

**FINAL REPORT: PHASE 2
EVALUATION OF THE EFFICIENCY
VERMONT RESIDENTIAL
PROGRAMS**

Prepared for

Vermont Department of Public Service
Montpelier, Vermont

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December 2005

SECTION ES EXECUTIVE SUMMARY	E-1
E.1 Introduction.....	1
E.1.1 Program Overview	1
E.1.2 Evaluation Objectives	2
E.2 Methods.....	2
E.3 Key Findings and Recommendations	2
E.3.1 Efficient Products: Lighting Component	2
E.3.2 Efficient Products: Appliance Component	4
E.3.3 Residential New Construction	6
E.3.4 Potential for New Program Initiatives: Appliance Recycling.....	8
E.3.5 Process Evaluation	10
 SECTION I INTRODUCTION	 I-1
I.1 Overview.....	I-1
I.1.1 Program Overview	I-1
I.1.2 Evaluation Objectives	I-2
I.2 Methods.....	I-3
 SECTION 1 LIGHTING PROGRAM ASSESSMENT	 1-1
1.1 Introduction.....	1-1
1.1.1 Evaluation Objectives	1-1
1.1.2 Background and Motivation	1-1
1.1.3 Overview of Data Collection and Analysis	1-2
1.1.4 Structure of this Report.....	1-3
1.2 Review of EVT Program Activity to Promote CFLs.....	1-4
1.2.1 Objectives and Operations	1-4
1.2.2 Patterns of Program Activity and Participation	1-5
1.3 Estimates of CFL Sales	1-9
1.3.1 CFL Sales in Vermont: 2004	1-9
1.3.2 Comparison to CFL Sales Studies of Other Geographic Regions	1-13
1.4 Segmentation of the Residential CFL Market	1-21
1.4.1 Overview.....	1-21
1.4.2 Factors Associated with CFL Awareness and Purchase	1-22
1.4.3 Remaining Market Potential	1-22
1.5 Installation Rates.....	1-23
1.6 Conclusions and Recommendations	1-24
1.6.1 Key Findings.....	1-24
1.6.2 Recommendations.....	1-26

SECTION 2	APPLIANCE PROGRAM ASSESSMENT.....	2-1
2.1	Introduction.....	2-1
2.1.1	Objectives	2-2
2.1.2	Data Collection and Analysis.....	2-2
2.1.3	Key Findings and Recommendations	2-3
2.2	Program Activity Summary	2-5
2.2.1	Objectives	2-5
2.2.2	Key Findings.....	2-5
2.2.3	Patterns of Customer Participation	2-6
2.2.4	Rebates by Store Type	2-6
2.3	Estimation of Appliance Sales and Energy Star Market Share.....	2-8
2.3.1	Summary	2-8
2.3.2	Clothes Washer Sales and ENERGY STAR Market Share.....	2-9
2.3.3	Refrigerator Sales and ENERGY STAR Market Share	2-13
2.3.4	Dishwashers Sales and ENERGY STAR Market Share	2-14
2.3.5	Room Air Conditioners Sales and ENERGY STAR Market Share	2-16
2.4	Assessment of Net Program Effects	2-17
2.4.1	Approach.....	2-17
2.4.2	Specification of Independent Variables	2-19
2.4.3	Model Selection	2-21
2.4.4	Model Enumeration: Estimation of Program Effect on ENERGY STAR Market Share in Vermont	2-22
2.4.5	Net Unit Sales and Energy Savings	2-24
2.4.6	Comparison to Massachusetts Analysis.....	2-24
2.4.7	Explanations for Apparent Reduction in Net Program Effects.....	2-26
2.5	Recommendations.....	2-27
 SECTION 3	 APPLIANCE SATURATION SURVEY	 3-1
3.1	Overview.....	3-1
3.1.1	Project Background.....	3-1
3.1.2	Report Overview.....	3-1
3.1.3	Methodology.....	3-2
3.2	Space Heating	3-3
3.2.1	Primary Heating System	3-3
3.2.2	Heating Systems and Controls	3-6
3.2.3	Heating System Efficiency	3-7
3.2.4	Supplemental Heating Systems.....	3-8
3.3	Air Conditioning and Ventilation	3-11
3.3.1	Air Conditioning	3-11
3.3.2	Ventilation.....	3-15
3.4	Water Heating	3-15

