W (base quantity: 48; watts: 100)	4.8	Inc 1L 100 W (base quantity: 48; watts: 100)	4.8	N/A
1961076	T8 2L-F32 w/ elec - 4' (base quantity: 16; watts: 59)	0.944	T8 2L-F32 w/ elec - 4' (base quantity: 16; watts: 59)	0.944	N/A
1961077	T8 2L-F17 w/ elec - 2' (base quantity: 1; watts: 37)	0.037	T8 2L-F17 w/ elec - 2' (base quantity: 1; watts: 37)	0.037	N/A
1961078	T8 2L-F32 w/ elec - 4' (base quantity: 14; watts: 59)	0.236	T8 2L-F32 w/ elec - 4' (base quantity: 14; watts: 59)	0.236	N/A
1961079	T8 2L-F32 w/ elec - 4' (base quantity: 14; watts: 59)	0.236	T8 2L-F32 w/ elec - 4' (base quantity: 14; watts: 59)	0.236	N/A
1961080	Inc 1L 150 W (base quantity: 1; watts: 150)	0.15	Inc 1L 150 W (base quantity: 1; watts: 150)	0.15	N/A

1961081	T12 2L-F40ES w/ EEMag - 4' (base quantity: 14; watts: 68)	0.952	T12 2L-F40ES w/ EEMag - 4' (base quantity: 14; watts: 68)	0.952	N/A
1961082	T12 2L-F20 w/ Mag - 2' (base quantity: 1; watts: 55)	0.055	T12 2L-F20 w/ Mag - 2' (base quantity: 1; watts: 55)	0.055	N/A
1961083	Inc 1L 60 W (base quantity: 48; watts: 60)	2.88	Inc 1L 60 W (base quantity: 48; watts: 60)	2.88	N/A
1961084	Inc 1L 100 W (base quantity: 24; watts: 100)	2.4	Inc 1L 100 W (base quantity: 24; watts: 100)	2.4	N/A
1961085	MH 100 W (base quantity: 7; watts: 125)	0.875	MH 100 W (base quantity: 7; watts: 125)	0.875	N/A
1961086	MH 150 W normal start (base quantity: 3; watts: 150)	0.45	MH 150 W normal start (base quantity: 3; watts: 150)	0.45	N/A
1961087	Baseline - 3 halogen - 90W - PAR38 Standard (base quantity: 10; watts: 270)	2.7	Baseline - 3 halogen - 90W - PAR38 Standard (base quantity: 10; watts: 270)	2.7	N/A
1961088	Inc 3L 60 W (base quantity: 2; watts: 180)	0.36	Inc 3L 60 W (base quantity: 2; watts: 180)	0.36	N/A
1961089	T8 1L-F32 w/ elec - 4' (base quantity: 3; watts: 32)	0.096	T8 1L-F32 w/ elec - 4' (base quantity: 3; watts: 32)	0.096	N/A
1961090	T8 1L-F32 w/ elec - 4' (base quantity: 2; watts: 32)	0.064	T8 1L-F32 w/ elec - 4' (base quantity: 2; watts: 32)	0.064	N/A
1961091	T8 1L-F32 w/ elec - 4' (base quantity: 5; watts: 32)	0.16	T8 1L-F32 w/ elec - 4' (base quantity: 5; watts: 32)	0.16	N/A
1961092	T8 1L-F32 w/ elec - 4' (base quantity: 2; watts: 32)	0.064	T8 1L-F32 w/ elec - 4' (base quantity: 2; watts: 32)	0.064	N/A
1961093	Inc 1L 60 W (base quantity: 1; watts: 60)	0.06	Inc 1L 60 W (base quantity: 1; watts: 60)	0.06	N/A
1961094	T8 2L-F32 w/ elec - 4' (base quantity: 3; watts: 59)	0.177	T8 2L-F32 w/ elec - 4' (base quantity: 3; watts: 59)	0.177	N/A
1961095	T8 2L-F32 w/ elec - 4' (base quantity: 7; watts: 59)	0.413	T8 2L-F32 w/ elec - 4' (base quantity: 7; watts: 59)	0.413	N/A
1961096	T8 1L-F32 w/ elec - 4' (base quantity: 4; watts: 32)	0.128	T8 1L-F32 w/ elec - 4' (base quantity: 4; watts: 32)	0.128	N/A
1961097	Cooling SEER/EER: 8.8; Heating COP: 3.1; Cooling IPLV: 8.8	24.21	Cooling SEER/EER: 8.8; Heating COP: 3.1; Cooling IPLV: 8.8	24.21	N/A
1961098	Cooling SEER/EER: 9.9; Heating COP: 3.2; Cooling IPLV: 9.9	6.819	Cooling SEER/EER: 9.9; heating COP: 3.2; Cooling IPLV: 9.9	6.819	N/A
1961099	Baseline HVAC and lighting energy consumption	-	Controls	-	N/A

* DPS cannot verify baseline kW from improved air conditioning controls. See explanation in section 6.

5. Define the efficiency upgrade.

Measure ID	Description of EVT Efficient Upgrade	EVT Efficient kW	Description of DPS Efficient Upgrade	DPS Efficient kW	Reason for DPS Change
1961074	Other T5 fixture w/ elec (input wattage and maint. data) (watts: 22)	0.484	Other T5 fixture w/ elec (input wattage and maint. data) (watts: 22)	0.484	N/A
1961075	Interior CF 1L 26W quad w/ elec (watts: 28)	1.344	Interior CF 1L 26W quad w/ elec (watts: 28)	1.344	N/A
1961076	Custom lighting controls (percent reduction: 0.4)	0.3776	Custom lighting controls (percent reduction: 0.4)	0.3776	N/A
1961077	Custom lighting controls (percent reduction: 0.4)	0.0148	Custom lighting controls (percent reduction: 0.4)	0.0148	N/A
1961078	HPT8 2L 32W troffer/wrap lamp system with low-BF ballast (watts: 49)	0.686	HPT8 2L 32W troffer/wrap lamp system with low-BF ballast (watts: 49)	0.686	N/A
1961079	HPT8 2L 32W troffer/wrap lamp system with low-BF ballast (watts: 49)	0.686	HPT8 2L 32W troffer/wrap lamp system with low-BF ballast (watts: 49)	0.686	N/A
1961080	Interior CF 1L 42W Triple w/ elec (watts: 46)	0.046	Interior CF 1L 42W Triple w/ elec (watts: 46)	0.046	N/A
1961081	T8 2L-F32 w/ elec - 4' (watts: 59)	0.826	T8 2L-F32 w/ elec - 4' (watts: 59)	0.826	N/A
1961082	T8 2L-F17 w/ elec - 2' (watts: 37)	0.037	T8 2L-F17 w/ elec - 2' (watts: 37)	0.037	N/A
1961083	Interior CF 1L 13W twin w/ Mag (watts: 15)	0.720	Interior CF 1L 13W twin w/ Mag (watts: 15)	0.720	N/A
1961084	Interior CF 2L 13W quad w/ elec (watts: 30)	0.720	Interior CF 2L 13W quad w/ elec (watts: 30)	0.720	N/A
1961085	Other exterior CF w/ elec (input wattage and maint. data) (watts: 32)	0.224	Other exterior CF w/ elec (input wattage and maint. data) (watts: 32)	0.224	N/A
1961086	Other exterior CF w/ elec (input wattage and maint. data) (watts: 57)	0.171	Other exterior CF w/ elec (input wattage and maint. data) (watts: 57)	0.171	N/A
1961087	CMH - 100 W - elec ballast (watts: 110)	1.1	CMH - 100 W - elec ballast (watts: 110)	1.1	N/A
1961088	Interior CF 3L 13W quad w/ elec (watts: 45)	0.09	Interior CF 3L 13W quad w/ elec (watts: 45)	0.09	N/A
1961089	HPT8 1L 32W industrial/strip lamp system with low-BF ballast (watts: 25)	0.075	HPT8 1L 32W industrial/strip lamp system with low-BF ballast (watts: 25)	0.075	N/A
1961090	HPT8 1L 32W industrial/strip lamp system with low-BF ballast (watts: 25)	0.05	HPT8 1L 32W industrial/strip lamp system with low-BF ballast (watts: 25)	0.05	N/A
1961091	HPT8 1L 32W industrial/strip lamp system with low-BF ballast (watts: 25)	0.125	HPT8 1L 32W industrial/strip lamp system with low-BF ballast (watts: 25) N/A	0.125	N/A
1961092	HPT8 1L 32W industrial/strip lamp system with low-BF ballast (watts:	0.05	HPT8 1L 32W N/A industrial/strip lamp system with low-BF ballast (watts:	0.05	N/A

	25)		25)		
1961093	Interior CF 1L 13W quad w/ elec (watts: 15)	0.015	Interior CF 1L 13W quad w/ elec (watts: 15)	0.015	N/A
1961094	HPT8 2L 32W industrial/strip lamp system with low-BF ballast (watts: 49)	0.147	HPT8 2L 32W industrial/strip lamp system with low-BF ballast (watts: 49)	0.147	N/A
1961095	HPT8 2L 32W industrial/strip lamp system with low-BF ballast (watts: 49)	0.343	HPT8 2L 32W industrial/strip lamp system with low-BF ballast (watts: 49)	0.343	N/A
1961096	HPT8 1L 32W industrial/strip lamp system with low-BF ballast (watts: 25)	0.1	HPT8 1L 32W industrial/strip lamp system with low-BF ballast (watts: 25)	0.1	N/A
1961097	Air-cooled HP w/ fossil heat =>240,<=375 kBtu/h (20-31.25 tons) 47°F db/43°F wb outdoor air (Tons: 20; cooling SEER/EER: 10.5; heating COP: 3.1; cooling IPLV: Need Input (Min 9))	22.74	Air-cooled HP w/ fossil heat =>240,<=375 kBtu/h (20-31.25 tons) 47°F db/43°F wb outdoor air (Tons: 20; cooling SEER/EER: 10.5; heating COP: 3.1; cooling IPLV: Need Input (Min 9))	22.74	N/A
1961098	Air-cooled HP w/ fossil heat =>65,<135 kBtu/h (5.42-11.25 tons) 47°F db/43°F wb outdoor air (Tons: 6; cooling SEER/EER: 11.5; heating COP: 3.2; cooling IPLV: Not Applicable)	6.48	Air-cooled HP w/ fossil heat =>65,<135 kBtu/h (5.42-11.25 tons) 47°F db/43°F wb outdoor air (Tons: 6; cooling SEER/EER: 11.5; heating COP: 3.2; cooling IPLV: Not Applicable)	6.48	N/A
1961099	Energy Management System - AC/Chiller controls - without Commissioning	-	Energy Management System - AC/Chiller controls - without Commissioning	-	-

* DPS cannot verify baseline kW from improved air conditioning controls. See explanation in section 6.

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

Lighting

For lighting measures, the method used both by EVT and DPS to estimate peak kW reduction and kWh savings was taken out of the Vermont Technical Resource Manual (TRM). The specific equations from this page are as follows:

Demand Savings

$$\Delta kW = ((Watts_{BASE} - Watts_{EE}) / 1000) \times ISR \times WHF_d$$

Energy Savings

$$\Delta kWh = ((Watts_{BASE} - Watts_{EE}) / 1000) \times HOURS \times ISR \times WHF_e$$

The primary difference between DPS and EVT is the WHF. DPS used an updated WHF for summer, winter and energy. These updated WHFs produced reduced estimates for saved kW and kWh and have been verified by DPS in Table 1 in this report. DPS discovered wide discrepancies between our savings and EVT savings for the following lighting measures: 1961074, 1961075, 1961080, 1961083, 1961084, 1961087, 1961088, and 1961093. DPS could not verify the EVT source for these discrepancies.

When calculating savings associated with occupancy sensor controls, EVT used a 0.40 reduction factor applied to both kW and kWh savings from the equations above.

HVAC

For HVAC measures, the method used both by EVT and DPS to estimate peak kW reduction and kWh savings was taken out of the Vermont TRM, page 34. EVT and DPS savings estimates matched.

Controls

EVT calculated savings associated with energy management system controls by reducing the baseline energy consumption of lighting fixtures and HVAC in hotel rooms, assuming that the EMS system could turn these appliances off when not in use. The source for baseline kWh for the HVAC was clearly identified in the CAT tool. The source for baseline kW for the HVAC as it applies to the EMS system savings was not documented nor was the source for baseline kW and kWh for lighting in the rooms. As a result, DPS was not able to verify estimated savings for this measure. In order for DPS to verify these savings we need to know the source of baseline kW and kWh for both the HVAC and lighting improvements that are connected to the energy management system.

7. Check if issues with any of the following:

____ Free ridership

____Spillover

____ Act 250 status

____ Hours of use/uptime

____ Commissioning adjustment

__X_ Cooling bonus/heating penalty

____ Load profile

____ MMBtu savings

____ Water savings

____ O&M savings

Briefly explain the issue(s).

Because the MMBtu heating penalty factor has been updated, the heating penalty in the CAT tool is no longer accurate. Using the new MMBtu heating penalty, DPS has estimated the new values for each of the installed efficiency upgrades. The new total penalty factor is -19.4 MMBtu. The calculation for this value can be found in GDS analysis tool.

Preparation for Forward Capacity Market (FCM) Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   We recommend Option A: Partially Measured Retrofit Isolation/Stipulated Measurement.

2. If critical documentation is missing, list additional information needed to verify savings to FCM standards.

   In order to verify savings associated with the Energy Management System, DPS needs to know the wattages and quantities of lighting fixtures connected to the this system, estimated normal run hours of these fixtures, and the source of EVT estimated baseline kW for the HVAC system.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- TRM User Manual_SV 2010
- NorwichInn341473GDSAnalV1
- CAT10a_4C140_T12_update
- Daikin Controller Savings Calc

Attachments

Metering Plan, sampling worksheet, supplemental work papers, and files.

