Report to the Public Service Board

Evaluation Activities Related to Statewide Energy Efficiency Utility Initial 3-year Contract Cycle (Years 2000 - 2002)

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Vermont Department of Public Service
112 State Street - Drawer 20
Montpelier, Vermont 05620-2601
(802) 828-2811
TTY/TTD (VT): 1-800-734-8390
e-mail: vtdps@state.vt.us
Internet: http://www.state.vt.us/psd

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I. Introduction

The September 30, 1999 Board order creating an Energy Efficiency Utility ("EEU") in Docket 5980 established that the Department of Public Service ("Department" or "DPS") has a specific role as the entity charged with providing formal evaluation of the efficiency utility programs and that these evaluation activities would be funded by energy efficiency charge ("EEC") funds collected by the Fiscal Agent. The Board approved Memorandum of Understanding further specified that the evaluation would include, but not be limited to, an assessment of market transformation accomplishments.

In its May 29, 2002 "Report and Recommendations to the Vermont Public Service Board Relating to Vermont's Energy Efficiency Utility", the Department provided a summary of DPS formal evaluation activities together with draft summary reports and preliminary findings.[1]

This document is a report on the results of that evaluation work and concludes the Department's' EEU evaluation activities for the years 2000 through 2002, the first three years of EEU operation.

Overview of EEU Evaluation Activities

On December 29, 2000, the DPS set forth the EEU Evaluation Plan for the 3 year period from March 1, 2000 through December 31, 2002 in a memorandum titled "Evaluation Effort: Report and Plans for Energy Efficiency Utility Evaluation Projects." This Plan, coupled with the Department's "Overview of DPS Evaluation Approach to Energy Efficiency Utility" of October 4, 2000, identifies and discusses legislative and Board requirements and objectives, EEU program evaluation objectives and requirements, and the Department's approach to fulfilling its evaluation responsibility.

There are three major categories of evaluation activity undertaken by the DPS in fulfillment of its EEU evaluation responsibilities. They are:

1. Verification of the claimed annual savings and total resource benefit claims by Efficiency Vermont ("EVT") and Burlington Electric Department ("BED") for each year of the 3 year period.

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[1] Appendix 5: Draft Summary Reports, Preliminary Evaluation Results, Xenergy and GDS Associates; Appendix 7: Report, "An Initial Assessment of Burlington Electric Department's Core Program Implementation", GDS Associates; and Appendix 8: Draft Report, "Customer Credit Program Implementation Assessment", GDS Associates.

This responsibility is specified in EVT's contract with the Public Service Board and in the Board order approving BED's authority to implement statewide efficiency programs for customers in its service territory. Following issuance of EVT and BED annual reports, the DPS conducts a thorough verification check of their claimed annual savings and total resource benefits. This involves an in-depth review of tracking system data and electronic and hard copy project files by DPS staff and West Hill Energy & Computing.. An independent engineering firm is retained to review certain large and/or complex commercial and industrial ("C&I") projects as needed and to assist in reviewing savings calculation methodologies and assumptions for unique and complex energy efficient measures and technologies.

In addition to the annual verification process, the DPS provides ongoing oversight of EVT's electronic data tracking system and conducts review of methodologies, algorithms and assumptions used by EVT and BED to claim electric savings and other benefits documented in a Technical Reference Manual developed and maintained by EVT.

2. Assessment of residential energy efficiency markets and establishment of baselines to better document the market and the effects of the EEU programs on those markets.

A number of evaluation activities are included in this area. In-depth surveys of vendors and contractors active in the residential new construction and efficient products marketplace were completed. An on-site survey of single family residential new construction was conducted to establish baseline efficiency practices and to determine the level of compliance with Vermont's residential energy code ("RBES"). A preliminary study was undertaken to investigate the level of energy efficient lighting and appliance purchases in Vermont as compared to purchases in a nearby New England state. A strategic process evaluation was conducted to identify potential improvements in the delivery of efficiency services to low income residents.

3. Assessment of non-residential, commercial and industrial energy efficiency markets to better document market conditions and the effects of the EEU programs on those markets.

In-depth surveys of architects, engineers, contractors, vendors and other market actors active in C&I new construction, renovation, and equipment replacement markets were completed to assess and characterize these diverse markets. Telephone surveys were conducted with building owners and occupants to provide data on current efficiency practices and to investigate their interaction with Vermont's C&I building design and construction community. On-site surveys of a number of recently constructed projects were conducted and the results of these surveys were compared with the market actor surveys to refine baseline efficiency practices. Strategic process evaluation research was incorporated into the market

characterization efforts to assess EVT's program performance and to identify potential improvements.

In addition to these three primary activities, the Department also conducted a formal assessment of the Burlington Electric Department's delivery of the statewide programs in the city and its record in coordinating the administration of the programs with EVT and Vermont Gas Systems ("VGS"). A formal assessment of the Customer Credit program was also conducted. Both of these reports were included in the appendix to the Department's "Report and Recommendations to the Vermont Public Service Board Relating to Vermont's Energy Efficiency Utility of May 29, 2002." The DPS also participated in a number of evaluation studies associated with regional energy efficiency initiatives coordinated by the Northeast Energy Efficiency Partnership (NEEP) and the Consortium for Energy Efficiency (CEE).

Finally, throughout the first three years of the EEU's operation the Department has taken an active role in monitoring the establishment, start-up and maturation of the EEU and its program services, planning activities, reporting methods and performance indicators. This has been pursued through a variety of informal evaluation and oversight activities. The Department has provided EVT and the EEU contract administrator with regular feedback to assess the performance, identify problems and explore opportunities to improve the effectiveness of EEU program design and delivery during this critical start-up period for Vermont's energy efficiency utility.

Budget and Expenditures

The EEU annual budgets for the first five years of EEU operation, as approved by the Board, included an annual budget for EEC funded evaluation activities undertaken by the DPS. The DPS budget for the first three years totaled $1,179,000, with the EEC fund providing $1,125,000 and BED providing $54,000. An additional $35,000 from federal grant money obtained to determine residential new construction energy code compliance was used to partially fund the study of residential new construction baseline practices. Finally, a small amount of interest income accumulated in the EEC fund over the 3 year period was used by the DPS for evaluation costs over the EEU contract cycle.

A summary showing available funds and DPS evaluation expenditures over the three year period are shown in the following table.