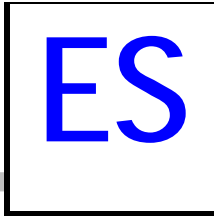
3.5	Laundry Equipment	3-18
	3.5.1 Clothes Washers.....	3-20
	3.5.2 Clothes Dryers	3-21
3.6	Food Preparation.....	3-21
	3.6.1 Penetration	3-21
	3.6.2 Fuel Shares of Cooking Equipment	3-22
	3.6.3 Dishwashers	3-23
3.7	Refrigerators and Freezers	3-24
	3.7.1 Penetration and Saturation	3-24
	3.7.2 Age of Equipment	3-25
	3.7.3 Equipment Features	3-26
3.8	Home Office Equipment.....	3-28
3.9	Entertainment Equipment	3-30
3.10	Miscellaneous Appliances	3-30
3.11	Lighting.....	3-32
	3.11.1 Lighting Fixture Inventory.....	3-32
3.12	Building Shell Features.....	3-32
	3.12.1 Windows	3-32
	3.12.2 Insulation.....	3-33
3.13	Energy Efficiency	3-34
	3.13.1 Lighting.....	3-34
	3.13.2 ENERGY STAR Awareness.....	3-35
	3.13.3 Efficiency Vermont Awareness	3-36
3.14	Customer Demographics.....	3-36

SECTION 4 REFRIGERATOR TURN-IN ASSESSMENT.....4-1

4.1	Introduction.....	4-1
	4.1.1 Objectives	4-1
	4.1.2 Overview of Data Sources and Approach.....	4-1
	4.1.3 Key Findings and Recommendations	4-3
4.2	Market Characteristics	4-5
	4.2.1 Overview.....	4-5
	4.2.2 Refrigerator and freezer units currently in Vermont households.....	4-5
	4.2.3 Usage Factors.....	4-6
	4.2.4 Characteristics of units in service	4-7
	4.2.5 Recently Discarded Units	4-9
4.3	Unit Energy Consumption (UEC) Analysis.....	4-10
	4.3.1 UEC Estimates Developed by Modeling RASS Data.....	4-10
	4.3.2 UEC Estimates from Refrigerators Replaced by EVT LISF Program.....	4-14

4.4	Net-to-Gross (NTG) Analysis.....	4-16
4.4.1	Details of the California Analysis.....	4-16
4.5	Effective Useful Life (EUL) of savings.....	4-18
4.6	Conclusion and Recommendations.....	4-18
4.6.1	Conclusions.....	4-18
4.6.2	Recommendations.....	4-19
 SECTION 5 VERRESIDENTIAL NEW CONSTRUCTION		5-1
5.1	Overview.....	5-1
5.1.1	Evaluation Objectives	5-1
5.1.2	Key Findings.....	5-1
5.1.3	Program Overview	5-3
5.2	New Construction Program Activity and Participation	5-5
5.3	Market Description	5-14
5.3.1	Demand Side Overview	5-14
5.3.2	Supply Side Overview	5-25
5.3.3	Detailed Builder Characteristics	5-29
5.4	Baseline Construction Practices.....	5-31
5.4.1	Characteristics of Homes Built	5-31
5.5	Energy Efficiency in Marketing and Construction Practices.....	5-34
5.5.1	Energy efficiency in the home sales and planning process.....	5-34
5.5.2	Energy-Efficient Features	5-35
5.5.3	Energy-Efficient Options	5-38
5.5.4	Energy Efficiency as a Business Proposition.....	5-40
5.6	Awareness of Energy Ratings and Standards	5-41
5.7	Vermont Energy Star Homes Program	5-42
5.7.1	Reported Program Awareness and Participation	5-42
5.7.2	Participating Builder Response to Vermont ENERGY STAR Homes	5-43
5.7.3	Nonparticipating Builder Response to Vermont ENERGY STAR Homes	5-47
5.8	Builder Survey Methods	5-50
 SECTION 6 TRADE ALLY IN-DEPTH INTERVIEWS.....		6-1
6.1	Insulation Contractors.....	6-1
6.1.1	Survey Objectives and Methods	6-1
6.1.2	Sample Characteristics.....	6-2
6.1.3	Awareness of Statewide Energy Standards.....	6-3
6.1.4	Awareness and Knowledge of EVT Programs	6-3
6.1.5	Marketing Energy Efficiency Features	6-4