Review Engineer: L.J. Eldredge/Energy & Resource Solutions
Date submitted to West Hill Energy: 7/15/2011
Date finalized by West Hill Energy: 7/28/2011
EVT Project ID Number:

Sample Group (Size): 4
Type of Project (NC/MOP, Retrofit): Retrofit

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
1959464	New T5 high-bay	10372	4.300	4.300	10372	4.300	4.300
1959465	New super T8 industrial/strip	487	0.202	0.202	487	0.202	0.202
1959466	New super T8 industrial/strip	2721	1.128	1.128	2721	1.128	1.128
1959467	New T5 high-bay	39641	8.815	8.815	39641	8.815	8.815
1959468	New T5 high-bay	2452	1.075	1.075	2452	1.075	1.075
1959469	New T5 high-bay	2411	0.860	0.860	2411	0.860	0.860
1959470	New super T8 industrial/strip	3179	0.707	0.707	3179	0.707	0.707
1959471	New super T8 industrial/strip	13872	4.949	4.949	13872	4.949	4.949
1959472	New super T8 industrial/strip	297	0.066	0.066	297	0.066	0.066
1959473	New super T8 industrial/strip	1949	0.808	0.808	1949	0.808	0.808
1959474	New super T8 industrial/strip	20893	4.646	4.646	11206	4.646	4.646
1959476	New super T8 industrial/strip	516	0.198	0.198	516	0.198	0.198
1959477	New super T8 industrial/strip	540	0.207	0.207	540	0.207	0.207
1959478	New super T8 industrial/strip	136	0.052	0.052	136	0.052	0.052
1959479	New super T8 industrial/strip	1844	0.404	0.404	1844	0.404	0.404
Total:		101308	28.417	28.417	91623	28.417	28.417

The table below shows other verified resource savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	Resource Type	Resource Units	EVT Claimed Resource Change	DPS Verified Resource Change
1959464	New T5 high-bay	Heating oil	MMBtu	-12.880	-12.880
1959465	New super T8 industrial/strip	Heating oil	MMBtu	-0.610	-0.610
1959466	New super T8 industrial/strip	Heating oil	MMBtu	-3.380	-3.380
1959467	New T5 high-bay	Heating oil	MMBtu	-49.250	-49.250
1959468	New T5 high-bay	Heating oil	MMBtu	-3.050	-3.050
1959469	New T5 high-bay	Heating oil	MMBtu	-2.990	-2.990
1959470	New super T8 industrial/strip	Heating oil	MMBtu	-3.950	-3.950
1959471	New super T8 industrial/strip	Heating oil	MMBtu	-17.230	-17.230
1959472	New super T8 industrial/strip	Heating oil	MMBtu	-0.370	-0.370
1959473	New super T8 industrial/strip	Heating oil	MMBtu	-2.420	-2.420
1959474	New super T8 industrial/strip	Heating oil	MMBtu	-25.960	-13.92
1959476	New super T8 industrial/strip	Heating oil	MMBtu	-0.640	-0.640
1959477	New super T8 industrial/strip	Heating oil	MMBtu	-0.670	-0.670
1959478	New super T8 industrial/strip	Heating oil	MMBtu	-0.170	-0.170
1959479	New super T8 industrial/strip	Heating oil	MMBtu	-2.290	-2.290

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   This retrofit project involved the replacement of metal halide and T12 lighting fixtures with T5 high-bay, and HPT8 industrial fixtures in a manufacturing facility.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   No, EVT did not meter this project.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   This project is correctly characterized as retrofit.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

Measure ID	Description of EVT Baseline	EVT Baseline kW	EVT baseline hours	Description of DPS Baseline	DPS Baseline kW	DPS Baseline Hours	Reason for DPS Change
1959464	400W MH normal start	9.1	2,412	400W MH normal start	9.1	2,412	No change
1959465	T12 2L-F96ES w/ Mag - 8'	0.3	2,412	T12 2L-F96ES w/ Mag - 8'	0.3	2,412	No change
1959466	T12 2L-F96 HO w/ Mag - 8'	1.422	2,412	T12 2L-F96 HO w/ Mag - 8'	1.422	2,412	No change
1959467	MH 400 W normal start	18.655	4,497	MH 400 W normal start	18.655	4,497	No change
1959468	MH 400 W normal start	2.275	2,281	MH 400 W normal start	2.275	2,281	No change
1959469	MH 400 W normal start	1.82	2,803	MH 400 W normal start	1.82	2,803	No change
1959470	T12 2L-F96ES w/ Mag - 8'	1.05	4,497	T12 2L-F96ES w/ Mag - 8'	1.05	4,497	No change
1959471	T12 2L-F96ES w/ Mag - 8'	7.35	2,803	T12 2L-F96ES w/ Mag - 8'	7.35	2,803	No change
1959472	T12 2L-F40ES w/ Mag - 4'	0.164	4,497	T12 2L-F40ES w/ Mag - 4'	0.164	4,497	No change
1959473	T12 2L-F96ES w/ Mag - 8'	1.2	2,412	T12 2L-F96ES w/ Mag - 8'	1.2	2,412	No change
1959474	T12 2L-F96ES w/ Mag - 8'	6.9	4,497	T12 2L-F96ES w/ Mag - 8'	6.9	2,412	Change based on facility information.
1959476	T12 2L-F40ES w/ Mag - 4'	0.492	2,607	T12 2L-F40ES w/ Mag - 4'	0.492	2,607	No change
1959477	T12 1L-F40ES w/ Mag - 4'	0.432	2,607	T12 1L-F40ES w/ Mag - 4'	0.432	2,607	No change
1959478	T12 1L-F30 w/ Mag - 3'	0.092	2,607	T12 1L-F30 w/ Mag - 3'	0.092	2,607	No change
1959479	T12 2L-F96ES w/ Mag - 8'	0.6	4,563	T12 2L-F96ES w/ Mag - 8'	0.6	4,563	No change

5. Define the efficiency upgrade.

Measure ID	Description of EVT Efficient Upgrade	EVT Efficient kW	EVT Efficient Hours	Description of DPS Efficient Upgrade	DPS Efficient kW	DPS Efficient Hours	Reason for DPS Change
1959464	T5 high-bay 4L-F54HO	4.8	2,412	T5 high-bay 4L-F54HO	4.8	2,412	No change
1959465	HPT8 2L 32W industrial/strip lamp system with low-BF ballast	0.098	2,412	HPT8 2L 32W industrial/strip lamp system with low-BF ballast	0.098	2,412	No change
1959466	HPT8 2L 32W industrial/strip lamp system with low-BF ballast	0.294	2,412	HPT8 2L 32W industrial/strip lamp system with low-BF ballast	0.294	2,412	No change
1959467	T5 high-bay 4L-F54HO	9.84	4,497	T5 high-bay 4L-F54HO	9.84	4,497	No change
1959468	T5 high-bay 4L-F54HO	1.2	2,281	T5 high-bay 4L-F54HO	1.2	2,281	No change
1959469	T5 high-bay 4L-F54HO	0.96	2,803	T5 high-bay 4L-F54HO	0.96	2,803	No change
1959470	HPT8 2L 32W industrial/strip lamp system with low-BF ballast	0.343	4,497	HPT8 2L 32W industrial/strip lamp system with low-BF ballast	0.343	4,497	No change
1959471	HPT8 2L 32W industrial/strip lamp system with low-BF ballast	2.401	2,803	HPT8 2L 32W industrial/strip lamp system with low-BF ballast	2.401	2,803	No change
1959472	HPT8 2L 32W industrial/strip lamp system with low-BF ballast	0.098	4,497	HPT8 2L 32W industrial/strip lamp system with low-BF ballast	0.098	4,497	No change
1959473	HPT8 2L 32W industrial/strip lamp system with low-BF ballast	0.392	2,412	HPT8 2L 32W industrial/strip lamp system with low-BF ballast	0.392	2,412	No change
1959474	HPT8 2L 32W industrial/strip lamp system with low-BF ballast	2.254	4,497	HPT8 2L 32W industrial/strip lamp system with low-BF ballast	2.254	2,412	Change based on facility information.
1959476	HPT8 2L 32W industrial/strip lamp system with low-BF ballast	0.294	2,607	HPT8 2L 32W industrial/strip lamp system with low-BF ballast	0.294	2,607	No change

1959477	HPT8 1L 32W industrial/strip lamp system with low-BF ballast	0.225	2,607	HPT8 1L 32W industrial/strip lamp system with low-BF ballast	0.225	2,607	No change
1959478	HPT8 1L 25W 3' industrial/strip lamp system with low-BF ballast	0.04	2,607	HPT8 1L 25W 3' industrial/strip lamp system with low-BF ballast	0.04	2,607	No change
1959479	HPT8 2L 32W industrial/strip lamp system with low-BF ballast	0.196	4,563	HPT8 2L 32W industrial/strip lamp system with low-BF ballast	0.196	4,563	No change

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

   Energy savings and peak reduction were calculated using the following formulas:

$$kWh_{savings} = \sum\left(Qty\ x\ \frac{watts_{per\ fixture}}{1000}\ x\ hrs\right)_{baseline} - \sum\left(Qty\ x\ \frac{watts_{per\ fixture}}{1000}\ x\ hrs\right)_{efficient}$$

$$kW_{peak\ demand} = \left\{\sum\left(Qty\ x\ \frac{watts_{per\ fixture}}{1000}\right)_{baseline} - \sum\left(Qty\ x\ \frac{watts_{per\ fixture}}{1000}\right)_{efficient}\right\}\ x\ CF$$

   These calculations are consistent with EVT's methods; however, measure 1959474 has annual operating hours of 4,497 in EVT's calculation and 2,412 in the DPS calculation. These hours are indicated in the file as built 6-1-10.xls; it is noted that hours are from George Norfleet on 6/14/2010.

7. Check if there are issues with any of the following:

   ____ Free ridership

   ____Spillover

   ____ Act 250 status

   _X_ Hours of use/uptime

   ____ Commissioning adjustment

____ Cooling bonus/heating penalty

____ Load profile

____ MMBtu savings

____ Water savings

____ O&M savings

Briefly explain the issue(s).

According to the file as built 6-1-10.xls the operating hours for measure 1959474 (LE11), located in the PCV Production area are 2,412. The CAT shows annual operating hours of 4,497 for this measure.

Preparation for Forward Capacity Market (FCM) Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   We recommend Option A.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- PrecisionCon385032ERSAnalysisv1.xls

Attachments

Metering Plan, sampling worksheet, supplemental work papers, and files.

Review Engineer: Lexicon Energy Consulting
Date submitted to West Hill Energy: 9/9/2011
Date finalized by West Hill Energy: 9/9/2011

EVT Project ID Number: 394285
Project Name: Pyle, Mike – M & J Dairy – Rx Lighting 1
Sample Group (Size): 3
Type of Project (NC/MOP, Retrofit): NC/MOP

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
2347207	New T5 Vapor-proof	17856	6.099	2.273	17856	3.386	4.825
2347208	New T5 Vapor-proof	17320	1.739	0.648	7233	1.372	1.955
Total:		35176	7.837	2.921	25089	4.758	6.780

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   This is an efficient Rx lighting retrofit project.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   No, EVT did not meter this project.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   The project is correctly characterized as a retrofit.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

Measure ID	Description of EVT Baseline	EVT Baseline kW	Description of DPS Baseline	DPS Baseline kW	Reason for DPS Change
2347207			MH 400 W	455 W	EVT did not document savings calculation; wattage used by DPS agrees with Technical Resource Manual (TRM)
2347208			2L-T5 equivalent	495 W	EVT did not document savings calculation; wattage used by DPS agrees with TRM

5. Define the efficiency upgrade.

Measure ID	**Description of EVT Efficient Upgrade**	**EVT Efficient kW**	**Description of DPS Efficient Upgrade**	**DPS Efficient kW**	**Reason for DPS Change**
2347207			T5 high bay 4L F54HO	240 W	EVT did not document savings calculation, wattage used by DPS agrees with TRM
2347208			T5 high bay 6L F54HO	360 W	EVT did not document savings calculation, wattage used by DPS agrees with TRM

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

This is an Rx lighting project with little documentation on how EVT's savings were calculated. There are some receipts indicating the types of new lighting fixtures that were installed.

Measure 2347201 is for installation of thirty-one T5 high-bay 4L efficient lighting fixtures. DPS agrees with the calculation for annual energy savings. However, kWload = 31*(455-240)/1000 = 6.665. Using EVT's blended RLW coincidence factors for winter (0.508) and summer (0.724), kWwin = 0.508 * 6.665 = 3.386 kW, and kWsum = 0.724* 6.665 = 4.825.

Measure 2347208 is for installation of twenty T5 high-bay 6L F54HO efficient lighting fixtures. The hours of an agricultural facility according to the TRM are 2679 hours annually. kWload = 20*(495-360)/1000 = 2.7 kW, and kWh annual = 2679 * 2.7 = 7233.3 kWh.

Using EVT's blended RLW coincidence factors for winter (0.508) and summer (0.724), kWwin = 0.508 * 2.7 = 1.372 kW and kWsum = 0.724 * 2.7 = 1.955 kW

7. Check if issues with any of the following:

____ Free ridership

____Spillover

____ Act 250 status

____ Hours of use/uptime

____ Commissioning adjustment

____ Cooling bonus/heating penalty

____ Load profile

____ MMBtu savings

____ Water savings

____ O&M savings

Preparation for Forward Capacity Market (FCM) Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   We recommend Option B: Retrofit Isolation/Metered Equipment.

2. If critical documentation is missing, list additional information needed to verify savings to FCM standards.

   Documentation as to how EVT arrived at its savings estimates is missing. DPS created savings calculations.

Attachments

Metering Plan, sampling worksheet, supplemental work papers, and files.

