Residential New Construction: Applying Cost-Effective Strategies to DSM

Kathryn Parlin, West Hill Energy Consultants
Jeffrey W. Forward, Vermont Department of Public Service
Bill Powell, Washington Electric Cooperative, Inc.
Al Bartsch, West Hill Energy Consultants

An innovative program for acquiring DSM resources from the residential new construction market has been developed and implemented in Vermont. This program design reduces utility costs, achieves high participation, garners savings from fuels other than electricity, and encourages comprehensive energy savings in each home.

In brief, the utility charges an assessment fee at the time of the application for service, provides in return comprehensive energy services to the builder, and offers a lump sum incentive for meeting a comprehensive compliance standard.

The Washington Electric Cooperative (''WEC'') began implementation of this program design in July of 1994. Early results from the WEC indicate that high participation and comprehensive measure savings can be achieved with this approach. The participation rate in WEC's territory improved dramatically from its previous, voluntary program (9%) to its assessment fee program (70%).

The authors will outline the basic concepts of the program, explain how the economics of this design create an attractive investment for utilities, discuss implementation issues and present the preliminary field results.

INTRODUCTION

An innovative program for acquiring Demand Side Management (DSM) resources from the residential new construction market has been developed and implemented in Vermont. This program design reduces utility costs, achieves high participation, garners savings from all fuel types, and encourages construction of homes which meet an overall efficiency standard. In brief, the utility collects a mandatory assessment fee at the time of the application for service, provides in return comprehensive energy efficiency services to the builder, and offers a lump sum incentive for meeting a comprehensive compliance standard.

The Washington Electric Cooperative (WEC) began implementation of this program in July of 1994, and early results indicate that high participation and comprehensive savings can be achieved with this approach. The participation rate in WEC's territory improved from its previous, voluntary program (9%) to its assessment fee program (70%). In addition to high participation, completed participants have generally built homes which are more efficient than required to meet WEC's compliance standard.

A cost effectiveness analysis was conducted for the first eighteen months of the program delivery. This analysis shows that the program passes the societal, utility and participant tests by a healthy margin, even at this early stage of implementation.

The following discussion will outline the basic concepts of the program, explain how the economics of this design create an attractive investment for utilities, and discuss implementation issues. This paper contains the following sections: overview, background, eligible market, marketing plan, incentives, delivery, program performance, implementation issues, and conclusion.

OVERVIEW

This program includes a combination of features designed to increase utility and societal benefits. The major elements are described briefly below:

- The utility collects the assessment fee from all appropriate new residential connections at the time of application for service.

- The program is delivered through a comprehensive set of energy efficiency services designed to increase the overall performance of the home in terms of efficiency, health and safety.

- The energy services provide a forum for the builder to discuss energy efficiency options directly with an energy specialist.

- A lump sum incentive is awarded to builders who meet the compliance requirements.

- The compliance standard is based on an overall efficiency level for the home, measured on a societal, life cycle cost basis.

- Upgrades are recommended for all energy uses, regardless of the fuel type.

In WEC's program, the assessment fee was set at $300. The cost to WEC of the energy services during 1995 was $450, and the lump sum incentive was set at $750. To meet the compliance standard and receive the lump sum incentive, the builder or owner must construct a home which is significantly more efficient than current construction practices.

WEC has chosen to deliver the energy services through a subcontractor, Energy Rated Homes of Vermont (ERH of Vermont). ERH of Vermont provides participants with a plan review, HERS energy rating and the utility-specific societal analysis (''scorecard''). The scorecard analysis defines the level of efficiency required for meeting the compliance standard. Both the HERS energy rating and scorecard analysis are provided at two points in the construction process: during the plan review and after the home has been completed. The HERS energy rating provides access to the Energy Efficient Mortgage Program.

