PNL-4764
UC-95d

An Evaluation of the Home Energy Rating Concept and the Massachusetts Pilot Project

M.L. Frankel
J.A. Duberg
Centaur Associates, Inc.

June 1983

Prepared for
Pacific Northwest Laboratory
Under Agreement B-B4272-A-U

Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
by Battelle Memorial Institute

Battelle

PNL-4764

DISCLAIMER

PACIFIC NORTHWEST LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC06-76RLO 1830

Printed in the United States of America
Available from
National Technical Information Service
United States Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22161

NTIS Price Codes
Microfiche A01

Printed Copy

Pages	Price Codes
001-025	A02
026-050	A03
051-075	A04
076-100	A05
101-125	A06
126-150	A07
151-175	A08
176-200	A09
201-225	A010
226-250	A011
251-275	A012
276-300	A013

PNL-4764
UC-95d

AN EVALUATION OF THE HOME ENERGY RATING CONCEPT AND THE MASSACHUSETTS PILOT PROJECT

M. L. Frankel
J. A. Duberg

Centaur Associates, Inc.

June 1983

Prepared for
Pacific Northwest Laboratory
Under Agreement B-B4272-A-U

Pacific Northwest Laboratory
Richland, Washington 99352

FOREWORD

This report is one of two companion reports on a pilot project in Massachusetts to test the home energy rating system concept. The report contains the results of an independent evaluation of the project conducted by Centaur Associates, Inc. The second report, The Massachusetts Home Energy Rating System Project, PNL-4763, prepared by Energyworks, Inc. and the Alliance to Save Energy, describes the rating system and the implementation process. Energyworks, Inc. and the Alliance designed the rating system used in the pilot program and worked with Mass-Save, Inc. to implement it. Mass-Save, Inc. is a non-profit corporation formed by utilities in Massachusetts to offer residential energy audits. Financial support for the pilot program came from the Office of Building Energy Research and Development, U.S. Department of Energy. The project was administered by the Pacific Northwest Laboratory.

The home energy rating system concept involves the periodic rating and labeling of the energy efficiency of residential dwelling units. In the Massachusetts pilot project, the rating was largely limited to detached single-family homes; multifamily and attached single-family homes are capable of being rated with modifications to the rating system. An energy-efficiency rating can be structured to include a home's relative energy efficiency in relation to other homes in the climatic region and also an estimate of energy consumption, cost, or both. The rating information can then be available to multiple user groups including home buyers/sellers, landlord/tenants, home builders, primary and secondary lending institutions, real estate brokers/agents, appraisers, and tax assessors.

The U.S. Department of Energy is principally interested in home energy ratings as a means of promoting residential energy conservation in a non-regulatory fashion by providing energy-efficiency information to housing consumers. Conservation can potentially occur in several ways, all of which relate to the fact that rating/labeling enhances the marketability of energy-efficient homes. The construction of energy-efficient homes and the retrofit of existing homes with features to improve energy efficiency is

likely to be encouraged because a rating should give builders and owners more confidence that their incremental energy conservation investment can be recaptured at the time of sale. A rating will also facilitate comparison shopping by home buyers and tenants. Sellers and landlords in high vacancy or high energy cost markets may feel they need to improve energy efficiency to attract energy-conscious buyers and tenants. There is also the potential for social pressure on owners to obtain a high rating. Finally, a rating can facilitate the purchase of an energy-efficient home by a buyer who only marginally qualifies for a loan by enabling a lender to lend more money than usual because of the expectation of lower energy costs permitting greater debt repayment capacity.

Perhaps the key element in rating the energy efficiency of homes is the delivery process -- ratings must be performed by competent individuals at relatively low cost for a rating program to be successful. This pilot program used residential energy auditors to perform the ratings. The program was intentionally designed this way because it was felt that the auditors would have a better understanding of residential energy efficiency than any other possible rating group and because the energy auditor already visits a home and collects energy-efficiency data. Consequently, the incremental cost to Mass-Save of performing each rating was small, about $5.

Future use of energy auditors to perform ratings is clouded by two limitations. The most important limitation is that covered utilities are only required by section 215(a) of the National Energy Conservation Policy Act (NECPA) to offer energy audits to their residential customers until January 1, 1985. Certain utilities may continue to offer audits beyond this date either voluntarily or because of provisions in state or local law. The second limitation is that under section 210(9) of NECPA, energy audits are not available for new homes.

One alternative group who could perform ratings is real estate appraisers. An advantage of using appraisers is that the incremental cost of performing a rating when an appraisal is already being conducted should be relatively low. Disadvantages include the fact that appraisers typically are likely to have less energy conservation knowledge than an experienced energy auditor;

appraisals are generally only performed when new bank funds are used in a sale transaction; and, most importantly, an appraisal is normally only done after a buyer and seller have finalized terms. Thus the advantage of a rating facilitating incorporation of energy efficiency into market value is largely lost unless a rating from a prior sale of the home is available. Other alternative rating groups include real estate brokers/agents, home builders, building inspectors, and independent rating entities.

In addition to the process of delivery, a second important issue is cost recovery. Who should pay for the rating and how much? Should the homeowner pay the full incremental cost of a rating? Should a rating be subsidized by ratepayers or taxpayers or both? Should any subsidy be reduced for subsequent ratings on the same house? The pilot program did not attempt to answer these specific questions, but they are obviously important to the successful implementation of a rating program.

The pilot study yielded several important conclusions and observations and several unanswered questions that merit additional study. Results from the study include the following:

1. A rating system can be designed with sufficient accuracy to be useful for user groups.

2. A rating can be successfully performed in the field by energy auditors in about fifteen minutes beyond the time required for an audit.

3. The principal beneficiaries of ratings are likely to be housing consumers. Ratings will facilitate comparison shopping and, in some cases, enable a home buyer to qualify for a higher mortgage loan than otherwise possible.

4. Real estate agents and brokers view ratings as a helpful tool for marketing energy-efficient homes, but are wary of too much emphasis possibly being placed on a rating by prospective buyers, and ratings possibly becoming mandatory.

5. Lending institutions are mildly interested in using ratings in residential lending; however, the impact on their business is likely to be very small.

Areas meriting further study include the following:

1. How the cost of providing ratings should be recovered.
2. The impact of cost to the homeowner on the demand for ratings.
3. Further technical development of the rating used in this pilot project and other rating methodologies including adaptation to a cooling climate.
4. Testing of alternative rating delivery approaches.

Home energy rating systems can potentially provide very useful information to housing consumers and various professional user groups. Whether this information can be provided at a cost commensurate with the benefit to user groups is still unclear. This pilot study revealed, however, that the concept is technically feasible and that delivery at low incremental cost is possible if a rating can be added to an existing program such as the Residential Conservation Service energy audit program.

