Independent Audit, 2008-2010

Management Letter

Vermont Energy Efficiency Utility

Submitted to: Vermont Public Service Board

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May 30, 2012

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Executive Summary

Frontier Associates, LLC (Frontier) submits this Management Letter to the Public Service Board of Vermont (Board) as part of its Independent Audit. Pursuant to 30 V.S.A. § 209(e)(12), the Board hired Frontier to conduct an independent audit of the reported savings and cost-effectiveness of the electric and heating-and-process (H&P) energy efficiency programs delivered by Efficiency Vermont (EVT) and the City of Burlington Electric Department (BED) and overseen by the Department of Public Service (Department). Together, EVT and BED comprise the Vermont Energy Efficiency Utility (EEU).

In order to fulfill the requirements of the audit, Frontier reviewed and critiqued the procedures and methodologies used by the Department in its savings claims verification process, audited the EEU Technical Resource Manual (TRM) (including the processes in place to update it), assessed database procedures, and conducted cost-effectiveness tests on reported spending and savings for the period January 1, 2008 through December 31, 2010.

Summary of Project Objectives

1. Methodology and process review to identify and recommend improvements related to the Technical Resource Manual, the Department's savings claims verification process, databases and/or other processes
2. Validate savings achieved by the EEU (January 1, 2008 – December 31, 2010)
3. Verify cost-effectiveness of EEU programs, as provided in 30 V.S.A. § 209(e)(12)

Overview of Audit Process and Methodology

Frontier began the audit process in March 2012 with a kick-off meeting to establish roles and expectations. The meeting included members of the Public Service Board, the Department of Public Service, Efficiency Vermont, and Burlington Electric Department. Following the kick-off meeting, Frontier submitted an information request to each party to gather key data components of our analysis. After we completed a preliminary review of all received information, we conducted in-person interviews with all parties to gather more detailed information regarding program management and to clarify data sets. Based on our interpretation of the audit requirements, Frontier designated personnel to contribute to the analysis and evaluation required under each task based on specific knowledge set. Key contributors to the review included:

- Jay Zarnikau, President – project guidance and oversight
- Amy Martin, Manager of Program Design & Evaluation – validation of reported savings and costs and cost-effectiveness evaluation
- Jason Fialkoff, Senior Associate – cost-effectiveness analysis
- Mark Kapner, Director of Engineering – validation of engineering values
- Angel Moreno, Energy Analyst II – validation of engineering values and overall methodology and process review

Tools used during the audit process include spreadsheet and database software applications and reference documents. Where used, reference documents are cited in the Audit Management Letter.

Overview of EEU Programs, 2008-2010

Over 174,000 Vermonters participated in the EEU programs in some fashion between 2008 and 2010. Approximately $99 million[1] was spent on energy efficiency initiatives, resulting in over 351,000 megawatt-hours (MWh) of energy savings, 60 MW of winter demand reduction and 52 MW of summer demand reduction.

Table 1: EEU Portfolio Annual Results[2]

	kWh	Summer kW	Winter kW	Incentive Costs ($)	Admin Costs ($)	Total Program Costs ($)
2008	148,187,928	20,573	23,460	$14,175,769	$18,510,066	$32,685,835
2009	86,029,310	13,626	15,563	$9,252,568	$18,387,082	$27,639,650
2010	116,911,610	17,390	21,278	$17,200,623	$21,009,842	$38,210,465
Total	**351,128,848**	**51,589**	**60,301**	**$40,628,961**	**$57,906,990**	**$98,535,951**

Cost-Effectiveness Analysis

Frontier's analysis indicates that the programs offered by EVT and BED (collectively referred to as the "EEU Portfolio") were cost-effective between 2008 and 2010, and will likely continue to be cost-effective in the near future. The value of the energy savings and demand reduction (in addition to non-electric fuel savings and water conservation) resulting from EEU efforts were higher than the costs required to implement the programs. This resulted in robust benefit cost ratios under each of the three tests conducted.

Frontier did not identify any factors likely to change that would significantly alter the results detailed in this finding over the next few years. Always a point of concern when planning energy efficiency portfolios, fluctuations in natural gas prices could result in avoided costs decreasing to levels much lower than the values assumed in this evaluation. However, modifications to the cost-effectiveness screening methodology recently established by the Board should help to offset negative impacts tied to lower avoided costs. These modifications, including a lower discount rate for the societal test (3% as opposed to 5.7%), non-energy benefit adjustment of 15%, and a low-income adjustment of an additional 15%, should help the EEU Programs remain cost-effective in the future.[3]

[1] Annual program costs including operating and administrative costs, technical assistance and services, incentives and DPS evaluation costs (excluding participant and third party costs). A detailed breakdown of costs is provided in Appendix A.

[2] Costs and Savings may not match up exactly with the numbers provided in the Annual Reports due to rounding issues and minor discrepancies in the Annual Report Summary Tables.

[3] Order entered February 7, 2012, "Order Re Cost-Effectiveness Screening of Heating and Process-Fuel Efficiency Measures and Modifications to State Cost-Effectiveness Screening Tool."

Table 2: Cost-Effectiveness Summary, Total EEU Portfolio

	Program Administrator Cost Test (PACT)	Total Resource Cost Test (TRC)	Vermont Societal Test (VT Societal)
EEU Portfolio	**2.96**	**2.57**	**3.15**

Methodology and Process Review

Frontier's methodology and process review included a targeted review of the savings values in the TRM and a study of the processes involved in managing and updating the TRM. We also conducted interviews with EVT, BED, the Department, and West Hill (measurement and verification contractor) to assess the efficiency and effectiveness of their data management and savings verification processes.

Our review of the TRM confirms that the engineering methodologies and stipulated values found within the TRM are consistent with industry standards and are appropriate for use in savings determination for prescriptive measures implemented through the EEU's programs. We provide suggestions for further assessment of selected measures where we believe additional accuracy can be achieved.

The Technical Advisory Group (TAG) process for updating the TRM is a collaborative approach that works well to identify necessary updates to savings baselines and other values, and to conduct detailed engineering reviews of new measure characterizations. We recommend expanding the role of the TAG to include creation of a formal M&V process for EEU programs.

The savings claims verification process, conducted by a third party M&V contractor, offers an independent assessment of the validity of EEU savings claims on an annual basis. Given the strength of the TAG process for managing the TRM, we are comfortable in the verification process for prescriptive measures. However, due to time constraints, the M&V contractor has not historically performed site inspections. We recommend that some site inspections be included in annual savings verification, especially for custom projects which require more rigorous M&V to validate savings.

Observations and Recommendations

The Vermont EEU is comprised of highly skilled staff and management. EVT, BED, and the Department have specialized staff dedicated to managing the various aspects of EEU program administration. Based on our interviews, we believe all parties have a sincere interest in contributing to the long term success of energy efficiency initiatives in Vermont. The efforts of all parties demonstrate a desire to continually increase process efficiencies and produce verifiable savings results.

Given this overall environment, we expect EEU programs to remain cost-effective, assuming that avoided costs do not dramatically decrease. However, we anticipate that the recent modifications made by the Board to the Vermont societal test will help to hedge against these potential decreases.

Over the past ten years, Vermont has established a solid framework for implementing, evaluating, and overseeing energy efficiency initiatives across the state. Nonetheless, we have identified a number of areas where improvement may be achieved. Our recommendations address aspects of the EEU process that could benefit from increased efficiency or collaboration.

- Program years covered by the independent audit are off by one year from the program performance years. We recommend aligning these time periods for a more cohesive documentation of program history.
- While both EVT and BED appear to be following generally accepted M&V guidelines, there does not appear to be a formally prescribed process in place for project M&V. M&V efforts at the project level on the part of EVT and BED have not been categorically approved by the Department. This can cause a breakdown between project performance as anticipated by the utility and as accepted by the Department during annual verification. We recommend establishing an accepted protocol that mandates M&V requirements based on project type. Incorporating the M&V requirements of the Forward Capacity Markets (FCM) offers an opportunity to formally align EEU program M&V requirements.
- The Department's M&V contractor conducts a diligent review of annual performance. However, verification that TRM values are being properly applied can be cumbersome due to factors including values that change from year to year and embedded calculations within utility tracking systems. EEU parties mentioned transitioning the TRM from a document format to a database format. We strongly encourage this transition as it will help to prevent use of outdated values and maintain transparency. In addition, we recommend that all parties work collaboratively to develop the database and that the database be housed in such a manner that all parties will have access to utilize and verify its content.
- Savings values found within the TRM are based on sound engineering principles that have been vetted by the TAG. In general, our review of these values supports their use in determining savings for EEU projects. Our review of the supporting calculation documents revealed only minor discrepancies between the values in the TRM and the values in the supporting documents.
- While the TRM offers a solid foundation for savings values, we encourage a more thorough annual savings verification process that includes site visits for a sample of projects. Information gleaned from site visits conducted by the M&V contractor will provide increased confidence in adjustments to EEU annual savings claims. Additionally, it will inform future updates to TRM values and M&V procedures.
- There are different losses associated with serving different customer classes. For example, higher line losses are incurred when serving residential customers at distribution voltage as opposed to industrial customers at transmission voltage. The application of a single line loss estimate to the savings estimates for all programs serving all customer classes fails to recognize this differential. Differentiating line losses by service voltage level when applying line loss estimates to the savings associated with energy efficiency programs may help to address this issue.

Scope of Work

Frontier undertook the following activities to provide an independent audit of the programs implemented by EEU in the period from 2008 to 2010:

Task 1: Methodology and Process Review

- Engineering values and modeling assumptions within the TRM
- TAG process for managing and updating the TRM
- EEU data management and reporting procedures
- The Department's savings claim verification process

Task 2: Verification of Reported Demand Reduction and Energy Savings

- Gross Savings Calculations
    - Demand Reduction
    - Energy Savings
- Net Savings Adjustments
    - To Account for:
        - Free Ridership
        - Spillover Effects
        - Persistence
        - Line Losses

Task 3: Cost-effectiveness Analysis

- Program Administrator Cost Test (also known as the Utility Cost Test)
- Total Resource Cost Test
- Vermont Societal Test

Methodology and Process Review

Frontier conducted a methodology and process review to identify and recommend improvements related to the Technical Resource Manual, the Department's savings claims verification process, databases and/or other processes. The following sections detail our engineering observations and provide an overview of EEU organization and administration.

The EEU operates under the direction of the Department, and EEU activities are subject to annual review by the Department. The Department's annual savings claim verification process relies heavily on the TRM for verification of prescriptive project savings. The stipulated values and engineering assumptions contained within the TRM are overseen by the Technical Advisory Group (TAG). Members of the TAG include EVT, BED, the Department, and West Hill Energy Corporation. The Department's verification of custom project savings is completed through an engineering review of a sample of custom projects.

Frontier's methodology and process review included an evaluation of the following:

1. Engineering values and modeling assumptions within the TRM.
2. The TAG process for managing and updating the TRM.
3. EEU data management and reporting procedures.
4. The Department's savings claim verification process.

Our evaluation of engineering values relied on industry standards and best practices for energy efficiency savings calculations in addition to a comparison of Vermont values with those of other regions. We looked for appropriate engineering methodologies and selection of baseline values. The estimated impacts of measures were checked against expected savings benchmarks for each type of technology. Our recommendations do not attempt to dictate specific engineering values for use; rather they propose resolutions for consideration by the Department and the TAG.

In order to assess the TAG process, the data management practices of the EEU, and the Department's verification process, Frontier traveled to Vermont and met with each party. We interviewed program administrators, technical program staff, and information technology staff at both EVT and BED, as well as the Department's staff and the Department's measurement and verification (M&V) contractor. Our interviews allowed for each party to provide us with an overview of their internal procedures as well as their individual perspectives on the overall process. We discussed challenges faced by each party and the methods used to work through those challenges. Overall, we found all parties to be diligently and honestly invested in implementing successful programs with verifiable savings. Our recommendations are intended as a guide for the Board to consider specific process areas that might benefit from improvement.

Validate Engineering Values and Modeling Assumptions

Frontier employed a targeted approach to reviewing the engineering values contained in the TRM. Program impacts across the audit period were determined according to their percent contribution to sector net MWh savings. Frontier performed a detailed review of measures in end use categories that contributed, cumulatively, up to 90% of total savings. End uses incorporated in our review include lighting, industrial process efficiency, motors, refrigeration, and space heat efficiency. The following table shows the percentage of savings attributed to each end use category.

Table 3: Percent Savings of End Use Categories

	End Use Category	% Savings
Business Energy Services	Lighting	67%
	Industrial Process Efficiency	11%
	Motors	8%
	Refrigeration	6%
Residential Energy Services	Lighting	89%
	Refrigeration	4%
Heating and Process Fuels Business	Space Heat Efficiency	100%
Heating and Process Fuels Residential	Space Heat Efficiency	97%

The sections that follow detail our observations and recommendations for each end use category listed in Table 3: Percent Savings of End Use Categories.

Lighting Observations:

During the audit period 2008 through 2010, program savings in both the business and residential sectors were sourced largely from lighting end-uses. The TRM lighting measures cover a wide range of technologies, but the general savings algorithms are comparable. The following bullet points address some observations related to measures within the lighting end use category.

- The calculation used to account for impacts on heating and cooling loads is not consistent across all lighting measures. The tables below compare the factors that are considered in the calculation for waste heat factor for demand (WHF_d) and waste heat factor for energy (WHF_e) across two fluorescent technology measures. Assumed values for cooling system efficiency, percent of spaces with mechanical cooling, and coincidence with summer peak period differ between the two measures. The compact fluorescent (CFL) measures consider percent outside air while the high performance T8 (HPT8) measure does not. The referenced document WasteHeatAdjustment.doc is a memo outlining the methodology used for interactive HVAC impacts, and the values described therein match the CFL Fixture measure, but not the HPT8 measure. The memo does not specify to which measures the methodology applies, nor does it have an effective date.