Table 1: DPS EEU Evaluation Expenditures for years 2000 through 2002

Funds Available	EEC Fund Allocation	$ 1,125,000
	BED Contribution	$ 54,000
	Subtotal	$ 1,179,000
	RBES grant	$ 35,000
	EEC fund accumulated interest (estimate)	$ 159,000
	Total	$ 1,373,000
Expenditures	Residential Evaluation	$ 564,825
	RBES compliance assessment	$ 35,000
	C&I Evaluation	$ 424,710
	Verification	$ 91,222
	Planning/Management	$ 109,672
	Other*	$ 30,588
Total Expenditures		$ 1,256,017

* Third year evaluation of BED performance and assessment of Consumer Credit Program.

DPS Verification of EVT Annual Savings and Total Resource Benefit ("TRB") claims

EVT's contract with the Public Service Board provides for the DPS to annually review and verify Efficiency Vermont's annualized MWh and total resource benefits claimed in its Annual Report. After a two month process of in-depth review and investigation, the DPS issues a report and recommendation to the EEU Contract Administrator and the Contract Administrator subsequently makes a recommendation to the Board regarding the appropriate savings EVT may claim for the reporting year.

The DPS has completed reviews for EVT's 2000, 2001, and 2002 reported savings. These results inform, in part, the performance incentive amount paid to the EEU contractor under the terms of its 3 year contract with the Public Service Board.

For the Year 2000, the DPS proposed the total annualized MWh savings be reduced by about 2.2%. The Contract Administrator made a recommendation to the Board adjusting EVT's savings claims by about 2%, which was subsequently certified by the Board.

For Year 2001, the DPS proposed reducing the EVT claimed annualized MWh savings by about 2%. The Contract Administrator supported the DPS adjustments in a May 24, 2002 memo to the Board and the Board certified the 2001 Annualized MWh savings and TRB recommended by the Contract Administrator. EVT subsequently issued a revised 2001 Annual Report on August 30, 2002.

For Year 2002, the DPS recommended reductions of about 3% in EVT's claimed annualized MWh savings and TRB. The 2002 review also verified that EVT met its performance indicator related to the average participant kWh savings obtained in its Low Income Single Family Program in 2002. The Contract Administrator notified the Board in a letter dated July 7, 2003 of his concurrence with the DPS' 2002 recommendation. The Public Service Board is expected to authorize VEIC performance incentives for the three year contract based on the savings and TRB amounts specified in that letter.

Further information can be found in the annual verification reports and recommendations identified in the document list at the end of this report and is available via the Department's website or upon request. A summary of DPS verification based revisions to claimed EVT savings and TRB is shown in the following table.

Table: Summary of Verification Process Results[2]

Year	Annualized MWh Claim	TRB Claim	Annualized MWh Revised	TRB Revised
2000	23,335	$19,931,041	22,794	$17,110,766
2001	37,565	$24,747,096	36,894	$23,775,913
2002	39,560	$25,938,348	38,369	$25,132,962

[2] The Verification adjustments do not include savings and TRB for the Customer Credit Program, since they are not included in EVT's contract targets.

Over the three year period, the DPS reviewed EVT's Technical Reference Manual ("TRM") and numerous revisions to the TRM and participated in periodic technical advisory group meetings with EVT and the Contract Administrator.

An independent audit of EVT's reported energy and capacity savings completed in late December 2002 found that "The EEU's estimates of annual energy and capacity savings, as verified and adjusted by the Vermont Department of Public Service, are reliable and unbiased estimates of program savings."[3]

Formal Evaluation Objectives and Strategy

The Energy Efficiency Utility programs are designed to acquire energy savings at the time of market transactions associated with new construction, renovation, remodeling, and equipment replacement. These so-called lost opportunities programs are most effective when they successfully intervene in and ultimately transform the markets where energy efficiency decisions are being made.

To evaluate the effectiveness of the EEU programs and initiatives, the DPS investigated the energy efficiency markets and market actors operating in Vermont. This focus on understanding markets - who the players are, how they make decisions, what are the barriers to efficiency investments, how might EVT and BED programs and initiatives be refined to address the markets and market barriers - defined the Department's initial evaluation framework for assessing Vermont's new EEU. Our objective was to develop a qualitative and quantitative assessment of the existing energy efficiency markets in Vermont.

The overall strategy for the independent evaluation through calender year 2002 was developed and set forth in a December 29, 2000 memorandum to the Board entitled *Evaluation Effort: Report, and Plans for Energy Efficiency Evaluation Projects* . The DPS retained the services of Martin Kushler , a nationally recognized energy efficiency evaluation consultant, to provide on-call evaluation planning, design, and management assistance and West Hill Energy & Computing to provide "hands on" review and analysis of EVT's data tracking systems and the data contained therein. West Hill also assisted in certain verification activities, review of engineering estimates and measure characterizations, and in the initial design of formal evaluation tasks.

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[3] "Independent Audit of Vermont Energy Efficiency Utility Energy and Capacity Savings for 2000 and 2001", Martin Cummings, December 20, 2002, p. 3

A Request for Proposals was issued in the fall of 2000 seeking to contract with one or two firms to undertake the formal evaluation studies for the three year period. From five proposals received, two contractor teams were chosen. Contracts were signed with Xenergy Inc. to provide residential sector evaluation services and GDS Associates to provide commercial and industrial sector evaluation and engineering review services.

A "kick-off" meeting was held with each contractor team early in 2001. Subsequent evaluation work plans, sampling plans, survey designs, interview guides and data collection instruments were developed by the contractors and submitted for review and comment to the DPS and its consultants, the EEU Contract Administer, and EVT.

As stated above, the independent research was designed and conducted to better document and characterize the specific markets and market participants targeted by EVT and BED programs. The evaluation activities utilized phone and on-site surveys to collect information on representative samples of program participants, non-participants and various market actors as well as primary data on equipment efficiency levels, current construction practices and market behavior. The results of the evaluation and market characterization research were compiled and analyzed by market sector and program. The market sector findings are, in turn, analyzed and synthesized into an integrated final report that summarizes progress and accomplishments and identifies problems and opportunities for improvement in EVT and BED services. The executive summaries prepared by Xenergy and GDS Associates are included in this report as appendices. These findings, coupled with lessons learned and current market data, will inform EEU operations and lead to increased effectiveness of core DSM program design and delivery in Vermont.

The following tables list the surveys conducted over this initial three-year evaluation period (2000-2002).