6.1.6	Energy Efficiency Market Opportunities.....	6-5
6.2	HVAC Contractors.....	6-6
6.2.1	Survey Objectives and Methods	6-6
6.2.2	Respondent Characteristics	6-7
6.1.3	2004 HVAC Installations.....	6-8
6.2.4	Awareness and Installation of ENERGY STAR-qualifying Equipment	6-9
6.2.5	Sizing and Installation Methods.....	6-11
6.2.6	Awareness and Assessment of EVT Programs	6-12
6.3	Remodelers	6-13
6.3.1	Survey Objectives and Methods	6-13
6.1.2	Sample Characteristics.....	6-14
6.1.3	Awareness of Statewide Energy Standards.....	6-15
6.1.4	Awareness and Knowledge of EVT Programs	6-16
6.1.5	Marketing Energy Efficiency Features	6-18
 SECTION 7 PROCESS EVALUATION.....		7-1
7.1	Internal Organization and Administration	7-1
7.2	Marketing: Customer Awareness and Perceptions	7-2
7.3	EVT Performance Metrics Compared to Other States.....	7-3
 SECTION A QUESTIONNAIRES		A-1
A.1	RASS Telephone Survey	A-1
	Space Heating	A-3
	Cooling.....	A-7
	Water Heating	A-9
	Refrigerators	A-10
A.2	Builder Questionnaire	A-26
A.3	Remodeler Questionnaire.....	A-47
A.4	HVAC Contractor Questionnaire.....	A-59
A.5	Insulation Contractor Questionnaire	A-77



E.1 INTRODUCTION

This Executive Summary presents an overview of the Phase 2 Evaluation of Efficiency Vermont's programs to promote the adoption of energy-efficient products and construction practices among residential customers and the building professionals who serve them. Efficiency Vermont (EVT) delivers energy efficiency programs to electric customers statewide, with the exception of customers served by the Burlington Electric Department. EVT initiated operation in November 2000, under contract to the Vermont Department of Public Service (DPS). Previous to that, electric and gas utilities delivered energy efficiency services to their customers under the regulatory supervision of DPS. KEMA, Inc. (formerly XENERGY Inc.) completed the first evaluation of EVT's residential programs in 2002.

E.1.1 Program Overview

EVT delivers three main residential programs.

- **Efficient Products.** The Efficient Products Program (EPP) encourages and facilitates the purchase of ENERGY STAR qualified home lighting products and appliances through a combination of customer incentives, merchandising support to retailers, advertising, and public relations. The appliance component focuses primarily on promoting ENERGY STAR qualified clothes washers; the lighting component primarily on promoting compact fluorescent light bulbs (CFLs).
- **New Construction.** The Residential New Construction (RNC) Program promotes the use of energy-efficient construction methods and components in new single-family homes. This is accomplished primarily by providing a combination of technical assistance, financial incentives, and marketing support to builders, along with Home Energy Ratings (which include on-site inspection and testing) to certify to buyers and owners that participating units meet high energy performance standards.
- **Existing Homes.** The Existing Homes Program consists of a number of initiatives designed to capture energy efficiency opportunities in existing homes through retrofit projects addressing building envelope, heating, and cooling systems. In some cases, these programs also aim to provide training and incentives for adoption of energy-efficient practices to contractors who typically serve those markets.