Review Engineer: GDS Associates
Date submitted to West Hill Energy: 7/18/2011
Date finalized by West Hill Energy: 7/28/2011

EVT Project ID Number: 389641
Project Name: Rutland High School / Stafford Tech – Lighting Plus – Phase 2
Sample Group (Size): 3
Type of Project (NC/MOP, Retrofit): Retrofit

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
2350707	New super T8 troffer/wrap	121	0.025	0.061	243	0.052	0.113
2350708	New super T8 troffer/wrap	276	0.047	0.115	263	0.047	0.101
2350709	New super T8 troffer/wrap	276	0.047	0.115	263	0.047	0.101
2350710	New super T8 troffer/wrap	219	0.039	0.072	219	0.039	0.072
2350711	New super T8 troffer/wrap	276	0.047	0.115	263	0.047	0.101
2350712	New super T8 troffer/wrap	30	0.009	0.022	29	0.009	0.019
2350713	New super T8 troffer/wrap	104	0.019	0.034	104	0.019	0.034
2350715	New super T8 troffer/wrap	1602	0.327	0.808	1,525	0.327	0.708
2350717	New super T8 troffer/wrap	1030	0.210	0.519	980	0.210	0.455
2350718	New super T8 troffer/wrap	959	0.196	0.483	913	0.196	0.424
2350719	LED wall-mount area fixture (WallPack)	2761	0.217	0.400	2,761	0.217	0.400
2350720	New super T8 troffer/wrap	923	0.210	0.387	923	0.210	0.387
2350721	New super T8 troffer/wrap	150	0.026	0.048	150	0.026	0.048
2350722	New super T8 troffer/wrap	60	0.013	0.032	57	0.013	0.028
2350723	New super T8 troffer/wrap	1178	0.210	0.387	1,177	0.210	0.387
2350724	New super T8 troffer/wrap	1570	0.280	0.517	1,570	0.280	0.517
2350725	New super T8 troffer/wrap	20	0.013	0.024	20	0.013	0.024
2350726	New super T8 troffer/wrap	77	0.013	0.032	35	0.006	0.013
2350727	New super T8 troffer/wrap	1717	0.350	0.865	1,416	0.303	0.657
2350728	New super T8 troffer/wrap	1144	0.233	0.577	141	0.030	0.065
2350729	New super T8 troffer/wrap	276	0.047	0.115	804	0.172	0.373
2350730	New super T8 troffer/wrap	355	0.047	0.115	176	0.038	0.082
2350731	Occupancy sensors	49	0.006	0.016	263	0.047	0.101
2350732	New super T8 troffer/wrap	658	0.117	0.216	338	0.047	0.101
2350733	New super T8 troffer/wrap	79	0.026	0.048	46	0.006	0.014
2350734	New super T8 troffer/wrap	849	0.187	0.344	219	0.039	0.072
2350735	New super T8 troffer/wrap	2553	0.443	0.818	79	0.026	0.048
2350736	New super T8 troffer/wrap	1231	0.280	0.517	849	0.187	0.344
2350737	New super T8 troffer/wrap	235	0.054	0.099	2,284	0.397	0.732
2350739	New super T8 troffer/wrap	891	0.132	0.326	163	0.037	0.068
2350740	New super T8 troffer/wrap	1919	0.391	0.967	372	0.060	0.003
Total		23,588	4.257	9.197	22,361	4.127	8.309

The table below shows other verified resource savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	Resource Type	Resource Units	EVT Claimed Resource Change	DPS Verified Resource Change
2350707	New super T8 troffer/wrap	Heating oil	MMBtu	-0.130	-0.264
2350708	New super T8 troffer/wrap	Heating oil	MMBtu	-0.310	-0.285
2350709	New super T8 troffer/wrap	Heating oil	MMBtu	-0.310	-0.285
2350710	New super T8 troffer/wrap	Heating oil	MMBtu	-0.270	-0.252
2350711	New super T8 troffer/wrap	Heating oil	MMBtu	-0.310	-0.285
2350712	New super T8 troffer/wrap	Heating oil	MMBtu	-0.030	-0.031
2350713	New super T8 troffer/wrap	Heating oil	MMBtu	-0.130	-0.120
2350715	New super T8 troffer/wrap	Heating oil	MMBtu	-1.780	-1.651
2350717	New super T8 troffer/wrap	Heating oil	MMBtu	-1.150	-1.062
2350718	New super T8 troffer/wrap	Heating oil	MMBtu	-1.070	-0.989
2350720	New super T8 troffer/wrap	Heating oil	MMBtu	-1.150	-1.062
2350721	New super T8 troffer/wrap	Heating oil	MMBtu	-0.190	-0.173
2350722	New super T8 troffer/wrap	Heating oil	MMBtu	-0.070	-0.061
2350723	New super T8 troffer/wrap	Heating oil	MMBtu	-1.460	-1.354
2350724	New super T8 troffer/wrap	Heating oil	MMBtu	-1.950	-1.806
2350725	New super T8 troffer/wrap	Heating oil	MMBtu	-0.020	-0.023
2350726	New super T8 troffer/wrap	Heating oil	MMBtu	-0.090	-0.038
2350727	New super T8 troffer/wrap	Heating oil	MMBtu	-1.910	-1.686
2350728	New super T8 troffer/wrap	Heating oil	MMBtu	-1.270	-1.062
2350729	New super T8 troffer/wrap	Heating oil	MMBtu	-0.310	-0.285
2350730	New super T8 troffer/wrap	Heating oil	MMBtu	-0.400	-0.366
2350731	Occupancy sensors	Heating oil	MMBtu	-0.050	-0.050
2350732	New super T8 troffer/wrap	Heating oil	MMBtu	-0.820	-0.252
2350733	New super T8 troffer/wrap	Heating oil	MMBtu	-0.100	-0.091
2350734	New super T8 troffer/wrap	Heating oil	MMBtu	-1.050	-0.976
2350735	New super T8 troffer/wrap	Heating oil	MMBtu	-3.170	-2.628
2350736	New super T8 troffer/wrap	Heating oil	MMBtu	-1.530	-1.415
2350737	New super T8 troffer/wrap	Heating oil	MMBtu	-0.290	-0.187
2350739	New super T8 troffer/wrap	Heating oil	MMBtu	-0.990	-1.091
2350740	New super T8 troffer/wrap	Heating oil	MMBtu	-2.140	-2.005

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   Rutland City Schools – High School / Stafford Tech – Lighting Plus is the second phase of a large project. Phase 2 includes lighting measures and one lighting control. The lighting retrofit project was mostly of HPT8 and outdoor wallpack fixtures.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   No, EVT did not meter this project.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

This project is correctly characterized as retrofit.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

   The baseline kW for each measure was taken from the EVT analysis tool for the efficient technology. These values have been reviewed and are consistent with industry standards.

   The Lighting Plus Audit Equipment List dated 9/16/2010 and the Eplus Data Collection/Installation Form as provided in 6021 I342.pdf had variant fixture types and quantities for various measures as detailed in the table below.

Measure ID	Description of EVT Baseline	EVT Baseline kW	Description of DPS Baseline	DPS Baseline kW	Reason for DPS Change
2350707 2350710 2350713 2350721 2350722 2350725 2350726 2350732 2350733 2350737 2350739	T8 2L-F32 w/Elec – 4' (qty 42; watts:60)	2.520	T8 2L-F32 w/Elec – 4' (qty 36; watts:60)	2.160	2350732 qty installed 3 not 9 as listed in CAT – Lighting Plus Audit Equipment List dated 9/16/2010
2350708 2350709 2350711 2350715 2350717 2350718 2350720 2350723 2350724 2350727 2350728 2350729 2350730 2350734 2350735 2350736 2350740	T8 4L-F32 w/Elec – 4' (qty 154; watts: 110)	16.940	T8 4L-F32 w/Elec – 4' (qty 151; watts: 110)	16.610	2350727 qty 14 not 15 as listed in CAT; 2350735 qty 17 not 19 as listed in CAT – Lighting Plus Audit Equipment List dated 9/16/2010
2350712	T12 2L – F40ER (34W) w/EE Mag (qty 1; watts: 68)	0.068	Same	0.068	No change
2350714 2350738	MH 50W (qty 3; watts: 65)	0.195	Same	0.195	No change
2350716	LED outdoor pole/arm area or Roadway Fixture (qty: 30; watts: 295)	8.850	LED outdoor pole/arm area or Roadway Fixture (qty: 31; watts: 295)	9.145	Qty installed 31 not 30 as listed in CAT – Lighting Plus Audit Equipment List dated 9/16/2010
2350719	MH 400W Normal Start (qty: 2; watts: 455)	0.910	Same	0.910	No change

2350731	HPT8 4' wrap – 2L (qty: 2: watts: 42)	0.084	Same	0.084	No change

Lighting Efficiency

$$kW_{base} = qty_{base} \times Watt_{base} / 1000$$

Occupancy Sensors

The baselines for these measures are the Light Fixtures without Occupancy Sensors

$$kW_{connected} = qty_{connected} \times Watt_{connected} / 1000$$

5. Define the efficiency upgrade.

The efficient kW for each measure was taken from the EVT analysis tool for the efficient technology. These values have been reviewed and are consistent with industry standards.

The Lighting Plus Audit Equipment List dated 9/16/2010 and the Eplus Data Collection/Installation Form as provided in 6021 I342.pdf had variant fixture types and quantities for various measures as detailed in the table below.

Measure ID	Description of EVT Efficient Upgrade	EVT Efficient kW	Description of DPS Efficient Upgrade	DPS Efficient kW	Reason for DPS Change
2350707	HPT8 4' wrap – 2L (qty: 4: watts: 42)	0.168	HPT8 4' wrap – 1L (qty: 4; watts 22)	0.088	Lighting Plus Audit Equipment List dated 9/16/2010
2350708 2350709 2350711 2350712 2350713 2350715 2350717 2350718 2350720 2350723 2350724 2350729 2350730 2350734 2350735 2350736	HPT8 4' wrap – 2L (qty: 115: watts: 42)	4.830	HPT8 4' wrap – 2L (qty: 113: watts: 42)	4.788	2350735 qty 17 not 19 as listed in CAT – Lighting Plus Audit Equipment List dated 9/16/2010
2350710 2350721 2350722 2350725 2350732 2350733	HPT8 4' wrap – 1 L (qty: 18, watts: 22)	0.396	HPT8 4' wrap – 1 L (qty: 12, watts: 22)	0.264	2350732 qty installed 3 not 9 as listed in CAT – Lighting Plus Audit Equipment List dated 9/16/2010
2350714	LED outdoor Wall-Mount	0.067	Same	0.067	No change

2350738	area Fixture (wallpack) (qty: 3; watts: 22.4)				
2350716	LED outdoor pole/arm area or Roadway Fixture (qty: 30; watts: 77.4)	2.323	LED outdoor pole/arm area or Roadway Fixture (qty: 31; watts: 77.4)	2.400	qty installed 31 not 30 as listed in CAT – Lighting Plus Audit Equipment List dated 9/16/2010
2350719	LED outdoor wall-mount area Fixture (wallpack) (qty: 2; watts:139)	0.278	Same	0.278	No change
2350726	HPT8 4' wrap – 1L (qty: 1; watts 22)	0.022	HPT8 4' wrap – 2L (qty: 1: watts: 42)	0.042	Lighting Plus Audit Equipment List dated 9/16/2010
2350727 2350728	HPT8 4' wrap – 2L (qty: 25: watts: 42)	1.050	HPT8 4 wrap – 2L (qty: 22: watts: 42) HPT8 4' wrap – 1L (qty: 6; watts 22)	1.056	Lighting Plus Audit Equipment List dated 9/16/2010
2350737 2350739	HPT8 4' wrap – 2L (qty: 10: watts: 42)	0.420	HPT8 4' wrap – 1L (qty: 18; watts 22)	0.396	Lighting Plus Audit Equipment List dated 9/16/2010
2350740	HPT8 4' wrap – 2L (qty: 20: watts: 42)	0.840	HPT8 4' wrap – 2L (qty: 17: watts: 42) HPT8 4' wrap – 1L (qty: 5; watts 22)	0.824	Lighting Plus Audit Equipment List dated 9/16/2010

Lighting Efficiency

$$kW_{eff} = qty_{eff} \times Watt_{eff} / 1000$$

Occupancy Sensors

The efficient case is zero demand with percent reduction used to allocate savings

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

Lighting Efficiency

$$kW\ Savings = (kW_{base} – kW_{eff}) \times Coincident\ Factor \times ISR \times WHF_d$$

$$kWh\ Savings = (kW_{base} – kW_{eff}) \times Hours \times WHF_e$$

Occupancy Sensors

$$kW\ Savings = kW_{connected} \times Percent\ Reduction \times Coincident\ Factor \times ISR \times WHF_d$$

$$kWh\ Savings = kW_{savings} \times Hours \times WHF_e$$

The percent reduction used for the occupancy sensors was 22.2%

Coincidence Factors for all lighting measures were set at CF_{win} 34.3% and CF_{sum} 63.3%

$WHF_{d\ summer}$ = 117.5%[1] for areas with mechanical cooling, was originally set at 134%

$WHF_{e\ summer}$ = 106.2%[2] for areas with mechanical cooling, was originally set at 112%

$$\text{MMBtu penalty} = \text{kWh Savings} * \text{MMBtu}_{WH} / \text{WHF}_e$$

7. Check if there are issues with any of the following:

____ Free ridership

____Spillover

____ Act 250 status

____ Hours of use/uptime

____ Commissioning adjustment

__x_ Cooling bonus/heating penalty

____ Load profile

_x__ MMBtu savings

____ Water savings

____ O&M savings

Briefly explain the issue(s).

The cooling bonus/heating penalty changes are incorporated by the updated waste heat factors for demand and energy for areas with mechanical cooling. The MMBtu savings factor was updated by the adjustment of the average heating system efficiency from .75 to .81.

Preparation for Forward Capacity Market (FCM) Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   We recommend Option A: Partially Measured Retrofit Isolation/Stipulated Measurement.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- RHS_Phase2_6021_I342_CAT10a.xls
- 6021_I342.pdf
- RutlandHigh S389641GDSAnalV1.xlsx

[1] Retrofit demand (kW) (kW factor x % of lighting kW savings)from Cooling Bonus Calculation revised Feb 1, 2011

[2] Retrofit demand (kWh) (kWh factor x % of lighting kWh savings)from Cooling Bonus Calculation revised Feb 1, 2011

Attachments

Metering Plan, sampling worksheet, supplemental work papers, and files.