Table 4: Waste Heat Factor – Demand

	CFL Fixture (1-C-2-g)	HPT8 (1-C-12-f)
% of spaces with mechanical cooling	47%	50%
% outside air	33%	not considered
coincidence of cooling with the summer peak period	80.8%	85%
cooling system efficiency	3.1 coefficient of performance (COP) for existing buildings 3.4 COP for new buildings	2.5 COP

Table 5: Waste Heat Factor – Energy

	CFL Fixture (1-C-2-g)	HPT8 (1-C-12-f)
% of spaces with mechanical cooling	47%	50%
% outside air	25%	not considered
% of lighting energy contributing to cooling load (ASHRAE lighting waste heat cooling factor)	29%	29%
cooling system efficiency	3.1 COP for existing buildings 3.4 COP for new buildings	2.5 COP

- The lighting waste heat cooling factor used in the WHF_e calculation is sourced from a 1993 American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE) Journal article. The article outlines a methodology that was validated against DOE-2 energy simulations.
- The COP value determined for cooling equipment does not distinguish between cooling type and size.
- The lighting power density baseline for projects started on or after January 2007 is ASHRAE 90.1-2004. Vermont's energy code, effective January 2012 is International Energy Conservation Code (IECC) 2009. IECC 2009 does list watt/ft^2 requirements in some building spaces that are more rigorous than ASHRAE 90.1-2004.
- Measure lifetimes in regional TRMs differed slightly in that Vermont provides a single lifetime, whereas TRMs of some other states provide separate values for new and retrofit projects. For example, the following table compares expected useful lives (EULs) assumed for some common lighting measures when implemented through utility energy efficiency programs in Vermont, Connecticut, and California.

Table 6: Lighting EULs

Measure	VT	CT	DEER (CA)
CFL Fixture	15	15 new construction, 13 retrofit	12
Lighting Controls	10	10 new, 9 retrofit	8
Linear Fluorescent	15	15 new, 13 retrofit	15, or rated ballast life/annual usage

- Lighting operating hours differ from regional TRMs for some building types. Vermont values are more conservative except in college buildings. The college building type in Vermont's TRM does not have sub-categories, whereas Connecticut and Massachusetts offer various operational hours depending on sub-function of a building on a college campus. See Table 7: Lighting Operating Hours for selected comparisons.
- The CFL measure for low-income single family has a persistence factor of 1. This is not likely to represent actual conditions. Numerous evaluation studies of energy efficiency programs demonstrate low realization rates for screw-in CFLs, suggesting that expected savings are not being realized in the field.
- Operational hours for pedestrian walk signals under the light-emitting diode LED Traffic signal measure vary from a 2002 Department of Energy study.[4] DOE: 2742 hours, VT: 1840 hours. Vermont values are conservative when compared against other sources.

Table 7: Lighting Operating Hours

Building Type	VT	CT	MA
Office	3435	3748	3610
Restaurant	4156	4182	5110
Retail	3068	4057	4089
Grocery/Supermarket	4612	Not provided	6074
Warehouse	2388	2602	3759
Elem/Secondary School	2080	2187	2596
College	5010	2187 (university) 3066 (dormitory) 2586 (class/administration)	3255, 3056(dormitory)
Health	3392	7666	Not provided
Hospital	4532	7674	8036
Hotel/Motel	2697	3064	8583
Manufacturing	3500	2857	4057
Other/Misc.	2278	Not provided	3951

[4] Navigant Consulting, *U.S. Lighting Market Characterization: Volume I: National Lighting Inventory and Energy Consumption Estimate*, p 28, September 2002.

The Vermont TRM includes considerations for factors that are not typical of deemed savings in other markets. Frontier recognizes these considerations as commendable on the part of the Technical Advisory Group (TAG) group to account for factors that can have an impact on the validity of the calculated savings values.

- Vermont considers an in-service-rate for some lighting projects to account for the percent of fixtures actively in use during the measure lifetime.
- The lighting controls measure has an operational testing factor (OTF) to account for the presence, or lack, of commissioning of control devices. Commissioning of lighting controls is essential to their performance. When operating schedules are not set properly or sensors are not properly calibrated, users are more likely to manually override the lighting controls, thereby reducing their associated energy savings.

Lighting Recommendations:

A consistent methodology to account for interactive HVAC impacts should be applied across all commercial lighting measures that are installed in a similar building stock. Buildings of similar construction and with similar usage characteristics are likely to have similar lighting and HVAC technologies. A review of the WasteHeatAdjustment.doc memo is recommended for a TAG meeting to ensure that the values appropriately apply to all measures. If it can be determined that certain lighting measures require a different methodology, then it should be outlined in the memo for future reference.

The current value used for the lighting waste heat cooling factor is based on an outdated source. DOE-2 is a widely accepted simulation engine; however, it has been updated since 1993 - specifically in the area of HVAC systems. Additionally, there are newer energy simulation engines that have more robust simulation capabilities (e.g. EnergyPlus). Researching a more recent study on the interactive effects of lighting on the HVAC system may uncover a value for the lighting waste heat cooling factor that more accurately describes current building practices, technologies and interactive performance of building systems. For example, in 2008, the Pacific Northwest National Laboratory prepared a report for the Department of Energy that explored modeling approaches for energy savings.[5] Included in this report is an analysis of their calculation for interactive effects of lighting.

Cooling system efficiency varies with type and size. Applying an average coefficient of performance (COP) to all building types overlooks the potential variation in actual system efficiency. It is likely that certain building types generally install similar cooling systems (e.g. a restaurant may install a unitary DX system while a college campus may have a chiller system). An investigation into industry trends may allow for a more appropriate COP determination based on building type.

While not applicable for projects started during the audit period 2008-2010, the baseline for the lighting power density measure should be revisited in light of the newly adopted commercial building energy code in Vermont. IECC 2009 went into effect in January 2012. IECC 2009 does not provide space types that are as detailed as ASHRAE, so we recommend that when investigating an update to this baseline, both IECC 2009 and ASHRAE 90.1-2010 are considered.

[5] Pacific Northwest National Lab, *Methodological Framework for Analysis of Buildings-Related Programs with BEAMS-2008,* September 2008.

The Vermont TRM offers a single value for measure useful life whereas other states offer a separate value for new construction and retrofit projects. We recommend looking further into this issue to determine if applying a separate value for new and retrofit projects is appropriate for the Vermont market.

Consider expanding the list of building types in the lighting operating hours table, and reevaluate the hours of operation listed under "college" buildings. This value is 35-56% higher than regional values for this building type. A more detailed definition of "college" may enable a more accurate estimate of lighting operational hours.

A field evaluation of residential sites where CFLs were installed should be done to verify the persistence factor for the residential CFL measure.

Industrial Process Efficiency Observations:

This section addresses the following five measures:

1. Efficient compressors, 40 hp and smaller
2. Cycling Dryers
3. Air-Entraining Air Nozzles
4. No Loss Condensate Drains
5. Air Receivers for Load/No Load Compressors

The table below summarizes the comparison of the estimated annual kWh savings per measure as reported in the TRM and our estimates for these measures. The remainder of this section explains the discrepancies between the formulae and parameters contained in the TRM and the referenced documents.

Table 8: Industrial Efficiency Measure Comparison

Measure	Estimated Savings kWh/yr (TRM)	Estimated Savings kWh/yr (Frontier calculation)
Efficient Compressor	21000	20430
Cycling Dryers	1170	1713
Air Entraining Air Nozzles	800	253
No Loss Condensate Drains	650	265
Air Receivers	10100	9786

1. Efficient Compressors

There are two differences between the TRM and referenced documents. First, the TRM formula for kW is kW = 0.9 x hp. The referenced document formula is kW = 0.94 x hp + 0.54.

Second, the efficient Compressor Factor used in the TRM is 0.705; the efficient Compressor Factor used in the referenced document is 0.675.

2. Cycling Dryers

The formulas are the same. However, the TRM uses a value of 4 CFM per compressor motor nominal hp; the referenced document uses 5 CFM per nominal hp.

3. Air-Entraining Air Nozzles

The formulas are the same. However, the TRM assumes that the nozzle is in use 3 seconds per minute of compressor operation, while the referenced document assumes 1 second per minute.

4. No Loss Condensate Drains

The formulas in the TRM and referenced document are the same but the input values differ considerably. The formula in the referenced document is:

ΔkWh = ALR x COMP x Hours x PNC, where:

ALR = air loss rate in CFM
COMP = compressor kW per CFM produced
Hours = hours per year the timed drain is open, and
PNC = percentage of time that compressed air escapes instead of condensate.
The TRM assumes a ¼ inch orifice with an ALR of 100.9 CFM. The referenced document assumes a 1/8 inch orifice with ALR of 25.2 CFM.

The TRM assumes 146 hours open; the referenced document assumes 69 hours.

The TRM uses a PNC of 75%; the referenced document uses a PNC of 50%.

5. Air Receivers for Load/No Load Compressors

The formulae differ in that the TRM uses 0.9 x hp to compute compressor kW, while the referenced document uses 0.94 x hp + 0.54 for kW.

Also, the values for compressor factors differ, for both baseline and efficient compressor.

The TRM uses 0.890 and 0.812 for the baseline and efficient compressor factors. The referenced document uses 0.909 and 0.806.

The one value we used from the TRM rather than the referenced document was annual hours of operation per year for two shifts. The TRM uses 3952 hours; the referenced document uses 4160 hours. We believe that 3952 hours more accurately reflects an industrial 2 shift operation:

7 am to 11 pm, weekdays, minus holidays and scheduled maintenance time.

Motor Observations:
The following are findings from measures in the motors end use category.

- The TRM table for Minimum Efficiencies Qualifying for Incentives appears to have some typographical errors. The efficiencies listed for 2 pole and 6 poles motors do not match those in NEMA table 12-12.

Table 9: Motor Efficiency Table

Motor HP	Vermont TRM			NEMA Table		
	2 poles	4 poles	6 poles	2 poles	4 poles	6 poles
1	82.5%	85.5%	77.0%	77.0%	85.5%	82.5%
1.5	86.5%	86.5%	84.0%	84.0%	86.5%	86.5%
2	87.5%	86.5%	85.5%	85.5%	86.5%	87.5%

- The TRM does not mention a requirement for motor sizing. Motors are routinely oversized, and the time of motor replacement offers an opportunity to replace incorrectly sized motors with equipment that is optimally sized to operate at maximum performance efficiency.
- The energy and demand calculations are consistent with industry standards. However, the existing baseline motor efficiency is based on EPACT 1992 and is outdated. The 2007 Energy Independence and Security Act (EISA) requires increased efficiencies for motors manufactured after December 2010. Savings for motor projects installed since December 2010 should consider using a more updated baseline value than the 1992 requirements.
- Default operating hours are provided in the TRM for HVAC fan and pump applications when actual operating hours are not known. All other applications are instructed to use 4500 hours. A 2002 Department of Energy study[6] of industrial motors demonstrates a trend of increased operating hours as motors increase in size.

Motor Recommendations:

The column headers in the Minimum Efficiencies Qualifying for Incentives table for 2 pole and 6 pole should be switched so that the correct efficiencies will be listed under the correct category.

Consider including a provision for optimal motor sizing. For maximum energy performance, motors should operate with a load factor between 65-100%. The nominal efficiency values used in the TRM savings calculations are based on a fully loaded motor. Requiring design documentation to verify that motors are optimally sized will help to minimize variation between prescriptive savings calculation and realized savings.

While not relevant to projects implemented during the audit period, Federal requirements mandate a new minimum efficiency for motors manufactured since December 2010. We recommend an update to the motor baseline to more accurately reflect what would have been installed absent the efficiency program. Savings opportunities may be reduced with the new Federal requirements, so it is worth considering a different baseline for replacement of rewound motors.

Operating hours play an important role in prescriptive savings calculations for motors. Consider developing default operating hours that increase with increasing motor size to more accurately represent field conditions in industrial applications.

[6] U.S. Department of Energy, *United States Industrial Electric Motor Systems Market Opportunities Assessment,* p. 42, December 2002.

Refrigeration Observations:

- The refrigeration economizer measure lists a persistence factor of 1. However, field experience demonstrates that economizers are frequently overridden or de-activated by operators. The effectiveness of economizer performance relies on a properly functioning system of dampers, calibrated sensors, and control loops. Improper maintenance leads to failure to repair the economizer when one component of the system fails. This is unfortunately common due to a variety of reasons including improperly trained staff and the perception of high cost repairs.
- Equipment duty cycles for a number of refrigeration measures are primarily based on assumptions from manufacturers. An independent assessment of cooler control energy measures in Massachusetts found much lower duty cycle rates when measured in the field than initially assumed for savings calculations. This same study returned an extremely low realization rate for savings from walk-in cooler economizers of 25%.[7]
- Commercial solid and glass door reach-in refrigerators, freezers, and ice-makers provide a kWh savings value based on equipment capacity. However, the savings are not dependent upon the specific capacity of the unit; rather they are listed in capacity ranges. The specific equipment capacity of installed units must be known to determine the correct savings values.
- The operating hours listed for floating head pressure control do not match the hours listed for the energy savings algorithm. The algorithm cites 5,858 hours while the narrative under the "operating hours" header cites 7,221 hours.

Refrigeration Recommendations:

Due to the high likelihood of failure of proper economizer operation prior to the end of its useful life, we recommend re-visiting the persistence factor for refrigeration economizers. A field inspection of economizers installed within the last 15 years of program operation could provide insight as to the percentage of economizers still in service. Data from these field inspections could inform an appropriate revision to the TRM value.

Duty cycles for compressors and economizer fans are assumed across a number of measures including refrigeration economizer, evaporator fan motor controls, and brushless DC motors. A metering study of duty cycling of commercial refrigeration components in the program coverage area would provide increased confidence in the values used for prescriptive savings determination.

We recommend restructuring the savings algorithms for commercial solid and glass door reach-in refrigerators, freezers, and ice-makers to consider actual equipment capacity rather than a pre-determined kWh savings value. Given that capacity information is already known for participating projects, use of this information to calculate savings is an efficient way to provide more accurate savings values.

The operating hours for floating head pressure control need to be verified in order to determine the appropriate value that is intended for use in savings determination.

[7] Select Energy Services, Inc., *Analysis of Cooler Control Energy Conservation Measures*, March 2004.