The Efficient Products and New Construction Programs have been part of EVT's portfolio since the organization's inception, and most Vermont utilities had operated predecessor programs for as many as 10 years prior to that. The Existing Homes Program was initiated in 2003 and is still in its early phases of development. As directed by DPS, KEMA did not evaluate the Existing

Homes Program. We did, however, capture responses to the program by vendors in the market they address, and those responses are reported in the relevant sections of the report.

E.1.2 Evaluation Objectives

The principal objectives of the evaluation were as follows.

- Estimate the net effects of EVT on purchases of compact fluorescent light bulbs (CFLs).
- Estimate the net effects of EVT on purchases of ENERGY STAR appliances.
- Assess the effect of EVT on new construction practices.
- Identify and characterize opportunities for new program efforts, particularly appliance recycling.
- Identify opportunities for improving performance of major program components.
- Assess overall program performance vis-à-vis similar programs.

E.2 METHODS

Table ES-1 summarizes the data collection and analysis efforts undertaken to support the evaluation.

E.3 KEY FINDINGS AND RECOMMENDATIONS

The following paragraphs present key findings and recommendations in regard to individual program components and opportunities for new initiatives.

E.3.1 Efficient Products: Lighting Component

Key Findings

- ***EVT's CFL promotion program showed strongly improved results in 2004.*** The number of CFLs purchased through the program through the combined coupon, ITP, and catalog channels grew to 178,669 in 2004 from 72,791 in 2003, and increase of 144 percent in one year. Over the same time period, sales of CFLs in the U. S. as a whole decreased by 6 percent.
- ***The recently introduced manufacturer buydown initiative (ITP) contributed significantly to overall program growth.*** The manufacturer buydown or ITP, which was implemented on a full scale in 2004, yielded sales of 34,430 CFLs. That is 19 percent of total program volume and 32 percent of the increase in volume from 2003 to 2004.

Table E-1
Summary of Phase 2 Residential Program Evaluation Research Activities

Activity / Summary of Topics Covered	Sample Size and Other Details
Review of tracking system database and other documentation.	
Interviews with DPS, EVT and Program Contractor Staff.	In-depth interviews with 15 individuals.
<p>1. Lighting Program Net Effects Study. Collect and analyze CFL sales data from a sample of Vermont locations. Corroborate findings with data from the Appliance Saturation Survey. Assess program net effects through comparison to similar data from other states.</p>	<ul style="list-style-type: none"> • Collected data from 5 retailers accounting for 70 – 80 percent of program volume. • Survey of 100 non-participating retailers to estimate CFL sales.
<p>2. Appliance Sales Data Collection and Net Effects Analysis. Collect appliance sales data from a sample of independent appliance dealers: volume of sales, model numbers for estimation of ENERGY STAR market share. Compile information on state-level appliance sales and ENERGY STAR market share from DOE and AHAM.</p>	<ul style="list-style-type: none"> • Sales data obtained from 48 retail locations, accounting for 50 percent of all program rebates
<p>3. Appliance Saturation Survey: Telephone Component. Collect information on appliance holdings, age, efficiency, CFL holdings and purchase, plug loads, heating and cooling equipment, basic housing and demographic characteristics, recruitment for on-site component.</p> <p>Appliance Saturation Survey: On-Site Component. Verify numbers and location of CFLs installed, appliance efficiency, appliance age (via model numbers), basic housing characteristics.</p>	<ul style="list-style-type: none"> • 600 random digit dial sample stratified by region • 83 nested sample recruited from the telephone panel
<p>4. Refrigerator Life Cycle Analysis. Estimate potential gross savings, net savings, and persistence of savings using a combination of primary and secondary data.</p>	<ul style="list-style-type: none"> • Data collected through the Appliance Saturation Survey, plus interviews with program staff, local appliance recyclers, and retailers
<p>5. New Construction Update: Builder Survey. Assess builders' knowledge of energy efficiency techniques and benefits; use of efficient construction techniques and equipment; opinions of business value of energy efficiency; current energy efficiency promotion practices; energy-related construction and specification practices prior to and since participation</p>	<ul style="list-style-type: none"> • 61 builders, random sample stratified by size and region
<p>6. Other trade ally interviews Assessment of program marketing and administrative effectiveness, customer response, and trade ally response.</p>	<ul style="list-style-type: none"> • 30 HVAC contractors, insulation contractors, appliance and lighting retailers, and remodelers.
<p>7. Process Evaluation. Comparison of EVT performance to that of other similar organizations. Dimensions of comparison will focus on market penetration and cost of conserved energy.</p>	Data to be derived primarily from EVT records and reports and publicly available information on other programs.