Review Engineer: Lexicon Energy Consulting
Date submitted to West Hill Energy: 7-26-11; 9-8-11; 9-12-11
Date finalized by West Hill Energy:

EVT Project ID Number: 375023
Project Name: Sugarbush – Snow Gun Replacement
Sample Group (Size): 5
Type of Project (NC/MOP, Retrofit): Retrofit

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	**Description**	**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**
2321535	Efficient snowmaking tower guns	109340	21.868	0.000	100,597	18.227	0
2321536	Efficient snowmaking ground guns	607200	121.440	0.000	404,784	73.341	0
Total:		716540	143.308	0.000	**505,382**	91.567	0

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   The first measure of this project installed twenty HKD guns on the Spring Fling trail on Lincoln Peak. This trail is used for racing and the HKDs will provide approximately half of the snow for the trail with existing ground guns providing the other half of the snow.

   The second measure provided eighty portable Ratnik Baby Snow Giants.

   The pre-retrofit guns are all ASC for both measures.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   No, EVT did not meter this project.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   The project's characterization as a retrofit is plausible

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

Measure ID	Description of EVT Baseline	EVT Baseline kW	Description of DPS Baseline	DPS Baseline kW	Reason for DPS Change
2321535	ASC gun	31.459	Same	26.220	Expected water use has been adjusted to 1.5x the mountain average. Since the baseline gun represents >75% of the total arsenal, and the proposed gun produces 1.5x the baseline gun, gun-hrs/yr should be approximately 1.5x the mountain average.
2321536	ASC gun	268.734	Same	162.302	Expected water use has been adjusted such that the weighted average gun-hrs/yr agrees with the mountain average. The proposed guns are allowed to consume 15% more per gun to account for their (10%) greater productivity and the expectation that the new guns will be used preferentially.

5. Define the efficiency upgrade.

Measure ID	Description of EVT Efficient Upgrade	EVT Efficient kW	Description of DPS Efficient Upgrade	DPS Efficient kW	Reason for DPS Change
2321535	HKD SV10	9.590	Same	7.993	Same as above
2321536	Ratnik Baby Snow Giant – new	147.299	Same	88.961	Same as above

Preparation for Forward Capacity Market (FCM) Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   Option C is the most viable option since these projects do not use electricity directly.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- SugarSnowmakingCalc-DPS.xls

Attachments

Metering Plan, sampling worksheet, supplemental work papers, and files.

Review Engineer: Emily Cross, CxAssociates
Date submitted to West Hill Energy: 7/27/2011
Date finalized by West Hill Energy: 9/1/11

EVT Project ID Number: 386602
Project Name: Tomlinson's Store - Rx Refrigeration 3
Sample Group (Size): 2
Type of Project (NC/MOP, Retrofit): NC/MOP

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
1945809	Refrigerator economizer	4155	1.387	0.000	3347	1.117	0.000
1945810	Refrigerator economizer	3916	1.307	0.000	3269	1.091	0.000
1945811	Refrigeration fan motor controls	5905	0.309	0.290	1851	0.097	0.091
1945812	Refrigeration door heater controls	13090	1.494	0.000	13090	1.494	0.000
1945813	Efficient blower fan	9429	1.076	1.076	4920	0.562	0.562
Total		36495	5.574	1.366	26477	4.361	0.653

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   This prescriptive project retrofitted an existing medium temperature reach in refrigeration cooler with the following measures:

   - More-efficient evaporator fan motors (ECM replaced PSC)
   - Mixing fans for reduction of evaporator fan usage when compressor is off
   - Air side economizer controls (medium temperature cooler)
   - Humidity-based door frame heater controls

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   EVT did not meter this project.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   It is not clear whether this project was correctly characterized. The 6013PRES program track was used because the measures were claimed on a prescriptive form. However, a CAT was submitted with one measure (the evaporator fan motors) calculated as a retrofit and the rest of the measures calculated as MOP because the project went through as predominantly prescriptive.

While this was a prescriptive project, EVT prepared a custom analysis for some of the measures. Based on the verification review, this shifted the project from prescriptive to custom.

The project has two types of measures: efficient motors and controls. The efficiency measure is calculated as retrofit, and the controls are calculated as MOP, irrespective of the efficiency upgrade known to have occurred as part of the project. Regardless of project classification, prescriptive or retrofit, controls should always be applied to the efficient equipment where both occur in same project. The measures are clearly part of the same system and are interactive. Project-specific information is known and indicates that the use of the Technical Resource Manual (TRM) blended baseline kW in the CAT custom analysis inaccurately represents the equipment and the savings.

The evaluation team determined that the measures should be adjusted to reflect the pre-existing technology (PSC=0.088 kW) in lieu of the TRM/CAT shaded pole baseline (SP=0.132 kW) for the evaporator fan motors. Additionally, the efficient evaporator fan (ECM=0.040 kW) should be used, rather than using the blended MOP baseline evaporator fan (0.123 kW) for controls measures where the evaporator fans are involved.

See also the additional discussion section below.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

Measure ID	**Description of EVT Baseline**	**EVT Baseline kW**	**Description of DPS Baseline**	**DPS Baseline kW**	**Reason for DPS Change**
1945809	No outdoor air economizer	1.530 0.123 per evaporator fan motor	No outdoor air economizer	1.260 0.04 per evaporator fan motor	Note 1
1945810	No outdoor air economizer	1.450 0.123 per evaporator fan motor	No outdoor air economizer	1.234 0.04 per evaporator fan motor	Note 1
1945811	Evaporator fans always on for circulation	1.439 0.123 per evaporator fan motor	Evaporator fans always on for circulation	0.468 0.04 per evaporator fan motor	Note N/A 1
1945812	Door heater always on	Not available*	Door heater always on	Same	
1945813	Shaded pole evaporator fan motors	1.544 0.132 per evaporator fan motor	PSC evaporator fan motors	1.030 0.088 per evaporator fan motor	PSC motors were used in the DPS analysis instead of the SP motors used by EVT

Note 1: Efficient ECM evaporator motors were used in the DPS analysis instead of the blended motor used by EVT. All other DPS inputs were the same at EVT inputs.
* not available as a separate value due to EVT savings calculation methodology.

5. Define the efficiency upgrade.

The efficiency upgrade is efficient motors and controls for an existing walk in cooler, as follows:

Measure ID	Description of EVT Efficient Upgrade	EVT Efficient kW	Description of DPS Efficient Upgrade	DPS Efficient kW	Reason for DPS Change
1945809	Refr. economizer WITH fan control - Hermetic/semi-hermetic compressor (2.75 hp) (5 fans/unit) Free cooling using cold outdoor air is used 2996 hours per year for the refrigerated coolers (38F setpoint) in lieu of running the compressors.	0.143	Refr. economizer WITH fan control - Hermetic/semi-hermetic compressor (2.75 hp) (5 fans/unit) Free cooling using cold outdoor air is used 2996 hours per year for the refrigerated coolers (38F setpoint) in lieu of running the compressors.	Same	N/A
1945810	Refr. economizer WITH fan control - Hermetic/semi-hermetic compressor (2.75 hp) (4 fans/unit) Free cooling using cold outdoor air is used 2996 hours per year for the refrigerated coolers (38F setpoint) in lieu of running the compressors.	0.143	Refr. economizer WITH fan control - Hermetic/semi-hermetic compressor (2.75 hp) (4 fans/unit) Free cooling using cold outdoor air is used 2996 hours per year for the refrigerated coolers (38F setpoint) in lieu of running the compressors.	Same	N/A
1945811	Evaporator fan motor controls - medium temp (25°-40° case temp) (9 fans/unit) Evaporator fans are turned off when the compressors are not running, and a lower wattage 0.035 kW mixing fan is turned on instead to prevent stratification.	0.742	Evaporator fan motor controls - medium temp (25°-40° case temp) (9 fans/unit) Evaporator fans are turned off when the compressors are not running, and a lower wattage 0.035 kW mixing fan is turned on instead to prevent stratification.	0.257	The TRM kW for the efficient ECM evaporator motors installed under this project were used in the DPS analysis to more accurately capture interactive effects instead of the blended motor kW used by EVT. All other DPS inputs were the same at EVT inputs.
1945812	Humidity-based refr. door heater controls - medium temp (25°-40° case temp) (17 doors/unit)	N/A*	Humidity-based refr. door heater controls - medium temp (25°-40° case temp) (17 doors/unit)	same	N/A
1945813	Brushless DC walk-in evap fan motor - medium temp (25°-40° case temp) - retrofit - PSC baseline (1 fans/unit)	0.468	Brushless DC walk-in evap fan motor - medium temp (25°-40° case temp) - retrofit - PSC baseline (1 fans/unit)	same	N/A

* Not available as a separate value due to EVT savings calculation methodology.

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

   Efficient Evaporator Fan Motors (1945813)

   The demand savings was calculated as the difference between the total baseline and efficient electrical loads for the nine evaporator fans, multiplied by the TRM cooling bonus of 1.3 for refrigerated coolers, which accounts for the reduction in compressor use as a result of the reduced measure wattage. The TRM applicable hours for this measure are 8760.

   The DPS kWh and kW adjustments were calculated according to the TRM methodology, substituting PSC (0.088 kW) instead of SP (0.132 kW) baseline kW based on the information in the prescriptive rebate form. The value in the CAT (0.132 kW) used by EVT at the time of the project does match the TRM; however, EVT stated that this is known to be out of date for projects with PSC motors and has since been corrected in the CAT when the existing equipment type is known to be PSC as for this project.

   Economizer Measures (1945809, 1945810) and Evaporator Fan Controls (1945811)

   The TRM kWh savings calculation for refrigeration economizer measures is based on a baseline compressor duty of 50%. In the baseline, the evaporator fans are on with the compressor (50% of the time), and the mixing fans are on in lieu of the evaporator fans when the compressor is off (the other 50% of the time). The efficient case is free cooling when the outdoor air is cold enough (63% of the time per the TRM), with an assumed avoided compressor kWh based on compressor type, and an assumed economizer fan kW necessary to bring in the outdoor air. The demand savings is calculated from the kWh savings per the TRM.

   Savings for the controls measures were calculated by the DPS according to the TRM with exceptions as follows:

   For the controls measures that involve the evaporator fans (1945809, 1945810, 1945811), the DPS used the ECM evaporator fan motor load (0.040 kW) as a project-specific baseline since that baseline was established in the project documentation. The 0.040 kW baseline was used in lieu of the blended evaporator fan in the TRM (0.123 kW), which is typically used as a MOP baseline. EVT prepared a custom analysis for this project to maximize savings therefore the measures were adjusted for consistency across all measures in the project resulting in the lower baseline kW being used in the DPS analysis.

   Further, for the evaporator fan controls measure (1945811), the kWh savings calculated by the CAT does not match the TRM, and the CAT refrigeration formula appears to be incorrect in this case (walk-in cooler evaporator fan controls with compressor duty cycle of 0.5). The CAT equation appears to neglect the compressor duty cycle of 0.5; however, the equation applies to all 8760 annual hours. The resulting savings calculated by the CAT is slightly underclaimed by EVT because the mixing fan load is effectively double counted (0.070 kW instead of 0.035 kW) due to the apparent error in the formula. However, for this project, since a different (lower) evaporator fan motor kW was used in the DPS analysis, there is an overall reduction in savings for this measure as shown in Table 1.

7. Check if there are issues with any of the following:

   _X_ Free ridership

   ____Spillover

   ____ Act 250 status

   ____ Hours of use/uptime

   ____ Commissioning adjustment

   ____ Cooling bonus/heating penalty

   ____ Load profile

   ____ MMBtu savings

   ____ Water savings

   ____ O&M savings

   Briefly explain the issue(s).

   The retrofit measure (evaporator fan motors, measure 1945813) was claimed with a free ridership of 1.00. It is unlikely that there is no free ridership for this measure and the TRM should be updated with a more reasonable assumption.

Preparation for FCM Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   Option B: metering.

2. If critical documentation is missing, list additional information needed to verify savings to FCM standards.

   Outstanding information including the items in the list below will be addressed via metering, site inspection, and customer interview during FCM 2010.

   - Project-specific power use of all fans and compressors
   - compressor nameplate type, capacity and location
   - confirmation of equipment installation and operation

Documentation

List all supplemental work papers and files used in the calculation of savings.

- DPS TRM refrigeration calculations v2 Tomlinson6013H438.xlsm
- TRM User Manual_SV 2010.doc

Additional Notes/Discussion

Regarding the project classification as prescriptive, if a blend of PSC/SP is always assumed for a prescriptive/MOP, then the prescriptive rebate form appears nominally inconsistent with the program, since it asks whether the replaced motor is SP or PSC. Whenever EVT has site-specific information it should be used in the savings calculation.

Review Engineer: GDS Associates, Inc.
Date submitted to West Hill Energy: July 18, 2011
Date finalized by West Hill Energy: 8/29/11

EVT Project ID Number: 376173
Project Name: Velan Valve - Compressed Air
Sample Group (Size): 5
Type of Project (NC/MOP, Retrofit): NC/MOP

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
2290350	Compressed air, compressor	279157	49.524	49.524	279157	63.11	55.71
2290351	CMPDRAIN	52067	9.237	9.237	52067	10.2	10.84
Total:		331224	58.761	58.761	331224	73.31	66.55

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   Velan is a manufacturer of large industrial valves. Their electricity consumption is largely lighting and motors on the production floor and compressed air. Conservation measures for this project focus on the compressed air system.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   Velan Valve is running two existing 75 hp air compressors. These compressors were metered to obtain an accurate account of air load, electrical load, and hours of operation.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   This project is correctly classified as a NC/MOP.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

Measure ID	Description of EVT Baseline	EVT Baseline kW	Description of DPS Baseline	DPS Baseline kW	Reason for DPS Change
2290350	Standard efficiency air compressor	100.39	Standard efficiency air compressor	114.28	Different Method used to calculate kW
2290351	Standard condensation drains	50.87	Standard condensation drains	54.87	Different Method used to calculate kW

5. Define the efficiency upgrade.

Measure ID	Description of EVT Efficient Upgrade	EVT Efficient kW	Description of DPS Efficient Upgrade	DPS Efficient kW	Reason for DPS Change
2290350	High efficiency air compressor	50.87	High efficiency air compressor	54.87	Different Method used to calculate kW
2290351	Compressed Air System – No Loss Drains	41.63	Compressed Air System – No Loss Drains	44.35	Different Method used to calculate kW

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

The baseline energy consumption for the existing compressors was calculated using EVT's Excel-based, proprietary analysis tool. The specific equations used for quantifying baseline energy consumption are listed below and are derived from this analysis tool.

