Fuel Switching Programs in Vermont: Issues and Experiences

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Vermont is currently engaged in a pioneering experiment where electric utilities are promoting the cost-effective substitution of alternate fuels for electricity as an element of demand-side programs. Various program designs have been developed, with a wide range of incentive levels. Projected participation rates vary from under 10% to over 50%. While some differences are a function of individual utilities' avoided costs and economic screening assumptions, they also reflect the particular characteristics of individual utilities' customers and differences of perception as to the extent of market barriers and the steps necessary to overcome them. Early program experience has already indicated that certain residential fuel switching programs can achieve cumulative participation rates of over 40%. Significant experience is also being gained as to the applicability, costs and impacts of fuel switching in a wide variety of applications.

Introduction

Switching customers' electric heat and hot water to another fuel as an efficiency measure does not seem a compelling idea to many utilities, particularly those who see themselves as sellers of electricity. But electric utilities are regulated monopolies obligated to do more than sell power. Their legal mandates generally include the promotion of the safety and convenience of the public by providing service at just and reasonable rates. Furthermore, in providing service at "reasonable" rates, it has been increasingly perceived to be the responsibility of utilities to provide required levels of service on a "least cost" basis.

In Vermont, that responsibility has been found to include encouraging customers to choose the use of substitute fuels, when this is the least-cost choice from a societal perspective. While virtually all Vermont utilities have responded with the development and implementation of demand-side programs which include fuel switching, the related policy and program design issues have become an area of contention among utilities, regulators and public interest groups in Vermont.

Fuel substitution has been incorporated into Vermont utility residential, commercial and industrial demand-side programs, addressing both existing and new construction, but program experience to date has been largely limited to the residential retrofit sector. It should also be noted that there are appropriate situations for conversion to electricity from alternate fuels, but that they are very limited and not have been extensively analyzed in Vermont. This paper will focus primarily on Vermont's experience regarding fuel switching of existing residential electric space heating (ESH) and electric water heating (EWH) to alternate fuels.

Background

On April 16, 1990, the Vermont Public Service Board (PSB) issued an order in Docket No. 5270 which directed all Vermont utilities to invest in comprehensive, cost-effective energy efficiency programs.[1] The order directed utilities to develop programs to capture all cost-effective demand-side resources, including fuel switching. The order followed eleven months of contested hearings involving all the state's twenty-four electric utilities, its only gas utility, the Department of Public Service (DPS) (which represents ratepayers), and public interest intervenors including the Conservation Law Foundation of New England (CLF), the Vermont Natural Resources Council and the Vermont Public Interest Research Group.

As an alternative to litigation, some of the utilities, the DPS and the intervenors entered into extensive collaborative negotiations to design comprehensive energy efficiency programs. Efforts with most utilities were quite successful in designing such programs. However, the negotiation with Central Vermont Public Service Corporation (CVPS), the state's largest utility, broke down over CVPS's refusal to invest in fuel switching. As a result, the DPS and intervenors filed a motion with the PSB to require such investments.

In litigation over the motion, CVPS took the position that fuel switching was not an energy conservation measure and therefore beyond the PSB's authority to order. Other utilities joined in the action and argued the PSB has no authority at all to order utilities to make any particular investment.

Ultimately, the PSB rejected the utilities' arguments and found fuel switching to be a conservation and load management resource which utilities should seek to acquire when cost-effective.[2] The PSB further found it had the power to direct a monopoly provider of essential services to employ up-to-date technology and practices necessary to deliver adequate service to its customers at least cost and ordered CVPS to analyze the merits of specific fuel switching measures and to develop a plan to acquire those energy efficiency resources.

A discussion of how the Vermont utilities have embarked on that unprecedented acquisition program is the subject of this paper.

Previous Vermont Experience With Fuel Switching

The Vermont State Energy Office and DPS initiated several early fuel switching initiatives in the late 1970s, primarily aimed at industrial, commercial and institutional conversions from oil to wood, but also to solar domestic hot water. Then, starting in the mid-1980s, Vermont began to see a number of systematic initiatives involving switching from electricity to alternative fuels for space heating and domestic water heating in schools, subsidized housing and individual homes. These are summarized briefly below.