Paul L. Hendrickson
Pacific Northwest Laboratory

PREFACE

This is a report on an evaluation of a home energy rating concept based on a Massachusetts pilot project. The evaluation of this pilot project was performed by Centaur Associates, Inc. during the period between December 1982 and April of 1983. The evaluation was conducted under contract Number B-B4272-A-U to Pacific Northwest Laboratory (PNL) and through the sponsorship of the U.S. Department of Energy.

The focus of the evaluation was on: 1) the compatibility of the Massachusetts rating with the RCS program, 2) who would use the rating and how, 3) qualitative estimates of benefits and costs, and 4) recommendations for further use and testing of the rating. In addition the evaluation of the rating concept also attempted to determine what if any effect the home energy rating has on the demand for energy audits, on the propensity of customers who received ratings to undertake recommended energy-efficiency home improvements, and on changes in mortgage lending procedures for energy efficient homes. The evaluation consisted of telephone and in-person discussions with the project developers, the various professional user groups, the recipients of the energy ratings, and control groups of audit customers that did not receive the energy rating. The evaluation was designed to determine the results of the pilot project, assess the project's effectiveness, and analyze the potential for transferring the rating procedure to other geographic locations.

The evaluation was performed by John A. Duberg and Michael L. Frankel of Centaur's staff. Paul Hendrickson, Senior Research Scientist at PNL, served as project officer for the contract. Susan Heard of the Building Services Division of the U.S. Department of Energy provided guidance and assistance to the evaluation effort. The authors also

thank Kitty Cox of Energyworks, Inc. and Linda Schuck of the Alliance to Save Energy for their assistance.

Michael L. Frankel
Centaur Associates, Inc.
Washington, D.C.

CONTENTS

CONTENTS (Cont.)

1.0 OVERVIEW OF THE EVALUATION

This report presents the results of an evaluation of the home energy rating concept and a pilot rating project in Massachusetts. This section introduces the reader to the evaluation by summarizing:

- Home energy ratings, in general and as used in the pilot project,
- The Massachusetts pilot project,
- Pilot project and broader evaluation objectives, and
- The evaluation methodology.

1.1 HOME ENERGY RATINGS

The energy rating used in the Massachusetts pilot project is one of approximately 50 ratings that have been developed by public and private agencies.(a) These ratings share an overall goal of increasing the energy efficiency of the housing stock, most by evaluating new housing, others by evaluating existing homes. The energy rating developed for the Massachusetts pilot project is primarily directed at existing homes.

Home energy rating systems are a relatively recent attempt to provide home energy-efficiency information to homeowners and in some instances to lenders, real estate agents and appraisers. They can be generally classified into three major categories: prescriptive systems (which

---

(a) Several dozen rating systems are reviewed by Paul Hendrickson et al in Overview of Existing Residential Energy-Efficiency Rating Systems and Measuring Tools. PNL-4359, Pacific Northwest Laboratory, October 1982.

assign points for specific home energy conservation features and give a cumulative rating for a home), calculational systems (which estimate energy use for a home based on building characteristics and life style assumptions), and performance systems (which estimate energy use based on historical energy use through fuel bills). These rating systems vary in technical complexity from "expert" judgments to sophisticated computer analyses.

The home energy rating system in the Massachusetts pilot project, developed by Energyworks, Inc., is a demonstration of a calculational system attached to the Residential Conservation Service (RCS) audit. By linking the rating to the RCS audit, the Massachusetts pilot project was able to acquire data for the rating with relatively little additional effort beyond that needed for the RCS audit and thereby substantially improve the cost-effectiveness of the rating. The outputs of the rating include:

- The home energy-efficiency score before and after the recommended home improvements on a scale of ten points where a zero represents a totally inefficient home[a], a ten represents a home that needs no heating energy input, and a seven represents a home built or improved to RCS standards.

- The estimated energy use of the home in Btu/square foot/degree-day before and after retrofitting.

(a) A totally inefficient house has no energy conservation features such as insulation, multiple glazings, or improvements to its heating plant and is very leaky in terms of air infiltration.

- The estimated annual energy cost for heating before and after the recommended improvement measures are made.

- The estimated cost of the improvements needed to raise energy efficiency to optimal levels.

The Massachusetts rating system is processed by hand with pre-formatted rating tables that are based on hundreds of heating load calculations on several different housing types. These calculations of heat loss for different home features (e.g., ceilings, walls, floors, etc.) have been prepared with the CIRA computer model[5] developed by Lawrence Berkeley Laboratory. The model is run with standard assumptions such as thermostat settings to isolate the home's energy characteristics from the life style characteristics of the owners.

Results of the rating are presented to the homeowner on one sheet of paper. The format is graphically laid out to enable the homeowner to easily see the "before" and "after" condition of his house and the necessary steps to get him from his present home to a more energy efficient home. Figure 1.1 illustrates an example of the rating form and the results. For purposes of contrast, an example of the Mass-Save[a] audit results form is also presented as Figure 1.2.

The rating information along with the recommended improvement actions and their costs are designed to improve the overall presentation of the audit. The graphics of this presentation, coupled with the easy to

---

(a) Mass-Save, Inc. was chartered in 1980 by more than 50 of the gas and electric utilities and municipal light departments in Massachusetts to provide the Residential Conservation Services (RCS) mandated by the National Energy Conservation Policy Act and by Massachusetts legislation. It is the nation's most extensive cooperative energy conservation program sponsored by utilities.

HOME ENERGY RATING

Prepared for: Name Joseph Smith
Address 33 Centre Street, Newton, MA
Auditor Signature Cristin Murphy
Date 10/1/82 Audit # 701100

HOME NOW

Heating Efficiency Score

0 1 2 3 4 (5) 6 7 8 9 10

Worst (No energy features) — Best (No heating bill)

$ approx. $1450
Estimated Annual Heating Cost

IMPROVED HOME

Heating Efficiency Score

0 1 2 3 4 5 6 (7) 8 9 10

Worst (No energy features) — Best (No heating bill)