BACKGROUND

In April of 1990, the Vermont Public Service Board (VPSB) issued an order in Docket 5270 requiring all electric utilities to plan and implement DSM programs which were determined to be cost-effective by the societal test.[1] In this order, the VPSB designated new construction as a sector requiring special attention. Unlike some other states, the VPSB regulates municipal and cooperative utilities as well as investor-owned utilities.

The Washington Electric Cooperative, a rural electric cooperative established through the Rural Electrification Program, is located in Vermont and has approximately 8,800 members. WEC's membership is 90% residential. Natural gas is not available in WEC's territory, precluding joint efforts to deliver DSM services. Review of new construction in previous years indicates that only 1% of new homes built each year have electric space heat and approximately 16% use electricity for heating water. WEC has also determined that approximately 30% of its new connections are mobile homes.

WEC, with its low incidence of electric space and water heating, is not unusual among Vermont utilities. Electric rates are quite high in Vermont relative to other areas of the country. The average statewide residential electric rate is approximately .10/kwh. In addition, the statewide electric peak usually coincides with the coldest winter weather. Consequently, seasonal rates as designed by utilities and regulators in Vermont have tended to discourage the installation of electric heat.

Without electric space heat as a common building practice, electric utilities were unable to identify electrical savings from thermal envelope measures or from heating system upgrades. The potential DSM resources from efficiency measures alone were limited in the residential new construction market. Therefore, the first generation of residential new construction programs in Vermont focused primarily on small prescriptive incentives for relatively modest electrical efficiency measures.

In this context, WEC began its program design efforts in 1991 with the intention of instituting a ''hook-up fee'' for new connects. A hook-up fee approach, as conceived by WEC, entailed a substantial fee that was to be charged to every new customer at the time he or she applied for service. This fee would be reduced if efficiency measures were installed.

The hook-up fee concept proved more complex than any of the parties originally anticipated. Rates in Vermont are essentially cost-based, and the prospect of designing a hook-up fee to offset the cost of new generation was daunting. There were also legal and accounting issues which arose due to the cooperative structure of the organization.

To address these issues, an alternative approach was developed based on a fee for service, an ''assessment'' fee rather than a hook-up fee. This concept evolved into a program which requires payment of the assessment fee at the time of application for service and offers in return a comprehensive set of services and direct incentives to builders producing high performance homes.

Early in 1993, WEC began implementation of an interim residential new construction program. In this program, WEC offered a HERS rating and plan review at no charge to the participant. Prescriptive incentives were also offered for efficient lighting fixtures, refrigeration and propane clothes dryers.

The design of the assessment fee program was completed in the fall of 1993 and WEC filed an amended program design with the VPSB in November of 1993. This design was approved in January of 1994 and replaced the interim

program on July 1, 1994. At this time, the assessment fee was added to WEC's tariff.

ELIGIBLE POPULATION AND TARGET MARKET

The program is designed to address lost opportunities in the residential new construction market. The eligible market is all projects which can be improved through efficient construction practices, i.e., modular homes and single-or multi-family site-built construction. At this time, mobile homes are not appropriate to receive energy services because there is no opportunity to improve the efficiency at the time of purchase and delivery. In WEC's program, mobile homes are referred to the residential retrofit program for direct install services.

MARKETING PLAN

With most DSM programs, one of the most difficult steps is to make the initial contact with the potential participant. In this program, the utility's first contact with the builder[2] of a new unit occurs during the application for service, when the assessment fee is collected. The purpose of the assessment fee is to capture the attention of the builder and to reduce the cost to the utility of providing the energy efficiency services. When the builder pays the fee, the utility has the opportunity to explain the features and benefits of the program.

Once the program is well established, the assessment fee approach reduces the need for traditional marketing strategies. Prior to program start-up, community education and outreach to builders can help to ease the transition to the new program.

Educating lenders is also an important component of the marketing plan. The most effective approach is to encourage participation prior to the start of construction, when it is easy to incorporate alternative suggestions. Some builders may not apply for service until after construction is underway. For this reason, lenders can play an important role in promoting the program when the builder or owner is applying for financing.