In 1985 about 50 of Vermont's 400 public schools, representing 27% of total floor area, were heated with electricity. By 1992, twenty of these schools had switched fuels or have conversions in process, representing more than half of the affected floor space. Where available, these conversions were made to natural gas-fired hydronic systems. Most others were to oil, but notably four switched to wood chip-fired boilers and one converted to a 325-kW oil-fired cogeneration system. These conversions received some support from state education aid, DPS's Institutional Conservation Program, and oil overcharge funds, but were primarily funded through local bond votes and driven by public awareness that cost savings would far exceed the debt service. While there has been no formal evaluation of these projects, they are reported to have achieved intended savings and have served as models for later projects.

Fuel switching has also been actively pursued in subsidized housing. Much of Vermont's public housing as well as housing built under the federal Section 8 and 23 programs was built with electric space heat. As one response, the Vermont Housing Finance Agency, which holds the mortgage for many of the Section 8 properties and wants to keep them affordable, began a program in 1987 to increase energy efficiency in these projects. Energy investment analyses of 31 electrically-heated projects by the non-profit Vermont Energy Investment Corporation (VEIC) have almost invariably found fuel switching to be cost-effective. Through shared savings arrangements with VEIC and financing assistance through the DPS Oil Overcharge Public Housing Program, public housing authorities have converted one housing project to a cogeneration system and another to a woodchip-fueled district heating system. When the two largest affordable housing developments in the state were purchased from private owners by tenant-managed non-profit organizations, they were converted from electricity to alternate fuels, one of them with partial funding from its electric utility.

Fuel switching has been widely pursued by individual homeowners as well. Both the DPS Home Energy Loan Program (HELP) and its successor, VEIC's Home Energy Improvement Loan Program (HEILP), have assisted in many conversions from electric heat to oil, natural gas and wood. Some data are available from VEIC's loan program. Under this program, the dominant types of conversions were to central hydronic systems with gas or oil-fired high-efficiency boilers and integrated, indirect domestic water heating. The average cost of conversion (including the distribution system) was $6050, and the average displaced electrical use was approximately 15,200 kWh/yr.[3]

This prior experience established both an awareness of the consumer economics of selective fuel switching and a base of technical and economic experience which contributed to analysis of fuel switching as a utility DSM measure.

Screening the Cost-effectiveness of Fuel Switching Measures

The appropriate methodology for the screening of fuel switching measures was a subject of some dispute among the DPS, the utilities, and the non-utility parties. General guidance from the PSB's order in Docket No. 5270 served as a basis for the approach used in collaborative program design, which is discussed further below.

The cost-effectiveness rule used is the "societal test", sometimes called the "total resource test". In selecting among competing measures, the parties agreed that the

objective is to maximize the net present value of societal benefits, rather than benefit/cost ratios.

In this context, societal benefits are the utility's avoided supply costs which result from fuel switching over the lifetime of the measures. Societal costs include initial measure installation cost, the cost of periodic component replacements, annual maintenance, and any other operating costs, including the cost of alternative fuel. The PSB order included directing utilities to explicitly account for risk and externalities in developing DSM programs. Most Vermont utilities used the PSB's suggested values of a 10% risk adjustment reducing the costs of all demand-side measures and a 5% environmental externality adder to the avoided costs.[4]

One important lesson learned through the screening process was the vital importance of screening space and water heating demand-side measures at different energy use levels, using the appropriate measure costs and savings for each level. Such analysis is essential for accurate estimation of fuel switching resources. For example, an existing electric water heater with very low usage would not be cost-effective to treat with any DSM measures other than tank wrap, pipe insulation and low-flow devices. Above a certain threshold, it may become cost effective to place the water heater under direct load control. At a moderate use level, fuel-switching to low-cost fuels (i.e., wood pre-heat or natural gas) can become the option with the greatest net benefits. At higher consumption levels, more costly conversions (i.e., stand-alone oil) become cost effective. At the highest levels of use, solar water heating, with a high first cost but low operating cost, becomes the optimal choice.

Overview of Vermont Utility Fuel Switching Programs

In the current regulatory context, Vermont utilities have been relatively free to adopt a wide variety of fuel switching program designs, reflecting individual utility characteristics, different perceptions of the magnitude of market barriers and varied opinion as to the level of intervention necessary to overcome these barriers. This, and the intensity of planned program evaluations, should result in Vermont being an instructive testing ground for fuel-switching designs. The various program designs chosen by Vermont utilities fall into four generic models, summarized briefly below.

Village of Stowe Water and Light Department and Village of Ludlow Electric Light Department

These are both small municipal utilities serving towns with major ski areas.