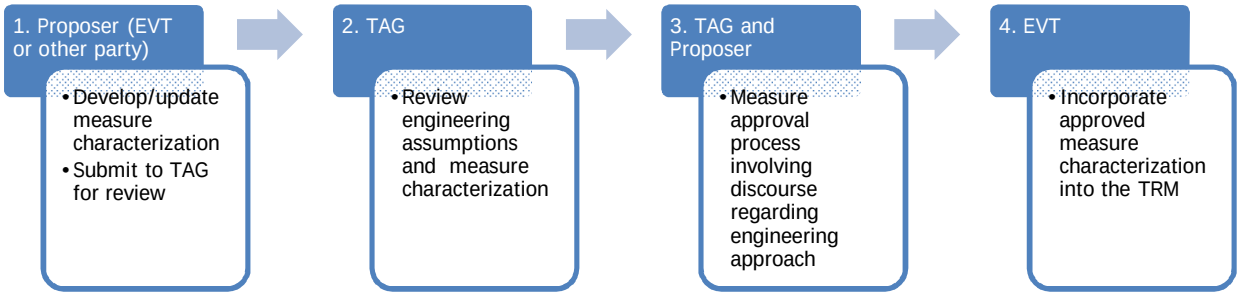
Space Heat Efficiency Observations:
Frontier's review of the space heat efficiency end use measures in the TRM did not identify notable issues of concern. The assumptions for system operation and savings calculation are consistent with industry standards, and we have no recommends for space heat efficiency.

Overall TRM Observations:
Our engineering review confirms that the engineering methodologies and stipulated values found within the TRM are consistent with industry standards and are appropriate for use in savings determination for prescriptive measures implemented through the EEU's programs. We have provided suggestions for further assessment of selected measures where we believe additional accuracy can be achieved. Our recommendations fall into 3 general categories: updating baselines, persistence factors, and other assumed values; disaggregating savings values by capacity; and confirming that TRM values are consistent with reference documents. We believe that attention to these recommendations will not result in significant changes to the estimated savings for the audit years 2008-2010, but rather offer increased confidence in future savings estimates.

Technical Advisory Group (TAG)

Measure characterizations found within the TRM go through an approval process involving the Technical Advisory Group (TAG). Any party may develop new measures or existing measure updates and submit them to the TAG for review; however, the majority of new measures are brought forth by EVT. EVT has a technology services group that evaluates the eligibility and appropriateness of new technologies. The originally stipulated net adjustment factors were established by the DPS; however, updates to these values are reviewed in the TAG forum as with new measures. The following chart outlines the general process for incorporating new and updating existing TRM measures.

Figure 1: TRM Update Process



This collaborative approach is commendable because it allows for involvement by interested parties throughout the TRM update process. The members of the TAG are given the opportunity to propose, review, and engage in discourse about any edits or refinements to the TRM. Thus savings determinations have been vetted by program implementers, regulatory staff, and M&V contractors before they are applied in the field.

The TRM is used primarily for prescriptive measures. Impacts for custom measures are determined on a case-by-case basis. Custom measures typically require site-specific detailed engineering analysis, and there is not a standard approach for the determination of savings that can be applied at the portfolio level.

However, there are standard industry protocols that can be adopted for use on custom projects in Vermont. The International Performance Measurement and Verification Protocol (IPMVP) is a guide published by the Department of Energy. The IPMVP offers an overview of best practices in savings determination for energy conservation measures. During our interviews, we learned that the IPMVP is generally followed, but it is not a mandatory requirement. We also learned that there remain unresolved issues from a 2010 BED project, and these issues have prevented final verification of 2010 BED program savings. A disagreement between BED and West Hill surrounding the appropriate metering approach has prevented resolution on this matter.

Recommendations:
We recommend that the TAG parties consider formally adopting the IPMVP or a similar standard for M&V. This will provide a consistent approach across all programs that clearly defines expected levels of M&V for savings determination in custom projects. A collaborative approach to developing the M&V protocols has been used successfully in other regions of the country. Establishment of these protocols prior to program roll-out and project inception can prevent retroactive savings adjustments that are due to differences in professional opinion regarding the best verification approach. As the TAG parties are already working collaboratively to agree on methods for savings determination of prescriptive projects, we believe this a good forum for development of M&V protocols for all projects, including custom projects.

Process Review of EEU Data Tracking and Reporting

Both EVT and BED have internal databases that they use to track program performance. Individual project information is input in their respective databases and the TRM savings algorithms are applied to produce gross and net program impacts. Custom project savings are entered independently. BED's database includes TRM formulas, whereas the EVT database has hard-coded calculations.

The following charts provide a high-level overview of the data management procedures of EVT and BED.

Figure 2: BED Data Management Flow Chart

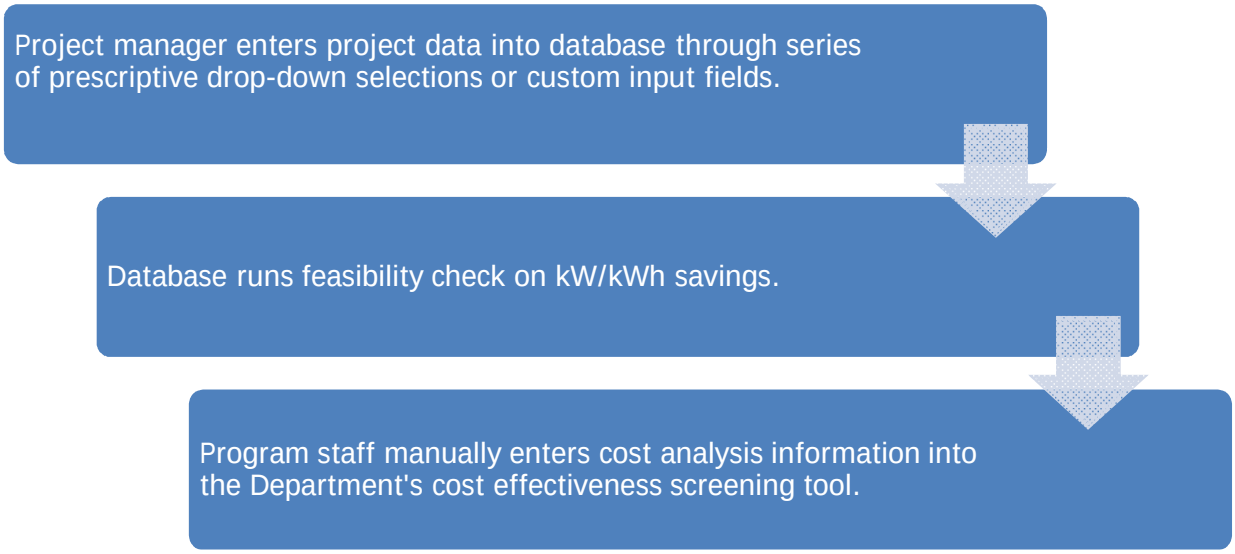
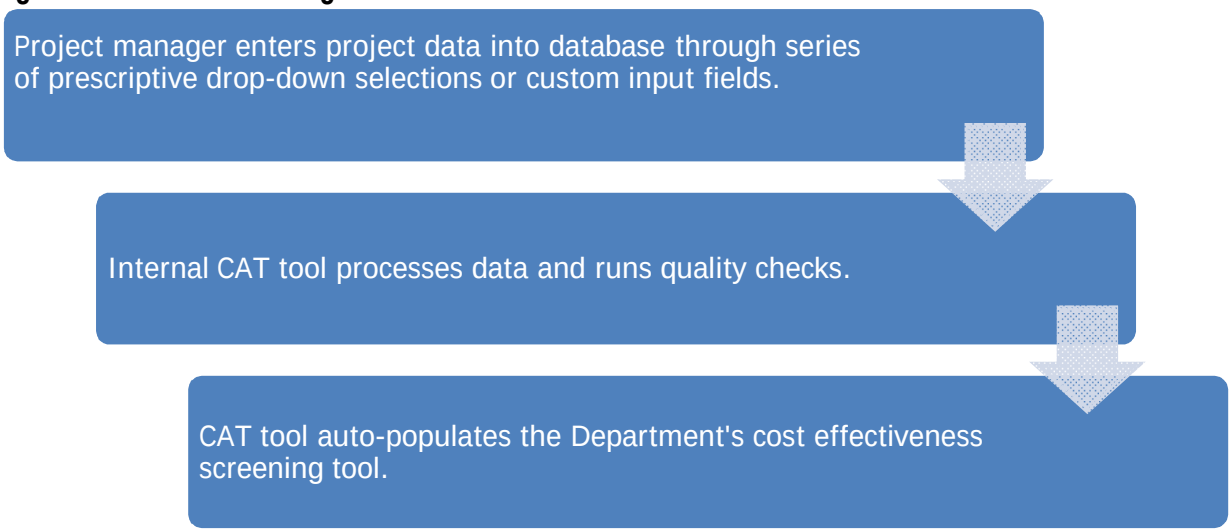


Figure 3: EVT Data Management Process Flow



Recommendations:

During West Hill's review, they found that verifying the savings calculation is more transparent in BED's database than in EVT's. Extensive additional work is required to validate the savings calculated in EVT's database. We recommend that EVT and the Department work together to facilitate verification of savings calculations that are applied through EVT's data management system. Potential methods to approach this could be either:

- Generation of reports detailing the system calculation algorithms and processes
- Restructure the database so that calculations are visible to auditors.

Both BED and EVT use project managers as the primary data entry method for project information. Program participants are not offered a method to submit prescriptive project data. The use of project managers is beneficial in that it builds relationships between the utilities and

participants and offers a preliminary quality check on project data. However, it is also a time intensive process, requiring that personnel are on hand to process each project. We recommend that the utilities consider online program management tools to enable participants to enter preliminary project information directly into the project tracking system. This relieves some of the labor burden on project managers, who are then able to process additional projects and focus their efforts on quality control. Additionally, online program access may encourage additional program participation provided that the interface is user friendly.

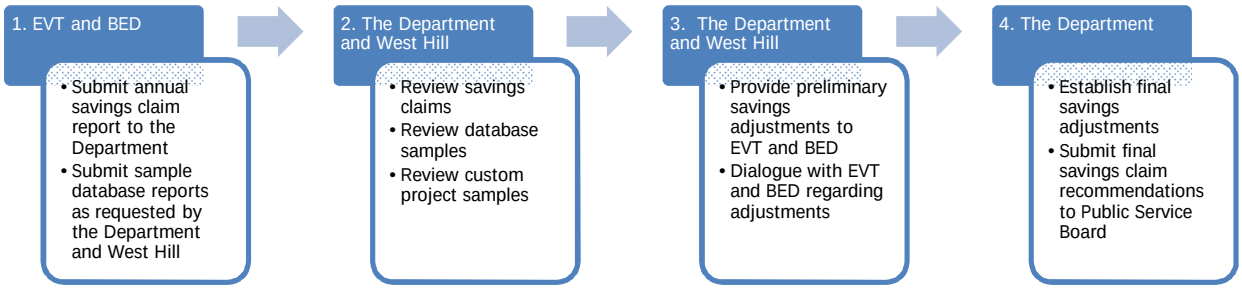
Evaluate DPS Procedures and Methodologies Related to the Savings Claims Verification Process

The Department contracts with West Hill Energy to perform an annual verification of both EVT and BED efficiency programs. West Hill conducts a paper review of program performance. Due to time constraints, no site verification is conducted. This review spans approximately 3 months and review activities include:

- Verifying that the TRM is correctly applied to prescriptive projects
- Pulling a sample of custom projects to review methods for savings determination
- Engaging in a negotiation phase with EVT/BED to discuss findings and recommendations for savings adjustments.

Following the annual savings claim verification, any procedural changes or changes to the database recommended by the Department are implemented by the EEU. Additionally, changes that are recommended for the TRM are handled through the TAG forum.

Figure 4: Annual Savings Verification Process



The Forward Capacity Markets (FCM) program requires more rigorous savings verification that is consistent with the New England Independent System Operators M&V process. Since 2009, West Hill has conducted FCM verification independent of verification of EEU programs. It is our understanding the issues surrounding the 2010 BED verification stem from the more rigorous FCM M&V requirements.

Recommendations:

Given that West Hill is only provided a 3 month window to conduct M&V activities, it is not feasible to conduct quality field inspections and verify seasonal performance data. However, on-site verification is critical to ensure program success. We recommend that the Department require site verification of a sample of projects as part of the annual savings claim verification process. Given that the verification contractor, currently West Hill, is a participant in the monthly TAG meetings, it is feasible that they could expand their participation to include ongoing field verification throughout the program year. Site inspection of a sample of prescriptive projects will help to verify that measures are installed as claimed and to gauge their persistence in the field. Additionally, a sample of custom projects is recommended in order to confirm that the engineering values used for savings determination are consistent with actual field conditions.

Because the verification contractor is performing verification for both EEU and FCM programs, we recommend that the Department look into aligning these two processes. The more rigorous M&V process conducted under the FCM program may offer improvements upon the current EEU program verification process. This alignment can make for a more efficient M&V process, and reduce discrepancies that may arise between the approved savings values for each program. As recommended for the TAG, formal establishment of an M&V process can increase confidence in program implementation. Provided that program plans are consistent with the pre-approved processes, savings verification will be streamlined.

Validation of Reported Savings and Costs

As part of the Independent Audit, Frontier was tasked with reviewing and validating the reported demand reduction (kW), energy savings (kWh), non-electric fuel impacts (MMBTU) and costs for the EEU Portfolio based on the results provided in EVT and BED's Annual Reports and database samples. As noted in the previous section, the methodology currently in place to estimate program performance is adequate, barring a need for increased field verification. Under the TAG process, assumptions and algorithms within the TRM are updated often to account for improving technologies and changes in the market. In addition, the savings verification process managed by the DPS provides a satisfactory review of the overall savings reported by EVT and BED each year. As a result of these standardized processes, Frontier believes the final savings as reported by the EEU each year are sufficiently vetted and represent an accurate picture of the EEU Portfolio's progress during the evaluation period.

Reported Savings

Both EVT and BED provided a large volume of data; in the interest of expediency, Frontier selected a sample of projects to spot check for each utility. EVT provided Frontier with a database snapshot, summing up projects for all three years of the analysis; BED provided a spreadsheet with similar data for Frontier's review.