INCENTIVES

The incentives for this program fall into three broad categories: direct incentives, assessment fee, and indirect incentives.

The primary direct incentive is a lump sum payment which is significantly greater than the assessment fee while taking into account the incremental costs of program compliance. The incentive is only paid if the home meets the compliance standard of the program as verified by the final inspection. No incentives are awarded if the home does not meet the compliance standard.

The payment of an assessment fee when service is requested is also a strong motivator to participate in the program. From the owner's or builder's perspective, he or she has already paid for the energy services, and most owners and builders choose to take advantage of them. The level of the assessment fee is set approximately at the cost to the utility of the energy efficiency services.

The energy services also provide indirect incentives to the builder. Providing timely technical support and detailed product information to the builder through the construction phase is critical to builder acceptance of the program. The HERS rating provides a strictly Btu-based analysis and a standardized energy label. It also gives the owner access to attractive financing options through the Energy Efficient Mortgage program, which allows homeowners a higher debt to equity ratio. The builder also receives accurate information regarding building tightness through the blower door test conducted as part of the final inspection.

Compliance standard

The compliance standard is based on a whole house energy analysis which consists of two distinct performance-based tests: a comprehensive test and an electrical test. The objective of this approach is that the whole house meets a certain overall performance standard. Both of these tests are based on the societal test as defined by the VPSB in VPSB Docket 5270. (See endnote 1.)

The difference between the comprehensive and electrical tests is the end uses that are analyzed. The comprehensive test incorporates as many energy end uses as possible, including space heating, cooling and water heating. The electrical test includes only electrical end uses which are not directly related to space or water heating, or cooling.

The process of analyzing the non-heating end uses separately was adopted for these reasons:

- to avoid undervaluing electrical efficiency for end uses which are not related to heating/cooling in the context of a whole house analysis
- to insure that electrical efficiency is not encouraged at the expense of efficiency in other fuels

These tests are conducted at two separate points in the process: first, when the participant submits the house plans for

review, and then upon completion, when the installations can be verified.

Performance-Based tests

To meet the compliance standard, the home must meet or exceed specified ''scores'' on both the comprehensive and electrical tests. These performance-based tests evaluate the efficiency level of the home for the eligible end uses in comparison to the ''base case'' (average construction practices)[3] and the ''best case'' (highly efficient building practices). The contribution of each end use to the final score is proportional to its contribution to the total energy-related societal costs of the home. Where appropriate, both the comprehensive and electrical analyses compare options across fuel types to determine the fuel and equipment which have the lowest life cycle costs.

As many energy end uses as possible should be included in the field analysis. Since the compliance standard is performance based, the greater the number of end uses analyzed, the greater the number of choices to reach compliance. The builder can decide which mix of measures to install to meet the compliance standard. Typically, compliance can be reached through different routes and the builder can identify trade-offs which are most appealing to the homeowner. For example, if a homeowner has a particular aversion to fluorescent lighting, the home should still be able to meet the compliance threshold through the installation of high efficiency HVAC and appliances.

Estimating program impacts

Program impacts are estimated in comparison to average construction practices. The goal of the program is market transformation, and the average construction standards are a measure of the potential for efficiency improvements. The impacts of WEC's program were measured against the results of a 1993 baseline study.[4] Updating the baseline every three years should give a good sense of changes in standard construction practices.

As the program matures, it becomes more difficult to establish what the construction practices would have been without the program. A successful program improves the efficiency of current construction practices and may render future program efforts non-cost-effective as the incremental improvements become smaller. On the other hand, continuing to move construction practices toward higher efficiency standards may require ongoing program activity. These factors must be considered in establishing the parameters for future program screening.