C&I Evaluation Activity		
Phone Survey	Sample Size	Status
Architect/Engineer	46	Complete
Contractors		
General	31	Complete
Mechanical	19	Complete
Electrical	23	Complete
Suppliers		
HVAC	4	Complete
Lighting	7	Complete
Motor	5	Complete
Window	7	Complete
End User		
New Construction	92	Complete
Remodeling, Renovation and Equipment Replacement	108	Complete
Existing	396	Complete
Engineering Review		
Project specific reviews	25	Ongoing
On-Site Survey		
New Construction	35	Complete
Remodeling, Renovation	27	Complete
Equipment Replacement	9	Complete

Residential Evaluation Activity		
Phone Survey		
Residential New Construction	Sample Size	Status
Homebuyer Program Participant	100	Complete
Homebuyer Program Non-participant	100	Complete
Builder Program Participant	25	Complete
Builder Non-participant	45	Complete
Remodeler	40	Complete
Other Market Actors	30	Complete
Efficient Products Program		
EPP Retailer	24	Complete
On-Site Survey		
Residential New Construction	160	Complete
EPP On-Site	100	Complete
EPP Mystery Shopper	8	Complete

The Department also contracted with GDS Associates to provide an assessment of the Burlington Electric Department's delivery of the core programs and its record in coordinating the administration of the programs with EVT and Vermont Gas Systems. The Department also retained GDS to conduct an initial investigation of the Customer Credit Program. These two evaluation studies, in conjunction with the integrated EVT program and market characterization evaluation, provide significant information and timely feedback on EVT's performance with respect to achieving its goals and objectives by program and key market segment.

II. Residential Markets Summary

Introduction

In broad conceptual terms, residential market interventions fall into three basic categories: (1) product efficiency standards (typically set a the federal level); (2) energy codes (typically set at the state level); and (3) energy efficiency program offerings (typically provided by utilities or supported through "system benefit funds"). Federal standards define the minimum efficiency standards for appliances sold in this country. In addition to the mandatory product efficiency minimum standards, the U.S. Department of Energy ("DOE") and the U.S. Environmental Protection Agency ("EPA") have defined a voluntary higher level of efficiency

known as "Energy Star" which is generally at least 10% more efficient than the federal standards.

In Vermont, a number of policy and program interventions are targeted at the residential market. For new housing construction, the Vermont Residential Building Energy Standards ("RBES" or "Code") sets a minimum level of energy performance. The residential new construction program, Vermont ENERGY STAR Homes, qualifies Energy Star homes that are at least 20% more efficient than the minimum set by the Code.

Efficiency Vermont and Burlington Electric Department delivered services for residential energy users through two largely separate programs, the Residential New Construction ("RNC") program and the Efficient Products Program ("EPP"). While there are significant areas of market overlap between these programs, the formal evaluation studies examined each market separately. Xenergy conducted the Efficient Products Program evaluation in its entirety. For the Residential New Construction Program evaluation, Xenergy conducted all activities except the Residential New Construction on-site baseline study. That activity was provided by West Hill Energy and Computing (WHEC) and the results incorporated by Xenergy into the RNC Final Report.

The following briefly describes the key findings of this comprehensive market overview in terms of market characteristics, market actors, market interventions and baseline efficiency levels. The executive summaries of the full reports prepared by Xenergy are included as appendices to this report. The full reports prepared by Xenergy and West Hill Energy & Computing for each market are available on line or upon request.

Residential Housing Market Characteristics

The 2000 United States Census counted roughly 295,000 housing units in Vermont, of which 240,000 were occupied year round. Seasonal or recreational housing accounted for nearly 45,000 of the total. The housing stock consists of 66% single family, 12% two-four family, 8 % mobile home, 3% single family attached, and the balance are multi-family buildings with five or more units.

Currently, new construction adds between 2,100 to 2,300 single family homes and 100 to 300 condominium units to the housing stock annually. Approximately half of these units are in the northwestern part of the state. Only about 5% of the homes are built "on spec", that is without a pre-defined buyer, in sharp contrast to other states where spec homes represent a large share of the market. Homeowners have a great deal of involvement with the building process in Vermont, building 20% of new homes for themselves. Approximately 20% of the new homes are manufactured housing. Overall, more than three quarters of new homes are either custom built or built to plans modified to suit the owners.

Home buyers tend to view energy efficiency in the framework of saving money, water, energy and/or other resources, although they also make a connection between energy efficiency and improved comfort. They see the barriers to improved efficiency as high initial costs, poor ventilation and the lack of desired features. With the high proportion of custom-built homes, the homeowner typically has many opportunities to provide input to the builder. About half of these homeowners recall discussing energy efficiency with their builders. Many suggested that these discussions fostered their interest in energy efficiency and motivated them to request efficient equipment and features.

Home builders tend to believe that energy efficiency is not a top priority for home buyers. While adding efficient features to the home increases the initial cost, the purchase price is more closely related to the location and other features of the home. Some builders indicated that certification through Efficiency Vermont's new construction program helps them to sell homes faster. Nonparticipating builders suggested that marketing assistance would be useful to them, although many also implied that homes are selling quickly in the current market without any outside support. While the responsibility for purchasing appliances generally falls on the homeowner, builders took on this task for approximately one-third of new homes.

There have been some significant efficiency gains between the baseline study conducted in 1995 and the recent one completed in 2002. About 60% of surveyed homes met the standard set out in the RBES code. Although the homes were very tightly built, only about a third had mechanical ventilation systems. Manufactured housing was found to be less efficient than site built homes. While homes left the factory just meeting the RBES code requirements, by the time the on site installation and equipment selection had been completed, many of these homes failed to meet the standard. Owner built homes were represented on both extremes of the efficiency scale. Heating systems tended to be oversized to an excessive degree, causing these systems to run less efficiently and use more fuel. Homes tend to be large (an average of 2,500 square feet) and had, on average, much more window area in comparison to the size of the home than was found in the 1995 baseline study.

The on site survey indicated that the homes built with assistance from Efficiency Vermont's program were significantly different from other homes in a number of respects. These homes passed the RBES code requirements at a higher proportion than the sample as a whole (80% as compared to 60%), were much more likely to have mechanical ventilation systems (70% as compared to 15%), and more likely to have efficient lighting and appliances.

Residential Appliance and Lighting Market Characteristics

Vermont households consume electricity through a variety of appliances and lighting devices. Almost 100% of homes have a least one refrigerator, 11% have two or more, and 35% of these refrigerators were built prior to the 1993 federal minimum standards for energy efficiency. Clothes washers appear in 80%, dishwashers in 47%, and room air conditioners in

25% of Vermont homes. The average home has roughly 30 lighting fixtures and 40 light bulbs. There are an estimated 5 million lighting fixtures in Vermont non-seasonal homes that will accept screw-based compact fluorescent lamp bulbs ("CFLs"). Since the early 1990's, roughly 330,000 CFLs and fluorescent fixtures have been distributed by promotional programs, which suggests many opportunities remain to increase the penetration of efficient lighting measures in the residential market.