Calculations

EQ1: Full-Load KW

(compressor motor BHP x 0.746) ÷ compressor motor efficiency

(fan motor BHP x 0.746) ÷ compressor motor efficiency

Using measured air-load values and referencing a prescriptive DOE chart for estimating input power percentage at varying capacities, EVT was able to determine the kW load by multiplying the compressor motor full-load kW by the power reduction factor then adding the fan motor full-load kW without a reduction factor. The equation for this measure is listed below.

Calculations

EQ2: kW Load

(compressor motor full-load kW x percent of full-load kW) + fan motor full-load kW

Multiplying the estimated kW by the metered weekly hours associated with each level of demand yields a total estimated kWh per week at various levels of metered air demand. This is then multiplied by a 51-week year to account for an estimation of annual kWh for the existing system. This equation used for calculating baseline annual energy consumption is accurate and used proper methodology.

For calculating the number of hours at different levels of air demand EVT divided three weeks of run hours at each level by the total number of hours metered over a three-week period. They then multiplied this ratio by the average number of work hours in a day (21) to establish number of daily run hours. They then multiplied daily run hours by a 5-day work week to establish weekly run hours. An easier way to obtain weekly run hours would have been to simply divide 3 weeks of metered run hours at each air demand level by 3.

This produces very similar results. The results for this method of calculating weekly run hours are presented in Table 1 under DPS Verified.

The same methodology as described above was also used for estimating energy consumption of the proposed system. The difference between the existing and proposed system is the proposed system has greater capacity which eliminates the need for two compressors as one large unit will exceed process demand. The proposed compressor also has a higher-efficiency motor and VAV controls, which result in a reduced electrical load.

The proposed compressor does have a CAGI sheet. It was confirmed that the equipment data listed in the proposed compressor CAGI sheet matches the data that was entered into EVT's analysis tool.

To estimate savings associated with the installation of no-loss drains, EVT first estimated the baseline average air loss through condensate drain from the US DOE Compressed Air Tip Sheet #3. This air-loss rate was multiplied by a 50% reduction factor to account for the percent of time that only air is escaping rather than the condensate the drain is meant to release. EVT subtracted the average air loss through the drain from the metered air-load data. The resulting air load served as the basis for estimating the proposed kW load for this measure. Savings associated with installing no-loss drains were derived from applying this conservation measure to the installed air compressor, not the baseline.

In summary, the baseline was reasonable and correct. Assumptions for calculations were site-specific. Better documentation of methods used for calculating weekly run hours would have been helpful. EVT estimated kW winter and summer peak by dividing annual kWh by annual run hours, then multiplying by a 0.95 coincidence factor. DPS used actual meter data and the data sheet of the newly installed compressor to estimate winter and summer peak kW. Details of the method used by DPS can be found in the analysis file.

Preparation for Forward Capacity Market (FCM) Verification

Which ISO option is recommended for FCM verification? (Options A through D)

We recommend Option B: Retrofit Isolation/Metered Equipment.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- Compressed Air System Analysis Tool version 3
- TRM User Manual No. 2009-60
- Compressor Data sheet for new equipment
- Meter Date Excel file name - D490A-DataPro2-AirFlow-01-corrected
- Meter Date Excel file name - E7411-01-Dent7-Comp1
- Meter Date Excel file name - E5541-01-Dent8-Comp2
- VelanValve376173GDSAnalV1

Review Engineer: Sharon Jones, Lexicon Energy Consulting
Date submitted to West Hill Energy: July 19, 2011
Date finalized by West Hill Energy: September 6, 2011

EVT Project ID Number: 383274
Project Name: Vermont Butter & Cheese - Refrigeration
Sample Group (Size): 5
Type of Project (NC/MOP, Retrofit): Retrofit

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
2289763	Lighting system, interior power density reduction	2,041	0.634	1.338	2,041	0.634	1.338
2289764	Motor, TEFC 2 hp	77	0.073	0.073	77	-	0.073
2289766	Custom refrigeration	41,874	0.000	10.773	41,874	-	10.773
2289768	Refrigeration compressor	98,690	11.631	13.003	120,812	14.816	3.533
2289769	Refrigeration fan motor controls	15,907	1.667	1.562	15,907	1.667	1.562
2289770	Custom refrigeration	75,758	8.929	9.981	58,858	6.719	6.719
2289771	Variable frequency drive, industrial process	88,251	13.973	13.973	77,877	11.537	11.537
2289772	Variable frequency drive, non-process, non-HVAC	2,501	1.188	1.188	843	0.096	0.096
2289773	Refrigerator economizer	15,284	5.101	0.000	15,284	5.101	-
Total:		340,383	43.197	51.891	333,573	40.570	35.631

The table below shows other verified resource savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	Resource Type	Resource Units	EVT Claimed Resource Change	DPS Verified Resource Change
2289766	Custom refrigeration	Propane	MMBtu	111.000	111.000

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   This project installed a new walk-in cooler and refrigeration system. The new refrigeration system includes a 177-ton ammonia system with a screw compressor and a 39-ton reciprocating compressor.

   This project replaced “multiple small stand-alone units as well as four refrigerated trailers.

The project is categorized a retrofit. The calculations (in decreasing order of savings) are as follows:

- Measure ID 2289768 is for the small reciprocating compressor. Savings are based on comparing the ammonia system at low load to the reciprocating compressor assuming the small compressor is used >80% of the time.
- Measure ID 2289771 is for VFD on glycol pump assumes constant 85% load factor on throttled pump.
- Measure ID 2289770 is for a new walk-in cooler and it compares the pre-retrofit trailer usage to the predicted usage of the new walk-in during times of low load (storage only). EVT measured power to two trailers for 3 weeks, multiplies the average power draw by 1.2 to estimate year-round load even though the average temperature during the measurement period was 43°F while the year-round average temperature is 45°F. A bin model would be recommended, but the estimate of load for the proposed case is more problematic. No info is given on the pre-retrofit system. **suggest bin model or delete 1.2 factor**
- Measure ID 2289766 is for rapid-close doors.

The calculations claim no savings for the ammonia system, implicitly assuming the proposed ammonia system is equally efficient as the pre-retrofit system.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   EVT metered the power to two refrigerated trailers used to store finished product.

   EVT metered outside air temperature (OAT) and relative humidity coincident with the power measurements.

   EVT also measured “Ice Builder #2” – this seems to be a condensing unit

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   This project is categorized as retrofit, but the comment that customer is planning to increase production by 50% makes it sound like MOP might be more correct. For example, “do nothing” may not be a viable alternative.

   Only measure 2289770, CM1, compares the pre-retrofit equipment to the proposed equipment. Most of the savings calculations are based on incremental improvements to the proposed system.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

Measure ID	**Description of EVT Baseline**	**EVT Baseline kW**	**Description of DPS Baseline**	**DPS Baseline kW**	**Reason for DPS Change**
2289763	Lighting power density at 0.9 W/sq ft * 2183 sf. Seasonal peak demand is uses a CF of 49.6% for winter and 78.1% for summer per loadshape 10 "Warehouse indoor lighting" and cooling bonus of 1.12 (WHF) for energy and 1.34 for demand	1.965	Same	1.965	No change. We do note that the "old" cooling bonus is used here, but considering that these spaces are substantially refrigerated, a higher than usual cooling bonus is appropriate. N/A
2289764	2 hp TEFC EEM at 84.0% efficiency	2.664	Same	2.664	No change in annual savings or summer peak demand. Winter peak demand is removed since condenser fans are unlikely to have much use in the winter.
2289766	Manual door assumed open 3 hrs/day	3.842	Same	3.842	No change. These loads and savings seem ok assuming that the doors are to an interior, heated space (such as a production environment) - uses 1.08 kW/ton from high load on NH3 compressor
2289768	New rotary screw ammonia compressor	28.4	Same	36.5	See comments below.
2289769	Evaporator fans operate continuously	3.755	Same	3.755	No change.
2289770	New walk-in cooler; baseline = pre-retrofit	11.58	Same	9.65	See comments below.
2289771	Constant-speed glycol pump	16.94 kW	Same	15.07 kW	The VFD calculation assumes constant power. Typically, a c/s pump will draw less power at reduced flow. DPS assumes a 75% load factor for the c/s motor at 50% flow
2289772	VFD on condenser fan	0.682	Same	0.350	Reduced load as described in measure 2289768 reduces energy requirement of condenser fans
2289773	Refrigeration economizer	6.746	Same	6.746	No change

Measure 2289768 (Compressor)

The screw compressor has almost twice the needed capacity. Also, the load seems to be overstated. The documentation indicated 10 klb/day, but the calculation was based on 12 klb/day. EVT calculated 135 ton load; correcting the error and making two of the loads non-coincident yields 91 tons. Specs indicate a 177 ton unit was selected. The DPS recalculated assuming right-sized (90-ton) unit, and dividing all TR by 1.2 to correct from 12 to 10klb/day.

In addition , there seem to be an error in the calculation of energy for the baseline compressor in which the kW (figured by multiplying the TR by the kW/TR) is further multiplied by the ratio of load to minimum load.

Measure 2289770 (Walk-in Cooler): EVT measured kW of two pre-retrofit trailers and assumed annual usage would be 1.2*measured usage since the average outside air temperature (OAT) during measurement period was 43F. However, annual average OAT is 45°F; therefore a multiplier of 1.0 is appropriate.

5. Define the efficiency upgrade.

Measure ID	**Description of EVT Efficient Upgrade**	**EVT Efficient kW**	**Description of DPS Efficient Upgrade**	**DPS Efficient kW**	**Reason for DPS Change**
2289763	Lighting power density	0.686	Same	0.686	No change
2289764	Motor, TEFC 2 hp 86.5% efficiency	2.587	Same	2.587	No change
2289766	Automatic door on walk-in cooler, assumed open 0.29 hr/day (10.5 sec per event, 100 events/day)	0.243	Same	0.243	No change
2289768	Small Vilter reciprocating compressor for light loads (39 tons >80% of time) comparing over-sized ammonia system to recip operating on-off	17.1	Same	22.7	Calculation compares operating 100% of time on screw to operating 80% of time on recip – erroneously claiming savings for the 20% of time at the highest load condition
2289769	Evaporator fan motor controls	0.123	Same	0.123	No change
2289770	New walk-in cooler	2.927	Same	2.927	No change
2289771	VFD on glycol pump	3.500	Same	3.500	No change
2289772	VFD on condenser fan	0.397	Same	0.254	Reduced load as described in measure 2289768 reduces energy requirement of condenser fans
2289773	Refrigeration economizer	0.375	Same	0.375	No change

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.
7. Check if there are issues with any of the following:

____ Free ridership

____ Spillover

____ Act 250 Status

____ Hours of use/uptime

____ Commissioning adjustment

____ Cooling bonus/heating penalty

____ Load profile

____ MMBtu savings

____ Water savings

____ O&M savings

__X_ Other

Briefly explain the issue(s).

Life (analysis period) – most measures use the default measure lives of 10 to 15 years but CM1, the new walk-in cooler, uses a 20-year life. While 20 years may be reasonable for the new cooler, it would not seem to be reasonable for the pre-retrofit baseline of using refrigerated trailers. We propose a 5-year life as reasonable for continued use of refrigerated trailers.

Preparation for FCM Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   We recommend Option B: kW measurement of the refrigeration systems and the glycol pump.

   - Include evap fans and free cooling
   - Attempt to measure door openings
   - Lighting and condenser saving minimal and may reasonably be omitted from verification

2. If critical documentation is missing, list additional information needed to verify savings to FCM standards.

   - Need equipment specifications for pre-retrofit equipment
   - Need equipment specifications for reciprocating compressor

Documentation

List all supplemental work papers and files used in the calculation of savings.

- Final2 Walk-in analysisR2.xls
- Glycol VFD savings.xls

Attachments

Metering Plan, sampling worksheet, supplemental work papers, and files.

Review Engineer: Lexicon Energy Consulting
Date submitted to West Hill Energy: September 8, 2011
Date finalized by West Hill Energy: September 8, 2011

EVT Project ID Number: 230080
Project Name: Via Cheese - Wastewater Lagoon
Sample Group (Size): 5
Type of Project (NC/MOP, Retrofit): Retrofit

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	**Description**	**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**
1944290	Custom industrial process	550263	125.661	125.661	959,043	109.480	109.480
Total:		550263	125.661	125.661	959,043	109.480	109.480

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   The project involves the installation of a new Biolac fine bubble aeration system utilizing 3 existing 40-hp blowers, reducing or eliminating the operation of the existing 8 mechanical surface aerators.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   Yes; pre-retrofit metering was done; Dent meters were installed on each of the three blowers from 8-22-09 to 9-18-09. The 15-hp mechanical aerators (aka surface splashers) were not metered.

   The power input to three blowers was measured for 4 weeks. The three blowers showed nearly identical operation, drawing approximately 50amperes per leg. Although each of the three legs were metered, rather than summing the kW with the meter or in the spreadsheet, EVT multiplied the average amperage and voltage by sqrt(3) and “chan 5 pf” to calculate total power.

   Power = Voltage * Amperage * sqrt(3) * PF

   This led to a different result than would have been calculated from the sum of the three measured channels. First, the calculation above is written for line voltage, e.g., a 480-volt system would show a 480V potential from line-to-line. However, from its magnitude of ~277, I infer that the voltage recorded in the file is line-to-neutral voltage. Further evidence that the calculation is incorrect comes from using the Voltage, amperes, and kW from EVT’s calculation to calculate power factor.