DELIVERY

The program offers builders a set of energy efficiency services which provide guidelines and assistance in the construction of an efficient home. The energy efficiency services include the following components: a plan review, a site-specific analysis of energy uses, technical advice during the construction phase, expert advice on product performance, installation procedures and availability, a HERS rating, and an on-site inspection with a blower door test upon completion.

Although WEC delivers the energy services through its subcontractor, the initial contact with the builder is conducted by WEC at the time the builder applies for electrical service. While the subcontractor has trained, professional staff and contributes its knowledge to the delivery of energy services, WEC's experience has also shown that the utility contact is vital to the success of the overall rating process. This initial ''gatekeeper'' utility function is often the first meaningful experience a builder or homeowner may have with a home energy rating, construction details or efficient lighting and ventilation technology.

Using the comprehensive set of energy efficiency services has a number of advantages:

(1) Participating builders receive one-on-one education from a residential energy specialist.

(2) Owners and builders are provided with long term economic analysis of recommended upgrades from an unbiased third party.

(3) Participants have the opportunity to discuss fuel choice options with the energy specialist to identify efficient appliances of any fuel type for the situation.

(4) Additional measures may be identified through the comprehensive review of end uses.

(5) Builders are provided with information on efficient products, where to get them, and expert advice on installation procedures.

(6) Meeting the program compliance standard should also assure builders that they have surpassed the efficiency requirements of a local building code, if one exists.

(7) The home energy rating provides an easily recognizable energy label for home buyers and access to attractive financing options through the Energy Efficient Mortgage.

PROGRAM PERFORMANCE

Preliminary results from WEC's implementation of this program design look promising. The analysis of program performance is presented in Tables 1 and 2. This analysis is based on potential participants applying for service from the inception of the program in July, 1994 through the end of December, 1995. The review of energy services and completed homes incorporates known activity of this group through March 31, 1996.

This program screening is a snapshot of program activity at a particular point in time, and in some ways represents a worst case scenario. A significant portion of participants' homes are still in progress. In the unlikely event that none of these homes meet the compliance standard, the cost effectiveness of the program will not change. As participants complete their homes, and presumably some of them will comply with the program requirements, the total net benefits of the program will increase.

The following sections discuss the following aspects of program performance: participation, utility costs, measure installations and program cost effectiveness.

Participation

The assessment fee appears to be an effective tool for encouraging participation. Table 1 summarizes the WEC's program activity. During the period of the analysis, a total of 94 possible participants, i.e., builders of site-built or modular homes, applied for service. Of this group, eight did not pay the assessment fee: three were waived based on income eligibility criteria and the other five benefited from WEC's policy of introducing the program by waiving the fee for the earliest participants. Of the 94 potential participants, 27 paid the fee and did not participate, 3 have not yet decided whether to participate (pending), and 64 chose to proceed with the energy services. In this context, the participation rate is defined as the proportion of the participants requesting energy services to the total number of potential participants. This rate is between 68% and 71%, depending on the actions of the three pending participants.

Table 1. *Program Activity*

Possible participants	94
Paid and walked	27
Pending	3
Requested energy services	64
Assessment fees	
Paid	86
Waived	8
Energy services	
In progress	22
Completed participants	
Passed compliance	23
Failed compliance	3
Inactive	16

This program has achieved higher participation than any other residential new construction program in Vermont. WEC's previous new construction program, which relied on offering a home energy rating to builders on a voluntary basis, had a low participation rate (9%), even though the builder was not required to contribute to the cost of the energy rating.

Another critical component of program performance is the rate of compliance. Of the 64 requests for energy services, 22 have not yet finished their homes (energy services in process), and 42 have completed construction (completed participants). Of the 42 completions, 23 passed the compliance standard, 3 had the final rating but failed to meet WEC's standard, and 16 did not choose to have a final rating. These results indicate that 24% of the total potential participants have complied with program standards. This rate is a lower boundary, since some of the participants currently in progress are likely to complete their homes and pass the compliance standard. Considering only the completed homes, 55% passed the compliance standard.