$ approx. $1050
Estimated Annual Heating Cost

Rated Features now in the home:						ENERGY FEATURES	Add these Features for Improved Rating:
very leaky	leaky	(moderately tight)	tight	very tight	N.A.	INFILTRATION LEVEL	Improve to "moderately tight" (add caulking & weatherstripping)
R-0	R-11	(R-19)	R-30	R-38	N.A.	CEILING INSULATION	Add: (R-11), R-19, R-30, R-38 To get a total of (R-30) R-38
R-0	R-7	(R-11)	R-19	R-19+	N.A.	WALL INSULATION	Add R-11
(R-0)	R-7	R-11	R-19	R-19+	N.A.	FLOOR INSULATION	(Add R-19)
single pane	single with drapes	double pane	(double with drapes)	triple	N.A.	WINDOW TREATMENT	Add storm windows or replace sash to get a double layer on each window
	absent		installed		(N.A.)	NEW HEATING SYSTEM	Install
	(absent)		installed		N.A.	FLAME RETENTION BURNER	(Install)
	(absent)		installed		N.A.	PIPE INSULATION	(Install)
	absent		installed		(N.A.)	DUCT INSULATION	Install
							Estimated Improvement Costs: $ 1525
Features in the home, but not rated:							**Add these important Features too. (Not rated)**
	absent		installed		(N.A.)	WINDOW INSULATION	Install
	absent		(installed)		N.A.	CLOCK THERMOSTAT	Install
	absent		(installed)		N.A.	WATER HEATER INSULATION	Install
	absent		installed		(N.A.)	SOLAR WATER HEATER	Install
	absent		installed		(N.A.)	VENT DAMPER	Install
	absent		installed		(N.A.)	ELECTRONIC IGNITION	Install
	absent		installed		(N.A.)	NEW COOLING SYSTEM	Install
	absent		installed		(N.A.)	SOLAR POOL HEATER	Install
	absent		installed		(N.A.)	HEAT GAIN RETARDANT	Install
						OTHER	

Home Now
Btu's/Square foot × degree days: 10

Note: The Predicted Annual Heating Cost for the house is based on the following assumptions:
Electricity: $/kwh: — Heating Oil: $/gal: 1.25 Natural Gas: $/ccf: —

Improved Home
Btu's/Square foot × degree days: 8

Disclaimer: Although every effort has been made to provide accurate information on this form, neither this form nor any entries made on it constitutes any warranty, express or implied, as to, without implied limitation, the presence or lack of energy features in the house, the heating fuel used in the house and its cost, or the actual annual heating energy consumption of the house.

FIGURE 1.1. Sample Home Energy Rating Form

Audit Report

MASS-SAVE HOM"ENERGY AUDIT REPORT
BROUGHT TO YOU BY:

BOSTON EDISON COMPANY

BOSTON GAS COMPANY

AUDIT NO: 159049
AUDITOR : SESSUM
DATE : 15-APR-83

APPLICABLE ENERGY CONSERVING MEASURES	FIRST YEAR SAVINGS	COSTS ($) CONTRACT	COSTS ($) DIY	COSTS ($) MAINT.	PAYBACK (YRS.) CONTRACT	PAYBACK (YRS.) DIY
1. INSTALL THERMOSTATS	85	103	66	N/A	1.0	0.7
2. INSULATE HOT WATER HEATER	32	43	16	N/A	1.2	0.4
3. INSULATE ATTIC	583	1866	526	N/A	2.7	0.8
4. TIGHTEN DOORS	12	48	12	N/A	3.4	0.9
5. INSULATE WALLS	101	587	N/A	N/A	4.9	N/A
6. INSTALL IID	46	268	N/A	N/A	5.0	***
7. TIGHTEN WINDOWS	58	511	129	N/A	7.5	1.9
8. INSTALL CAULKING	19	216	33	N/A	9.7	1.5
9. SOLAR DHW	73	3369	1789	50	18.1	9.6
10. REPLACE HEATING SYSTEM	53	2385	N/A	60	44.8	N/A

APPLICABLE ENERGY CONSERVING PRACTICES:

(1, 4, 6,11,12,14,15,16,18,19,20,21,23,24,25,30,31,32)

ASSUMPTIONS

YOUR AUDIT REPORT IS BASED ON THE FOLLOWING INFORMATION ABOUT YOUR HOME:

AVERAGE INSIDE TEMPERATURE: 65 F

ESTIMATED ANNUAL HEATING COSTS IF NO CONSERVATION ACTION IS TAKEN:

NAT. GAS: 946.0 CUBIC FT.: @ $ 0.90 = $ 851.40 COMBUSTION EFFICIENCY 75%
__TESTED __NOT TESTED

ESTIMATED ANNUAL COOLING COSTS IF NO CONSERVATION ACTION IS TAKEN:

Mass-Save Inc.

FIGURE 1.2. Sample Mass-Save, Inc. Audit Results Form

understand 0-10 score, are intended to motivate a homeowner to undertake the recommended actions. They are also designed to provide an easily understood reference for lending criteria. Both the rating score and the estimated fuel bills provide the lender with an indication of the home's energy efficiency, using standardized life-style assumptions. The rating, when used to justify relaxed loan underwriting criteria, can in theory substantially increase the number of eligible home buyers.(a) The rating information can also be used by real estate brokers to market homes, by appraisers to assess value, and by home buyers as a rough guide to the efficiency of homes they are considering purchasing.(b)

1.2 THE MASSACHUSETTS PILOT PROJECT

The pilot project was conducted in two phases. In the first phase the rating procedure was developed and field tested on 20 homes. Discussions were held with consumers and user groups (i.e., lenders, real estate brokers, appraisers) to refine the rating and its delivery. Mortgage underwriting guidelines were clarified by having a secondary lender, the Federal Home Loan Mortgage Corporation (FHLMC), evaluate test mortgages for properties with varying energy efficiencies and for borrowers with varying creditworthiness and varying mortgage payment-to-income ratios.

The second phase was primarily concerned with conducting ratings in Plymouth County and the city of Arlington and with promoting the use of

---

(a) Assuming a $60,000 mortgage at 13 percent interest over 30 years, an additional 5 million families nationwide could qualify for homeownership if they were allowed to devote an additional 4 percent of income to mortgage payments. Figures derived from National Association of Home Builders data.

(b) The rating assigns a relative value for a given type of home. Thus ratings for different types of homes (e.g., one-story ranch style vs. multi-story Victorian) are not, strictly speaking, comparable.

ratings by lenders, real estate brokers, and consumers. During the pilot project (roughly November 1982 through January 1983), 512 Mass-Save customers received an energy rating. In this period one existing home which had an energy rating was sold with an energy conservation retrofit loan rolled into the mortgage. The mortgage was purchased by a secondary lender, the Federal National Mortgage Association (FNMA). In February 1983, arrangements were made to provide ratings for eight new homes which will be available for sale using relaxed underwriting guidelines (i.e., higher payment-to-income ratios).

1.3 PILOT PROJECT AND BROADER EVALUATION OBJECTIVES

Because of the varied and distinct perspectives of the parties involved in the implementation and sponsorship of the pilot project, several sets of objectives for the energy rating project were formed. Although all of these objectives are interrelated, it is useful for the purposes of this evaluation to separate them into two major categories -- pilot project objectives and broader evaluation objectives.

The developers and implementers of the pilot project -- Energyworks, Inc., the Alliance to Save Energy, and Mass-Save, Inc. -- prepared a set of objectives relating to the implementation of the specific rating procedure developed for the pilot project. These objectives included:

- Demonstrate the linkage of the rating to the RCS audit,
- Demonstrate the use of the rating by the secondary lenders market,
- Document problems and benefits to users (including Mass-Save, customers, lenders, real estate brokers), and
- Measure the accuracy of the rating.