   Power factor = kW / kVA

Using EVT's averaged values of voltage and amperage and calculated kW, we calculate power factor of ~1.5 whereas power factor can never be greater than 1.0.

For Blowers 2 and 3 there are additional issues as the Channel 5 power factor is listed as 30% rather than the 90% shown for Blower 1. It is nearly inconceivable that three identical blowers could have such different power factors with such similar amperage draw. We conclude that channel 5 was not set up properly for blowers 2 and 3.The DPS recalculated the power draw for each blower using a simple sum of the power recorded for channels 1, 2, and 3.

3. Is this project correctly characterized as MOP, NC or retrofit? If not or unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   Peer review states "exisitng[sic] deteriorated air distribution system" – which sounds like MOP despite assurances in the PO that "No changes need to be made and the entire effort from study to project implementation is being evaluated on an energy savings basis therefore project is classified as Retrofit 6012."

   The savings are calculated as a Retrofit project. It is unclear what exactly was deteriorated in the pre-retrofit air distribution system. The pre-retrofit system appeared to be fully operational at the time of pre-retrofit monitoring.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

Measure ID	Description of EVT Baseline	EVT Baseline kW	Description of DPS Baseline	DPS Baseline kW	Reason for DPS Change
1944290	Operate 3 blowers and 8 mechanical aerators	220.6	Same	168.9	See below.*

*Revised calculation using same data EVT under-estimated pre-retrofit power draw, calculated annual energy use then divided by 4,160 hr/yr (from a standard loadshape 84, industrial process) and multiplied by 95% CF to determine peak demand. DPS calculates the power draw during the peak demand period as equal to the average power draw since the data shows no discserablediscernible variation by time of day or day of week. Furthermore,8760 hrs/yr and 100% CF are used since this calculation is based on 24-hour/day metering.

5. Define the efficiency upgrade.

Measure ID	Description of EVT Efficient Upgrade	EVT Efficient kW	Description of DPS Efficient Upgrade	DPS Efficient kW	Reason for DPS Change
1944290	Install "Biolac" system. Operate blowers and mechanical aerators as needed. On 4-30-10 EVT observed 1 blower and 3 mechanical aerators in use post-retrofit.	95.0	Same	59.4	Revised calculations as discussed for baseline equipment as above.

6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

   The pre-retrofit metering data was used as described in item #2 above. Energy and demand savings were both based on around-the-clock operation. By contrast, EVT calculated demand savings based on annual savings assuming 4,160 hours of operation and 95% coincidence factor. Since this process operates around-the-clock and the calculation is based on average operation over 4 weeks, diversity is already included and 8760 hours is the appropriate divisor.

7. Check if there are issues with any of the following:

   ____ Free ridership (blank in CAT)

   ____Spillover (blank in CAT)

   ____ Act 250 status

   __X_ Hours of use/uptime

   ____ Commissioning adjustment used 100%, seems ok

   ____ Cooling bonus/heating penalty

   ____ Load profile (see hours of use discussion above; 95% CF seems reasonable)

   ____ MMBtu savings

   ____ Water savings

   ____ O&M savings

   Briefly explain the issue(s).

   The issue is discussed above.

Preparation for FCM Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   We recommend Option B.Whole building meter data may also be useful since this equipment represents most of the load on the utility meter.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- Blower Energy AnalysisR1.xls

Attachments

Metering Plan, sampling worksheet, supplemental work papers, and files.

Review Engineer: Al Bartsch, West Hill Energy and Computing, Inc.
Date submitted to West Hill Energy: September 1, 2011
Date finalized by West Hill Energy: September 1, 2011

EVT Project ID Number: 379778
Project Name: VSAC - Server Virtualization - Phase 1
Sample Group (Size): 2
Type of Project (NC/MOP, Retrofit): NC/MOP

The Efficiency Vermont (EVT) and Department of Public Service (DPS) verified savings are shown in the table below.

Measure ID	Description	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
1891589	Custom office equipment efficiency	41479	4.735	4.735	20,739	2.367	2.367
Total:		41479	4.735	4.735	20,739	2.367	2.367

M&V Approach

1. Brief summary of the project (one sentence to one paragraph).

   VSAC upgraded servers as scheduled and reduced the number of servers needed through the common practice of server virtualization.

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   No

3. Is this project correctly characterized as MOP, NC or retrofit? If not or unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   As the servers were upgraded by a pre-defined schedule, market opportunity is correct.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

Measure ID	Description of EVT Baseline	Description of DPS Baseline
1891589	Replacing the obsolete servers with an equal number of new servers	Replacing the old servers with the reduced number of servers needed due to the increased computing power of new servers and the now common practice of server virtualization

5. Define the efficiency upgrade.

Measure ID	Description of EVT Efficient Upgrade	Description of DPS Efficient Upgrade
1891589	New virtualized servers	The installation of virtualized servers is now common practice and should no longer be considered an efficiency upgrade.

6. Discussion

   Information technology evolves rapidly according to Moore's Law. Server virtualization is a mature technology that is a fraction of the cost of replacing servers on a one-for-one basis. Due to the increased computing power of newer servers there is no performance penalty associated with server virtualization. There are also reduced IT staff costs associated with virtualized servers. The EVT assumption of a base case that involves an initial cost that is almost two times greater, requires a higher amount of regular maintenance, and has no performance benefits defies basic business logic. Virtualized servers should be considered the base case when replacing older servers. See http://www.techrepublic.com/topics/virtualization?tag=hdr;hdr-topicnav for more information.

   For the purposes of savings verification EVT has demonstrated some involvement with the participants that justifies allowing 50% of the savings. The DPS recognizes that there are significant savings in data centers and would like to discuss a comprehensive approach to this market.

Preparation for Forward Capacity Market (FCM) Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   Not applicable – there are no FCM savings as server virtualization is standard practice.

Attachments

Metering Plan, sampling worksheet, supplemental work papers and files

Review Engineer: GDS Associates
Date submitted to West Hill Energy: June, 28, 2011
Date finalized by West Hill Energy: August 5, 2011

EVT Project ID Number: 230379
Project Name: VSB – BGS – Montpelier complex – Performance Contract
Sample Group (Size): 5
Type of Project (NC/MOP, Retrofit): Retrofit

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	**Description**	**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**
2354416	Comprehensive Building Commissioning	305,554	34.881	34.881	277,338	31.660	31.660
2354417	Custom air conditioning	20,318	0.343	16.409	20,318	0.343	16.409
2354418	Variable frequency drive motor control	94,939	11.711	10.851	94,939	11.711	10.851
2354419	Variable frequency drive motor control	187,220	23.094	21.398	187,220	23.094	21.398
Total		608,031	70.029	83.539	579,865	66.808	80.318

Measurement and Verification (M&V) Approach

1. Brief summary of the project (one sentence to one paragraph).

   This project covers the 2010 portion of a multiyear project. This portion of the project includes building commissioning, air conditioning and VFDs

2. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   No, EVT did not meter this project.

3. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   This project is correctly characterized as retrofit.

4. Define the baseline for each measure. (Use tables provided below if appropriate.)

   - Measure 2354416: The baseline for this measure is 7,926,721 kWh. This represents the preexisting conditions' annual usage for the building based on the Montpelier usage analysis spreadsheet for the period of 11/17/09 through 10/13/10.
   - Measure 2354417: The baseline for this measure is the cooling tower fan motors at 133 State Street without controls running.

     kW_{base} = hp *.746 * load factor / ef

     hp = 10 hp

load factor = .85

ef = efficiency of fan is .917

$kWh = \sum kW_{base}$ * Fan Run % * Hours for each bin temperature

- Fan Run % is based on constant speed runtime curve based on Bin Temp wet-bulb °F at 30% runtime >= 45 and 100% runtime >= 73.
- Hours = bin hours for Burlington
- Measures 2354418 and 2354419: The baseline for these measures is constant volume AHUs.
- Running 4am to 10pm 7 days/week based on the bin hours for Burlington.

5. Define the efficiency upgrade.
   - Measure 2354416: Efficient case for this measure is the weather normalized after retrofit annual usage for the building based on the Montpelier usage analysis spreadsheet for the period of 11/17/09 through 10/13/10 is 6,469,664 kWh.
   - Measure 2354417: Baseline for this measure is the cooling tower fan motors with VFDs installed.

     $kW_{eff} = kW_{lead} + kW_{lag}$ for the stages based on bin hours for Burlington.

     $kW_{lead} = kW_{base}$ * Lead Fan Speed % / (1- VFD losses)

     $kW_{lag} = kW_{base}$ * Lag Fan Speed % / (1- VFD losses)

   - Lead and Lag Fan Speed are based on the VFD proposed fan stage for the bin hours
   - VFD Losses are 3%
   - Measure 2354418 and 2354419: Efficient case for these measures are AHUs with VFDs with each space unoccupied 50% of the time and flow reduction of 20% for an overall air volume flow reduction of 10% running 4 a.m. to 10 p.m. 7 days/week based on the bin hours for Burlington.
6. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.
   - Measure 2354416: Annual savings for the entire Montpelier project was determined by the analysis for the 4 years of utility data from 2004 to 2007 for baseline of usage normalized for Weather Data and Heating Degree Days. The entire annual savings based on November 2009 through October 2010 of 1,457,057 was used for the 2009 and 2010 project savings. The reduction of 877,242 of the 2009 kWh claim was used to create a remainder kWh savings for 2010 of 579,815 kWh. The savings for the three other 2010 measures was subtracted to determine allocated savings for this measure of 305,554 kWh.

Below is the table from the Project Overview 2010 document.

1,457,057 kWh	**2009 and 2010 Usage Reported Savings**
877,242 kWh	**2009 kWh Claim**
579,815 kWh	**Remaining kWh for 2010***

	2010 Original	**2010 Actuals**	
		305,554 kWh	ECM2_EMS
		20,318 kWh	ECM_133StCoolingTower
		85,445 kWh	ECM9_109 Ad_111State AHU VFDs
		168,498 kWh	ECM10_109 State AHU VFDs
Totals kWh	911,450 kWh	579,815 kWh	63.6%

The claimed savings for verification show different totals than in the table in the project overview for two measures: 94,939 for ECM9_109 Ad_111State AHU VFDs (2354418) and 187,220 for ECM10_109 State AHU VFDs (2354419). Using the remainder of the remainder method to determine savings for this measure, the new savings would be adjusted by 28,216 kWh or a total of 277,338 kWh.

$\Delta kW = \Delta kWh * \text{Coincident Factor} / 8760 \text{ hours}$

Coincident Factor 100%, Winter and Summer

Measure 2354417

$\Delta kWh = kWh_{base} - kWh_{eff}$

$\Delta kW = \Delta kWh * \text{Coincident Factor} / 1000 \text{ hours}$

Coincident Factor 1.7% Winter, 80.8% Summer

Measure 2354418, 2354419

$\Delta kWh = kWh_{base} - kWh_{eff}$

$\Delta kW = \Delta kWh * \text{Coincident Factor} / 4856 \text{ hours}$

Coincident Factor 59.5% Winter, 55.5% Summer

Preparation for FCM Verification

Which ISO option is recommended for FCM verification? (Options A through D)

We recommend Option A: Partially Measured Retrofit Isolation/Stipulated Measurement and Option C: Whole Facility/Regression.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- Copy of VSBMontThroughoctober2010 (3).xls
- CAT10a_5_26660_2010.xls
- ECM-09 109 State St Addition & 111 State St VFDs.xls
- ECM-10B 109 State St Multizone AHU VFDs.xls
- VT 133 State St cooling Tower VFD Calc.xls

Attachments

Metering Plan, sampling worksheet, supplemental work papers, and files.

Review Engineer: GDS Associates
Date submitted to West Hill Energy:
Date finalized by West Hill Energy: 8/30/2011

EVT Project ID Number: 357272
Project Name: White Caps Industries – Williston – Gut Rehab
Sample Group (Size): 4
Type of Project (NC/MOP, Retrofit): NC/MOP

The table below shows the verified savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	Description	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
1943331	Lighting system, interior power density reduction	9085	1.822	3.409	10297	2.169	3.560
1943332	Lighting system, interior power density reduction	13601	2.797	5.234	17332	3.745	6.146
1943333	Lighting system, interior power density reduction	7625	1.568	2.935	9682	2.092	3.434
1943334	Occupancy sensors	1654	0.332	0.620	1574	0.332	0.544
1943335	Occupancy sensors	6374	1.311	2.453	6189	1.337	2.195
1943336	Occupancy sensors	3574	0.735	1.375	3401	0.735	1.206
1943337	Lighting system, interior power density reduction	5966	1.104	2.066	5677	1.104	1.812
1943338	Lighting system, interior power density reduction	-1938	-0.359	-0.671	-1844	(0.359)	(0.589)
1943339	Lighting system, interior power density reduction	44	0.027	0.051	42	0.027	0.045
1943340	Lighting system, interior power density reduction	2346	1.011	1.354	2232	1.011	1.187
1943341	Lighting system, interior power density reduction	409	0.141	0.189	389	0.141	0.166
1943342	Lighting system, interior power density reduction	0	0.000	0.000	0	0.000	0.000
1943343	Lighting system, interior power density reduction	6522	1.047	1.403	6207	1.047	1.230
1943344	Lighting system, interior power density reduction	2965	0.476	0.638	2821	0.476	0.559
1943345	Lighting system, interior power density reduction	2392	0.384	0.515	2276	0.384	0.451
1943346	Lighting system, interior power density reduction	2916	0.468	0.627	2775	0.468	0.550
1943347	Lighting system, interior power density reduction	1137	0.392	0.525	1082	0.392	0.460
1943348	Lighting system, interior power density reduction	248	0.040	0.053	236	0.040	0.047
1943349	Dimming controls and ballasts	87	0.038	0.050	83	0.038	0.044
1943350	Occupancy sensors	4333	0.696	0.932	4123	0.696	0.817