Although 45% of the completed participants did not meet the compliance standard, it does not necessarily follow that the program had no impact on these partial participants. Even preliminary exposure to program materials among these builders may have had some spillover effect, or have lead to some investment decision not otherwise made in absence of the assessment fee program. For example, two of the participants who failed to meet the compliance standard completed the process to obtain the blower door test.

Utility costs

The assessment fee paid by the builder has a direct impact on utility costs in that it offsets the utility's cost of providing the energy services and limits the utility's financial outlay for providing energy services which do not produce any savings. While the utility still has some administrative costs regardless of the builder's participation level, this incentive structure helps to control delivery costs.

The assessment fee also has an indirect impact on utility costs. By capturing the builder's attention and creating a financial incentive to the builder for participating in the

program, the demand for energy services increases without requiring extensive marketing efforts on the part of the utility.

The utility's administrative costs per eligible hook up for WEC's program came to $73, which reflects the delivery of the program through a subcontractor and the low level of marketing required. WEC's overhead costs (administrative and energy services) can also be viewed in the context of participants who have installed efficiency upgrades, i.e., passed the compliance standard.

At this early stage of program development, WEC's program has resulted in utility costs of $270 per participant requesting energy services. As ''in progress'' participants complete their homes and pass the compliance standard, utility costs will increase due to the payment of the incentive and costs associated with the final energy rating. Assuming ''in progress'' participants pass the compliance standard at a rate similar to the known group of completions, WEC's costs will increase to $470 per participant.[5]

Another common measure of program cost effectiveness is the levelized utility costs per lifetime kWh saved. The program to date has generated 610 MWh of lifetime savings, resulting in levelized utility costs of $.029 per kWh. Even accounting for higher utility costs resulting from more completions, the levelized utility costs will remain in the range of $.029 to $.034 per kWh. To place these utility costs in perspective, WEC's long run marginal cost is in the range of $.055 per kWh. WEC's levelized costs for this program also compare favorably to successful new construction programs in other states.[6]

Installed measures

This program was designed to promote the efficiency of all fuel types. It is based on a whole house, comprehensive energy rating which analyzes all components of the home and recommends improvements accordingly. The recommendations may include thermal shell improvements, HVAC upgrades, high efficiency domestic hot water, lighting, refrigeration, clothes washers and dryers, and mechanical ventilation equipment.

The comprehensive approach to energy efficiency also provides the opportunity to analyze all uses of electricity. During the process of the whole house energy analysis, the energy specialist can identify all potential electrical uses, and can address site-specific equipment needs.

Some electrical savings may also accrue from upgrades primarily directed at reducing alternative fuel use. For example, recommendations are likely to include thermal shell upgrades and other measures aimed at decreasing the heating or cooling load of a home. This reduction in heating or cooling load results in a decrease in the operating hours of the HVAC system, which translates into a corresponding drop in usage of not only heat pump compressors but also blower motors, circulating pumps, burners and other auxiliary system components. In either a heating or cooling climate, these savings are likely to be coincident with weather-related peak power demands. In WEC's program, the savings from space heating auxiliary use (burners, motors and circulating pumps) due to thermal upgrades account for 10% of the total avoided cost benefits.

Based on WEC's experience, the average complying participant installed efficient equipment for more than four of the six end uses analyzed.[7] Almost all of the passing participants surpassed the baseline in the efficiency of the thermal shell, lighting and hot water. Over half installed efficient ventilation and decided to install propane clothes dryers rather than electric. A third installed refrigerators which were at least 10% more efficient than the 1993 federal efficiency standard.