In Section 2.0 of this report, findings relating to the pilot project objectives are summarized. More detailed findings relating to these objectives are in Section 3.0.

These sections also present the summary and detailed findings related to a more widespread application of energy ratings. This second group of findings responds to the broader objectives of the evaluation, which can be summarized as follows:

- Describe pilot program objectives and activities.
- Analyze whether the pilot program fulfills its objectives.
- Analyze the effectiveness and usefulness of the rating.
- Evaluate the concept of the rating, its compatibility with RCS, and its cost-benefits.
- Recommend further use and testing of the rating concept.

Given these objectives, the evaluation was concerned with the immediate impacts of the pilot project and the longer term impacts that could result from the future use of energy ratings. The possible future use of ratings could be reasonably assumed to follow from a continued implementation of the pilot project's rating by Mass-Save in Massachusetts or from the implementation of energy ratings (though not necessarily the specific rating developed for the pilot project) by agencies outside of Massachusetts.

1.4 EVALUATION METHODOLOGY

The evaluation of this pilot project in Massachusetts focused on the various users of home energy ratings including: (1) the approximately

500 homeowners who received the ratings as an added piece of information to the audits, (2) the auditors and Mass-Save officials who implemented the pilot program, (3) the real estate agents and lenders who participated in the home sales and home improvements process and who were involved in the pilot project, and (4) several other local and national organizations such as utilities, mortgage insurers, and appraisers.

In addition to the homeowner surveys, 60 in-person interviews were held with real estate, lending, appraising, and Mass-Save groups that were involved in this pilot project. Appendix A presents a list of the interviewees. Involvement in the project ranged from delivering an audit and a rating, making an energy home improvement loan and adopting new lending qualifications for energy-efficient homes, to simply being aware of the project and having attended briefings on its implications. The issues covered in these interviews and the statistics are presented in Appendices B, C and D.

The evaluation plan also included the review of newspaper articles, press releases and other publications that reflected the promotion of the pilot project as well as the views of the organizations doing the promotions. Appendix E summarizes the press coverage.

2.0 SUMMARY FINDINGS

This portion of the report presents a summary of the home energy rating evaluation results. The results are discussed in two sections -- those summary findings pertaining to the implementation of the Massachusetts pilot project and a general summary of the home energy rating concept based on prospects for a more widespread application of the Massachusetts model. Section 3.0 of this report presents the specific findings of the evaluation in terms of consumer reactions and the reactions of professional users to the home energy rating system.

2.1 THE MASSACHUSETTS PILOT PROJECT

The Massachusetts pilot project was smoothly implemented and well received by consumers and professional users of home energy ratings. Over the short span of the pilot project the Mass-Save auditors were able to routinely administer 500 energy ratings as part of their normal audit procedures. Also during this period a substantial number of lenders, appraisers, and real estate agents were exposed to the home energy rating concept and instructed in its use. As a result the major objectives of the pilot project were met.

Linking Ratings to Audits

- In demonstrating that the rating could be linked to the audit, the pilot project clearly showed that the expense of adding the rating was minimal compared to the cost of conducting the audit. In addition to a few project administration expenses, the rating cost approximately $5 above the normal $115 audit costs.(a) Auditors had no difficulty in administering the RCS rating and actually felt good about being able to provide another useful service

---

(a) Audit cost data provided by Dan Waintroob, Technical Director, Mass-Save, Inc.

to the homeowner. They enjoyed doing the rating because it gave the entire audit process a better conclusion in terms of the home's energy efficiency score and estimated heating bills.

- Among homeowners the addition of the rating to the audit was very well accepted. When the acceptance of the energy rating in random samples of rated and nonrated homeowners were compared, the only statistically significant difference was that rated more than nonrated homeowners felt that the rating would be useful at time of sale.

Homeowner Acceptance

- The energy rating was accepted by the two leading secondary mortgage corporations, FHLMC and FNMA. Ratings were tested against the mortgage underwriters guidelines for debt-to-income ratios and found to be a useful supporting element in decisions to relax these guidelines for energy efficient homes. Furthermore, the ratings were instrumental in new guidance arranging for the costs of an energy retrofit loan to be incorporated into the home mortgage and to have the combined loan purchased by the secondary lender at the time of sale.

The Acceptance of Ratings by Secondary Lenders

- During the brief pilot project period one home mortgage loan was made using the energy rating and incorporating an energy retrofit loan. This loan was then purchased by FNMA in advance of having the energy improvements made. Many local lenders were aware of the energy guidance promoted by the secondary lenders, and of the fact that ratings could be used to support decisions to relax debt-to-income ratios or the incorporation of energy

Acceptance of Ratings by Local Lenders

retrofit loans. None of the lenders rejected the notion of a rating system. However, all but one of the eleven lenders interviewed felt no urgency or need to use energy ratings. At this time they were busy enough making mortgage loans that did not require any information as to the energy efficiency of the homes.

- Although 500 ratings were performed during the pilot project period none of the 12 real estate agents interviewed had any experience in actually using a rating during a home sale. Only one firm actively promoted energy efficiency by paying to have audits performed as part of the listing process. Most of the remaining agents felt that the rating would be an advantage in selling an energy-efficient property and may help to limit the bad news of an energy inefficient property. Several agents felt that the delay in receiving a rating (one to two weeks) was a potential problem. The Massachusetts Association of Realtors indicated that because of tough consumer protection laws in the state against misrepresentation, real estate agents would be in a difficult legal position of having to explain rating results, especially if they contradicted the homeowner's opinions.

Acceptance of Ratings by Real Estate Agents

2.2 THE RATING CONCEPT

In the analysis of the broader objectives of this project, the evaluation had to assume a hypothetical perspective because of the brevity of the pilot project and the absence of direct experience with ratings on the part of many of those who were exposed to the rating

system. This was particularly true in the case of the professional user groups.

The broader objectives cover much of the same ground as the pilot project objectives, but from a different perspective. For example, an important objective for the pilot project was demonstrating that local lenders could exploit the relaxed underwriting guidelines issued by the FHLMC and FNMA. In moving to a more widespread application, the analogous issue becomes whether local lenders would exploit the opportunities afforded by secondary lenders. The distinction is important particularly given the assumption that any rating program would be voluntary. It should also be clearly stated that the objective of demonstrating a willingness on the part of lenders to use ratings is substantially more difficult to achieve than demonstrating their ability to use ratings.