Within the EVT Database, Frontier checked several inputs based on data provided in the 2008 and 2010 TRM. Specifically, Frontier reviewed:

- Load Shapes (LS)
- Reported gross and net savings per participant (kW, kWh, MMBTU)
- Estimated Useful Life ("EUL" or "measure life")
- Free-ridership, spillover effects and persistence

Savings, EUL and free-ridership, spillover effects, and persistence data were consistent with the TRM. Reported gross and net savings were in line with what is expected on a per participant basis (for example, Frontier did not notice any gross over- or underestimation of savings based on typical installations). In addition, the EULs assigned per measure within Frontier's sample matched up with the TRM.

Frontier also conducted a review of the free-ridership, spillover effects and persistence values contained within the 2010 TRM and spot checked a sample of projects to ensure these values were not only correct based on the TRM, but also in line with values typically used in other jurisdictions. Due to the somewhat subjective nature of these estimates, it can be difficult to authoritatively state that a value is correct or incorrect. Frontier has concluded that the values utilized by the EEU are in line with other jurisdictions; in fact, the level of detail assigned to these values is much higher than what is seen throughout other parts of the nation. If not already under consideration, the EEU may want to consider conducting a free-ridership/spillover study specifically tied to lighting measures within the next few years. Because lighting constitutes such a large portion of total savings, added precision at this level may prove beneficial in estimating more accurate net savings values.

The vast majority of load shapes pulled from the EVT database snapshot matched the TRM. However, Frontier did notice one potential issue during the review. Within the sample, Frontier discovered that there were no measures installed that matched the 2010 TRM LS 12 (commercial indoor lighting). However, there were numerous commercial indoor lighting measures installed that matched the 2008 TRM LS 12. Based on the large sample size, Frontier expected to find a 2010 version of LS 12 within its sample. This raises some concern that the 2010 TRM LS 12 was not accurately captured in the 2010 databases. It is possible this could be the result of random sampling. Frontier recommends EVT (and BED) check their databases to ensure all Load Shapes are up-to-date and match the current TRM.

Frontier's review of BED's spreadsheet was positive, with data points aligning with expected values.

Reported Costs

Frontier pulled annual program cost data from the Annual Reports for each utility. For EVT, Frontier used savings tables excluding customer credit programs at the direction of the Board. Frontier relied on the EEU Summary reports for BED, as opposed to the Total Summary reports which contain programs outside the scope of this audit.

The Board provided total evaluation costs over the three year period for EVT and BED and verified the cost breakdown for each was correct. EVT provided the performance bonus to be included in the cost-effectiveness evaluation. Spreadsheets detailing total costs for EVT, BED and the combined EEU are provided in Appendix A.

Observations and Recommendations

Based on the data provided by the EEU and within the Annual Reports, Frontier verifies that the reported savings and costs contained within EVT and BED's Annual Reports (2008-2010) are generally reliable. Moreover, the EEU should be commended for establishing and utilizing a standardized reporting form over a number of years. This increases transparency within the overall process, ensuring ratepayers, interested parties, and independent auditors such as Frontier can fairly easily track costs and achievements over the life of the energy efficiency programs.

While Frontier believes the savings data reported annually to the DPS are generally reliable, it was difficult to get a strong handle on the detailed savings methodologies used to estimate and evaluate savings tied to custom projects. Frontier recommends the Board consider expanding or refocusing certain parts of the Independent Audit to include a more in-depth analysis of custom projects.

Cost-effectiveness Analysis

Frontier's analysis indicates that the EEU programs were cost-effective between 2008 and 2010, and will likely continue to be cost-effective in the near future, barring a substantial drop in avoided costs. Frontier's Audit team analyzed the EVT and BED programs independently and as an overall "EEU Portfolio." In addition, cost-effectiveness tests were conducted for each utility at the market sector (Business Energy Services and Residential Energy Services) and further broken down by electric and heating-and-process fuel programs for EVT, resulting in benefit-cost ratios at multiple levels. This additional analysis will provide the Board with more insight into program performance across different markets. Benefit-cost ratios for the EEU Portfolio are shown in the following table; independent test results for EVT and BED are described in detail in the following sections.

Table 10: EEU Portfolio, Cost-Effectiveness Summary

	Program Administrator Cost Test (PACT)	Total Resource Cost Test (TRC)	Vermont Societal Test (VT Societal)
EEU Portfolio	**2.96**	**2.57**	**3.15**

It is important to note that the objective of this audit was to "perform an independent review of the cost-effectiveness of EVT's and BED's programs."[8] As a result, Frontier adapted its cost-effectiveness tool to align with the particulars required by the Board when evaluating efficiency programs (including costing periods, environmental externalities, non-electric fuel and other related inputs). However, due to the large quantity of projects completed by the EEU between 2008 and 2010, Frontier was not able to analyze cost-effectiveness at a measure, or even a project, level. Instead, based on direction by the Board, and in the spirit of conducting an overall review of the EEU Portfolio over a three year period, Frontier focused its efforts at the Market Sector level, relying on the end use breakdown summary tables provided in the Annual Reports.

Several adjustments were made in an attempt to produce more precise results. For example, by evaluating the portfolios using end use data within each market sector (e.g., analyzing lighting impacts at the market sector level versus analyzing total savings not specific to particular end uses), Frontier was able to more precisely allocate demand reduction and energy savings across the EEU costing periods and capture those savings over a more realistic estimated useful life. Frontier believes this approach captured the appropriate level of detail within the scope of this project.

In the same vein, total costs, kW, kWh, MMBTU and water savings produced in this evaluation may not match exactly with the values provided in the Annual Reports. This is due to both rounding issues and minor discrepancies found within the Annual Reports in which totals did not match up with the sum of their parts (identified in spreadsheets to be provided to the Board). Frontier attempted to match savings as closely as possible to reported values; any differences noted are minor and would not impact overall cost-effectiveness results.

[8] "Request for Proposal – Independent Auditor of EEU," Issued by the Vermont Public Service Board, December 6, 2011.

Overview of Cost-Effectiveness Tests

Frontier conducted cost-effectiveness analyses using three different methodologies consistent with standards established by the California Standard Practice Manual. Benefit-cost ratios were calculated for the PACT, TRC and the Vermont Societal Test. In order to maintain consistency, Frontier utilized the same approach to evaluate the EEU Portfolio and its respective parts. Brief descriptions of each test are provided below.

Program Administrator Cost Test (PACT)

The Program Administrator Cost Test (PACT) measures each program's potential to reduce the utility's revenue requirements in the form of reduced generation capacity investments, and reduced production and purchased power requirements. This test helps utilities evaluate demand side management (DSM) programs for their potential contribution to least cost planning objectives. The benefits and costs applied to the PACT are:

Table 11: PACT Inputs

Benefits	Costs
Avoided energy-related costs	Program Incentives[9]
Avoided capacity-related costs	Administrative Costs[10]

Total Resource Cost Test (TRC)

The Total Resource Cost Test (TRC) is a summation of all participant and utility reduced costs (benefits) and all utility increased costs. When viewed as a ratio, reduced costs are in the numerator and increased costs in the denominator. Since the TRC only incorporates costs (either avoided or expended) in its calculation, customer incentives are excluded from its calculation. Customer incentives are also transfer payments, so if included, they would net out when expressed as benefits to the customer (numerator) and costs to the utility (denominator). The benefits and costs applied to the TRC are:

[9] Includes only those costs identified as "incentives to participants or trade allies" within Annual Reports. Frontier understands it is possible some "technical assistance costs" (ex: educational programs and efforts) could be tied in with incentives. However, because Frontier could not determine which portion of such costs should be allocated to either incentives or more administrative-type costs, all service costs were included under "Administrative Costs."

[10] For the purposes of this report, "Administrative Costs" refers to all operating, technical assistance/service, DPS evaluation costs.

Table 12: TRC Inputs

Benefits	Costs
Avoided energy-related costs	Administrative Costs[11]
Avoided capacity-related costs	Incremental Costs[12]
Non-electric fuel savings	Performance Bonus (if applicable)[13]
Water savings	

Vermont Societal Cost Test (VT Societal)

The Societal Test is a variant of the Total Resource Cost Test, with the addition of "externalities." Externalities in the "Vermont Societal Cost Test" (VT Societal) include electric and non-electric environmental impacts and a "risk adjustment" that reduces total costs [excluding fuel externalities] to reflect the lower risk associated with energy efficiency programs relative to energy supply alternatives. The benefits and costs applied to the VT Societal are:

Table 13: Vermont Societal Inputs

Benefits	Costs
Avoided energy-related costs	Administrative Costs[14]
Avoided capacity-related costs	Incremental Costs[15]
Non-electric fuel savings	Performance Bonus (if applicable)[16]
Water savings	(-) Risk Adjustment
Environmental Externalities	

Cost-Effectiveness Inputs and Assumptions

Based on the understanding that the Board and EEU seek to maximize consistency in cost-effectiveness testing across energy efficiency initiatives, Frontier analyzed cost-effectiveness for EVT and BED (including both EVT's electric and heating-and-process fuel initiatives) assuming the same avoided costs, discount rate, risk adjustments, and externalities. Frontier relied heavily on the inputs and assumptions found in the 2010 Screening Tool to conduct its analysis.

The calculator inputs and externality values used to calculate benefit-cost ratios are described and sourced in the following table. Total costs used in the tests are detailed in Appendix A.

[11] For the purposes of this report, "Administrative Costs" refers to all operating, technical assistance/service, DPS evaluation costs.

[12] For the purposes of this report, "Incremental Costs" include all participant and third party costs.

[13] Performance Bonus cost equals the sum of bonuses 2008-2010 in the year received; added after PV of other costs already calculated.

[14] For the purposes of this report, "Administrative Costs" refers to all operating, technical assistance/service, DPS evaluation costs.

[15] For the purposes of this report, "Incremental Costs" include all participant and third party costs.

[16] Performance Bonus cost equals the sum of bonuses 2008-2010 in the year received; added after PV of other costs already calculated.

Table 14: Cost-effectiveness Model, Inputs and Externalities

Calculator Inputs	Value	Source
Discount Rate	5.70%	2010 Screening Tool (Rate calculated by DPS)
Avoided Costs	Appendix B	2010 Screening Tool
Avoided Costs (Water)	$9.91/CCF	2010 Screening Tool
Load Shapes	Appendix B	2010 TRM and EVT Database Sample
Line Losses	NA	TRM
Persistence/Free-ridership	NA	TRM
Externalities	**Value**	**Source**
Risk Discount on Costs	10%	Docket 5270 (reaffirmed in Docket 5980 and 6290)
Electric Externality	$0.01/kWh	2010 Screening Tool (same value across all costing periods)
Non-Electric Externalities	Appendix B	2010 Screening Tool

While we have adopted values and assumptions approved by the Department and traditionally used for cost-effectiveness analysis in Vermont, we suggest that some of these assumptions be revisited. It is our understanding that the values used for avoided transmission costs may soon be revised. Projections made in 2010 may no longer be accurate, and avoided energy costs may need to be revisited in light of recent depressed natural gas prices. The application of the same line loss values to energy efficiency achievements regardless of customer class or service voltage level should be re-examined. Higher line losses are normally incurred when serving residential customers at distribution voltage than industrial customers at transmission voltage. Thus a kilo-watt of onsite demand reduction at a home may have more value in displacing generation needs than a similar reduction in demand at an industrial site. Such difference in value can be readily recognized if different line loss factors are applied to projects at sites served at different voltage levels.

Cost-Effectiveness Results

The following section provides cost-effectiveness results for the combined EEU portfolio, as well as individual results for EVT and BED's portfolios.

EEU Portfolio

The EEU Portfolio produced solid benefit-cost ratios for each of the three cost-effectiveness tests. The Tables below detail total costs and savings for each year during the evaluation period and benefit-cost ratios for the PACT, TRC, and VT Societal. In addition, Frontier has provided a detailed breakdown of the benefits and costs included in the VT Societal Test for the Board's review.

Table 15: EEU Portfolio, Annual Results

	Summer kW	Winter kW	kWh	MMBTU	Incentive Costs ($)	Admin Costs ($)	Total Program Costs ($)
2008	20,573	23,460	148,187,928	36,723	$14,175,769	$18,510,066	$32,685,835
2009	13,626	15,563	86,029,310	59,104	$9,252,568	$18,387,082	$27,639,650
2010	17,390	21,278	116,911,610	67,191	$17,200,623	$21,009,842	$38,210,465
Total	**51,589**	**60,301**	**351,128,848**	**163,018**	**$40,628,961**	**$57,906,990**	**$98,535,951**

Table 16: EEU Portfolio, Test Results

	Program Administrator Cost Test	Total Resource Cost Test	Societal Test
Benefit/Cost Ratio	2.96	2.57	3.15
Net Benefits ($000s)	182,196.52	195,698.78	242,661.55
Total Benefits ($000s)	275,231.99	320,680.31	355,389.73
Total Costs ($000s)	93,035.48	124,981.53	112,728.18

Table 17: EEU Portfolio, Vermont Societal Test

Societal Test			
Benefits		**Costs**	
Avoided Energy Related Costs	$194,722,753	Incremental Costs[17]	$67,822,943
Avoided Summer Capacity Costs	$51,290,749	Utility Administrative Costs[18]	$54,710,580
Avoided Winter Capacity Costs	$29,218,493	Performance Bonus[19]	$2,448,007
Environmental Externalities	$34,709,426	Risk Adjustment	-$12,253,352
Non-electric Fuel Savings	$30,729,023		
Water Savings	$14,719,289		
Total Benefits	**$355,389,732**	**Total Costs**	**$112,728,178**
Benefit-Cost Ratio		**3.15**	

[17] For the purposes of this report, "Incremental Costs" include all participant and third party costs as reported by EVT and BED. Typically, incremental costs are reported net of free riders. Based on the Annual Reports, Frontier could not discern whether or not "participant costs" or "third party costs" included in the summary tables accounted for free-ridership. As a result, the full incremental cost reported by EVT and BED were included in the benefit-cost analysis. This is the most conservative approach for this matter; moreover, Frontier estimates the overall benefit-cost ratio would not be greatly impacted at the overall portfolio level.

[18] For the purposes of this report, "Administrative Costs" refers to all operating, technical assistance/service, and DPS evaluation costs.