The following table shows the number of major appliances shipped to the Vermont market on an annual basis and the percent of sales of each that met the U.S. Department of Energy ("DOE") EnergyStar standard.

Appliance	Shipment(range 1999-2001)	% Energy Star in 2001
Clothes Washers	12,000 – 13,000	32.2%
Refrigerators	12,000 – 13,000	11.2%
Dish Washers	8,500 – 9,500	45.6%
Room Air Conditioners	6,000 – 8,500	10.7%

Market Indicators and Program Effects

Market indicators attempt to capture a snapshot of the market, to describe the structure and characteristics of the market, and key market segments, at a point in time. Over time, changes in products and behaviors are measured against the initial baselines. During this first evaluation phase of the energy efficiency utility, the DPS focused on developing baselines for measuring future market effects. The following discussion provides a few examples of the information collected for this purpose.

Market Actors

The outlets for efficient products include about 150 stores that sell lighting products, of which 110 participate in the EEU lighting program. On the major appliance side, 90 retailers participate in the program, which represents almost all of the state's major appliance vendors at any given time, allowing for changes in ownership and management. These vendors include chains stores, department stores, and independent retailers. Customers purchase appliances for both new and existing homes through these outlets. This level of retailer participation in the EEU's programs is noteworthy and represents a real success story for EVT.

Compared to the appliance market, the actors in Vermont's new construction market are harder to define and change more often. In building or general contracting, roughly 700 firms claim to be active in Vermont's residential new construction market. Most of these firms are small, with fewer than five employees building less than 3 houses per year. The majority of builders work in multiple markets and are doing a substantial amount of remodeling in addition

to new construction work. Of the firms that indicate residential new construction as their primary activity, 70% also undertake residential remodeling projects, 28% do some commercial new construction work, and 32% are active in commercial remodeling as well. Builders select appliances for about one-third of all new homes.

The evaluation also surveyed a small sample of lenders and real estate firms to determine the impact of energy efficiency programs and codes on their businesses. Five out of six lenders had some knowledge and experience of various energy efficiency mortgage products. They noted several barriers to using these products, including the limitations of the automated underwriting systems, perceptions of limited viability on the secondary mortgage market, and an information deficit on the cost and benefits of efficiency from both the lender and borrower perspective. Lenders and real estate firms as a group did not express much interest in energy efficiency. Realtors discuss the efficiency of a home when the potential buyer asks about it or if the realtor sees it as a selling point of a particular home. Lenders were not enthusiastic about promoting the energy efficiency mortgage products and did not see the efficiency of homes as a part of their responsibility.

Cross Market Strategies

Efficiency Vermont strategies address markets across the entire supply chain. A widely available household product, the compact fluorescent lamp ("CFL"), is illustrative of this approach. During the early years of efficiency programs, utilities offered free lamps or substantial rebates to customers to reduce the purchase price and increase acceptance in the market place. This single link approach had limited success. The program has evolved to include the following services:

1. Marketing support for retailers
   The program provides coupons, point-of-purchase display materials, and staff training to increase consumer awareness and use. It also conducts semi-annual inventories of the number, type and price of products on display to help determine program effectiveness.

2. Instant coupons for consumers
   Coupons lower out-of-pocket cost, focus attention on certain products, lend the coupon sponsor's credibility to the product and provide instant gratification.

3. Coordination with regional and national initiatives to influence manufacturers
   These programs have encouraged manufacturers to adopt quality and performance standards, have reduced manufacturing cost by increasing demand, and have provided a means of differentiation in a commodity market.

A comparable multi-pronged approach is applied to the lighting fixture, appliance, and housing markets, tailored to meet the needs and abilities of the market actors. EVT's impacts through the Vermont Energy Star Homes Program and the Efficiency Products Program are discussed below.

Vermont Energy Star Homes Program

Houses last a long time and account for a significant portion of each individual's annual energy use. Improving the energy efficiency of new homes at the time of construction provides substantial long-term savings and is justly a focus of market intervention efforts. The table below compares a 1995 baseline survey to one conducted as part of this evaluation effort. For a variety of reasons, there are questions about the statistical validity of the 1995 survey that cannot be resolved. Nonetheless, the comparison below is gives a valuable insight into the effects of RBES and EVT's Residential New Construction Program.

Comparison of 1995 and 2002 Residential New Construction On-site Home Inspection Results

Compliance Feature	1995 n = 151	2002 n = 158	Comments
Percent of homes meeting UA Requirements	35 – 40%	59%	"UA" is a measure of thermal transmittance, the amount of energy that leaves through solid materials
Attic insulation meets or exceeds code requirements	61%	68%	
Wall insulation meets or exceeds code requirements	57%	90%	
Basement wall insulation meets or exceed code requirements	48%	62%	
% glazing area with 2-pane, Low-e	70%	80%	This type of window is more efficient, but the gains in efficiency may be offset by the increase in volume
Mean Air Infiltration	~.45 ACH	.31 ACH	ACH - Air Changes/ Hour is the natural rate of air exchange through the shell. It is related to the amount of energy that is lost by air movement.
Mechanical ventilation installed per proposed code update	6%	32%	
Mean AFUE of Central Heating Systems	n/a	0.850	AFUE – Average Fuel Utilization Efficiency. In 1995, 20 percent of boilers did not meet code requirement: AFUE 80.
Mean Heating system Oversizing Factor	>100 %	92%	In 1995, 71 percent of heating systems were more than 100% oversized.
Percent with tankless coil water heating	32%	3%	Tankless heaters generate high standby losses thus are inefficient compare to other equipment.

Key findings of the evaluation with regard to the residential new construction market and program are listed below.

- Single family homes that successfully participate in the program achieve higher levels of energy efficiency than those that do not.

- The program has been effective in serving multifamily developments.

- Program participation is still a relatively low percentage (10-15%) of the total market.

- Barriers to wider adoption of more efficient construction include a fragmented market, inaccurate perception of its cost, and a somewhat localized concentration of program participants.

- Manufactured homes are a substantial portion of the market (at least 17%) and are generally less efficient than other types.

- New homes are now more efficient than they were before adoption of RBES and the implementation of the statewide program.

Recommendations for program improvement and suggested avenues for future evaluation efforts were also identified by the evaluation. They include:

- Target the manufactured home market for intensive recruitment and training . These homes account for almost a fifth of the market and tend to among the least efficient.