- ***Vermont recorded the highest level of CFL sales per household of any state for which sales data (as opposed to program activity records) were available.*** Using a combination of program records, retailer survey data, and retailer sales records collected by EVT, KEMA was able to develop a robust estimate of total CFL sales in the state in 2004 of 271,170 units or 1.08 units per household. Among areas with active promotional programs, the Pacific Northwest recorded sales of 1.01 units per household estimated

using similar methods. Analysis of point-of-sale scanner data conducted for California utilities found that 2004 sales in California totaled 0.43 units per household and 0.29 units at the national level.

- ***The Net-to-Gross ratio estimated for EVT's promotion of CFLs ranges from 1.22 to 1.36.*** The Net-to-Gross ratio estimated for EVT's promotion of CFLs ranges from 1.22 to 1.36. That is, 2004 CFL sales attributable to the program's influence range from 217,088 to 243,844 units versus the 178,669 units sold or subsidized through the program. This estimate was not sensitive to wide variations in the estimate of key input variables. It is also significantly higher than the current estimate of 1.19 used for planning and savings tracking purposes.
- ***At the household level, installation rate was not strongly related to the number of CFLs purchased.*** Thus, we do not believe that attempts to more closely enforce unit limits for individual customers will yield higher net program savings.

Recommendations

The findings of this evaluation clearly indicate that EVT has done a very good job with the lighting program, particularly in the past two years. KEMA suggests the following steps to sustain and enhance the progress that has been made.

- ***Expand the ITP manufacturer buydown component of the program.*** We believe further development of this approach will help reduce unit costs of the program and diversify the base of retailers and customers participating in the program.
- ***Require that EVT attempt to collect CFL sales information from all participating retailers.*** EVT's success in obtaining the sales data used for this evaluation and the usefulness of the analysis these data supported suggests that the effort should be incorporated into ongoing operations.

E.3.2 Efficient Products: Appliance Component

Key Findings

- ***Vermont continues to have high Energy Star market shares for all four appliances.*** When compared to national and regional averages, Vermont's ENERGY STAR market share in chain stores for each of the four major appliance categories is consistently among the highest estimated levels for individual states.
- ***The weight of evidence suggests that EVT's appliance program and its utility-based predecessors, as well as other long-standing utility programs had a profound impact on the national market success of energy-efficient clothes washers.*** A study commissioned by the Consortium for Energy Efficiency (CEE) found that utility energy efficiency program managers, primarily from California and the Northwest states, played a crucial role in initiating the development of the infrastructure required for effective market transformation programs: contacts with manufacturers, technology assessments, and

common equipment specifications.¹ These efforts were organized on the national level by CEE, beginning informally in 1992. The Vermont utilities joined the initiative in 1996. This work in turn supported a major national effort involving manufacturers and over 200 local program sponsors by the year 2000. Since then the national market share of ENERGY STAR clothes washers has grown from 9 percent to 27 percent (2004). In 2007, the federal minimum standard will be revised to match the current ENERGY STAR specification.