[19] Performance Bonuses provided by EVT. Because the Independent Audit spanned two different program performance periods (2006-2008 and 2009-2011), one-third of the actual performance bonus was included in this analysis to account for the 2008 program year. EVT provided a projected performance bonus to cover years 2009 and 2010 of this analysis. See Appendix A for more details.

EVT Portfolio

EVT's energy efficiency initiatives between 2008 and 2010 were cost-effective at the portfolio level. The electric programs were also cost-effective at all levels. However, the Total H&P Portfolio was not cost-effective under the PACT. This result is simply due to the nature of the program and is explained in more detail below.

Table 18: EVT Portfolio, Annual Results

	Summer kW	Winter kW	kWh	MMBTU	Incentive Costs ($)	Admin Costs ($)	Total Program Costs ($)
2008	19,719	22,259	140,562,978	36,723	$13,536,078	$17,606,034	$31,142,112
2009	12,857	14,871	80,648,500	59,104	$8,803,256	$17,637,121	$26,440,377
2010	16,311	20,218	110,449,000	67,191	$16,098,016	$20,237,835	$36,335,851
Total	**48,887**	**57,347**	**331,660,478**	**163,018**	**$38,437,351**	**$55,480,990**	**$93,918,341**

Table 19: EVT Portfolio, Test Results

	Program Administrator Cost Test	Total Resource Cost Test	Societal Test
Benefit/Cost Ratio	2.94	2.57	3.16
Net Benefits ($000s)	171,823.29	186,775.37	231,346.96
Total Benefits ($000s)	260,502.55	305,772.13	338,688.85
Total Costs ($000s)	88,679.27	118,996.76	107,341.89

Table 20: EVT Portfolio, Vermont Societal Test

Societal Test			
Benefits		**Costs**	
Avoided Energy Related Costs	$138,950,103	Incremental Costs[20]	$64,142,718
Avoided Summer Capacity Costs	$48,763,611	Utility Administrative Costs[21]	$52,406,040
Avoided Winter Capacity Costs	$27,788,840	Performance Bonus[22]	$2,448,007
Environmental Externalities	$32,916,720	Risk Adjustment	-$11,654,876
Non-electric Fuel Savings	$31,110,738		
Water Savings	$14,158,841		
Total Benefits	**$338,688,852**	**Total Costs**	**$107,341,889**
Benefit-Cost Ratio		**3.16**	

EVT Electric Portfolio

The EVT electric programs were cost-effective at all levels. The tables below provide additional details.

Table 21: EVT Electric

	Program Administrator Cost Test	Total Resource Cost Test	Societal Test
Benefit/Cost Ratio	3.01	2.55	3.14
Net Benefits ($000s)	173,797.57	177,953.11	221,367.79
Total Benefits ($000s)	260,264.31	292,574.15	324,766.13
Total Costs ($000s)	86,466.75	114,621.04	103,398.34

Table 22: EVT Electric Business Energy Services

	Program Administrator Cost Test	Total Resource Cost Test	Societal Test
Benefit/Cost Ratio	2.59	2.51	3.10
Net Benefits ($000s)	92,016.55	98,492.80	123,178.23
Total Benefits ($000s)	149,762.41	163,723.36	181,885.73
Total Costs ($000s)	57,745.86	65,230.55	58,707.50

[20] For the purposes of this report, "Incremental Costs" include all participant and third party costs as reported by EVT and BED. Typically, incremental costs are reported net of free riders. Based on the Annual Reports, Frontier could not discern whether or not "participant costs" or "third party costs" included in the summary tables accounted for free-ridership. As a result, the full incremental cost reported by EVT and BED were included in the benefit-cost analysis. This is the most conservative approach for this matter; moreover, Frontier estimates the overall benefit-cost ratio would not be greatly impacted at the overall portfolio level.

[21] For the purposes of this report, "Administrative Costs" refers to all operating, technical assistance/service, and DPS evaluation costs.

[22] Performance Bonuses provided by EVT. Because the Independent Audit spanned two different program performance periods (2006-2008 and 2009-2011), one-third of the actual performance bonus was included in this analysis to account for the 2008 program year. EVT provided a projected performance bonus to cover years 2009 and 2010 of this analysis. See Appendix A for more details.

Table 23: EVT Electric Residential Energy Services

	Program Administrator Cost Test	Total Resource Cost Test	Societal Test
Benefit/Cost Ratio	3.85	2.75	3.39
Net Benefits ($000s)	81,781.01	82,250.82	100,980.08
Total Benefits ($000s)	110,501.90	129,247.31	143,276.92
Total Costs ($000s)	28,720.89	46,996.48	42,296.84

EVT H&P

The Heating-and-Process Fuel initiatives offered by EVT during the evaluation period were cost-effective under the TRC and VT Societal; however, both the Business H&P and Residential H&P Portfolios failed the PACT. Because the PACT examines energy efficiency programs from the perspective of the utility, in this case, an electric utility, it makes sense that a program designed to increase the efficiency of non-electric fuels may not pass. For example, EVT's 2010 H&P Business Energy Services portfolio produced approximately 14,000 MMBTU of non-electric fuel savings; however, it also resulted in an increase of over 240,000 kWh of energy and 65 MW of demand during the winter months (due mostly to end uses installed within the "air conditioning efficiency" category. Because the PACT does not include any non-electric benefits that may result, the increased electric costs outweigh the minimal electricity savings and the benefit-cost ratio result is less than one. That said, EVT's overall H&P Business Portfolio produced strong test results of 4.42 and 5.17 under the TRC and VT Societal, respectively.[23]

Table 24: EVT H&P

	Program Administrator Cost Test	Total Resource Cost Test	Societal Test
Benefit/Cost Ratio	0.11	3.02	3.53
Net Benefits ($000s)	-1,974.28	8,824.89	9,981.80
Total Benefits ($000s)	238.24	13,200.61	13,925.35
Total Costs ($000s)	2,212.52	4,375.72	3,943.55

Table 25: EVT H&P Business Energy Services

	Program Administrator Cost Test	Total Resource Cost Test	Societal Test
Benefit/Cost Ratio	-0.07	4.42	5.17
Net Benefits ($000s)	-476.89	3,098.44	3,394.44
Total Benefits ($000s)	-30.60	4,003.25	4,208.77
Total Costs ($000s)	446.29	904.81	814.33

[23] Frontier included some 2009 spending attributed to EVT's H&P Energy Services, as reported in Table 2.1.22 of EVT's 2010 Annual Report.

Table 26: EVT H&P Residential Energy Services

	Program Administrator Cost Test	Total Resource Cost Test	Societal Test
Benefit/Cost Ratio	0.25	2.58	3.03
Net Benefits ($000s)	-1,497.39	5,777.82	6,661.96
Total Benefits ($000s)	501.06	9,426.96	9,946.18
Total Costs ($000s)	1,998.45	3,649.14	3,284.22

BED EEU Portfolio

BED's energy efficiency initiatives between 2008 and 2010 were cost-effective under all testing methodologies. It is important to note that Frontier reported only the costs and savings as reported by BED in its Annual Reports. As a result, because BED reports the non-electric fuel increases resulting from its EEU Portfolio, but does not report any non-electric fuel savings, the results listed below are slightly skewed. Frontier assumes that, in reality, BED's energy efficiency services result in a net decrease in non-electric fuels (similar to EVT). If this is the case, benefit-cost ratios for the TRC and VT Societal would be higher than what is reflected in the following tables. This also explains why BED's PACT test is higher than the VT Societal. This fact provides further proof that, even when some benefits are excluded, BED's EEU Portfolio is cost-effective.

Frontier recommends that the Board and BED work together to determine whether or not reporting non-electric fuel savings would be beneficial in future years.

Table 27: BED EEU Portfolio, Annual Results

	Summer kW	Winter kW	kWh	MMBTU	Incentive Costs ($)	Admin Costs ($)	Total Program Costs ($)
2008	854	1,202	7,624,950	-2,330	$639,691	$904,032	$1,543,723
2009	769	692	5,380,810	-1,263	$449,312	$749,961	$1,199,273
2010	1,079	1,060	6,462,610	-2,183	$1,102,607	$772,007	$1,874,614
Total	**2,702**	**2,954**	**19,468,370**	**-5,775**	**$2,191,610**	**$2,426,000**	**$4,617,610**

Table 28: BED EEU Portfolio, Test Results

	Program Administrator Cost Test	Total Resource Cost Test	Societal Test
Benefit/Cost Ratio	3.38	2.40	2.98
Net Benefits ($000s)	10,373.23	8,923.41	11,352.76
Total Benefits ($000s)	14,729.44	15,289.89	17,082.59
Total Costs ($000s)	4,356.21	6,366.48	5,729.83

Table 29: BED EEU Portfolio, Vermont Societal Test

Societal Test			
Benefits		**Costs**	
Avoided Energy Related Costs	$10,772,650	Incremental Costs[24]	$3,680,226
Avoided Summer Capacity Costs	$2,527,138	Utility Administrative Costs[25]	$2,304,540
Avoided Winter Capacity Costs	$1,429,653	Non-Electric Fuel Increase	$381,715
Environmental Externalities	$1,792,706	Risk Adjustment[26]	-$636,648
Non-electric Fuel Savings	NA		
Water Savings	$560,448		
Total Benefits	**$17,082,595**	**Total Costs**	**$5,729,832**
Benefit-Cost Ratio		**2.98**	

Table 30: BED Business Energy Services

	Program Administrator Cost Test	Total Resource Cost Test	Societal Test
Benefit/Cost Ratio	3.50	2.18	2.72
Net Benefits ($000s)	6,580.09	4,978.78	6,561.29
Total Benefits ($000s)	9,212.36	9,212.36	10,371.51
Total Costs ($000s)	2,632.27	4,233.58	3,810.22

Table 31: BED Residential Energy Services

	Program Administrator Cost Test	Total Resource Cost Test	Societal Test
Benefit/Cost Ratio	3.20	2.85	3.50
Net Benefits ($000s)	3,793.14	3,944.62	4,791.48
Total Benefits ($000s)	5,517.08	6,077.52	6,711.09
Total Costs ($000s)	1,723.93	2,132.90	1,919.61

[24] For the purposes of this report, "Incremental Costs" include all participant and third party costs as reported by EVT and BED. Typically, incremental costs are reported net of free riders. Based on the Annual Reports, Frontier could not discern whether or not "participant costs" or "third party costs" included in the summary tables accounted for free-ridership. As a result, the full incremental cost reported by EVT and BED were included in the benefit-cost analysis. This is the most conservative approach for this matter; moreover, Frontier estimates the overall benefit-cost ratio would not be greatly impacted at the overall portfolio level.

[25] For the purposes of this report, "Administrative Costs" refers to all operating, technical assistance/service, and DPS evaluation costs.

[26] Risk Adjustment was applied based on total costs, including non-electric fuel increase costs. Based on Frontier's understanding of the risk adjustment, the only costs to be excluded from the 10% discount are fuel externalities.

Observations and Recommendations

The Vermont EEU is comprised of highly skilled staff and management. EVT, BED, and the Department have specialized staff dedicated to managing the various aspects of EEU program administration. Based on our interviews, we believe all parties have a sincere interest in contributing to the long term success of energy efficiency initiatives in Vermont. The efforts of all parties demonstrate a desire to continually increase process efficiencies and produce verifiable savings results.

Given this overall environment, we expect EEU programs to remain cost-effective, assuming that avoided costs do not dramatically decrease. However, we anticipate that the recent modifications made by the Board to the Vermont societal test will help to hedge against these potential decreases.

Over the past ten years, Vermont has established a solid framework for implementing, evaluating, and overseeing energy efficiency initiatives across the state. Our recommendations address aspects of the EEU process that could benefit from increased efficiency or collaboration.

- Program years covered by the independent audit are off by one year from the program performance years. We recommend aligning these time periods for a more cohesive documentation of program history.
- While both EVT and BED appear to be following generally accepted M&V guidelines, there does not appear to be a formally prescribed process in place for project M&V. M&V efforts at the project level on the part of EVT and BED have not been categorically approved by the Department. This can cause a breakdown between project performance as anticipated by the utility and as accepted by the Department during annual verification. We recommend establishing an accepted protocol that mandates M&V requirements based on project type. Incorporating the M&V requirements of the Forward Capacity Markets (FCM) offers an opportunity to formally align EEU program M&V requirements.
- The Department's M&V contractor conducts a diligent review of annual performance. However, verification that TRM values are being properly applied can be cumbersome due to factors including values that change from year to year and embedded calculations within utility tracking systems. EEU parties mentioned transitioning the TRM from a document format to a database format. We strongly encourage this transition as it will help to prevent use of outdated values and maintain transparency. In addition, we recommend that all parties work collaboratively to develop the database and that the database be housed in such a manner that all parties will have access to utilize and verify its content.
- Savings values found within the TRM are based on sound engineering principles that have been vetted by the TAG. In general, our review of these values supports their use in determining savings for EEU projects. Our review of the supporting calculation documents revealed only minor discrepancies between the values in the TRM and the values in the supporting documents.

- While the TRM offers a solid foundation for savings values, we encourage a more thorough annual savings verification process that includes site visits for a sample of projects. Information gleaned from site visits conducted by the M&V contractor will provide increased confidence in adjustments to EEU annual savings claims. Additionally, it will inform future updates to TRM values and M&V procedures.

Appendix A

- Spreadsheets reflect cost summaries as totaled from EVT and BED Annual Reports, respectively. Data points in red or with comments may reflect aforementioned discrepancies in data within Annual Reports; Frontier will provide spreadsheets to the Board.
- Performance Bonus estimates provided by EVT. Because the Independent Audit spanned two different program performance periods (2006-2008 and 2009-2011), one-third of the actual performance bonus was included in this analysis to account for the 2008 program year. EVT provided a projected performance bonus to cover years 2009 and 2010 of this analysis. The following table shows EVT's estimated annual performance bonus.

Table 32: Estimated EVT Performance Bonus

Performance Bonus	Estimated Bonus/Year
2008 Electric Bonus	$772,007
2009 Electric Bonus	$811,000
2010 Electric Bonus	$811,000
Total Electric Bonus	$2,394,007
2008-2010 H&P Bonus	$54,000
EVT Total Bonus	**$2,448,007**

- DPS Evaluation Costs as shown in the following table include costs associated with M&V, the Contract Administrator and Fiscal Agent, and the Fiscal Agent Audit.