Given this context, the summary findings related to the broader evaluation objectives follow:

Pilot Project Objectives	•	As indicated above, the pilot project objectives were achieved. The assessment of the technical accuracy of the rating was outside the scope of this evaluation.
Effectiveness of Rating	•	The rating used in Massachusetts has proved to be an effective vehicle for providing energy-efficiency information to conaumers and professional user groups. Virtually all homeowners reported that they understood the rating information. Similar results were obtained from interviews with user groups.
Usefulness of Rating	•	Almost 80 percent of rated homeowners found the rating a useful addition to the audit, while over 60 percent felt it would be useful during the sale

of their homes. Real estate brokers, on the whole, also felt the rating would prove more useful than the audit in marketing homes. For lenders the rating also would provide useful, supplementary data when reviewing a mortgage application.

- Costs asaociated with the rating include not only those associated with its delivery to the customer but also administrative and opportunity costs for user groups. As noted above the marginal cost of the rating when added to the RCS audit is low. For both lenders and real estate brokers, the administrative "costs" may be high when the rating is added to the home sale process, which was described as complex and bureaucratic. If that process had to be delayed to await the completion of an energy rating, many professional users would be reluctant to use the rating. Energy must compete with other factors, such as interest rates, for the attention of professional users. At times like those of the pilot project when energy was not a major concern, many professional users interviewed felt that their time was better spent dealing with matters other than energy efficiency. State energy officials expressed concern about competition between energy ratings and such other add-ons to the RCS audit as financing and no/low cost conservation information. These state officials, along with some utility officials feared that customers would become saturated with conservation information and reach a point of information overload. This promotion of ratings might come at the cost of some other add-on to the audit.

Costs of Rating

- Homeowners, brought together in focus groups, felt that energy ratings could be useful in home sales although energy efficiency compared to cost and location would not be a major factor in selecting a home. Mass-Save generated a substantially higher audit response rate when a free rating was offered than when the rating was not offered. This result may or may not be influenced by a "something for nothing" attitude among customers. For real estate brokers the benefits from a rating appear to be conditional. For an efficient home the rating would be a strong selling point. For an inefficient home a minority of brokers felt a rating or an audit could show buyers how to solve energy problems. A majority of brokers felt a rating on an inefficient home could or would scare off buyers. A few brokers felt the rating could become a negotiating point between seller and buyer and provide an opportunity for a deal to collapse. With one exception lenders did not foresee major benefits either in terms of more qualified borrowers or of retrofit loan business. Both lenders and real estate brokers saw relatively few customers as potential beneficiaries of relaxed underwriting guidelines because only 5 to 10 percent of customers were considered marginally qualified. Similarly these users felt the current market for retrofiting at time of sale was small, although a few users felt that such a market could

Benefits of Ratings

be developed.[a] Finally, user groups interest in the potential benefits from the rating would drop either in strong real estate markets resulting from lower interest rates or in respites from energy problems resulting from energy price stability or mild weather.

The findings summarized above are based on statements of those interviewed for the study. They lead in turn to some observations by the evaluators.

- The pilot project appears to have demonstrated that the Massachusetts energy rating could serve as a vehicle for providing energy-efficency information to customers and professional user groups and for being used in the home sale process. While there have been some negative responses among user groups, they do not represent insurmountable problems.

- There is doubt, however, that the energy rating would be widely used by user groups at this point, particularly in the absence of continued training and recruitment within these groups. It appears as though widespread use of the energy ratings at the local level can be easily stalled. It's as though all the users -- homeowners, real estate agents, lenders, and appraisers -- are standing in a circle looking to their right and left waiting for someone to initiate and spearhead the routine use of the energy

---

[a] This is probably related to the lack of interest by lenders in the RCS program. For the RCS program, the lenders' indifference is rooted in the small size of retrofit loans which are not profitable. As a result there has been some effort to encourage utility financing of these loans.

rating in the sale of homes. This status typifies attempts to introduce institutional changes and to overcome the inertia which is typical of the lending and real estate industries.

- Lack of demonstrated benefits to user groups which was possibly inevitable given the time frame of the pilot project is the major barrier to the adoption of ratings by user groups. Nonetheless, broader adoption of the rating could occur if a few lenders or brokers use the ratings. In such a case it appears as if other lenders and brokers could then use the rating to remain competitive.

- The secondary lenders are the most influential of the user groups. They are able to use simpler information on energy efficiency than that provided by the Massachusetts rating system. Thus, a need exists for demonstrations of simpler energy rating systems. Simpler ratings may also reduce some of the administrative barriers seen by local lenders and real estate brokers.

It appears that for a small additional administrative coat, ratings could continue to be provided as an add-on to the Mass-Save RCS audit. This would provide a much larger test case over a longer time period thereby establishing a data base that avoids some of the shortcomings of this pilot project evaluation. However, at the same time other investigations should be pursued on simpler forms of the rating that could be administered by auditors as well as non-energy experts. These investigations should also explore adding such ratings to walk-through audits, mail-in audits, slide rules, and thermograph audits.

3.0 SPECIFIC FINDINGS

The home energy rating system was designed as a tool for homeowners, home buyers, real estate brokers, lenders, auditors, and appraisers. Interviews with these users were conducted over the course of project implementation. Homeowners who received the audits and the ratings were interviewed within a month of having those results presented to them. Other users of the ratings were interviewed shortly after they had attended briefings on the pilot project or in the course of their use of the ratings in home sales or home loans.

The evaluation was carried out under certain constraints, the most important of which was a shortage of time for the pilot project. This time constraint provided little opportunity for the full effects of the rating to materialize. In particular, the roughly three-month period of the pilot project afforded little chance for homes that had been rated to go on the market, be sold, be financed, and then to have the mortgage sold on the secondary market. Consequently the evaluation often focused on process issues with interviewees among the user groups who had little or no direct experience with rated homes. Thus the findings of the evaluation must be considered tentative in the absence of more direct experience with ratings.

The emphasis on process also points out several strengths and weaknesses in the evaluation.

- More than 60 interviews were held with representatives of organizations potentially involved in the processes of delivering ratings and using ratings in the sale of homes. The diversity of viewpoints expressed during these interviews strongly suggests that the sample was a fair reflection of the industries and organizations which can potentially use the rating.

- Interviews were conducted with 100 out of a total of about 500 homeowners who received the energy rating in addition to their audit. These interviews were conducted shortly after the ratings were performed while the rating process and its information were still fresh in the homeowners' minds.

- Interviews were held with 100 homeowners in two control groups who received the audits without the rating information. The use of a control group helped offset the biases of self selection and of providing socially acceptable responses since the control group received audits and were thus similarly involved in energy conservation.(a)

- The evaluation took place in three geographic areas in Massachusetts. This had the effect of broadening the characteristics of the population base exposed to the rating while keeping constant the weather characteristics and fuel prices. The geographic distribution also provided an opportunity to evaluate differences in the institutional settings of the lending and real estate community.

Despite these strengths there are also a few weaknesses that must be kept in mind when reviewing the findings. These include...