It is also interesting to note that many of the passing participants went beyond WEC's requirements. Although the compliance standard was set at a score of 5, the passing scores averaged 6.8 on the comprehensive test, and 5.8 on the electrical test. The program is projected to save 26,142 kWh, 3,900 gallons of oil and 1,300 gallons of propane a year from the 23 participants who passed the compliance standard.[8]

Program cost effectiveness

Table 2 shows the results of the cost effectiveness screening for the program. The columns provide the screening results by the societal, utility and participant test. The top half of the chart lists the program costs broken out into utility and measure costs, followed by the program benefits and the summary of net benefits and benefit/cost ratio at the bottom.[9] The societal test does not include the assessment fees or incentives paid, since these costs are essentially a transfer payment. Most of the O&M costs are associated with the operating costs of a propane dryer, where propane was determined the cost effective option and chosen by the participant. The non-electric benefits are predominately from fossil fuel savings due to thermal shell and hot water efficiency upgrades.

The avoided cost benefits are modest due to the limited potential for electrical efficiency improvements. However, the utility costs are still considerably lower, making it possible to deliver a cost-effective program. The results of the utility test indicate that it would be difficult to acquire these DSM resources in a cost effective manner with a more traditional program design.

Table 2. *Program Cost Effectiveness*

	Societal Test	Utility Test	Participant Test
Utility costs			
Energy Services	$17,000	$18,900	$0
Administrative	$6,200	$6,900	$0
Assessment fees paid	$0	$(25,000)	$25,800
Incentives paid	$0	$17,300	($17,300)
Subtotal	$23,200	$17,300	$8,500
Measure costs			
Direct costs	$42,900	$0	$47,700
O&M costs	$20,800	$0	$23,100
Subtotal	$63,700	$0	$70,800
TOTAL PROGRAM COSTS	$86,900	$17,300	$79,300
Benefits			
Avoided cost benefits	$51,500	$44,700	$44,700
Non-electric benefits	$160,700	$0	$160,700
TOTAL PROGRAM BENEFITS	$212,200	$44,700	$205,400
Program net benefits	$125,300	$27,400	$126,100
Program benefit/cost ratio	2.4	2.6	2.6

Note: All costs are in 1995 dollars. Benefits and O&M costs are net present values.

As mentioned above, this analysis represents a lower boundary of program cost effectiveness. Even small improvements in program performance results in significant increases to program cost effectiveness. For example, if these ''in progress'' homes meet the compliance standard at the same rate as the homes already completed (55%), the utility net benefits increase by 35% and the societal net benefits by 60%.

IMPLEMENTATION ISSUES

The assessment fee is perhaps the most unique aspect of this program design. There was an initial concern that the fee would create a negative reaction to the program and hamper its effectiveness. However, actual implementation has proven this concern to be unfounded. In general, participants who choose to take advantage of the energy services find them to be valuable. WEC has developed a number of strategies to overcome negative perceptions and deliver this program effectively.

1. All utility staff are prepared to discuss the benefits of participation to the customer. Often, the first contact a new customer has with the utility is with a meter reader or a lineman. It is important that the program design, objectives and the rationale for providing such a service be clear to all employees, not only those responsible for implementation.

2. Builders need to be assured that their individual schedule will not be held up by the rating process. The delivery of services is provided in a timely manner. Program staff monitor the status of ratings in progress on a regular basis.

3. Implementation allows for variable lengths of individual projects. Some homes are completed in a short period, while others may take several years. Implementors and subcontractors must take individual time horizons into account with each rating.

With careful attention to how this program is presented to builders and customers, the increased participation rates and comprehensive energy savings should far outweigh any perceived disadvantages. It is, in fact, a comprehensive customer service and should be promoted as such.

CONCLUSION

This paper has described a program design for mitigating lost opportunity in the residential new construction market. The primary advantages of this program design over other residential new construction programs are the targeted marketing approach, the reduction in utility costs and high participation rate due to the assessment fee and the comprehensive savings achieved through the incentive structure and compliance standard.

Preliminary field results based on the experience of one Vermont utility indicate high participation and comprehensive savings can be achieved at a low utility cost per participant. The participation rate in this program is approximately 70%, and appears to be increasing. Completed participants have generally surpassed the compliance standard by a significant margin and have installed efficient equipment for more than four end uses on average. These components have contributed to the low levelized utility cost of $.029 per kWh.