- Develop mechanisms to extend the reach of the program. Most of the building activity is focused in the Northwest section of the state. as is most of the program activity. To significantly increase participation rates, the program will have to extend its reach.

- Correct perceptions on the cost of RBES compliance. Builders consistently overestimate the cost of compliance, a barrier education would help overcome.

- Increase share among participating builders. Determine why participating builders sought program certification for only 60% of their projects, and not all of them. A future evaluation should focus on project “drop-outs” and reasons.

Efficient Products Program

The evaluation included on-site visits for a sample of existing year-round residences in Vermont. The following table shows the average number of light fixtures in homes, by room, and the number of efficient products installed.

Lighting Fixtures and Bulbs Installed in Sample Homes

	FIXTURES		BULBS	
Room	**Average #/Room**	**Percent CFL**	**Average #/Room**	**Percent CFL**
Bedroom	2.41	0.20%	2.97	2.60%
Hallway	1.57	0.00%	1.96	5.20%
Bathroom	2.07	1.10%	3.26	3.80%
Living Room	2.91	0.40%	3.59	6.90%
Kitchen	2.9	3.30%	3.88	8.70%
Dining Room	1.96	3.40%	3.8	4.70%
Other Interior Rooms	2.78	3.20%	3.54	7.10%
Total per Interior Room	**2.43**	**1.60%**	**3.21**	**5.40%**
Exterior	2.27	0.60%	2.64	10.80%
Total per House	**30.56**	**1.50%**	**36.73**	**5.80%**

The evaluation also considered program impact. The chart shows the sales of compact fluorescent lamps directly attributable to the efficiency programs. This data shows a clear difference between utility programs and EVT implementation which began in 2000.

One of the most significant finding of the evaluation effort is that the programs are impacting the market for energy efficient products in Vermont. For example between 2001 and 2002, with regard to CFL bulbs:

- the variety of models stocked increased by 31%,
- stocking of Energy Star-labeled models increased by nearly five times, to 68%, and
- the price for Energy Star models declined by 16%.

In addition to bulbs sales, Energy Star fixtures have become a significant part of the market, accounting for nearly 8% of all new fixtures purchased in the state.

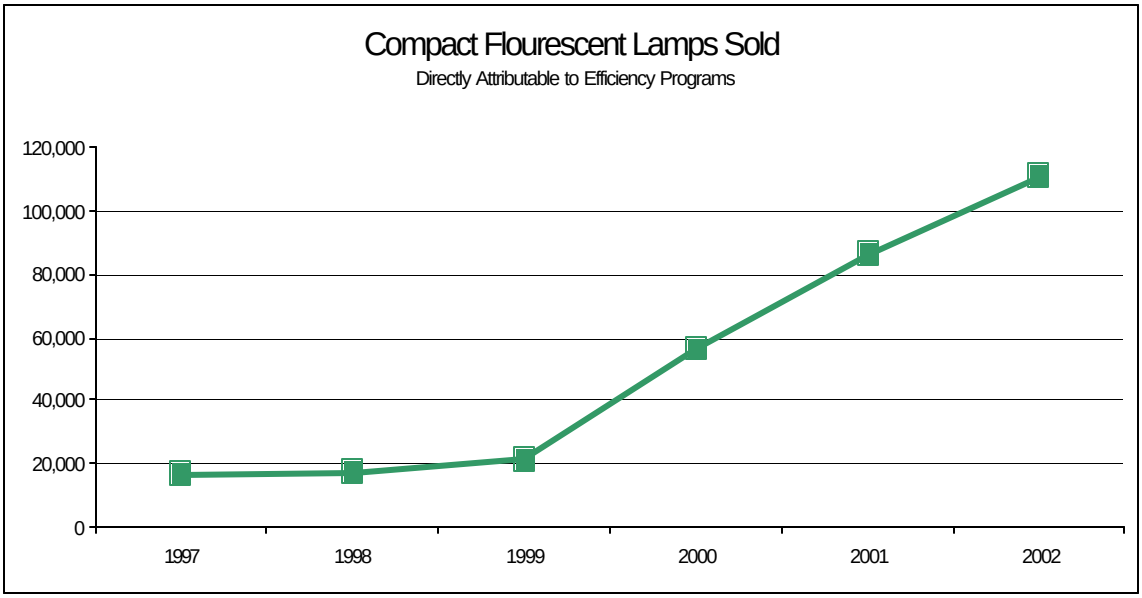
With regard to major appliances, the evaluation shows that Vermont has achieved some relatively good market penetrations of efficient products, and that this is related to the existence of efficiency programs over time. Key points include:

- EVT programs have influenced retailer stocking decisions, and are rated highly by them.

- The market share of Energy Star clothes washers in Vermont was three times the national average for the analysis period.

- The net effect of EVT programs on the sales of efficient appliances, even those that are not eligible for incentive payments, is positive.

- The program has increased customer knowledge and acceptance of Energy Star clothes washers as shown by an increasing proportion of washers purchased without incentives.



- The Vermont market share of efficient appliances recovers more rapidly after the introduction of new standards compared to the national average.

The following table highlights the differences between the Vermont Market and the national market.

Overview of Key Market Indicators by Appliance and Year

	1999	2000	2001
CLOTHES WASHERS			
Number of Energy Star Models Available	35	64	84
Vermont Energy Star Percent Models Displayed*	22%	25%	28%
Vermont Energy Star Market Share	26%	27%	32%
US Market Share (Chains)	9%	9%	10%
REFRIGERATORS**			
Number of Energy Star Models Available	331	301	58
Vermont Energy Star Percent Models Displayed	21%	30%	20%
Vermont Energy Star Market Share	19%	21%	11%
US Market Share (Chains)	24%	27%	17%
DISHWASHERS			
Number of Energy Star Models Available	173	265	158
Vermont Energy Star Percent Models Displayed	31%	41%	41%
Vermont Energy Star Market Share	35%	39%	46%
US Market Share (Chains)	12%	11%	20%

** Code and Energy Star specifications changed in early 2001, accounting for shift in market

The evaluation also identified areas for program improvement and suggested avenues for future evaluation efforts. They include:

Lighting

- Develop mechanisms to reach new customers. Analysis of rebate records for the beginning of 2002 suggests that the number of first-time participants is falling compared to past years.

- Develop mechanisms to increase use of efficient fixtures by remodelers. The remodeling market accounts for one-fourth of all new fixture installations.

Appliances

- Focus program design with regard to retailer stocking and selling practices of appliances that are currently not receiving program incentives . The evaluation noted differences in niche markets that might be addressed through focused study.