- The timing of the pilot project was probably more disadvantageous than beneficial. Normally the winter

---

(a) Several responses from these limited samples compared closely with results of larger statewide Mass-Save surveys in 1981 and 1983.

months, during which the ratings were offered, are a slow period for home sales. However, a dramatic drop in interest rates created a flurry of real estate activity as well as considerable refinancing of existing mortgages. The apparent increase in real estate business following the previous high interest rate period was also due to the smaller number of agents who were still in business. Thus lenders and real estate brokers did not have extra time to consider the rating; indeed many were struggling to meet workloads.

- Although many ratings have been performed they are still a novelty with auditors and not generally well integrated with the presentation of audit results. Therefore it is difficult to evaluate the administrative and technical burdens of providing ratings as an add-on to the audits.

- There are a few admitted deficiencies in the rating such as the wide disparity between estimated and actual heating bills, the exclusion of water heating considerations, restriction to only one type of heating fuel, etc. These technical difficulties may have biased some of the evaluation results.

- Some of the observations in this evaluation are probably unique to Massachusetts because of their tough consumer protection laws, the high level of interest in energy conservation, severe winters, high cost of heating fuel, and an agressive energy audit organization.

Finally, it is important to understand and interpret cautiously the statistical significance of the homeowner survey with respect to the larger populations of rated and nonrated customers in Plymouth County

and Arlington as well as the state as a whole. Appendix D discusses this issue and provides a test to determine the statistical validity of comparisons between the rated and nonrated customer observations.

Both the strengths and weaknesses need to be understood in reviewing the findings and the recommendations for further research discussed later in this report.

3.1 HOMEOWNERS

Homeowners are the ones who are most directly affected by the use of energy ratings. They are the ones who actually pay utility bills, undertake energy retrofits, and buy and sell homes; thus acceptance by the homeowner is important if the energy rating is to become an effective tool in the marketplace.

The following general comments summarize the results of a homeowner survey undertaken in both Arlington and Plymouth County. The survey included two test groups and two control groups, each consisting of 50 randomly selected homeowners who requested energy audits from Mass-Save. Two test groups, one each in Arlington and Plymouth County, received the results of an audit and an energy rating. Both were discussed with the homeowners during the interview. The control group in Arlington (nonrated) also received the rating but the results of the rating were not discussed with the homeowner. The control group in Plymouth County (nonrated) did not receive the rating and only the audit results were discussed with the homeowner.

The following summarizes observations of all interviews in both Arlington and Plymouth County:

- The response of all (rated and nonrated) homeowners to the audit experience was extremely positive. Ninety-five percent of all participants found the audit to be useful.

Ninety-seven percent indicated that they would recommend the audit to others.(a) In written comments, homeowners frequently mentioned how much they learned from the audit, or that their previous plans or ideas had been confirmed.

- Of all homeowners receiving a rating, 77 percent found the rating useful. Particularly where the rating was high, customers mentioned its probable value in selling their homes.

- In 96 percent of all cases, the audit recommended that energy improvements be made. Eighty-six percent of all respondents had made or planned to make improvements. There was little difference noted between the responses of the two rated and the two nonrated groups. Of all improvements which were made or planned, 73 percent were specifically influenced by the audit, and these were divided fairly evenly between rated and nonrated customers.(b)

- Among all rated customers, 92 percent of those that found the rating useful had made or planned to make improvements. Of those that did not find the rating useful, 71 percent made or planned to make improvements.

(a) In an independent statewide survey of audited customers prepared for Mass-Save by Decision Research Corporation (conducted in December 1981), responses were similar: over 90 percent of audited households found the audit useful. Ninety-two percent reported that they would recommend the audit to others. Preliminary results of a similar (March 1983) survey indicate no substantial differences in these proportions.

(b) Over 80 percent of respondents in the December 1981 survey conducted by Decision Research Corporation felt the audit was useful in their decision to undertake energy improvements.

- The audit and the energy rating were easily understood. Ninety-eight percent of all participants indicated that they understood the audit. In the case of rated customers, more detailed questions were asked. Among rated customers, 97 percent recalled their present home heating costs; 92 percent recalled their present home energy rating; 100 percent recalled what improvements had been recommended.

- Only one rated customer indicated difficulty in understanding that estimated heating bills are based on characteristics of the home itself, and that actual costs may be affected by living habits. However, comments added by four additional participants indicated that these respondents also did not fully understand this concept.

- Sixty-four percent of all the rated customers expected the audit to be useful at the time of home sale. Fifty-four percent of all nonrated customers felt the same way. In written comments, customers mentioned the rating as a convenient way of comparing the energy efficiency of one house to another and as a means of evaluating energy conservation measures that had been taken or were planned.

The following two sub-sections present a more detailed discussion of the homeowner reactions to audits and ratings in Arlington and Plymouth County. This information is summarized in Table 4.1.

3.1.1 Arlington Test

In Arlington, Massachusetts 160 homeowners participated in the pilot home energy rating project. All 160 homes received a Mass-Save audit

TABLE 4.1. Summary of Homeowner Survey
(Percentage of Positive Responses)

	Arlington			Plymouth		
	NonRated	Rated	Valid[a] Difference	NonRated	Rated	Valid Difference
1. Would you recommend the audit to others?	100%	94%	No	98	96	No
2. Did you understand the audit results?	98	100	No	96	100	No
3. Did you make or plan energy improvements?	90	88	No	84	84	No
4. Did the audit influence your decisions for energy improvements?	78	84	No	56	70	No
5. Was the rating a useful addition to the audit?	--	72		--	82	
6. Did you understand the normalization features of the audit?	--	100		—	98	
7. Would the audit be useful at time of sale?	62	58	No	46	69	Yes
8. Overall was the audit a useful experience?	98	96	No	92	96	No

[a] A valid difference between the test and control samples is assumed to be one where there is less than a 4.55% chance that the observed difference is due to sampling error. (See Appendix D.)

with a home energy rating. To develop a control group for the pilot project, however, only 83 of the homeowners received an explanation of the rating results. The remaining 77 homeowners received only the normal audit results (nonrated customers). Of the 160 homeowners, two random groups of 50 were interviewed by telephone. The test group (rated customers) was asked a series of questions about the audit and about the energy rating. The control group (nonrated customers) was asked questions only about the audit.

The following are the statistical observations of the interviews in Arlington:

- One hundred percent of the nonrated customers would recommend the audit to others. Ninety-four percent of the rated customers would recommend the audit. The percentage difference between rated and nonrated customers is not statistically valid.[a] Of the few rated customers who would not recommend the audit (which in these cases included an explanation of the rating) to others, the reasons given were that (1) they were provided an unrealistic estimate of their current heating bill and (2) they were given no new information regarding energy efficiency or conservation measures.

- Ninety-eight percent of the nonrated customers found the overall experience with the audit a useful one. Ninety-six percent of the rated customers found the experience useful. The percentage difference between rated and nonrated customers is not statistically valid.