Table 33: DPS Evaluation Costs

	2008	2009	2010	Total
DPS Costs (VEIC)	$862,841	$809,333	$931,717	$2,603,891
DPS Costs (BED)	$65,159	$67,667	$54,283	$187,109

Table 34: EEU Cost Summary, 2008-2010

EVT Costs Summary (2008-2010) (Excluding Customer Credit)	EVT Electric & H&P 2008-2010 All Programs	BED Costs Summary (2008-2010)	BED ELECTRIC COSTS 2008-2010 All Programs	EEU Portfolio 2008-2011 All Programs
Operating Costs		BED Administration Costs		
Administration	$ 1,341,686	General	$ 586,223	
Information Systems	$ 2,350,959	Implementation	$ 169,376	
ISO-NE Regional Capacity Activities	$ 269,985	Planning	$ 19,685	
Smart Grid	$ 18,581	Marketing	$ 282,587	
DRP & DRPP	$ 281,658	IT Development	$ 59,677	
Services and Initiatives	$ 14,827,222			
Marketing/Business	$ 13,255,911			
Subtotal Operating Costs	**$ 32,346,002**	**Subtotal Admin Costs**	**$ 1,117,548**	**$ 33,463,550**
Incentive Costs		Incentive Costs		
Incentives to Participants	$ 38,140,335	Participants	$ 2,181,206	
Incentives to Trade Allies	$ 297,017	Trade Allies	$ 10,404	
Subtotal Incentive Costs	**$ 38,437,352**	**Subtotal Incentive Costs**	**$ 2,191,610**	**$ 40,628,962**
Technical Assistance Costs		Service Costs		
Services to Participants	$ 19,579,288	Participants	$ 1,121,343	
Services to Trade Allies	$ 951,809	Trade Allies	$ -	
Subtotal Technical Assistance Costs	**$ 20,531,097**	**Subtotal Service Costs**	**$ 1,121,343**	**$ 21,652,440**
Total EVT Costs	**$ 91,314,451**	**Total BED Costs**	**$ 4,430,501**	**$ 95,744,952**
Total Participant Costs	$ 64,128,501	Evaluation Costs (include DPS Costs)	$ 187,109	$ 64,315,610
Total Third Party Costs	$ 3,385,241	Participant	$ 3,868,062	$ 7,253,303
Total Services and Initiatives Costs	**$ 158,828,193**	**Total Program Costs**	**$ 8,485,672**	**$ 167,313,865**
Department of Public Service Costs				
Total Cost (minus BED's portion) including:	**$ 2,603,891**	**(see Evaluation Costs above)**		**$ 2,603,891**
DPS M&V				
Contract Administrator and Fiscal Agent				
Fiscal Agent Audit				
Total Costs (All parties)	**$ 161,432,084**	**Total Costs (All Parties)**	**$ 8,485,672**	**$ 169,917,756**
Performance Bonus (added to three year total only)	$ 2,448,007			
TOTAL	**$ 163,880,091**		**$ 8,485,672**	**$ 172,365,763**
Frontier Model		Frontier Model		
Annual Rebate (Incentives to Part and Trade Allies)	$ 38,437,352	Annual Rebate (Incentives to Part and Trade Allies)	$ 2,191,610	$ 40,628,962
Total "Admin" (Operating Costs, Tech Asst, DPS Costs)	$ 55,480,990	Total "Admin" (Operating Costs, Tech Asst)	$ 2,426,000	$ 57,906,990
Total Annual Program Costs	$ 93,918,342	Total Annual Program Costs (includes eval in admin)	$ 4,617,610	$ 98,535,952
Total Participant and Third Party Costs	$ 67,513,742	Total Participant and Third Party Costs	$ 3,868,062	$ 71,381,804

Table 35: EVT Electric Programs Cost Summary, 2008-2010

EVT Costs Summary (2008-2010)		EVT ELECTRIC COSTS										
Excluding Customer Credit	Classification of Costs	2008			2009			2010			2008-2010
	"Incentives" vs "Admin"	Business	Residential	Total	Business	Residential	Total	Electric Business	Electric Residential	Total	Summary
		2008	2008	2008	2009	2009		2010	2010		
Operating Costs	Allocation Factor	55%	45%		55%	45%		54%	46%		
Administration	Admin	$ 410,963	$ 330,751	$ 741,714	$ 183,776.68	$ 150,424.32	$ 334,201	$ 143,538.98	$ 122,232.02	$ 265,771	$ 1,341,686
Information Systems	Admin	$ 436,957	$ 351,672	$ 788,629	$ 464,490.14	$ 372,007.86	$ 826,498	$ 397,411.96	$ 338,420.04	$ 735,832	$ 2,350,959
ISO-NE Regional Capacity Activities	Admin	$ -	$ -	$ -	$ -	$ -	$ -	$ 145,814.90	$ 124,170.10	$ 269,985	$ 269,985
Smart Grid	Admin	$ -		$ -	$ -	$ -	$ -	$ 10,035.32	$ 8,545.68	$ 18,581	$ 18,581
DRP & DRPP	Admin	$ -		$ -	$ -	$ -	$ -	$ 152,119.31	$ 129,538.69	$ 281,658	$ 281,658
Services and Initiatives	Admin	$ 2,258,383	$ 2,026,288	$ 4,284,671	$ 2,838,883	$ 2,153,313	$ 4,992,196	$ 2,843,643	$ 2,534,315	$ 5,377,958	$ 14,654,825
Marketing/Business	Admin	$ 2,203,003	$ 1,564,319	$ 3,767,322	$ 2,044,641	$ 1,843,934	$ 3,888,575	$ 2,920,988	$ 2,374,613	$ 5,295,601	$ 12,951,498
Subtotal Operating Costs	**Admin**	**$ 5,309,307**	**$ 4,273,029**	**$ 9,582,336**	**$ 5,521,791**	**$ 4,519,679**	**$ 10,041,470**	**$ 6,613,551**	**$ 5,631,835**	**$ 12,245,386**	**$ 31,869,192**
Incentive Costs											
Incentives to Participants	Incentive	$ 9,924,228	$ 5,505,068	$ 15,429,296	$ 5,921,991	$ 2,648,880	$ 8,570,871	$ 10,781,462	$ 4,434,311	$ 15,215,773	$ 37,215,940
Incentives to Trade Allies	Incentive	$ 23,113	$ 83,669	$ 106,782	$ 9,537	$ 76,112	$ 85,649	$ 8,775	$ 76,211	$ 84,986	$ 277,417
Subtotal Incentive Costs	**Incentive**	**$ 9,947,341**	**$ 3,588,737**	**$ 13,536,078**	**$ 5,931,528**	**$ 2,724,992**	**$ 8,656,520**	**$ 10,790,237**	**$ 4,510,522**	**$ 15,300,759**	**$ 37,493,357**
Technical Assistance Costs											
Services to Participants	Admin	$ 5,432,809	$ 1,170,768	$ 6,603,577	$ 4,950,126	$ 1,186,494	$ 6,136,620	$ 4,970,143	$ 848,518	$ 5,818,661	$ 18,558,858
Services to Trade Allies	Admin	$ -	$ 557,280	$ 557,280	$ -	$ 257,831	$ 257,831	$ -	$ 136,698	$ 136,698	$ 951,809
Subtotal Technical Assistance Costs	**Admin**	**$ 5,432,809**	**$ 1,728,048**	**$ 7,160,857**	**$ 4,950,126**	**$ 1,444,325**	**$ 6,394,451**	**$ 4,970,143**	**$ 985,216**	**$ 5,955,359**	**$ 19,510,667**
Total EVT Costs	NA	**$ 20,689,457**	**$ 9,589,814**	**$ 30,279,271**	**$ 16,403,445**	**$ 8,688,996**	**$ 25,092,441**	**$ 22,373,931**	**$ 11,127,573**	**$ 33,501,504**	**$ 88,873,216**
Total Participant Costs	Incremental Costs	$ 11,458,608	$ 12,734,838	$ 24,193,446	$ 9,573,214	$ 9,574,058	$ 19,147,272	$ 12,533,950	$ 4,865,426	$ 17,499,376	$ 60,840,094
Total Third Party Costs	Incremental Costs	$ 289,210	$ 1,051,615	$ 1,340,825	$ 241,855	$ 585,707	$ 827,562	$ 402,054	$ 811,547	$ 1,213,601	$ 3,381,988
Total Services and Initiatives Costs (Tot	NA	**$ 32,437,275**	**$ 23,376,267**	**$ 55,813,542**	**$ 26,218,514**	**$ 18,848,761**	**$ 45,067,275**	**$ 35,409,935**	**$ 16,804,546**	**$ 52,214,481**	**$ 153,095,298**
Department of Public Service Costs	Allocation Factor	58%	42%		58%	42%		68%	32%		
Total Cost (minus BED's portion) including:		$ 500,448	$ 362,393	$ 862,841	$ 469,413	$ 339,920	$ 809,333	$ 633,568	$ 298,149	$ 931,717	$ 2,603,891
DPS M&V	Admin										
Contract Administrator and Fiscal Agent	Admin										
Fiscal Agent Audit	Admin										
Total DPS Costs	Admin	**$ 500,448**	**$ 362,393**	**$ 862,841**	**$ 469,413**	**$ 339,920**	**$ 809,333**	**$ 633,568**	**$ 298,149**	**$ 931,717**	**$ 2,603,891**
Total Costs (All parties)		**$ 32,937,723**	**$ 23,738,660**	**$ 56,676,383**	**$ 26,687,927**	**$ 19,188,681**	**$ 45,876,608**	**$ 36,043,503**	**$ 17,102,695**	**$ 53,146,198**	**$ 155,699,189**
Performance Bonus (added to three year total only)											**$ 2,394,007**
Frontier Model											
Annual Rebate (Incentives to Part and Trade Allies)		$ 9,947,341	$ 3,588,737	$ 13,536,078	$ 5,931,528	$ 2,724,992	$ 8,656,520	$ 10,790,237	$ 4,510,522	$ 15,300,759	$ 37,493,357
Total "Admin" (Operating Costs, Tech Asst, DPS Costs)		$ 11,242,564	$ 6,363,470	$ 17,606,034	$ 10,941,330	$ 6,303,934	$ 17,245,254	$ 12,217,262	$ 6,915,200	$ 19,132,462	$ 53,983,750
Total Annual Program Costs		$ 21,189,905	$ 9,952,207	$ 31,142,112	$ 16,872,858	$ 9,028,926	$ 25,901,774	$ 23,007,499	$ 11,425,722	$ 34,433,221	$ 91,477,107
Net Participant Investment		$ 11,747,818	$ 13,786,453	$ 25,534,271	$ 9,815,069	$ 10,159,765	$ 19,974,834	$ 13,036,004	$ 5,676,973	$ 18,712,977	$ 64,222,082

Table 36: EVT Heating & Process Fuels and Total EVT Portfolio Cost Summary, 2008-2010

EVT Costs Summary (2008-2010)	EVT Heating & Process Fuels				EVT Electric & H&P
Excluding Customer Credit	2009/2010	2009	2010	2009/2010	2008-2010
	H&P Business	H&P Residential	H&P Residential	H&P Bus/Res Total	All Programs
Operating Costs					
Administration	$ -			$ -	$ 1,341,686
Information Systems	$ -			$ -	$ 2,350,959
ISO-NE Regional Capacity Activities	$ -			$ -	$ 269,985
Smart Grid	$ -			$ -	$ 18,581
DRP & DRPP	$ -			$ -	$ 281,658
Services and Initiatives	$ 9,631	$ 29,835	$ 132,931	$ 172,397	$ 14,827,222
Marketing/Business	$ 214	$ 166,706	$ 137,493	$ 304,413	$ 13,255,911
Subtotal Operating Costs	**$ 9,845**	**$ 196,541**	**$ 270,424**	**$ 476,810**	**$ 32,346,002**
				$ -	$ -
Incentive Costs				$ -	$ -
Incentives to Participants	$ 128,950	$ 146,738	$ 648,707	$ 924,395	$ 38,140,335
Incentives to Trade Allies	$ 2,400	$ -	$ 17,200	$ 19,600	$ 297,017
Subtotal Incentive Costs	**$ 131,350**	**$ 146,738**	**$ 665,907**	**$ 943,995**	**$ 38,437,352**
				$ -	$ -
Technical Assistance Costs				$ -	$ -
Services to Participants	$ 97,972	$ 195,326	$ 727,132	$ 1,020,430	$ 19,579,288
Services to Trade Allies	$ -	$ -		$ -	$ 951,809
Subtotal Technical Assistance Costs	**$ 97,972**	**$ 195,326**	**$ 727,132**	**$ 1,020,430**	**$ 20,531,097**
				$ -	$ -
Total EVT Costs	**$ 239,167**	**$ 538,605**	**$ 1,663,463**	**$ 2,441,235**	**$ 91,314,451**
				$ -	$ -
Total Participant Costs	$ 643,628	$ 301,817	$ 2,342,962	$ 3,288,407	$ 64,128,501
Total Third Party Costs		$ -	$ 3,253	$ 3,253	$ 3,385,241
Total Services and Initiatives Costs (Total Program Co	**$ 882,795**	**$ 840,422**	**$ 4,009,678**	**$ 5,732,895**	**$ 158,828,193**
Department of Public Service Costs					
Total Cost (minus BED's portion) including:	*DPS Evaluation Costs not included in H&P Analysis; Only costs included in analysis are those included in the Annual Report (2010 Annual Report, Table 2.1.19)*				$ 2,603,891
DPS M&V					
Contract Administrator and Fiscal Agent					
Fiscal Agent Audit					
Total DPS Costs					**$ 2,603,891**
Total Costs (All parties)	**$ 882,795**	**$ 840,422**	**$ 4,009,678**	**$ 5,732,895**	**$ 161,432,084**
Performance Bonus (added to three year total only)				**$ 54,000**	**$ 2,448,007**