- Retain the clothes washer incentive. Despite the growing market share of efficient washers nationwide, and the increasing number of units sold without an incentive in Vermont, the incentive is a valuable tool for influencing both salesperson and purchaser behavior.

- Investigate the opportunity for a program to promote the early retirement of refrigerators and freezers. The evaluation estimated that there are over 80,000 refrigerators and 76,000 freezers in Vermont that could be cost-effectively replaced or retired with an average annual savings of 1,000 kWh per unit.

III. Commercial and Industrial Markets Summary

Introduction

The objectives of the evaluation efforts were to investigate the characteristics of the market, determine the efficiency of current market practices and clarify the decision making process among various market players in order to identify barriers to cost-effective efficiency investments in Vermont. While this first set of evaluation activities was not intended to provide a complete analysis of Efficiency Vermont's and Burlington Electric's programs, specific aspects of program design and implementation.

The commercial and industrial ("C&I") market is complex and has numerous interacting components, frequently dictated by the scale and type of projects. This sector encompasses businesses of all types, as well as institutions, hospitals, warehouses, and waste waster treatment plants, to name a few. Some large projects require the skills of many design professionals, including architects, mechanical and electrical engineers, lighting designers and various contractors and subcontractors. Other projects are often completed by a general contractor alone. Variations in the type and scale of projects and the composition of construction teams require a correspondingly wide range of market intervention strategies to effectively reach this population.

The market evaluation was conducted using an analysis of the Department of Labor and Industries' permit database, review of census data and summary information from other sources. Two components of the market study were instrumental in identifying current construction practices, eg, a survey of market actors and on-site visits to assess actual construction practices in a sample of buildings. Interactions among market players were explored through telephone surveys with architects, engineers, contractors, suppliers, C&I businesses, building owner/operators and others interacting in Vermont's small, but diverse C&I markets.

Market Structure and Size

Approximately 20,000 C&I firms are located in Vermont.[4] Overall, Vermont firms show the same variation in size as other New England firms. More than half of the state's C&I firms occupy buildings under 5,000 square feet in size, while fewer than 15 percent of them (or less than 3,000 firms) occupy buildings of 25,000 square feet or more. To put Vermont's C&I

[4] Data from 1997 Economic Census, U.S. Census Bureau (19,717 establishments with payrolls). A published business list for 2002 reported 32,262 firms, including sole proprietorships without payroll. Statewide, there are 42,303 commercial and 413 industrial electricity accounts.

stock in perspective, a nearby out-of-state utility serving an area about half the size of Vermont has approximately 4,000 large C&I accounts.

From the perspective of efficiency-related practices, this market can be divided into three sub-sectors: new construction, renovation and equipment replacement. The new construction sector encompasses new buildings and additions, whereas renovations range from gut rehabs to simple remodeling projects. The equipment replacement market consists of those businesses making major purchases of energy consuming equipment outside of the new construction and renovation markets. Some highlights of recent activity in these market sectors are listed below.

- During 1998-1999, the state issued about 470 permits to C&I establishments for new construction projects.

- Less than 10% of these permits were for industrial applications, which tended to be large, higher cost projects.

- About half of the new construction projects were initiated to create more space for offices, warehouses or institutions (including health care and all types of public assembly).

- Slightly less than half of the total new construction permits were requested for small projects (less than 5,000 square feet), about one-third were for medium-sized buildings (5,000 to 25,000 square feet), and about 15% were for very large buildings (greater than 25,000 square feet).

- In the same period, about 370 permits for renovation projects were identified.[5]

- Retail is the single business type with the most permits for renovations and remodeling, accounting for about 25% of all of the permits in this subsector.

- The firms undertaking renovation and new construction projects were somewhat larger, on average, than general C&I firms: 41% were under 5,000 square feet and 19% were over 25,000 square feet, compared with 54% and 12% of general C&I firms.

- Among the general C&I population, about 40% had purchased equipment (windows, heating, and/or lighting) in the two years prior to the evaluation survey.

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[5] The number of permitted renovation projects is relatively small in comparison to the number of firms engaged in new construction. These numbers should be regenerated from the most recent files from DLI and further investigated in the next round of evaluation.

- Of those that had purchased equipment, about 40% had purchased windows, 54% had purchased heating equipment, and 57% had purchased lighting.

Market Players

Most of the designers and contractors working in Vermont are involved in both the new construction and renovation/remodeling markets for large and small C&I and residential customers, creating an environment where social connections and word-of-mouth referrals have a major impact on the outcome of many construction projects. An exception to this finding is general contractors; the larger firms tend to work exclusively in the C&I sector. When describing the markets they work in, many respondents emphasized the small size of the market and the need for flexibility.

Perhaps our most important findings have to do with the size of C&I firms. There are few truly "large" C&I firms or customers or large construction projects in Vermont. Vermont's largest firms would be considered small or medium-sized in many other markets, and most construction projects in the state are less than 5,000 square feet in size.

It is frequently assumed that the largest design and construction firms specialize in serving the largest C&I customers and are the most knowledgeable about energy-efficiency opportunities. Our research however revealed that, in Vermont, size does not predict which market actors and end users will be the most informed and proactive in regards to energy efficiency. In fact, many of the most cutting-edge market actors are smaller designers, contractors, and suppliers. Larger C&I firms tend to *install* the most measures, but small and large market actors are equally likely to *encourage* their clients to choose energy-efficiency options. Also, it is apparent that the characteristics of the professionals used on a project contribute as much, or more than, size of the firm to the number of efficiency measures used. These findings for Vermont are consistent with those found in studies conducted in the Pacific Northwest.

Considering the new construction and renovation markets together, about half of the permitted projects were designed by an architect and 40% were design-built by the contractor and project owners. Most projects had a lighting contractor, general contractor and mechanical contractor. The size of the design team roughly broke out into thirds, with the top third using five to six professionals, the middle third using three to four, and the bottom third using one or two. Project size was not a factor in the number of professionals used, except among projects involving six professionals.

The table below shows the size of the design and contracting firms and their share of the market. For example, about 80% of architectural firms have less than 5 employees, and architects work on about half of all construction projects. Not surprisingly, the larger projects

more likely involve architects than smaller ones, with the result that architects design about 60% of the floor space. While architects worked on two-thirds of the very largest projects, they also worked on one-third of the smallest projects.