The Village of Stowe Water and Light Department (Stowe) implemented Vermont's first utility fuel switching program. In 1987, Stowe recognized that its escalating capacity costs and poor load factor were being largely driven by commercial lodging and vacation-home electric space heat. It was then estimated that 18% of Stowe's winter peak was due to ESH load. The utility developed a "carrot and stick" strategy to encourage fuel switching through a program combining strong price signals with information and extensive technical assistance. Stowe raised commercial demand charges and instituted a mandatory residential demand rate for customers using over 2000 kWh per month or 12 kW in two successive winter months. The "carrot" part of the strategy is that Stowe provides an extremely detailed technical and financial analysis of a customer's efficiency and fuel switching options, including detailed cost estimates and cash flow analysis. For customers who choose to implement recommendations, the utility will provide complete arranging services, at no charge, including detailed specifications, bid solicitation, installation supervision and inspection. All these services are provided by the VEIC.

The Village of Ludlow Electric Light Department (Ludlow) offers a variation on the Stowe model. In October 1990, Ludlow initiated a pilot program, offering $600 for removal of ESH and $70 for removal of electric hot water heaters to any customer on the utility's ESH tariff (mandatory for any customer with over 1800 kWh or 8 kW for two consecutive winter months) and to any electric water heating customer.

Ludlow offered the program via direct mail to customers on the ESH tariff. Each was provided with an estimate of savings and the cash flow (using 12% interest-rate financing) they could expect based on a heating load derived from analysis of their historical bills and the estimated cost of a typical central hydronic system ($8,000 to $9,000). Those that show interest are sent a sample contract and a list of contractors. Before the work is performed, the utility tallies the existing electric heating equipment and later collects removed units for disposal.

Table 1. Utility Fuel Switching Program Characteristics

Utility	Technical Assistance Offered	Financial Incentives Offered	Financing Services Offered
Stowe	• on-site analysis • financial analysis • arranging services	none	none
Ludlow	• mailing to customers w/estimates of typical cost and payback	credit on electric bill of $600 for heating and $70 for water heating	none
BED	• on-site analysis • financial analysis • arranging services	buy-down of installed cost to 3-year customer payback	customer pays 60% of estimated savings on loan through cooperating bank
WEC	• on-site analysis • financial analysis • arranging services	buy-down of installed cost to 2.5-year customer payback	customer pays 50% of estimated savings on bills for up to five years
CVPS	• on-site analysis • financial analysis • arranging services	none	assistance in obtaining market-rate financing from third parties
GMP	• on-site analysis • financial analysis • arranging services	none	assistance in obtaining market-rate financing from third parties
CUC	• on-site analysis • financial analysis • arranging services	none	assistance in obtaining market-rate financing from third parties

Table 2. Utility Characteristics

Utility	Number of Residential Customers	Pre-Program Electric Space Heat Saturation	Pre-Program Electric Water Heating Saturation	Estimated Average Space Heat Use (kWh)	Estimated Average Water Heating Use (kWh)
Stowe	2,314	14.5%	30.0%	6340	2964
Ludlow	2,726	24.1%	48.1%	5847	2733
BED	14,600	15.6%	46.6%	5532	3576
WEC	5,486	3.7%	49.0%	8855	3400
CVPS	105,000	8.7%	49.0%	8767	4268
GMP	67,077	8.7%	42.3%	8665	3400
CUC	16,082	11.0%	67.7%	7302	3400

Burlington Electric Department (BED)

The goal of BED's "Heat Exchange" program is to convert over half of BED's residential primary ESH customers to other fuels. The program has a unique emphasis on rental housing (reflecting the fact that 68% of BED's ESH customers are renters) where low-cost retrofits of direct-vent space heaters is an option.

The program begins with an audit that evaluates options for fuel switching and, if cost-effective, presents the building owner the estimated price, projected annual savings and a financing scenario. BED-developed minimum weatherization standards must also be met to receive program financial incentives.

Building owners may choose either a loan or a rebate for cost-effective fuel switching. The loans are made available through a local bank. Customers pay a fixed amount equal to 60% of the savings estimate from the audit for a maximum of five years with BED paying any remaining balance. When the loan mechanism is used, BED acts as the building owner's "agent" to arrange for installation of the conversion.