Frontier Model					
Annual Rebate (Incentives to Part and Trade Allies)	$ 131,350	$ 146,738	$ 665,907	$ 943,995	$ 38,437,352
Total "Admin" (Operating Costs, Tech Asst, DPS Costs)	$ 107,817	$ 391,867	$ 997,556	$ 1,497,240	$ 55,480,990
Total Annual Program Costs	$ 239,167	$ 538,605	$ 1,663,463	$ 2,441,235	$ 93,918,342
Net Participant Investment	$ 643,628	$ 301,817	$ 2,346,215	$ 3,291,660	$ 67,513,742

Table 37: BED Total Portfolio Cost Summary, 2008-2010

BED Costs Summary (2008-2010)		BED ELECTRIC COSTS									
Data pulled from Annual Reports	Classification of Costs	2008			2009			2010			2008-2010
	"Incentives" vs "Admin"	Business	Residential	Total	Business	Residential	Total	Electric Business	Electric Residential	Total	Summary
		2008	2008	2008	2009	2009		2010	2010		
BED Administration Costs											
General	Admin	$ 53,602	$ 105,789	$ 159,391	$ 116,788	$ 93,003	$ 209,791	$ 99,966	$ 117,075	$ 217,041	$ 586,223
Implementation	Admin	$ 17,651	$ 39,004	$ 56,655	$ 18,895	$ 37,904	$ 56,799	$ 24,130	$ 31,792	$ 55,922	$ 169,376
Planning	Admin	$ 1,158	$ 648	$ 1,806	$ 3,408	$ 2,309	$ 5,717	$ 7,646	$ 4,516	$ 12,162	$ 19,685
Marketing	Admin	$ 15,466	$ 161,870	$ 177,336	$ 21,868	$ 1,495	$ 23,363	$ 30,349	$ 51,539	$ 81,888	$ 282,587
IT Development	Admin	$ 16,064	$ 17,037	$ 33,101	$ 9,642	$ 5,794	$ 15,436	$ 6,674	$ 4,466	$ 11,140	$ 59,677
	Admin										
	Admin										
Subtotal Admin Costs	**Admin**	**$ 103,941**	**$ 324,348**	**$ 428,289**	**$ 170,601**	**$ 140,505**	**$ 311,106**	**$ 168,765**	**$ 209,388**	**$ 378,153**	**$ 1,117,548**
											$ -
Service Costs											$ -
Participants	Admin	$ 250,666	$ 159,918	$ 410,584	$ 224,900	$ 146,288	$ 371,188	$ 249,095	$ 90,476	$ 339,571	$ 1,121,343
Trade Allies	Admin	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Subtotal Service Costs	**Admin**	**$ 250,666**	**$ 159,918**	**$ 410,584**	**$ 224,900**	**$ 146,288**	**$ 371,188**	**$ 249,095**	**$ 90,476**	**$ 339,571**	**$ 1,121,343**
											$ -
Incentive Costs											$ -
Participants	Incentive	$ 365,698	$ 273,852	$ 639,550	$ 300,924	$ 147,296	$ 448,220	$ 843,316	$ 250,120	$ 1,093,436	$ 2,181,206
Trade Allies	Incentive	$ -	$ 141	$ 141	$ 840	$ 252	$ 1,092	$ 6,495	$ 2,676	$ 9,171	$ 10,404
Subtotal Incentive Costs	**Incentive**	**$ 365,698**	**$ 273,993**	**$ 639,691**	**$ 301,764**	**$ 147,548**	**$ 449,312**	**$ 849,811**	**$ 252,796**	**$ 1,102,607**	**$ 2,191,610**
											$ -
Total BED Costs	NA	**$ 720,305**	**$ 758,259**	**$ 1,478,564**	**$ 697,265**	**$ 434,341**	**$ 1,131,606**	**$ 1,267,671**	**$ 552,660**	**$ 1,820,331**	**$ 4,430,501**
											$ -
Evaluation Costs (include DPS Costs)	Admin	$ 43,576	$ 21,583	$ 65,159	$ 44,608	$ 23,059	$ 67,667	$ 35,630	$ 18,653	$ 54,283	$ 187,109
Participant	Incremental Costs	$ 841,866	$ 282,367	$ 1,124,233	$ 1,745,750	$ 216,551	$ 1,962,301	$ 458,549	$ 322,979	$ 781,528	$ 3,868,062
Total Program Costs	NA	**$ 1,605,747**	**$ 1,062,209**	**$ 2,667,956**	**$ 2,487,623**	**$ 673,951**	**$ 3,161,574**	**$ 1,761,850**	**$ 894,292**	**$ 2,656,142**	**$ 8,485,672**
Total Costs		**$ 1,605,747**	**$ 1,062,209**	**$ 2,667,956**	**$ 2,487,623**	**$ 673,951**	**$ 3,161,574**	**$ 1,761,850**	**$ 894,292**	**$ 2,656,142**	**$ 8,485,672**
Frontier Model											
Annual Rebate (incentives to Part and Trade Allies)		$ 365,698	$ 273,993	$ 639,691	$ 301,764	$ 147,548	$ 449,312	$ 849,811	$ 252,796	$ 1,102,607	$ 2,191,610
Total "Admin" (Operating Costs, Tech Asst)		$ 398,183	$ 505,849	$ 904,032	$ 440,109	$ 309,852	$ 749,961	$ 453,490	$ 318,517	$ 772,007	$ 2,426,000
Total Annual Program Costs (includes eval in admin)		$ 763,881	$ 779,842	$ 1,543,723	$ 741,873	$ 457,400	$ 1,199,273	$ 1,303,301	$ 571,313	$ 1,874,614	$ 4,617,610
Net Participant Investment		$ 841,866	$ 282,367	$ 1,124,233	$ 1,745,750	$ 216,551	$ 1,962,301	$ 458,549	$ 322,979	$ 781,528	$ 3,868,062

Appendix B

Avoided Costs

- Based on 2010 Screening Tool, line losses removed
- All end use savings reported as net values
    - Electric Avoided Costs
    - Non-Electric Avoided Costs

Non-Electric Externalities

- Based on 2010 Screening Tool

Load Shapes (LS) and Estimated Useful Lives (EULs)

- LS and EUL per end use were calculated based on a combination of sample data pulled from the EVT Database and the TRM
    - Load shapes listing more than one code as the source were calculated using a weighted average pulled from the EVT Database sample
    - EULs sourced as "EVT DB" were calculated using a weighted average pulled from the EVT Database sample
    - EULs sourced as "Business Weighted Avg" reflect the weighted average lifetime as listed in the Annual Report for the appropriate market sector and year; these values were selected because Frontier did not feel the sample size for particular end uses were appropriate or representative of the potential measures actually installed

Table 38: Electric Avoided Costs

	Winter Peak Energy	Winter Off-Peak Energy	Summer Peak Energy	Summer Off-Peak Energy	Winter Capacity	Summer Capacity (with T&D)
	$/kWh	$/kWh	$/kWh	$/kWh	$/kW	$/kW
2008	0.1143	0.0863	0.1063	0.0818	69.69	104.03
2009	0.1074	0.0827	0.1079	0.0755	69.71	104.06
2010	0.0676	0.0523	0.0700	0.0513	69.73	165.05
2011	0.0719	0.0564	0.0742	0.0536	69.75	150.95
2012	0.0782	0.0608	0.0772	0.0570	69.72	141.91
2013	0.0785	0.0643	0.0793	0.0623	69.69	121.89
2014	0.0790	0.0653	0.0802	0.0625	69.65	121.85
2015	0.0790	0.0659	0.0818	0.0625	69.61	123.18
2016	0.0794	0.0671	0.0848	0.0636	69.57	124.53
2017	0.0809	0.0689	0.0863	0.0663	69.56	124.52
2018	0.0842	0.0705	0.0877	0.0685	69.52	125.86
2019	0.0846	0.0721	0.0900	0.0694	69.48	125.82
2020	0.0848	0.0722	0.0897	0.0694	69.44	127.16
2021	0.0836	0.0714	0.0882	0.0700	69.41	128.52
2022	0.0845	0.0732	0.0903	0.0711	69.37	129.88
2023	0.0871	0.0738	0.0937	0.0734	69.34	131.23
2024	0.0916	0.0753	0.0992	0.0779	69.30	132.59
2025	0.0931	0.0764	0.1014	0.0798	69.27	146.46
2026	0.0947	0.0776	0.1036	0.0818	69.23	160.34
2027	0.0963	0.0787	0.1058	0.0838	69.20	174.25
2028	0.0979	0.0799	0.1081	0.0859	69.16	188.18
2029	0.0995	0.0811	0.1105	0.0880	69.12	202.14
2030	0.1012	0.0823	0.1129	0.0902	69.09	214.72
2031	0.1028	0.0835	0.1153	0.0924	69.05	214.76
2032	0.1046	0.0847	0.1178	0.0947	69.02	214.81
2033	0.1063	0.0860	0.1204	0.0970	68.98	214.85
2034	0.1081	0.0873	0.1230	0.0994	68.94	214.89
2035	0.1099	0.0886	0.1257	0.1019	68.91	214.93
2036	0.1117	0.0899	0.1284	0.1044	68.87	214.97
2037	0.1136	0.0912	0.1312	0.1070	68.84	215.02
2038	0.1154	0.0926	0.1341	0.1096	68.79	215.05
2039	0.1174	0.0939	0.1370	0.1123	68.76	215.09
2040	0.1193	0.0953	0.1400	0.1151	68.72	215.04
2041	0.1213	0.0968	0.1430	0.1180	68.69	214.98
2042	0.1233	0.0982	0.1461	0.1209	68.64	214.92
2043	0.1254	0.0997	0.1493	0.1239	68.61	214.87
2044	0.1275	0.1011	0.1525	0.1269	68.57	214.82
2045	0.1296	0.1026	0.1558	0.1301	68.53	214.75
2046	0.1318	0.1042	0.1592	0.1333	68.50	214.70
2047	0.1339	0.1057	0.1627	0.1366	68.50	214.70
2048	0.1362	0.1073	0.1662	0.1400	68.50	214.70
2049	0.1384	0.1089	0.1698	0.1434	68.50	214.70
2050	0.1407	0.1105	0.1735	0.1470	68.50	214.70
2051	0.1431	0.1121	0.1773	0.1506	68.50	214.70
2052	0.1455	0.1138	0.1811	0.1543	68.50	214.70
2053	0.1479	0.1155	0.1851	0.1581	68.50	214.70

Table 39: Non-Electric Fuel Avoided Costs

	End-Use Non-Electric Fuel Avoided Costs ($/MMBtu)							
	Res. Distillate	LPG	Res. Natural Gas	Com. Distillate	Com. Natural Gas	Kerosene	Wood	Wood Pellets
2008	17.71	30.99	13.42	15.61	11.25	18.42	6.34	12.68
2009	17.49	24.91	9.28	14.17	6.72	16.99	6.30	12.59
2010	15.64	24.04	10.35	13.37	7.80	15.18	5.63	11.26
2011	16.34	24.91	10.95	14.37	8.39	15.87	5.88	11.77
2012	17.95	26.84	11.35	15.95	8.79	17.44	6.46	12.93
2013	19.32	29.09	11.37	17.38	8.82	18.76	6.96	13.91
2014	20.92	31.29	11.45	18.95	8.89	20.32	7.53	15.06
2015	22.65	33.63	11.54	20.55	8.98	21.99	8.15	16.31
2016	24.36	36.14	11.67	22.11	9.11	23.65	8.77	17.54
2017	25.96	38.58	11.84	23.57	9.29	25.21	9.35	18.69
2018	26.02	38.70	12.04	23.67	9.49	25.27	9.37	18.73
2019	26.18	38.90	12.12	23.82	9.57	25.43	9.42	18.85
2020	26.25	38.82	11.96	23.80	9.41	25.49	9.45	18.90
2021	26.32	39.04	11.84	23.93	9.29	25.57	9.48	18.95
2022	26.53	39.28	11.93	24.18	9.37	25.77	9.55	19.10
2023	26.41	39.04	12.13	24.03	9.57	25.65	9.51	19.01
2024	26.74	39.19	12.48	24.32	9.92	25.97	9.63	19.25
2025	27.24	39.86	12.59	24.77	10.03	26.45	9.81	19.61
2026	27.75	40.54	12.70	25.24	10.14	26.95	9.99	19.98
2027	28.26	41.24	12.81	25.72	10.26	27.45	10.18	20.35
2028	28.79	41.94	12.92	26.20	10.37	27.96	10.36	20.73
2029	29.33	42.66	13.03	26.70	10.48	28.48	10.56	21.12
2030	29.87	43.39	13.15	27.20	10.60	29.01	10.75	21.51
2031	30.43	44.14	13.26	27.72	10.72	29.55	10.96	21.91
2032	31.00	44.89	13.38	28.24	10.84	30.10	11.16	22.32
2033	31.58	45.66	13.49	28.77	10.96	30.67	11.37	22.73
2034	32.16	46.44	13.61	29.32	11.08	31.24	11.58	23.16
2035	32.76	47.24	13.73	29.87	11.20	31.82	11.79	23.59
2036	33.37	48.05	13.85	30.43	11.33	32.41	12.01	24.03
2037	34.00	48.87	13.97	31.01	11.45	33.02	12.24	24.48
2038	34.63	49.71	14.09	31.59	11.58	33.63	12.47	24.93
2039	35.28	50.56	14.22	32.19	11.71	34.26	12.70	25.40
2040	35.93	51.43	14.34	32.80	11.84	34.90	12.94	25.87
2041	36.60	52.31	14.47	33.42	11.97	35.55	13.18	26.35
2042	37.28	53.21	14.59	34.05	12.10	36.21	13.42	26.84
2043	37.98	54.12	14.72	34.69	12.24	36.89	13.67	27.35
2044	38.69	55.05	14.85	35.35	12.37	37.57	13.93	27.85
2045	39.41	55.99	14.98	36.01	12.51	38.27	14.19	28.37
2046	40.14	56.95	15.11	36.69	12.65	38.99	14.45	28.90
2047	40.89	57.93	15.24	37.39	12.79	39.71	14.72	29.44
2048	41.65	58.92	15.37	38.09	12.93	40.45	15.00	29.99
2049	42.43	59.93	15.51	38.81	13.08	41.21	15.27	30.55
2050	43.22	60.96	15.64	39.55	13.22	41.98	15.56	31.12
2051	44.03	62.00	15.78	40.29	13.37	42.76	15.85	31.70
2052	44.85	63.07	15.92	41.05	13.52	43.55	16.14	32.29
2053	45.68	64.15	16.06	41.83	13.67	44.37	16.45	32.89