- ***The net effects of the program on the market share of ENERGY STAR clothes washers sold in a given year have declined significantly in recent years.*** In 2001, the net unit sales attributable to the program were estimated at 1,045 versus total program-subsidized sales of 2,719 for a net-to-gross ratio of 0.38. In 2004, the maximum number of net unit sales attributable to the program was 724 versus program volume of 4,179 units, for a net-to-gross ratio of 0.17. This is a maximum estimate that reflects the inclusion in the analysis of a variable that captures the effect of past program efforts as well as other factors that accounted for past growth in Vermont's ENERGY STAR clothes washer market share.
- Findings of decreased net effect in the current year are consistent with recent increases in national ENERGY STAR appliance market shares, as well as with other regional studies. These findings are consistent with a similar analysis conducted in 2003 for a consortium of Massachusetts utilities, and with the overall perceptions of appliance program managers around the country.

Recommendations

- ***In the short run, we believe that EVT should continue to administer rebates for ENERGY STAR clothes washers.*** This is necessary to maintain good relationships with retailer channels that have been built up over many years and to prevent potential sell-offs of non-qualifying models prior to implementation of the next round of federal minimum energy efficiency standards in 2007.
- ***Assess and implement changes to the program that can increase cost effectiveness.*** These expedients may include:
 - Reduce incentive amounts.
 - Limit the duration of appliance incentive promotions to specific months. This approach has been tried in the Pacific Northwest. Market share of ENERGY STAR appliances remain high in that region.
 - Restrict eligibility to models that qualify for the Consortium for Energy Efficiency's Tier 3 standards.
- ***In the longer term it may advance efficiency goals to redirect incentive and business development resources away from appliance promotions to other opportunities. EVT***

¹ Feldman, Shel, Mitchell Rosenberg, Jane Peters. 2001. *The Residential Clothes Washer Initiative: A Case Study of a Collaborative Effort to Transform a Market*. Boston: Consortium for Energy Efficiency.

should initiate discussions with appliance retailers to develop procedures for an exit strategy.

E.3.3 Residential New Construction

Findings

- ***The portion of single-family new homes that enroll in the program is very high compared to participation rates for similar programs elsewhere.*** In the years for which data were available (2001 through 2003), the program developed leads on 1,551 to 1,950 projects, which corresponds to 61 to 74 percent of the typical volume of single-family homes permitted each year (around 2,500). The program also does a good job converting leads to enrollments. This ratio ranged from 39 to 52 percent in the three years covered. The percentage of permitted single family homes that enrolled in the program remained stable in the range of 29 to 32 percent from 2001 to 2003.
- ***EVT has reduced the portion of projects that drop out of the program prior to certification and the pace at which projects are processed.*** Portion of projects completed in same year as enrollment increased from 14% in 2001 to 36% in 2003.
- ***Number of builders with projects enrolled and number of builders participating for the first time increased steadily from 2001 through 2003.*** As of the end of 2003, 200 builders had completed projects through the program.
- ***The number of builders completing multiple projects in one year increased to 30 in 2003 v. 12 in 2002.*** Repeat participation is key to the execution of EVT's strategy to transform the residential new construction market.
- ***The depth and quality of energy efficiency measures in participating homes increased significantly from 2002 through 2004.*** The portion of completed projects with 6+ end-uses addressed increased from 38% in 2002 to 69% in 2004. The portion of completed projects meeting Energy Star rating criterion (86.0) increased from 77% in 2002 to 92% in 2004.
- ***Baseline energy efficiency practices improved between the Phase 1 evaluation (2001) and the Phase 2 study (2005), particularly for measures promoted by the EVT program.*** Inclusion of selected energy efficiency measures, including Energy Star® appliances, energy efficiency fluorescent hard-wired lighting fixtures, and use of blower door tests to measure air infiltration, has increased since the Phase 1 study. These increases are likely a result of program influence.
- ***KEMA uncovered additional evidence of market transformation in interviews with builders.*** Key findings in this regard were as follows.
 - Builder awareness of the non-energy benefits of energy-efficient equipment (including increased comfort and lower equipment maintenance costs) increased by statistically significant margins since 2001.