(a) See Appendix D for a discussion of the statistical significance associated with this sample size.

- Seventy-two percent of the rated customers found the addition of the rating to the audit useful. Most of these customers felt that: the rating gave them an energy efficiency comparison with other homes (26 percent); the rating could improve the marketability of their homes (14 percent); and that the rating reinforced their own previously undertaken or planned improvements (12 percent).

- None of the rated customers reported difficulty understanding the fact that the estimated heating bills are based on the characteristics of the home and may be different from actual costs which include life style considerations. However, comments in four cases revealed that this was not fully understood by those individuals. This misunderstanding caused some dissatisfaction with the audit in these few cases.

- All of the rated and all but one of the nonrated customers indicated that they understood the audit (which for rated customers included an explanation of the rating). In the case of rated customers, the question was broken down further to determine their specific understanding of present features, present and future scores, present and future estimated heating bills, and recommended improvements. Of those customers that did not understand some part of the rating information, 26 percent could not recall the estimated heating bill after the improvements were made and 22 percent could not recall the rating after the improvements were made. One hundred percent of the customers understood the list of recommended improvements.

- Ninety percent of the nonrated customers indicated that they are making or planning energy improvements to their homes. Eighty-eight percent of the rated customers indicated the same thing. The percentage difference between rated and nonrated customers is not statistically valid.

- Of those rated and nonrated customers having made or planning to make recommended energy improvements, the breakdown by type of improvement is as follows:

	Nonrated	Rated
Insulation	48%	52%
Caulking	22	36
Storm windows/doors	22	20
Weather stripping	50	32
Heating modifications	8	14

(The percentages add to more than 100 because customers generally reported on more than one type of improvement.)

- Seventy-eight percent of the nonrated customers felt that the audit influenced their decision to make or to plan energy improvements. Eighty-four percent of the rated customers felt the same way. The percentage difference between rated and nonrated customers is not statistically valid.

- Sixty-two percent of the nonrated customers expected the audit to be useful at the time of home sale. Fifty-eight percent of the rated customers expected the audit/rating to be useful at the time of sale. This percentage

difference between rated and nonrated customers is not statistically valid.

3.1.2 Plymouth County Test

In Plymouth County, Massachusetts 49,000 homeowners received a direct mail announcement from Mass-Save offering an energy audit and an opportunity to request a separate energy rating.[a] Homeowners were asked specifically to request the rating in addition to the audit. The audit was offered for $10. The optional energy rating was offered for free. This was done as a test to determine what, if any, influence the offer of an energy rating had on the demand for audits. The response rate for the audit was 0.6 percent and the response rate for the audit plus the rating was 1.1 percent. This is a significant difference arguing for the positive influence of the rating in the demand for audits. However, it should be noted that the energy rating offer was providing homeowners something for free and this in itself may have accounted for some of the difference in response rates.

In all, 246 ratings were performed in Plymouth County. A test group of 50 randomly selected homeowners who had received the rating was interviewed by telephone. A control group of 50 homeowners who had received the audit but not the rating was also selected at random and interviewed by telephone.

(a) Between November 22 and 26, 1982, 49,000 utility customers in Plymouth County received an announcement offering a free Home Energy Rating with an audit. The rating was described as a summary of the Mass-Save energy survey information which would allow home buyers and sellers, real estate brokers, appraisers and mortgage lenders to compare homes on the basis of their energy efficiency. It emphasized that a high energy rating may enhance the sale value of one's home and help the buyer obtain financing.

The following are the statistical observations of the interviews in Plymouth County.

- Ninety-eight percent of the nonrated customers would recommend the audit to others. Ninety-six percent of the rated customers would recommend the audit/rating. This percentage difference between rated and nonrated customers is not statistically valid.

- Ninety-two percent of the nonrated customers found the overall experience with the audit a useful one. Ninety-six percent of the rated customers found the experience useful. The percentage difference between rated and nonrated customers is not statistically valid.

- Four of the respondents (less than 10 percent) in the rated group indicated in written comments that they were dissatisfied with the performance of the auditor. This was reflected in answers to questions about the usefulness of the audit, the usefulness of the rating, and whether or not they would recommend the audit to others.

- Eighty-two percent of the rated customers found the addition of the rating to the audit useful. Most of the customers felt that the rating gave them an energy efficiency comparison with other homes (20 percent), that the rating could improve the marketability of their home (22 percent), and the rating reinforced their own previously undertaken or planned improvements (12 percent).

- All but one of the rated customers understood the fact that the estimated heating bills are based on the

characteristics of the home and may be different from actual costs which include life style considerations.

- Ninety-six percent of the rated and all of the nonrated customers indicated that they understood the audit. For the rated customers, the question was broken down further to determine their specific understanding of present features, present and future scores, present and future estimated heating bills, and recommended improvements. Of those rated customers who did not understand some part of the rating information, 22 percent could not recall the present energy features of their house and 6 percent could not recall the present rating of their house. Ninety-eight percent recalled and understood the recommended improvements.

- Eighty-four percent of the rated customers indicated that they are making or planning energy improvements to their homes. Eighty-four percent of the nonrated customers indicated the same thing.

- Of those rated and nonrated customers having made or planning to make recommended energy improvements, the breakdown by type of improvement is as follows:

	Nonrated	Rated
Insulation	52%	58%
Caulking	14	26
Storm windows/doors	20	18
Weather stripping	24	34
Heating modifications	16	6

(The percentages add up to more than 100 percent because customers generally reported on more than one type of improvement.)

- Fifty-six percent of the nonrated customers felt that the audit influenced their decision to make or plan energy improvements. Seventy percent of the rated customers felt the same way. This percentage difference is not statistically valid.

- Forty-six percent of the nonrated customers expected the audit to be useful at the time of home sale. Seventy percent of the rated customers expected the audit to be useful at the time of sale. This percentage difference between rated and nonrated customers is statistically valid. This difference can probably be explained by the promotional campaign conducted by Mass-Save and Energyworks in Plymouth County. The announcement of the rating service, the press briefings and newspaper articles may have educated homeowners as to the value of an energy rating.

- However, in spite of the publicity, 58 percent of the nonrated group indicated that they were unaware that a rating had been offered. An additional 4 percent who had not requested a rating thought that they had, and were expecting to receive it.

- The announcement of home energy ratings available through Masa-Save was made through several channels. The following table summarizes how homeowners heard about the ratings.

Newspaper	29%	No Recall	6%
Direct Mail	47	TV	0
Word of Mouth	18	Radio	0
		Total	100%

Overall, homeowners responded positively to both the audit and the rating. The concept of an energy-efficiency rating was understood and well accepted by the test groups.