Building owners may alternately receive a rebate when they arrange for fuel switching on their own or put in a more expensive system than the least-cost option recommended by BED. The rebate amount is equal to the payment that BED would have made under the loan mechanism for its recommended least-cost system.

Washington Electric Cooperative (WEC)

The Washington Electric Cooperative (WEC) has adopted the most aggressive approach to fuel switching in Vermont. Fuel switching is routinely evaluated as part of the retrofit service delivered to all high-use members. Results are produced at the time of the site visit, using a field version of the utility's screening tool on a notebook computer. If a fuel switching measure is determined to be the least cost option under the societal test, WEC will "buy down" the cost of the conversion to a 2.5-year member payback. Members pay a fixed annual amount equal to 50% of their estimated first-year savings through a monthly charge on their electric bill for up to five years, assuring significant positive cash flow to the member. This co-payment requirement is waived for members with incomes less than 200% of poverty guidelines. WEC provides full arranging services at no cost to the participant, including detailed specifications, bid solicitation, installation supervision and inspection.

WEC offers the same incentives for fuel switching as for any other major DSM retrofit, reflecting a perception that the market barriers are similar.

Central Vermont Public Service Corporation (CVPS), Green Mountain Power Corporation (GMP) and Citizens Utilities Company (CUC)

These three utilities are all large (for Vermont), investor-owned utilities with serious reservations regarding the role of electric utilities in fuel switching. All developed similar fuel-switching programs. These utilities assert, that saturations of ESH and EWH are declining, that current market conditions do much to encourage customer fuel switching, that alternate fuel suppliers can and will provide much of the assistance and incentives required, and that the role of electric utilities can be largely informational and advisory.

Each of these utilities will analyze the societal cost-effectiveness of fuel switching ESH and EWH as part of their comprehensive DSM retrofit programs. Fuel switching will be compared to conserve and control options and recommended to customers when found to result in higher net societal benefits. System designs, estimated cost and savings and referral to financing sources will be provided, as well as referrals to alternate fuel suppliers for further assistance. Low-income customers may receive additional assistance or incentives, if found to be necessary.

Table 1 compares key features of each of the program designs described above. Table 2 summarizes selected characteristics of each utility, including utility estimates of average ESH and EWH loads. The variation in loads is largely due to differences in customer characteristics (BED serves a disproportionate number of apartments, while Stowe and Ludlow serve many second homes). Table 3 presents the utilities' planning assumptions regarding anticipated implementation of fuel switching by customers.

Illustration of Program Differences

An example based on a hypothetical, typical Vermont home with ESH offers an interesting illustration of some of the differences in the fuel-switching elements being offered by Vermont utilities. In each case, the same house and options have been evaluated, based on the varied fuel switching analyses, policies, and screening assumptions currently filed by each of these Vermont utilities.

Table 3. Projected Fuel Switching Participation

Utility	Utility Estimates of Customers Who Will Fuel Switch Over the Life of the Program (typically 5-8 years): % of All Primary Electric Space Heat Customers	% of All Electric Water Heating Customers	Assumed Free Riders
Stowe	55%	50%	10%
Ludlow	45%	49%	25%
BED	61%	50%	30%
WEC	51%	22%	10%
CVPS	7%	3%	10%
GMP	13%	6%	75%
CUC	16%	10%	25%

Consider a detached, raised ranch home built in the late 1970s, with an assumed annual ESH usage of 10,000 kWh, EWH of 3,400 kWh, and no availability of natural gas. In the various utility programs, three of the most likely heating system conversions evaluated would be:

- a hydronic heating system with a central low-mass oil-fired boiler and indirect heating of domestic hot water as a zone off the boiler, with an estimated installed cost of $7,150.

- two high-efficiency (seasonal 87%) sealed-combustion, direct-vent, kerosene-fired space heaters with no conversion of domestic water heating, with an estimated installed cost of $3,000.

- two high-efficiency (seasonal 80%) sealed-combustion propane-fired space heaters, again, without conversion of domestic water heating, with estimated installed cost of $2,000.

If this home were in Stowe, the oil system would show the best investment performance over the long term, as well as resulting in the greatest societal net benefits, and would be recommended. The cost to the utility for analysis and arranging services would be about $700. No further contribution to the installation would be made by the utility.

If the home were in Ludlow, the utility would allow the customer to take a credit on their electric bills over the next two years of $670 for the oil system, or $600 for either the kerosene or propane systems. The choice would be left to the customer.