This program design is adaptable to other utilities with different situations. For example, in a state with an energy efficiency building code, the program's verification of installation could substitute for verification of code compliance, and utilities could market the program as a service to help

builders meet code compliance. In areas with natural gas, this program design could easily be delivered through a joint effort. For utilities who are already providing comprehensive services, the assessment fee may be a mechanism for improving participation and lowering costs.

As the electric industry continues to restructure, there will continue to be regulatory support for residential energy services. As an outreach mechanism to capture customers' interest in other services, the initial contact with the new customer through the assessment fee program could potentially position the utility for delivering those services. The comprehensive (electric and non-electric) analysis which the HERS and scorecard mechanisms provide can position in the utility as an energy services provider. The rating process offers the opportunity to gather accurate end use and demographic data which could then be used to market of other services.

ACKNOWLEDGEMENTS

We would like to thank the other members of the collaborative team, Scudder Parker, Joe Bongiovanni, John Bellefeuille and Leigh Seddon, for the countless hours spent considering this program design from all angles.

ENDNOTES

1. The VPSB defined the societal test as a life cycle cost analysis which incorporates a 10% risk adjustment to measure costs and an adjustment to avoided cost benefits to reflect the impact of externalities. WEC increases the avoided cost benefits of electric efficiency measures by 17%, the non-space heating fuel choice measures by 14%, and space heating fuel choice measures by 9%. Fuel choice measures compare electricity to other fuels for a specific end use to determine the most cost effective option.

2. The program is targeted to both builders and owners. For simplicity, program participants are generally referred to as ''builders'' throughout this paper.

3. The ''base case'' is determined from a study of baseline construction practices which should be reviewed and updated on a regular basis.

4. In Vermont, the three largest utilities have recently concluded an extensive baseline study to establish standard building practice throughout the state. This study found construction practices to be somewhat more efficient than originally assumed by the 1993 study.

5. Fourteen additional ''in progress'' participants are assumed to finish, with twelve expected to meet the compliance standard, and two expected to fail. This scenario results in total utility overhead costs of $30,000 with 64 participants who requested energy services.

6. Utility levelized costs range from $.029 to $.086 for the residential new construction programs analyzed in Nadel's study of successful DSM programs. (Nadel, Pye & Jordan 1994)

7. The following end uses were analyzed: lighting, refrigeration, ventilation, clothes drying, space heating, and water heating.

8. Measure savings are calculated from standard engineering algorithms. Participant savings are measured in comparison to the baseline.

9. Measure benefits and O&M costs were calculated over the measure life, up to maximum of thirty years for thermal shell improvements.

REFERENCES

Dworkin, M., 1990. Investigation into Least-Cost Investments, Energy Efficiency, Conservation, and Management of Demand for Energy, Docket 5270 Order. Vermont Public Service Board, Montpelier, Vt. April 16.

Faesy, R. 1993. Residential New Construction Baseline to Four Stars Plus Modeling. Paper prepared for Vermont Department of Public Service, Montpelier, Vt., June 25.

Forward, J., 1995. ''The Washington Electric Cooperative Assessment Fee Program: An Innovative Strategy for Boosting Participation and Increasing Savings in a Residential New Construction DSM Program.'' *In Proceedings of the March 1995 Third National New construction Programs for Demand Side Management Conference, 409 420.* Boston, Mass.

Geller, H., and S. Nadel. 1994. *Market Transformation Strategies to Promote End-Use Efficiency*. Washington DC/ Berkeley, California: American Council for an Energy-Efficient Economy.

Nadel, S., M. Pye, and J. Jordan. 1994. *Achieving High Participation Rates: Lessons Taught by Successful DSM Programs*. Washington DC/Berkeley, California: American Council for an Energy-Efficient Economy.