- Customer requests for Energy Star® rated high-efficiency heating and cooling equipment as priced options have increased dramatically since the Phase 1 evaluation: builders representing 39 percent of the new construction market in Vermont indicated that customers request the equipment as compared with only 8 percent in 2001.
- Builder perceptions of the importance of energy efficiency to the success of their businesses have increased, another likely demonstration of the program's success in transforming the new construction market.

Recommendations

EVT has significantly improved the quality of marketing and delivery for the Residential New Construction program since the Phase 1 evaluation. KEMA has no recommendations for improving program operations or design. Over the course of the evaluation, DPS and KEMA raised questions concerning the cost effectiveness of the program, prompted by its relatively low share of total *annual electric savings* as a portion of total annual electric savings achieved by EVT's residential programs. Upon review of cost and benefit results published in EVT's 2004 Annual Report² the program appears to be cost-effective on a total resources basis. Specifically:

- In 2004, the RNC program accounted for 25 percent of EVT's total budget for residential energy efficiency programs.
- First year MMBtu savings, which take into account fossil fuel energy as well as the energy content of delivered electricity accounted for 21 percent of total MMBtu savings.
- The program as a whole was not subjected to a formal total resource benefit-cost analysis in the 2004 *Annual Report*. However, cost and benefit estimates included in the report suggest that the program was cost-effective. The discounted value of the lifetime savings generated by the 2004 RNC program totaled \$2.615 million (constant 2003 dollars), without accounting for the environmental and energy market risk adders that have been incorporated into cost-effectiveness calculations in Vermont. The total cost of the program, also in 2003 dollars, was estimated at \$1.901 million.
- The observations concerning electric savings that led to the initial concern about the cost effectiveness of the program are accurate. The RNC accounts for only 3 percent of estimated annual electric savings from residential programs, and 6 percent of the lifetime savings. The more favorable total resource results stem from the program's emphasis on longer-lived measures and on measures that save primarily fossil fuel energy.

KEMA recommends that EVT in conjunction with DPS take steps to clarify the rationale for the program. For example, it seems likely that some of the improvement in baseline construction practices is attributable to the program. RNC is also an important for reducing overall energy costs of consumers and a vehicle for leading the market towards future increases in the

² Efficiency Vermont. November 2005. *Year 2004 Annual Report and Annual Savings Claim*. Burlington, VT. Tables 2.1.16 and 3.1.12.

stringency of the Energy Code. Moreover, the RNC is an important channel for the delivery of energy-efficient lighting fixtures. During the period between evaluations, we recommend that the EVT Business Development and Planning staffs seek to characterize these program contributions more fully than was possible in this evaluation and to develop potential changes to the program that will enhance these effects.

E.3.4 Potential for New Program Initiatives: Appliance Recycling

The DPS requested that KEMA assess the potential cost-effectiveness of an initiative to provide incentives to customers to turn in used refrigerators and freezers. KEMA used data collected through the 2005 Residential Appliance Saturation Survey (RASS), EVT data, and evaluations of appliance turn-in programs in other jurisdictions to estimate:

- Likely volume and characteristics of appliances that would be turned in;
- Average unit annual energy consumption (UEC) for units likely to be collected by the program (a measure of gross savings per unit);
- A net-to-gross ratio (NTG) that reflects the net effect of a turn-in initiative on a customer's decision to recycle an appliance, versus retaining it in use or transferring it to another user;
- A measure effective useful life (EUL) that reflects how long the appliance would have remained in service in the absence of a turn-in initiative.

The DPS and the Energy Efficiency Utility can use these findings, along with cost information from appliance recycling service providers, to assess the cost-effectiveness of pursuing an appliance turn-in initiative.