Type of Business	% with < 5 employees	% of construction projects	% of floor space
Architects	80%	50%	60%
Engineering Firms	46%	33%	50%
General Contractors	70%	79%	81%
Mechanical Contractors	65%	68%	82%
Electrical Contractors	75%	85%	89%

For half of the projects that did not use an architect, contractors worked directly with project owners in a construction approach termed "design-build." In the design-build process, the owners hire a construction firm to complete a project for a specified amount with little input from the owner into the plans or specifications. In general, the firm has wide latitude in most aspects of the final product. Fifty percent of contractors report at least half their work is design-build, and all but 25 percent report they do some design-build work. Ten percent of architects and 50 percent of engineers report doing a little design-build work.

Engineers and architects tend to be the most knowledgeable about energy efficiency options, and equipment suppliers among the least knowledgeable. Most engineers report that they regularly set energy goals for projects, perform analyses to identify energy efficient options and recommend efficient equipment. Although the vast majority of architects and engineers reported that their clients were concerned about energy efficiency, less than half of these had marketing materials on the topic to present to their clients.

General contractors had a much lower level of awareness and knowledge of energy efficiency options and products. This contrast between engineers and general contractors is significant because general contractors supervise about 80% of construction projects, whereas engineers are used on only about 40%. General contractors commonly make critical decisions regarding equipment selection.

Equipment suppliers tend to be small firms with annual revenues under $5.0 million. They generally sell equipment designed for the both the C&I and residential markets. In contrast to engineers, some equipment suppliers, particularly those selling motors, expressed their lack of knowledge about efficient options and their belief that buyers were more concerned about other features of their products.

Decision Making

We asked the C&I firms with construction projects and the construction professionals to identify the people that most influence the selection of heating equipment and the selection of lighting equipment. There was little agreement among the responses of the different groups. Every market group was identified by at least one group as being among the top two decision-makers for HVAC and lighting equipment decisions.

These findings can be understood in the broader context of C&I construction. There are three junctures in the process where key decisions regarding the building and equipment efficiency are made. These are:

- the planning and design process,
- modifications to the design during implementation, frequently changes that reduce first costs but tend to increase energy use, and
- equipment purchases, which may be the most efficient equipment meeting the specs, or less efficient equipment, if reducing first costs is a priority.

At each stage, the market players have different roles. In the planning and design phase, the design professionals often work closely with their clients. During construction, those professionals making the day-to-day decisions will have a greater impact. Suppliers will be more influential in the selection and purchase of equipment. Those market players that influence the design as it is implemented, i.e., architects, mechanical engineers and general contractors, are likely to have the greatest influence on the overall efficiency of the end product.

C&I firms installed more efficiency measures, on average, when they discussed energy use with mechanical engineers, or with architects or general contractors, than when such conversations did not take place. In addition, firms installed more measures when they had been in contact with more professionals. Contact increases the likelihood that design markets are exposed to energy efficiency ideas.

Our study suggests energy efficiency efforts will have the greatest impact when they increase the ability of each of the market actors to talk about efficiency with clients and other professionals. Certainly, each market actor needs to know about available incentives and technical assistance options. Each market actor also needs an opportunity (from outreach, conferences, or training) to learn about efficiency options relating to their specific areas of expertise and how to discuss the options with other professionals and with clients. When efficiency programs only target owners, architects, and engineers, they are reaching only half (or less) of the market participants influencing efficient building construction.

Barriers to Efficiency

The evaluation also identifies some of the conditions that may be hindering efficiency improvements in the market place. Some of these barriers are discussed below.

- While about 90% of designers (architects and engineers) report that their clients express a concern for facility energy costs, they also report that their clients are unwilling to devote adequate funds to analyze efficient options. Without analysis, efficient options are simply taken off the table.

- Designers and contractors identify difficulties in obtaining reliable information on the costs and benefits of efficient options as a barrier to the installation of efficient equipment.

- Some contractors mention the higher initial costs of the efficient equipment as a hurdle for many clients.

- Window and motor suppliers express an interest in efficiency but perceive their clientele as more interested in other features.

- Lighting suppliers stress concerns about the quality of the light output of efficient fixtures.

- Business owners perceive that construction firms are not raising opportunities for higher efficiency options for discussion.

Baseline Construction Practices

The process of assessing baseline construction practices for the C&I market is complex. The small size and fragmented nature of the market makes it particularly complicated. The survey of market actors was designed to view the market in a more general sense from the perspective of the players actually designing and doing the construction. The on-site visits were conducted to assess actual construction practices on a set of buildings.

Each of these approaches has its own advantages and disadvantages. Construction-related companies typically build or work on numerous buildings each year, so interviewing a sample of these companies may provide a picture that covers a large part of the market with only few phone calls. However, a common problem with telephone surveys of contractors is that the respondents have a tendency to overstate their commitment to energy efficiency. Site visits provide field observations about the actual equipment and building practices selected, but this advantage may be offset by the difficulty in obtaining an adequate sample size, particularly in the C&I market with such a wide range of projects and types of buildings. Thus, the strategy of approaching the market from two angles and integrating the results was designed to obtain a more complete view of actual baseline practices.

The telephone survey of market players has been completed and the results, i.e., self-reported estimates of standard building practices, have been compiled. Seventy-one (71) site visits were also completed. Analysis of the survey data continues, as self-reported data from the various market actors likely overstates current efficiency construction practices.

In general, most architects, engineers and mechanical contractors displayed a reasonably high awareness of efficient products and practices in their particular field (60 to 80% of respondents). Architects and engineers try to incorporate energy efficiency into the design phase of the project with pre-design discussions, modeling and design analysis. In contrast, awareness of efficiency options among general contractors was far less common (fewer than one third of the contractors).

While awareness of various efficient options seemed reasonably high for many of the groups of market actors, the self-reported installation rates for some basic measures were surprisingly low for new construction and renovation projects, such as T-8 lighting (38%), lighting controls (26%), economizers (25%), variable frequency drives (18%) and high efficiency furnaces (23%). These installation rates for equipment replacement projects tended to be even lower.

Act 250

In general, the market players with a greater degree of direct experience with Act 250 tended to have a more positive view of its impact. Engineers and property developers held the most favorable opinion of the energy impact of Act 250; about two-thirds of both groups thought that projects reviewed under Act 250 had either more or a higher level of energy-efficiency features than they would have had without the Act 250 review. About half of the architects, general contractors, and C&I firms with permitted construction projects shared this view. Smaller proportions of electrical and mechanical contractors agreed with this opinion. Larger general contractors were more likely than smaller ones to have been involved in Act 250 and to rate its effect highly.