If the home were served by BED, using BED's avoided costs and screening assumptions, the central oil system would not be found cost-effective. The kerosene and propane systems would both screen as cost-effective, and BED would offer incentives based on either. The net first-year customer savings would be estimated to be $653 for the kerosene system and $516 for the propane option. The customer would be asked to pay 60% of this amount for five years, a total of $1,960 for the kerosene system or $1550 for the propane system. BED would pay the balance, plus the cost of arranging services. If the customer preferred the oil system, BED's rebate would be limited to the $1,419 that BED would have paid toward the kerosene system, leaving the customer to make the additional $5,731 investment.

If the same home were served by WEC, the oil system would be recommended as the best choice because it produces the greatest net benefits (over $10,800) under the WEC screening assumptions. First-year savings would be estimated at $1,472, so the Co-op member would pay half of this ($736) each year for five years, or $61.33 per month on their electric bill. The total customer co-payment would be $3,680, with WEC picking up the balance of $3,970.

If fuel switching measures for this house were screened by CVPS, the oil system wouldn't pass. The kerosene and

propane systems would screen and would be recommended to the customer. Interested customers would be referred to a list of kerosene and propane fuel and equipment dealers. CVPS would also provide information on any other sources or programs for financing, and offer to provide technical assistance to the customer related to installation, including specifications, contract review and inspection.

If the home were served by CUC, the kerosene system would screen as producing the greatest net benefits (approximately $5,900), followed by the propane system and then the oil system (net benefits about $4,600 and $3,900 respectively). Accordingly, the systems would be recommended in that order and customers would be provided with information and referrals to fuel and/or equipment dealers who provide each of these types of systems.

Lastly, if this home were served by GMP, their response would be similar to that of CVPS and CUC, except that GMP would find that the oil system had the greatest net benefits (approximately $2,500) and recommend it as the best choice. Like CVPS and CUC, the customer could take the information from the utility and choose whatever system they wish (or choose instead to pursue any cost-effective conserve and control options, with any associated incentives, that the utility might offer).

Early Experience of Programs

Experience with these programs is still limited. Some are not yet in the field, and no formal evaluations have yet been conducted. Some program activity tracking results and impressions of program managers already show interesting differences among the programs.

Stowe

Stowe's program has already achieved much of its participation goal. In mid-1990, the utility had approximately 335 customers on the residential demand rate, largely associated with electric space heat. By March of 1992, this number had dropped to 197, a 42% reduction. To date, of the 207 total residential electric space heat units where fuel switching has been analyzed, approximately 90 (44%) have already switched to alternate fuels.

The utility manager estimates that winter peak load requirements have been reduced by 1.0 to 1.5 MW (7.2% to 10.9% of peak load) because of fuel switching. He attributes the success of the program to (1) the combination "carrot and stick" approach, (2) the introduction of the program through local community business leaders, and (3) the high quality of the audit analysis and reports. In addition, the offer of complete arranging and installation management services has been important, particularly for second homes with out-of-state owners where this was a significant convenience.

The utility's cost to date for the program has been approximately $222 per fuel-switched customer. Most conversions have been to central hydronic systems, using either oil or propane boilers, with integrated indirect heating of domestic hot water. Full data on conversion costs will be determined as part of a survey of program participants, but appear to be in the range of $5,000 to $9,000.

Preliminary analysis of residential pre- and post-fuel switching billing data suggests average savings of 9,304 kWh and 6 kW coincident demand per customer.

Ludlow

In the first year of the program (1991-1992), approximately 30 customers received rebates and switched to alternate fuels for space heating. In addition, the program appears to have resulted in a significant number of "free drivers," as indicated by another 30 electric space heat customers who switched fuels as a result of the program but received no incentive because they were not on the heating tariff due to their use of demand limiters.

Preliminary analysis of pre- and post-fuel switching billing data suggests average savings of 8,580 kWh from fuel switching.

The 1992 Ludlow winter peak was approximately 10% less than its all-time peak in 1990. A significant portion of this would appear to be attributable to fuel switching, but consideration of other factors, such as weather, must await program evaluation.

Burlington

In the first year of operation (1991), BED's "Heat Exchange" program audited 28% of the approximately 2200 units in the city with electric space heat. As of February 1992, 188 units had already converted and most of the remaining 434 were moving toward conversion.