1943351	Occupancy sensors	321	0.052	0.069	306	0.052	0.061
1943352	Occupancy sensors	351	0.056	0.076	334	0.056	0.066
1943353	Occupancy sensors	209	0.072	0.096	199	0.072	0.085
1943354	Occupancy sensors	2166	0.348	0.466	2061	0.348	0.409
1943355	Lighting system, interior power density reduction	5966	1.104	2.066	5677	1.104	1.812
1943356	Lighting system, interior power density reduction	-1938	-0.359	-0.671	-1844	(0.359)	(0.589)
1943357	Lighting system, interior power density reduction	44	0.027	0.051	42	0.027	0.045
1943358	Occupancy sensors	1877	0.347	0.650	1786	0.347	0.570
1943359	Occupancy sensors	2007	0.372	0.695	1910	0.371	0.610
1943360	Occupancy sensors	154	0.095	0.177	146	0.095	0.155
1943361	AC, Cool Choice tier 2 0-65 KBtu/hr	394	0.008	0.387	394	0.008	0.387
1943362	AC, Cool Choice tier 2 0-65 KBtu/hr	492	0.007	0.344	492	0.007	0.344
1943363	AC, Cool Choice tier 2 0-65 KBtu/hr	321	0.004	0.171	321	0.004	0.171
1943364	AC, Cool Choice tier 2 0-65 KBtu/hr	394	0.008	0.387	394	0.008	0.387
1943365	AC, Cool Choice tier 2 0-65 KBtu/hr	394	0.006	0.275	394	0.006	0.275
1943366	AC, Cool Choice tier 2 0-65 KBtu/hr	492	0.007	0.344	492	0.007	0.344
1943367	AC, Cool Choice tier 2 0-65 KBtu/hr	394	0.008	0.387	394	0.008	0.387
1943368	AC, Cool Choice tier 2 0-65 KBtu/hr	394	0.008	0.387	394	0.008	0.387
1943370	AC, Cool Choice tier 2 0-65 KBtu/hr	492	0.007	0.344	492	0.007	0.344
1943371	AC, Cool Choice tier 2 0-65 KBtu/hr	321	0.004	0.171	321	0.004	0.171
1943373	AC, Cool Choice tier 2 0-65 KBtu/hr	394	0.008	0.387	394	0.008	.387
1943374	AC, Cool Choice tier 2 0-65 KBtu/hr	492	0.007	0.344	492	0.007	.344
1943376	HVAC economizer	2441	0.000	0.000	2441	0	0
Total:		87909	16.224	31.364	92604	18.07	31.02

The table below shows other verified resource savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

Measure ID	**Description**	**Resource Type**	**Resource Units**	**EVT Claimed Resource Change**	**DPS Verified Resource Change**
1943331	Lighting system, interior power density reduction	Natural gas	MMBtu	-10.110	-11.15
1943332	Lighting system, interior power density reduction	Natural gas	MMBtu	-15.140	-18.77
1943333	Lighting system, interior power density reduction	Natural gas	MMBtu	-8.490	-10.49
1943334	Occupancy sensors	Natural gas	MMBtu	-1.840	-1.70

1943335	Occupancy sensors	Natural gas	MMBtu	-7.100	-6.70
1943336	Occupancy sensors	Natural gas	MMBtu	-3.980	-3.68
1943337	Lighting system, interior power density reduction	Natural gas	MMBtu	-6.640	-6.15
1943338	Lighting system, interior power density reduction	Natural gas	MMBtu	2.160	2.00
1943339	Lighting system, interior power density reduction	Natural gas	MMBtu	-0.050	-0.05
1943340	Lighting system, interior power density reduction	Natural gas	MMBtu	-2.610	-2.42
1943341	Lighting system, interior power density reduction	Natural gas	MMBtu	-0.460	-0.42
1943343	Lighting system, interior power density reduction	Natural gas	MMBtu	-7.260	-6.72
1943344	Lighting system, interior power density reduction	Natural gas	MMBtu	-3.300	-3.06
1943345	Lighting system, interior power density reduction	Natural gas	MMBtu	-2.660	-2.47
1943346	Lighting system, interior power density reduction	Natural gas	MMBtu	-3.250	-3.01
1943347	Lighting system, interior power density reduction	Natural gas	MMBtu	-1.270	-1.17
1943348	Lighting system, interior power density reduction	Natural gas	MMBtu	-0.280	-0.26
1943349	Dimming controls and ballasts	Natural gas	MMBtu	-0.100	-0.09
1943350	Occupancy sensors	Natural gas	MMBtu	-4.820	-4.47
1943351	Occupancy sensors	Natural gas	MMBtu	-0.360	-0.33
1943352	Occupancy sensors	Natural gas	MMBtu	-0.390	-0.36
1943353	Occupancy sensors	Natural gas	MMBtu	-0.230	-0.22
1943354	Occupancy sensors	Natural gas	MMBtu	-2.410	-2.23
1943355	Lighting system, interior power density reduction	Natural gas	MMBtu	-6.640	-6.15
1943356	Lighting system, interior power density reduction	Natural gas	MMBtu	2.160	2.00
1943357	Lighting system, interior power density reduction	Natural gas	MMBtu	-0.050	-0.05
1943358	Occupancy sensors	Natural gas	MMBtu	-2.090	-1.93
1943359	Occupancy sensors	Natural gas	MMBtu	-2.230	-2.07
1943360	Occupancy sensors	Natural gas	MMBtu	-0.170	-0.16

Measurement and Verification (M&V) Approach

The table below shows other verified resource savings as determined by Efficiency Vermont (EVT) and the Department of Public Service (DPS).

> White Caps Industries is in the former Rossignol Ski headquarters. The building has been gutted and renovated. This project covers installed lighting power density reductions, lighting controls and energy efficient HVAC units. The building is multi-use with three large office areas, and a fitness center among other spaces.

1. Did EVT meter this project? If so, discuss any issues that arose with the metering.

   No metering data was provided.

2. Is this project correctly characterized as MOP, NC, or retrofit? If not or if unable to determine, please explain and identify any additional information needed to ascertain the correct project characterization.

   This project is correctly classified as a New Construction.

3. Define the baseline for each measure. (Use tables provided below if appropriate.)

   1943331-194333, 1943337-1943348, and 1943355-1943357: Space by Space Lighting Power Density. EVT appeared to use a blend of Building Area and Space by Space values for Lighting Power Density. DPS used only Space by Space values from the 2005 Vermont Guidelines for Energy Efficient Commercial Construction. Baseline kW was calculated from the following:

   $$kW_{BASE}=LPD_{BASE}*Area/1000$$

   1943334-1943336, 1943349-1943354, 1943358-1943360: The baseline for occupancy sensors is based on the watts controlled per unit. Baseline kW was calculated from the following:

   $$kW_{BASE}= Quantity*Per\ Unit\ Controlled\ Watts/1000$$

   1943361-1943374: The baseline kW are based on the baseline EER/SEER as defined in Vermont Guidelines for Energy Efficient Commercial Construction. Baseline kW was calculated from the following:

   $$kW_{BASE}=(System\ Size*12(1/EER_{BASELINE})*FLH)/1000$$

   where,

   System Size is tons, and 12 is the conversion to Btu/hr

   FLH = 800

   1943377: This is a prescriptive measure that only reports a baseline kW. Baseline kW was calculated from the following:

   $$kW_{BASE}=SF*System\ Size(1/EER_{EFFICIENT})/HOURS$$

   where,

   System Size is in tons

   SF= Based on modeling for Burlington is 4576

   Hours = 4438

Measure ID	Description of EVT Baseline	EVT Baseline kW	Description of DPS Baseline	DPS Baseline kW	Reason for DPS Change
1943331-1943333	LPD for office area 1.0 W/ sq ft	33.902	LPD for office area 1.1 W/Sq Ft	37.292	LPD for offices is 1.1 from Table 805.5.3.
1943334	Controlled watts per occupancy sensor and number of sensors.	3.087	Controlled watts per occupancy sensor and number of sensors.	3.087	No change.
1943335	Controlled watts per occupancy sensor and number of sensors.	12.453	Controlled watts per occupancy sensor and number of sensors.	12.453	No change.
1943336	Controlled watts per occupancy sensor and number of sensors.	6.842	Controlled watts per occupancy sensor and number of sensors.	6.842	No change.
1943337	LPD for atrium up to 3 floors of 0.06 W/ sq ft	4.212	LPD for atrium up to 3 floors of 0.06 W/ sq ft	4.212	No change.
1943338	LPD of corridor of 0.50 W/ sq ft	1.638	LPD of corridor of 0.50 W/ sq ft	1.638	No change.
1943339	LPD of restrooms of 0.90 W/sq ft	0.639	LPD of restrooms of 0.90 W/sq ft	0.639	No change.
1943340	LPD of Exercise Center of 0.90 W/sq ft	1.386	LPD of Exercise Center of 0.90 W/sq ft	1.386	No change.
1943341	LPD of corridor of 0.50 W/ sq ft	0.351	LPD of corridor of 0.50 W/ sq ft	0.351	No change.
1943342	LPD of electrical/mechanical Room of 1.50 W/ sq ft	0.098	LPD of Electrical/Mechanical Room of 1.50 W/ sq ft	0.098	No change.
1943343	LPD of Exercise Center of 0.90 W/sq ft	4.525	LPD of Exercise Center of 0.90 W/sq ft	4.525	No change.
1943344	LPD of Lounge/Recreation Area of 1.20 W/sq ft	0.648	LPD of Lounge/Recreation Area of 1.20 W/sq ft	0.648	No change.
1943345	LPD of bar/lounge leisure dining of 1.40 W/sq ft	0.728	LPD of bar/lounge leisure dining of 1.40 W/sq ft	0.728	No change.
1943346	LPD lobby of 1.30 W/sq ft	0.861	LPD lobby of 1.30 W/sq ft	0.861	No change.
1943347	LPD of Exercise Center of 0.90 W/sq ft	0.632	LPD of Exercise Center of 0.90 W/sq ft	0.632	No change.
1943348	LPD of dressing room/locker room of 0.60 W/sq ft	1.199	LPD of dressing room/locker room of 0.60 W/sq ft	1.199	No change.
1943349	Controlled watts per occupancy sensor and number of sensors.	0.375	Controlled watts per occupancy sensor and number of sensors.	0.375	No change.
1943350	Controlled watts per occupancy sensor and number of sensors.	3.478	Controlled watts per occupancy sensor and number of sensors.	3.478	No change.
1943351	Controlled watts per occupancy sensor and number of sensors.	0.172	Controlled watts per occupancy sensor and number of sensors.	0.172	No change.
1943352	Controlled watts per occupancy sensor and number of sensors.	0.188	Controlled watts per occupancy sensor and number of sensors.	0.188	No change.
1943353	Controlled watts per occupancy sensor and number of sensors.	0.240	Controlled watts per occupancy sensor and number of sensors.	0.240	No change.

1943354	Controlled watts per occupancy sensor and number of sensors.	1.159	Controlled watts per occupancy sensor and number of sensors.	1.159	No change.
1943355	LPD for Atrium up to 3 floors of 0.06 W/ sq ft	4.212	LPD for Atrium up to 3 floors of 0.06 W/ sq ft	4.212	No change.
1943356	LPD of Corridor of 0.50 W/ sq ft	1.638	LPD of Corridor of 0.50 W/ sq ft	1.638	No change.
1943357	LPD of Restrooms of 0.90 W/sq ft	0.639	LPD of Restrooms of 0.90 W/sq ft	0.639	No change.
1943358	Controlled watts per occupancy sensor and number of sensors.	2.156	Controlled watts per occupancy sensor and number of sensors.	2.156	No change.
1943359	Controlled watts per occupancy sensor and number of sensors.	2.306	Controlled watts per occupancy sensor and number of sensors.	2.306	No change.
1943360	Controlled watts per occupancy sensor and number of sensors.	0.588	Controlled watts per occupancy sensor and number of sensors.	0.588	No change.
1943361	Baseline EER of 13.	2.954	Baseline EER of 13.	2.954	No change.
1943362	Baseline EER of 13.	3.692	Baseline EER of 13.	3.692	No change.
1943363	Baseline EER of 13.	2.215	Baseline EER of 13.	2.215	No change.
1943364	Baseline EER of 13.	2.954	Baseline EER of 13.	2.954	No change.
1943365	Baseline EER of 13.	2.954	Baseline EER of 13.	2.954	No change.
1943366	Baseline EER of 13.	3.692	Baseline EER of 13.	3.692	No change.
1943367	Baseline EER of 13.	2.954	Baseline EER of 13.	2.954	No change.
1943368	Baseline EER of 13.	2.954	Baseline EER of 13.	2.954	No change.
1943370	Baseline EER of 13.	3.692	Baseline EER of 13.	3.692	No change.
1943371	Baseline EER of 13.	2.215	Baseline EER of 13.	2.215	No change.
1943373	Baseline EER of 13.	2.954	Baseline EER of 13.	2.954	No change.
1943374	Baseline EER of 13.	3.692	Baseline EER of 13.	3.692	No change.
1943376	Installed EER of 15.	0.344	Installed EER of 15.	0.344	No change.

4. Define the efficiency upgrade.

1943331-194333, 1943337-1943348, and 1943355-1943357: Reduce Lighting Power Density from Baseline. The efficient kW are calculated by:

$$kW_{EE}=\text{Installed Watts}/1000$$

1943334-1943336, 1943349-1943354, 1943358-1943360: Install Occupancy Sensors and dimming controls and ballasts in order to reduce operating hours of lighting fixtures.

$$kW_{EE}=kW_{CONNECTED}*SVG$$

where,

$kW_{CONNECTED}$ = Quantity*Per Unit Controlled Watts/1000

SVG= 10%-30%, depending on the space installed and usage

1943361-1943374: Install energy efficient air cooled single package AC units, and dual enthalpy economizers.

$$kW_{EE}=(\text{System Size}*12(1/EER_{EE})*FLH)/1000$$

where,

System Size is Tons, and 12 is the conversion to Btu/hr

FLH = 800

1943377: This is a prescriptive measure that only reports a baseline kW.