Table 40: Non-Electric Externalities

VT End-Use Externalities ($/MMBtu)			
Distillate	LPG	Natural Gas	Kerosene
$1.94	$1.47	$1.22	$1.94

Table 41: Load Shapes

Business Energy Services - End Uses	Winter On	Winter Off	Summer On	Summer Off	LS Source
Air Conditioning Eff.	0.1670	0.0260	0.6240	0.1830	LS #15
Cooking and Laundry	0.4201	0.2878	0.1688	0.1233	LS #9
Design Assistance	0.2500	0.2500	0.2500	0.2500	Frontier
Hot Water Efficiency	0.4453	0.3052	0.1469	0.1026	LS #7, 8, and 53
Hot Water Fuel Switch	0.4020	0.3200	0.1510	0.1270	LS #6 and 52
Industrial Process Eff.	0.4620	0.2040	0.2320	0.1020	LS #45, 46, 47
Lighting	0.4749	0.2113	0.2134	0.1004	LS 13 (2010) and 12 (2008)
Motors	0.3991	0.3136	0.1722	0.1150	LS #16, 21, 25, 55
Other Efficiency/Custom	0.2500	0.2500	0.2500	0.2500	Frontier
Other Fuel Switch	0.3870	0.6120	0.0000	0.0010	LS #17
Other Indirect Activity	0.3170	0.3490	0.1590	0.1750	VEIC Sample
Refrigeration	0.3300	0.3260	0.1700	0.1740	LS #14
Space Heat Efficiency	0.3870	0.6120	0.0000	0.0010	LS #17
Space Heat Fuel Switch	0.3870	0.6120	0.0000	0.0010	LS #17
Ventilation	0.3440	0.3660	0.1490	0.1410	LS #16
Residential Energy Services - End Uses	**Winter On**	**Winter Off**	**Summer On**	**Summer Off**	**LS Source**
Air Conditioning Eff.	0.0070	0.0280	0.5330	0.4320	LS #11
Cooking and Laundry	0.4201	0.2878	0.1688	0.1233	LS #9
Hot Water Efficiency	0.4453	0.3052	0.1469	0.1026	LS #7, 8, and 53
Hot Water Fuel Switch	0.4020	0.3200	0.1510	0.1270	LS #6 and 52
Lighting (assuming mix indoor/outdoor)	0.3665	0.3524	0.1290	0.1522	LS# 1 and 2
Monitoring and Metering	0.3690	0.3500	0.1300	0.1510	LS #1
Motors	0.0000	0.0000	0.6500	0.3500	LS #100
Other Fuel Switch	0.4200	0.2880	0.1690	0.1230	LS #9
Other Indirect Activity	0.3170	0.3490	0.1590	0.1750	VEIC Sample
Refrigeration	0.3080	0.3300	0.1710	0.1910	LS #4
Space Heat Efficiency	0.4550	0.5300	0.0060	0.0090	LS #5
Space Heat Fuel Switch	0.4550	0.5300	0.0060	0.0090	LS # 5
Ventilation	0.3170	0.3490	0.1590	0.1750	LS #10
Dishwashing (BED only)	0.4870	0.2910	0.1430	0.0790	LS #8

Table 42: Estimated Useful Life (EUL)

Business Energy Services - End Uses	EUL	Source
Air Conditioning Eff.	15.0	EVT DB
Cooking and Laundry	14.0	EVT DB
Design Assistance	Business Weighted Avg	Business Weighted Avg
Hot Water Efficiency	8.2	EVT DB
Hot Water Fuel Switch	30.0	EVT DB
Industrial Process Eff.	11.6	EVT DB
Lighting	13.8	EVT DB
Motors	16.7	EVT DB
Other Efficiency/Custom	Business Weighted Avg	Business Weighted Avg
Other Fuel Switch	Business Weighted Avg	Business Weighted Avg
Other Indirect Activity	5.0	EVT DB
Refrigeration	9.0	TRM
Space Heat Efficiency	Business Weighted Avg	Business Weighted Avg
Space Heat Fuel Switch	Business Weighted Avg	Business Weighted Avg
Ventilation	10.0	TRM
Residential Energy Services - End Uses	**EUL**	**Source**
Air Conditioning Eff.	16.3	EVT DB
Cooking and Laundry	14.0	EVT DB
Hot Water Efficiency	8.2	EVT DB
Hot Water Fuel Switch	30.0	EVT DB
Lighting (assuming mix indoor/outdoor)	7.0	EVT DB
Monitoring and Metering	3.0	TRM
Motors	10.0	TRM
Other Fuel Switch	14.0	TRM
Other Indirect Activity	5.0	EVT DB
Refrigeration	17.0	TRM
Space Heat Efficiency	25.0	TRM
Space Heat Fuel Switch	25.0	TRM
Ventilation	10.0	TRM
Dishwashing (BED only)	14.0	TRM

Independent Audit, 2008-2010

Report to the Legislature

Vermont Energy Efficiency Utility

Submitted to: Vermont Public Service Board

Frontier Associates, LLC

May 30, 2012

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Introduction

Frontier Associates, LLC (Frontier) submits this Report to the Legislature as part of its Independent Audit. Pursuant to 30 V.S.A. § 209(e)(12), the Board hired Frontier to conduct an independent audit of the reported savings and cost-effectiveness of the electric and heating-and-process (H&P) energy efficiency programs delivered by Efficiency Vermont (EVT) and the City of Burlington Electric Department (BED) and overseen by the Department of Public Service (Department). Together, EVT and BED comprise the Vermont Energy Efficiency Utility (EEU).

In order to fulfill the requirements of the audit, Frontier reviewed and critiqued the procedures and methodologies used by the Department in its savings claims verification process, audited the EEU Technical Resource Manual (TRM) (including the processes in place to update it), assessed database procedures, and conducted cost-effectiveness tests on reported spending and savings for the period January 1, 2008 through December 31, 2010.

Summary of Project Objectives

1. Methodology and process review to identify and recommend improvements related to the Technical Resource Manual, the Department's savings claims verification process, databases and/or other processes
2. Validate savings achieved by the EEU (January 1, 2008 – December 31, 2010)
3. Verify cost-effectiveness of EEU programs, as provided in 30 V.S.A. § 209(e)(12)

Overview of Audit Process and Methodology

Frontier began the audit process in March 2012 with a kick-off meeting to establish roles and expectations. The meeting included members of the Public Service Board, the Department of Public Service, Efficiency Vermont, and Burlington Electric Department. Following the kick-off meeting, Frontier submitted an information request to each party to gather key data components of our analysis. After we completed a preliminary review of all received information, we conducted in-person interviews with all parties to gather more detailed information regarding program management and to clarify data sets. Based on our interpretation of the audit requirements, Frontier designated personnel to contribute to the analysis and evaluation required under each task based on specific knowledge set. Key contributors to the review included:

- Jay Zarnikau, President – project guidance and oversight
- Amy Martin, Manager of Program Design & Evaluation – validation of reported savings and costs and cost-effectiveness evaluation
- Jason Fialkoff, Senior Associate – cost-effectiveness analysis
- Mark Kapner, Director of Engineering – validation of engineering values
- Angel Moreno, Energy Analyst II – validation of engineering values and overall methodology and process review

Tools used during the audit process include spreadsheet and database software applications and reference documents. Where used, reference documents are cited in the Audit Management Letter.

Overview of EEU Programs, 2008-2010

Over 174,000 Vermonters participated in the EEU programs in some fashion between 2008 and 2010. Approximately $99 million[1] was spent on energy efficiency initiatives, resulting in over 351,000 megawatt-hours (MWh) of energy savings, 60 MW of winter demand reduction and 52 MW of summer demand reduction.

Table 1: EEU Portfolio Annual Results[2]

	kWh	Summer kW	Winter kW	Incentive Costs ($)	Admin Costs ($)	Total Program Costs ($)
2008	148,187,928	20,573	23,460	$14,175,769	$18,510,066	$32,685,835
2009	86,029,310	13,626	15,563	$9,252,568	$18,387,082	$27,639,650
2010	116,911,610	17,390	21,278	$17,200,623	$21,009,842	$38,210,465
Total	**351,128,848**	**51,589**	**60,301**	**$40,628,961**	**$57,906,990**	**$98,535,951**

Cost-Effectiveness Analysis

Frontier's analysis indicates that the programs offered by EVT and BED (collectively referred to as the "EEU Portfolio") were cost-effective between 2008 and 2010, and will likely continue to be cost-effective in the near future. The value of the energy savings and demand reduction (in addition to non-electric fuel savings and water conservation) resulting from EEU efforts were higher than the costs required to implement the programs. This resulted in robust benefit cost ratios under each of the three tests conducted.

Frontier did not identify any factors likely to change that would significantly alter the results detailed in this finding over the next few years. Always a point of concern when planning energy efficiency portfolios, fluctuations in natural gas prices could result in avoided costs decreasing to levels much lower than the values assumed in this evaluation. However, modifications to the cost-effectiveness screening methodology recently established by the Board should help to offset negative impacts tied to lower avoided costs. These modifications, including a lower discount rate for the societal test (3% as opposed to 5.7%), non-energy benefit adjustment of 15%, and a low-income adjustment of an additional 15%, should help the EEU Programs remain cost-effective in the future.[3]

[1] Annual program costs including operating and administrative costs, technical assistance and services, incentives and DPS evaluation costs (excluding participant and third party costs). A detailed breakdown of costs is provided in Appendix A.

[2] Costs and Savings may not match up exactly with the numbers provided in the Annual Reports due to rounding issues and minor discrepancies in the Annual Report Summary Tables.

[3] Order entered February 7, 2012, "Order Re Cost-Effectiveness Screening of Heating and Process-Fuel Efficiency Measures and Modifications to State Cost-Effectiveness Screening Tool."

Table 2: Cost-Effectiveness Summary, Total EEU Portfolio

	Program Administrator Cost Test (PACT)	Total Resource Cost Test (TRC)	Vermont Societal Test (VT Societal)
EEU Portfolio	**2.96**	**2.57**	**3.15**

Methodology and Process Review

Frontier's methodology and process review included a targeted review of the savings values in the TRM and a study of the processes involved in managing and updating the TRM. We also conducted interviews with EVT, BED, the Department, and West Hill (measurement and verification contractor) to assess the efficiency and effectiveness of their data management and savings verification processes.

Our review of the TRM confirms that the engineering methodologies and stipulated values found within the TRM are consistent with industry standards and are appropriate for use in savings determination for prescriptive measures implemented through the EEU's programs. We provide suggestions for further assessment of selected measures where we believe additional accuracy can be achieved.

The Technical Advisory Group (TAG) process for updating the TRM is a collaborative approach that works well to identify necessary updates to savings baselines and other values, and to conduct detailed engineering reviews of new measure characterizations. We recommend expanding the role of the TAG to include creation of a formal M&V process for EEU programs.

The savings claims verification process, conducted by a third party M&V contractor, offers an independent assessment of the validity of EEU savings claims on an annual basis. Given the strength of the TAG process for managing the TRM, we are comfortable in the verification process for prescriptive measures. However, due to time constraints, the M&V contractor has not historically performed site inspections. We recommend that some site inspections be included in annual savings verification, especially for custom projects which require more rigorous M&V to validate savings.

Observations and Recommendations

The Vermont EEU is comprised of highly skilled staff and management. EVT, BED, and the Department have specialized staff dedicated to managing the various aspects of EEU program administration. Based on our interviews, we believe all parties have a sincere interest in contributing to the long term success of energy efficiency initiatives in Vermont. The efforts of all parties demonstrate a desire to continually increase process efficiencies and produce verifiable savings results.

Given this overall environment, we expect EEU programs to remain cost-effective, assuming that avoided costs do not dramatically decrease. However, we anticipate that the recent modifications made by the Board to the Vermont societal test will help to hedge against these potential decreases.

Over the past ten years, Vermont has established a solid framework for implementing, evaluating, and overseeing energy efficiency initiatives across the state. Nonetheless, we have identified a number of areas where improvement may be achieved. The following recommendations address aspects of the EEU process that could benefit from increased efficiency or collaboration.

- Program years covered by the independent audit are off by one year from the program performance years. We recommend aligning these time periods for a more cohesive documentation of program history.
- While both EVT and BED appear to be following generally accepted M&V guidelines, there does not appear to be a formally prescribed process in place for project M&V. M&V efforts at the project level on the part of EVT and BED have not been categorically approved by the Department. This can cause a breakdown between project performance as anticipated by the utility and as accepted by the Department during annual verification. We recommend establishing an accepted protocol that mandates M&V requirements based on project type.
- EEU parties mentioned transitioning the TRM from a document format to a database format. We strongly encourage this transition as it will help to prevent use of outdated values and maintain transparency. In addition, we recommend that all parties work collaboratively to develop the database and that the database be housed in such a manner that all parties will have access to utilize and verify its content.
- Savings values found within the TRM are based on sound engineering principles that have been vetted by the TAG. In general, our review of these values supports their use in determining savings for EEU projects. Our review of the supporting calculation documents revealed only minor discrepancies between the values in the TRM and the values in the supporting documents.
- While the TRM offers a solid foundation for savings values, we encourage a more thorough annual savings verification process that includes site visits for a sample of projects. Information gleaned from site visits conducted by the M&V contractor will provide increased confidence in adjustments to EEU annual savings claims. Additionally, it will inform future updates to TRM values and M&V procedures.
- There are different losses associated with serving different customer classes. For example, higher line losses are incurred when serving residential customers at distribution voltage as opposed to industrial customers at transmission voltage. The application of a single line loss estimate to the savings estimates for all programs serving all customer classes fails to recognize this differential. Differentiating line losses by service voltage level when applying line loss estimates to the savings associated with energy efficiency programs may help to address this issue.

Additional detail on these recommendations can be found in the Audit Management Letter.