Key Findings

Market of Available Units

- Of the 600 RASS respondents, 128 (21 percent) reported that they had had a refrigerator and/or freezer removed from their home in the past three years.
- The majority of all reported discarded units (62 percent) were 15 years or older.
- The vast majority (98 percent) of respondents who disposed of one refrigerator in the past 3 years said that the refrigerator had been their primary refrigerator (not an extra or a back-up unit).
- 64 percent of the discarded primary units were reported to be “working” units (just old or replaced). Twelve percent were reported to be “working, but in need of repair, and nearly 24 percent were characterized as not working when they were discarded.

Savings Estimates

- **Unit energy savings.** KEMA estimated potential unit gross savings from a turn-in program by applying data from the RASS on the age, usage patterns, and means of disposal of refrigerators and freezers to Unit Energy Consumption (UEC) data developed by other studies. This approach yielded estimates of potential gross savings per unit of 1,899 kWh per year.
- **Potential net energy savings.** KEMA developed estimates of potential net program energy savings using the results of recent evaluations of refrigerator turn-in programs in California. Applying findings regarding participation and net-to-gross ratios from these studies, we arrived at an estimated net savings of 1,824 MWh/year. Table E-1 displays the results of this estimate. By way of comparison, the planned level of savings for the clothes washer component of the Appliance program was 1,238 MWh/year in 2004.

Table E-2
Preliminary Estimate of Net Program Electricity Savings Potential

Number of Households	249,450
Annual Participation Rate	1.1% x
Annual unit gross savings (UEC)	1,899 kWh/Year x
Net-to-Gross Ratio	<u>0.35</u> x
Annual Gross Savings	1,824 MWh/Year

Recommendations

It is clear that an appliance recycling program offers significant savings. We are confident that the estimate of annual unit gross savings represents a reasonable estimate of savings that can actually be achieved with the collection of each unit. We are less confident about the assumed participation rate and NTG ratio. Any attempt to project a participation rate for Vermont on the basis of observations in other states is somewhat speculative. In the case of the NTG ratio, we note that this performance parameter has varied in unpredictable ways within single jurisdictions. The results of this analysis strongly suggest that further efforts to assess the cost-effectiveness of a prospective appliance recycling program are warranted. We recommend taking the following steps.

- Approach vendors such as Recycling North and Appliance Recycling Centers of America to obtain non-binding estimates of the costs of operating a program that involves recycling of 1,500 to 2,500 units.
- Conduct cost-effectiveness screening using the net and gross savings estimates developed for this analysis.

- Conduct sensitivity analysis by varying the average gross savings figure as high as 2,000 kWh per year, and the NTG ratio as high as 0.50.
- Based on the results of this analysis, assess the likelihood of the program becoming cost effective.

E.3.5 Process Evaluation

Generally, KEMA found EVT's residential programs to be very well-managed. In particular, we found the organization's marketing and program tracking procedures and results to be excellent in comparison with peer programs.

One of the most useful ways to assess the overall performance of EVT is to compare it to that of "peer programs" using a consistent set of indicators. In this case, peer programs would consist of long-established public benefit-funded energy efficiency programs that address all or most of the customers in a given state. Unfortunately, regulators in the individual states do not collect program performance information in uniform ways. Thus direct comparisons between programs need to be treated as very general in nature.

Overall, Vermont tied with three out of eight other peer programs considered for the highest level of electric savings as a portion of sales with 0.8 percent. EVT's residential programs captured savings equal to 0.9 percent of total residential electric sales in Vermont.

The cost per first year savings provides a very rough measure of cost-effectiveness for a portfolio of programs. It would be much more appropriate to consider the combined results of the portfolio using the Total Resource Cost Test, or similar measures that take measure lifetime savings, customer costs, and environmental benefits into account. However, such an analysis would require a great deal more data than is readily available from other programs. With this caveat in mind, we see that EVT ranked third among states with peer programs in terms of cost per first year kWh savings. For all of EVT's programs combined, this figure was \$0.281/kWh. The range for this indicator ran from \$0.231/kWh in Wisconsin to \$0.580/kWh in New Jersey. Thus, EVT's performance in this regard was very close to the best of the range presented by the eight peer programs.