Measure ID	Description of EVT Efficient Upgrade	EVT Efficient kW	Description of DPS Efficient Upgrade	DPS Efficient kW	Reason for DPS Change
1943331-1943333	Reduction of Baseline LPD, Calculations based on installed watts.	22.382	Reduction of Baseline LPD, Calculations based on installed watts.	22.382	No change.
1943334	Per unit percent reduction of 20% based on space.	2.470	Per unit percent reduction of 20% based on space.	2.470	No change.
1943335	Per unit percent reduction of 20% based on space.	9.962	Per unit percent reduction of 20% based on space.	9.962	No change.
1943336	Per unit percent reduction of 20% based on space.	5.474	Per unit percent reduction of 20% based on space.	5.474	No change.
1943337-1943348	Reduction of Baseline LPD, Calculations based on installed watts.	11.519	Reduction of Baseline LPD, Calculations based on installed watts.	11.519	No change.
1943349	Per unit percent reduction of 10% based on space.	0.338	Per unit percent reduction of 10% based on space.	0.338	No change.
1943350	Per unit percent reduction of 20% based on space.	2.782	Per unit percent reduction of 20% based on space.	2.782	No change.
1943351	Per unit percent reduction of 30% based on space.	0.120	Per unit percent reduction of 30% based on space.	0.120	No change.
1943352	Per unit percent reduction of 30% based on space.	0.132	Per unit percent reduction of 30% based on space.	0.132	No change.
1943353	Per unit percent reduction of 30% based on space.	0.168	Per unit percent reduction of 30% based on space.	0.168	No change.
1943354	Per unit percent reduction of 30% based on space.	0.811	Per unit percent reduction of 30% based on space.	0.811	No change.
1943355-1943357	Reduction of Baseline LPD, Calculations based on installed watts.	5.050	Reduction of Baseline LPD, Calculations based on installed watts.	5.050	No change.
1943358	Per unit percent reduction of 30% based on space.	1.509	Per unit percent reduction of 30% based on space.	1.509	No change.
1943359	Per unit percent reduction of 30% based on space.	1.614	Per unit percent reduction of 30% based on space.	1.614	No change.

1943360	Per unit percent reduction of 30% based on space.	0.412	Per unit percent reduction of 30% based on space.	0.412	No change.
1943361-1943374	Installation of Energy Efficient equipment with higher than Baseline EER.	31.949	Installation of Energy Efficient equipment with higher than Baseline EER.	31.949	No change.
1943376	Only shown in Baseline Calculations	0	Only shown in Baseline Calculations	0	No change.

5. Describe the method used to estimate peak kW reduction and kWh savings. Identify any differences between the DPS and EVT methods and inputs, if not specified in items 4 and 5 above.

   The method used both by EVT and DPS to estimate peak kW reduction and kWh savings was taken out of the Vermont TRM manual. The specific equations are as follows:

   Lighting Power Density

   Energy Savings

$$\Delta kWh = (kW_{BASE} - kW_{EE}) \times HOURS \times WHF_e$$

   Demand Savings

$$\Delta kW = (kW_{BASE} - kW_{EE}) \times \text{Coincident Factor} \times WHF_d$$

   where,

$$kW_{base} = (LPD_{BASELINE} \times \text{Area})/1000$$

$$kW_{EE} = \text{Installed Wattage}/1000$$

   The primary difference between DPS and EVT is the WHF. DPS used an updated WHF for summer, winter and energy. EVT used a baseline LPD based on Building Area for the first three measures, and LPD's based on the Space by Space Method for the remaining measures. DPS used a Space by Space LPD for all measures.

   When calculating savings associated with occupancy sensor controls, the listed reduction factor applied to both kW and kWh savings from the equations above.

   HVAC Measures

   Energy Savings

$$\Delta kWh = kBTU/hr \times ((1/SEER_{BASE} - 1/SEER_{EE})) \times FLH_S$$

   Demand Savings

$$\Delta kW = kBTU/hr \times (1.1/SEER_{BASE} - 1/EER_{EE}) \times \text{Coincident Factor}$$

The only difference in calculations between EVT and DPS was in the kW load reduction of measure AC16. It appeared EVT used the .80 Operational Testing Factor in the kW and KWh calculations. DPS only used this factor in the kWh savings calculations.

Dual Enthalpy Economizer Measure

Energy Savings

$$\Delta kWh = SF \times Tons \times OTF/EER$$

Demand Savings

$$\Delta kW = \Delta kWh/4438$$

where,

SF=Savings Factor = 4576

Tons= Tonnage of Equipment

OTF= Operational Testing Factor, 1.0 when project undergoes Operational Testing or Commissioning

4438=Typical hours of economizer operation

6. Check if there are issues with any of the following:

____ Free ridership

____Spillover

____ Act 250 status

____ Hours of use/uptime

____ Commissioning adjustment

__X_ Cooling bonus/heating penalty

____ Load profile

__X_ MMBtu savings

____ Water savings

____ O&M savings

Briefly explain the issue(s).

The cooling bonus/heating penalty changes are incorporated by the updated waste heat factors for demand and energy for areas with mechanical cooling. The MMBtu savings factor was updated by the adjustment of the average heating system efficiency from .75 to .81.

Preparation for Forward Capacity Market (FCM) Verification

1. Which ISO option is recommended for FCM verification? (Options A through D)

   We recommend Option A - Partially Measured Retrofit Isolation/Stipulated Measurement.

Documentation

List all supplemental work papers and files used in the calculation of savings.

- Whitecapsind357272GDSHVACAnalV1
- Whitecapsind357272GDSLightingAnalV1
- CAT10a_4C534

Attachments

Metering Plan, sampling worksheet, supplemental work papers, and files.

Appendix B

EVT's Quality Assurance

Report for the iLED Program

Quality Assurance Report for the iLED Program – Contract Year 2010

Submitted to **Vermont Department of Public Service**

Submitted by **EVT**

September 9, 2011

TABLE OF CONTENTS

1. INTRODUCTION

In late 2010, Efficiency Vermont implemented a new initiative to promote early replacement of display lighting with more efficient screw-base LED lighting. This was a limited time offer, good only through the end of 2010, with significantly enhanced incentives. Savings calculations and costs were processed as custom projects, but the project process was streamlined through the use of a rebate form collecting project data and providing standard incentives. It was brought to EVT's attention that one of the contractors, Austin technology did not properly balance its short term sales objectives with EVT's long term program objectives. That is, the distributor may have encouraged the sale of the iLED efficient technology without regard for the ramifications of product installment at the customer premise. As part of this pilot initiative, Efficiency Vermont undertook a more rigorous Quality Assurance approach to identify what happened in the market place and to glean if there would be any necessary adjustment to be made for this Pilot program or programs like this in the future.

Table 1 Locations of Calculations & Steps

Step	Description	Application/File
1	Prepare List of iLED Projects	All iLED Projects 2010.xlsx
2	Split project list into Austin and non-Austin projects	All iLED Projects 2010.xlsx
3	Determine appropriate sample size	This document
4	List of all Measures in Sample Projects	SampleMeasures.xls
5	Perform inspections & calculate ISR	ILED Inspection Results.xlsx
6	Determine if Austin and Non-Austin Samples are equivalent	This document
7	Calculate cooling bonus adjustment to initial claim	CoolingBonusCalculation.xlsx
8	Multiply post-CBA claim by ISR	This document

2. Baseline Savings Claim

The initial claim for all iLED projects was calculated using a Microsoft Access Database. To be eligible, projects had to have been reported in budget year 2010. The measures were filtered to only include LED measures.

Table 2 Initial iLED Claim

Projects	kWh	kW Win	kW Sum	Qty	Average Annual Hours
649	6,552,235	1047.1	1743.7	39,498	3,410[1]

3. Cooling Bonus Adjustment

First, we will adjust the initial claim to reflect the adjustment to the cooling bonus agreed upon by the DPS and EVT. This was done as follows.

- Each measure of the 649 eligible products were queried to determine the cooling bonus factors that had been applied to them.
- The measures were copied into a Microsoft excel Spreadsheet titled CoolingBonusCalculation, sheet “OriginalClaim”.
- A second sheet was created, initially as an exact copy of “OriginalClaim” sheet.
    - Two Find & Replace operations were performed. Wherever the CoolingBonuskWh factor had been 1.116, it was replaced with 1.058. Where the CoolingBonusSum was 1.34, it was replaced with 1.17.
    - $New\ kWh = Old\ kWh * \frac{New\ kWh\ Cooling\ Bonus}{Old\ kWh\ cooling\ Bonus}$
    - $New\ kW = Old\ kW * \frac{New\ kW\ Cooling\ Bonus}{Old\ kW\ cooling\ Bonus}$
- In cases where no cooling bonus had been applied initially, the cooling bonus factors would be all one, and no adjustment was made. In cases where the cooling bonus had been applied, the claim would be reduced according to the reduction in the cooling bonus.

[1] Calculated from data in Microsoft Access Database: *iLEDSV2010*, Query **iLED2010AnnualHours.** For each measure, the quantity was multiplied by the annual hours for that measure. The total of hours*quantity was divided by total quantity to get the average hours.

- The claim, adjusted for cooling bonus would be as shown in Table 3 iLED Claim After Cooling Bonus Adjustment. The resulting realization rate is 96.0% for kWh and 89.9% for kW. Approximately 75% of measures were adjusted.

Table 3 iLED Claim After Cooling Bonus Adjustment

Projects	kWh	kW Win	kW Sum
649	6,286,637	1047.1	1,566

4. Sampling Procedure

In light of the outlier identified (Austin technology), Efficiency Vermont decided to evaluate this initiative in two sample groups, one for Austin technology projects and one group to evaluate the balance of the ILED 2010 projects. Efficiency Vermont randomly selected 48% of the projects in the first sample group and the second group sample size was determined according to the procedure outlined in the "*Model Energy Efficiency Program Impact Evaluation Guide"* www.epa.gov/eeactionplan, starting on page D-6. EVT chose to size the sample to be large enough to achieve 80% confidence to the ±10% precision level.

$$n_o = \frac{z^2 * cv^2}{\alpha^2}$$

where:

n_o is the initial estimate of the required sample size before sampling begins.

cv is the *coefficient of variance*, defined as the *standard deviation* of the readings divided by the *mean*. Until the actual *mean* and *standard deviation* of the population can be estimated from actual samples, 0.5 is often accepted as an initial estimate for *cv*. The more homogenous the population, the smaller the *cv*.

a is the desired level of *precision*.

z is the standard normal distribution value for the desired *confidence* level.

With the requirements stated above, we required a sample size of:

$n_o = 41$

In accordance with this calculation, 44 projects were chosen from the non-Austin group.

Table 4 Sample Groups – Initial Claim

Group	Projects	kWh	kW Win	kW Sum	Qty	% of Subgroup

Austin Energy	15	312,962	46.5	105.9	2147	63.0
Non-Austin	44	1,239,536	167.0	278.6	6045	18.1

Table 5 Subgroups – Initial Claim

Group	Projects	kWh	kW Win	kW Sum	Qty	% of Total
Austin Energy	31	432,109	66.1	138.4	3,067	3,410
Non-Austin	578	5,683,399	906.5	1474.3	33,376	

5. Inspection Results

The only valid metric from the inspection was ISR – the measures tended to be grouped together by Lamp Type, even when they had different operating hours. It is doubtful that there was any correlation between ISR and any other easily defined factor – the main reason for a low ISR was "haven't gotten around to it yet". Presumably, that factor is independent of any other variables.

5.1. Compare Pass/Fail Proportions from the Different Group

One main function of the inspection was to determine if the projects completed by the Austin Energy group were statistically distinct from the remaining sample. The method of testing for statistical significance is taken from "Statistical Method for Testing, Development and Manufacturing"[2] , by Forrest W. Breyfogle. From Breyfogle,

$$\chi^2 = (n_1 + n_2)\frac{\left[abs(x_1y_2 - x_2y_1) - \frac{n_1 + n_2}{2}\right]}{n_1n_2(x_1 + x_2)(y_1 + y_2)}$$

$$n_1 and\ n_2 = sample\ sizes$$
$$x_1 and\ x_2 = number\ of\ passes$$
$$y_1 and\ y_2 = number\ of\ failures$$

Group	Pass	Fail	Total	kW Sum	Qty	% of Total
Austin Energy	1535	612	2147	138.4	3,067	3,410
Non-Austin	4288	1757	906.5	1474.3	33,376	

Chi-squared value was significantly below the threshold, so there was no statistically significant difference between the Austin Energy sample and the randomly selected non-Austin Energy sample.

[2] http://books.google.com/books?id=q-IqQvoVkc0C&lpg=PP1&pg=PR7#v=onepage&q&f=false, Section 9.11, page 122

6. Final Claim

Status	kWh	kW Win	kW Sum
Original Claim	6,552,235	1,047.1	1,743.7
Cooling Bonus	6,286,637	1,047.1	1,566.0
Post-ISR	4,457,226	742.4	1,110.3

7. Adjustments to Earlier Lists

- Project 6012-J603: 55 MR16's were not installed, but they were deleted from the claim prior to the submission of our claim to the DPS. As such, they were deleted from the inspection sample.
- Project 6012-J578: A measure of 28 MR16's was deleted from KITT prior to the submission of the claim to the DPS. As such, the items were deleted from the inspection sample.
- Project 6012-K173: The Passed Inspection quantities were put into the "Dim Brightness and Faulty Lamp" column. These items were moved to the "Passed Inspection" column.
- Project 6013-K542: These items were not included as "Passed Inspection", but they were marked as pass on the inspection sheet. These items were moved to the "Passed Inspection" column.
- Duplicate Items: Many projects/measures were included on multiple lines. All lists were checked for duplicates using the "Find Duplicates" Query function in Microsoft Access.
- Report Date Filtering: The iLED Project List was filtered to only included projects and claims with a Report Date of 12/31/2010 or earlier.