Conversions completed to date have split almost equally between space heaters (49%) and central systems (51%), with most of the central systems going into single-detached homes. Forty percent of the space heat conversions have occurred in single-detached homes, 54% in apartments and 6% in condominiums.

Almost all the conversions have been to natural gas (87%), which is unique to Burlington as it is the only service territory in Vermont with significant availability of natural gas.

BED's program has required weatherization in 27% of the units where fuel switching has been implemented, at an average customer cost of $142 for the direct cost of measures and a societal cost of $168 per unit, including the costs of program delivery.

Tables 4 and 5 present the costs and estimated savings for fuel switching projects completed through this program through February, 1992.[5]

Table 4. Estimated Savings from BED Fuel Switching

	Multi-Unit	Single Detached	Condominiums	All Participants
Space Heating				
Number of Conversions	99	73	11	183
Annual Avg. kWh Savings	7,399	16,976	11,708	11,478
Avg. Coincident kW Savings	2.8	6.4	4.4	4.3
Water Heating				
Number of Conversions	6	40	4	50
Annual Avg. kWh Savings	2,770	5,021	3,809	4,654
Avg. Coincident kW Savings	0.7	1.2	0.9	1.1

Table 5. Costs of BED Fuel Switching

	Number of Units	Direct Measure Cost	Total (Societal) Installed Cost	Total Cost To Utility
Space Heating				
Space Heaters	92	$1,375	$1,685	$403
Central Systems	97	$4,471	$4,939	$1,081
All	189	$2,964	$3,355	$800
Water Heating				
Integrated Systems	42	$531	$680	$78
Stand-Alone Tanks	8	$469	$641	$78
All	50	$521	$674	$78

Conclusion

Over the coming several years, Vermont electric utilities' varied approaches to fuel switching as a demand-side measure can be expected to be a continuing and valuable source of early feedback for other utilities and regulatory jurisdictions on this controversial aspect of least-cost resource acquisition.

Early program experience has already indicated that certain residential fuel-switching program strategies can achieve cumulative fuel-switching participation rates of over 40%, with significant reductions to utility winter peak loads. Other strategies, with a wide range of incentives and anticipated participation rates ranging from 7% to over 60% have yet to be tested.

Over the coming year, Vermont utility programs can be expected to generate a sizable body of experience as to the applicability, costs and impacts of fuel switching, in a wide variety of applications. This information will prove particularly useful in updating both program planning assumptions and assumptions used in site-specific cost-effectiveness screening.

There are a number of open issues which will be the subject of considerable attention as Vermont's experiment with fuel switching proceeds. The determination of the appropriate risk adders and adjustments for environmental externalities for fuel switching are expected to be the subject of exhaustive scrutiny in the coming year. The level of incentives and/or assistance which the major investor-owned utilities will have to provide to overcome market barriers to cost-effective fuel switching will be closely examined as their programs become operational.

The relationship of gas utilities to electric utility fuel switching programs needs further definition and proposals for integrating societally-optimal levels of weatherization into programs where customers are switched to non-regulated fuels needs to be further pursued. Lastly, particularly in the context of Vermont's strong commitment to utilization of renewable energy resources, efforts need to be made to look more closely at the potential for improved technology and lower costs to make renewables a more cost-effective fuel switching and fuel choice option.

As indicated in this paper, fuel switching programs must continue to be debated and analyzed in the context of the larger public policy discussions about energy strategy and environmental quality. There are real regional and historical differences, as well as changing objectives which will shape the discussion. While most decisions regarding fuel switching to date have been made within the confines of regulated utility least-cost planning, these decisions have ultimately broader impacts and in the future should necessarily incorporate broader community and societal concerns.

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Endnotes

1. VT P.S.B. Order in Docket 5270-CV-1, 4/16/90.

2. VT P.S.B. Order in Docket 5270-CV-1, 3/19/91.

3. "Impact Assessment of Home Energy/Improvement Loan Program", Vermont Energy Investment Corporation, 1992.

4. Two utilities adopted environmental adders of 9% for space heat fuel switching, 15% for water heater fuel switching (and 17% for ordinary DSM), following a DPS study of emission control costs. CVPS opposed use of any adders for fuel switching (but not for other DSM). Board orders on this area of dispute are pending.

5. Participant information from BED's program activity tracking system. Savings (in kWh) are estimated from pre-participation billing analysis. KW impacts are scaled from kWh using a factor from BED load research.