Program Description

Efficiency Vermont began operating in March 2000 offering programs, including service to C&I firms, built on pre-existing utility sponsored programs. The programs focus on opportunities for energy efficiency in new construction, major renovations, remodeling, and equipment replacements. EVT and BED offer incentives and technical assistance to encourage businesses to install efficient equipment, and provides analyses and modeling of efficiency options. EVT also created a specialized service to educate organizations about, and help them meet, the energy-efficiency requirements of Act 250 (Vermont's land-use planning and

development law), and the DPS's "Vermont Guidelines for Energy Efficient Commercial Construction."

During the years 2000 through 2002, EVT built the participation in its C&I programs through a comprehensive marketing and outreach program. Targeted audiences included architects, building decision-makers, the media, utilities, trade allies, and each utility's largest C&I firms. EVT produced informational materials, and expanded and marketed the annual Better Buildings by Design Conference to the C&I sector. In addition, EVT works with regional and national organizations to use the leverage of these larger markets to influence manufacturers and wholesalers active in the Vermont market.

Program Results

C&I businesses that received services from EVT and BED are more likely than other firms to report having installed efficiency measures. Using statistical regression analysis, we found use of Efficiency Vermont and Burlington Electric Department services makes a positive contribution to the number of energy efficiency measures installed in projects. While EVT is serving firms throughout the state, its technical assistance is reaching fewer of the non-Act 250 projects in rural and small urban areas than it is in other project/location combinations.

We also investigated the general awareness level of Efficiency Vermont and Burlington Electric Department and its services among the critical market players. The table below shows the proportion of market players aware of the EEU and the proportion that have used its services. The last column shows the percentage of the surveyed firms that used these services and rated them highly. These results indicate that Efficiency Vermont and Burlington Electric have been reasonably successful in achieving high awareness levels in the market place. They also show that there is room for improvement in encouraging more firms to use their services and in responding to the needs of their design and construction clients.

Market Player	% Aware of EVT or BED	% Use of Services	% rating EVT highly of those who used EVT
Architects	84%	47%	61%
Engineers	100%	81%	48%
General Contractors	77%	29%	57%
Mechanical Contractors	68%	31%	54%
Electrical Contractors	75%	30%	82%

Other accomplishments in the C&I sector from the program's inception in March 2000 through the end of the 2002, as reported by Efficiency Vermont and BED, include the following.

- EVT actions saved 48,494 MWh (exceeding its goal of 42,267 MWh) and BED actions saved 4,971 MWh.

- EVT served 1,181 C&I firms (through 11/30/02) and BED served 110 C&I customers.

- EVT offered 25 workshops and seminars.

- EVT worked with 783 market actors, including architects, consultants, general contractors, electrical contractors, mechanical and heating, ventilation and air conditioning ("HVAC") contractors, facilities engineers, project engineers and developers.

- One hundred and sixteen (116) C&I firms installed measures through EVT's C&I new construction program in 2000 and 2001, about 26% of the estimated eligible market.

- Four hundred and eighty two (482) C&I firms received services and installed measures through EVT's C&I market opportunities program in 2000 and 2001, representing about 12% of the estimated eligible market.

Future Directions

The evaluation activities to date support EVT's multi-faceted strategy to approach Vermont's C&I markets, and also point to some areas still needing attention, such as: enhancing strategies to reach rural and small urban areas, increasing education efforts aimed at contractors and real estate developers, targeting outreach to suppliers to improve knowledge and promotion of particular products, continuing to work with regional and national efforts to influence manufacturers, and developing strategies to promote comprehensive building and lighting design, possibly through demonstration sites to showcase high quality, efficient products and building design features. Another potential area for education of construction firms is emphasizing the importance of initiating discussions with their clients about efficient options early in the project design process.

The initial round of evaluation efforts has resulted in a list of priorities for future evaluation research. Some tasks which build upon the first round evaluation are currently underway, e.g., completing the analysis of construction practice data collected from the on site surveys. The complexity of this market requires further investigation into the characteristics of various types of construction projects and market participants. As a continuation of assessing

the market conditions and providing context for the work completed by EVT, market indicators established in the first round should be re-visited and compared to the initial baselines. The surveys of market actors indicate that further questioning of these parties may be a fruitful source of ideas for innovative ways to address a number of difficult to reach market segments such as small electrical and HVAC contractors and the non-Act 250 new construction market. Finally, the next round of evaluation activities should include some targeted impact evaluation and realization rate analysis for specific measures with a greater degree of uncertainty regarding market acceptance, measure performance and savings levels.

IV. List of Appendices and Supporting Documents

List of Appendices

Appendix 1: "Efficient Products Program Evaluation Report", Executive Summary, Xenergy Inc.

Appendix 2: "Residential New Construction Program Evaluation Report", Executive Summary, Xenergy, Inc.

Appendix 3: "Evaluation of the Commercial and Industrial Sector Markets and Activities of Vermont's Energy Efficiency Utility", Executive Summary GDS Associates

Appendix 4: "Getting the Big Picture of a Small Place", Overview of the GDS C&I evaluation project, Jane S. Peters, et al.

List of Project Documents

The following documents are available on request from the Vermont Department of Public Service. They will also be posted on the Department's web site at:

http://www.state.vt.us/psd/ee/ee.htm

1. Final Report: Phase 1 Evaluation of the Efficiency Vermont Efficient Products Program, Xenergy Inc., June 10, 2002

2. Vermont Residential New Construction 2002, West Hill Energy & Computing, Inc., January 2, 2003

3. Preliminary Market Characterization: Low Income Programs, Xenergy, October 2001

4. Evaluation of the Commercial & Industrial Sector Markets and Activities of Vermont's Energy Efficiency Utility, GDS Associates Team, March 31, 2003 and Revised, May '03 Chapter 8, volumes 1 and 2

5. An Initial Assessment of Burlington Electric Department's Core Program Implementation, GDS Associates, May 24, 2002

6. Draft Report, "Customer Credit Program Implementation Assessment", GDS Associates, May 23, 2002

7. DPS Report and Recommendations to the Vermont Public Service Board Relating to Vermont's Energy Efficiency Utility of May 29, 2002 with attachments and appendices

8. DPS annual "Verification for Efficiency Vermont Year xxxx Savings and total Resource Benefit (TRB) Claim" report and recommendation for the years 2000, 2001, and 2002

9. "Independent Audit of Vermont Energy Efficiency Utility Energy and Capacity Savings for 2000 and 2001", Martin Cummings, December 20, 2002

10. NEEP "Scoping Study on Market Penetration Tracking of Energy-Efficient Motors and Packaged HVAC Systems in New England and New York", Nexus Market Research, Inc., August 8, 2003

11. NEEP "Motorup Evaluation and Market Assessment", Xenergy Inc., November 5, 2001

12. CEE Energy Star Customer Awareness Survey 2000