However, the homeowner survey showed little difference in the response of those who did and did not receive a rating. In only one instance was there a statistically significant difference between the responses of the rated and the nonrated groups: more rated than nonrated homeowners in Plymouth County believed the audit would be useful to them in selling their homes.

Because of the limitations of time and geography, the evaluation of the pilot project could not address the question of how the rating would affect home sale transactions if the ratings were as widely familiar and accepted a measure to consumers, as the mile-per-gallon (MPG) rating is for automobiles. Suppose that home energy ratings were, in fact, commonly available and understood. A home's comparative energy efficiency then could routinely be reviewed at the time of home sale. But this would not necessarily mean that energy efficiency would become a more important factor in the decision to purchase or not to purchase a home. The decision to buy a home is based on a vast array of factors, the most important of which are location, cost, and a host of rational and irrational personal preferences. Whether an energy rating affects the marketability of home at all is uncertain.

In June 1982, focus groups representing homeowners who had recently been active in the real estate market and who were knowledgeable of what it costs to run a home were convened by Data Research Corporation[1] to identify the usefulness of a home energy rating in

buying or selling a home. Some of the panelists had had an RCS energy audit. The consensus was that energy efficiency was a minor consideration in selecting a home compared to such factors as cost and location. If all other things were equal, it was expected that buyers would be interested in a home with lower heating costs, although this was not considered critical because something can be done to improve the heating efficiency of a home. According to Decision Research Corporation (1982), "The general feeling was that a rating would be nice to have but it would not have a significant role in the home selection process." These focus groups met in the spring following a colder than typical New England winter (5926 degree days versus a 5621 average) during a time when mortgage interest rates were in the 17 to 18 percent range, prohibitively high for almost all prospective home purchasers, and when fuel oil averaged about $1.30 per gallon or slightly more than current prices.

3.2 SECONDARY LENDERS

Secondary lenders purchase home mortgage loans from local (primary) lenders, thereby freeing local lenders of having to carry the mortgages in their own portfolio and enabling them to make further loans. The purpose of a secondary lending market, on a national level, is to provide additional funds to local lenders and to even out geographic imbalances in the supply and demand for home mortgage loans. The secondary lenders that participated in the Massachusetts energy rating pilot project were the Federal National Mortgage Association (FNMA), also known as Fannie Mae and the Federal Home Loan Mortgage Corporation (FHLMC), known as Freddie Mac. Although both organizations are federally chartered, they are private, profit-making corporations competing with non federally chartered private secondary lenders.

The combination of a rapid increase in interest rates and the uncertainty over future interest rate fluctuations has prompted many local lenders to severely limit the number of long-term home mortgage loans in their portfolios. Therefore, secondary lenders have become a very important element in financing home loans. (All of the primary lenders interviewed in connection with this project sold their mortgage loans to secondary lenders.) The importance of this fact is measured not only in the number of loans purchased but also by the influence of the underwriting guidance issued by the secondary lenders. Local lenders review their guidelines very carefully to avoid having their loans rejected and thus "sold back" into their own portfolio. The underwriting guidelines of FHLMC and FNMA are strictly adhered to by the local lenders. These guidelines have also been adopted by other private secondary lenders.

The main energy-related underwriting guidelines issued by the secondary lenders for "investment quality" home mortgages cover the debt-to-income ratio of the borrower and the loan-to-value ratio of the

property. Recognizing that a structure's energy efficiency and, therefore, the utility bills play an important part in the debt-to-income ratio, the secondary lenders agreed in 1979 to relax this ratio for energy-efficient homes. Similarly, the secondary lenders also agreed to acknowledge the value of energy-efficiency features in considering the guidelines for loan-to-value ratios. The underlying problem in implementing these guidelines is in determining what exactly is an energy-efficient home. The energy rating implemented in the Massachusetts pilot project is a tool to solve this problem. Interviews with representatives of FHLMC and FNMA at both the headquarters and regional office levels about the usefulness of the rating yielded the following observations.

- The change in secondary lender policy to include the recommended home energy improvement costs (as specified by the rating) in the basic mortgage loan, before the improvements are completed, is seen as the most positive outcome of the pilot rating project. At the present time FNMA has no plans to offer this retrofit policy nationwide.

- The Federal Home Loan Mortgage Corporation recently reaffirmed its commitment to financing energy-efficient housing by issuing an energy addendum to the appraisal report. This form allows the appraiser to "rate" the energy efficiency of the property in a qualitative manner -- High, Adequate, or Low -- or by appending a more quantitative energy rating score such as the one used in the Massachusetts project (see Section 3.5).

- Secondary lenders were willing to accept loans made under existing relaxed debt-to-income guidelines based on energy ratings as long as the primary lender was comfortable with the rating as evidence of the home's energy efficency.

The secondary lenders preferred not to prescribe or dictate the specific "rating" or investment criteria to the primary lender even though primary lenders are eager to receive specific criteria to avoid the possibility of loan rejections.

- It was difficult to determine specifically why the secondary lenders participated in the pilot project. The reasons given were a combination of: (1) ratings gave technical substance to their existing guidance on energy costs and underwriting principles; (2) some of their customers, local lenders in Massachusetts, who were eager to participate in the pilot project wanted to sell loans made with the assistance of the ratings; and (3) as large, influential national corporations with federal charters they have a social responsibility and obligation to explore new ways for lending institutions to contribute to energy conservation.

- One FHLMC official speculated that the use of energy ratings could significantly increase the number of qualified homebuyers, though most secondary lenders were ambivalent on the point. It was much too early to tell whether the pilot project energy ratings would generate additional lending business for FHLMC or FNMA. No marketing studies had been performed to show what the prospects of energy ratings would be in increasing the number of home loans, loan values, or the investment quality of loans. There were no immediate plans to conduct such studies.

- A survey of primary mortgage lenders by FHLMC in May 1980[3] revealed that 90 percent of respondents did not offer special or preferential loan considerations for

energy-efficient homes. In the same survey, less than one-third of the respondents informed borrowers of their energy lending programs or encouraged applicants to finance energy improvements.

- Although there has been some recent general interest in linking mortgage defaults to rising energy costs, secondary lenders do not see increased energy efficiency resulting in fewer defaults. In FHLMC's 1980 survey very few lenders considered energy costs a contributing factor in defaults. Unemployment and divorce are the major causes for default.

Secondary lending institutions have indicated an interest in promoting energy conservation through policies which encourage loans for that purpose and which recognize energy efficiency in qualifying borrowers for home mortgages. The energy rating used in the Massachusetts pilot project, however, is seen as only one of the possible tools to be used by the primary lender in making an investment quality loan decision, based on energy considerations, for subsequent sale to a secondary lender.(a) The rating itself is not as important to the secondary lender as it is to the primary lender who actually makes the investment decisions. However, any underwriting guidance issued by secondary lenders will have a very strong influence on the operations of the primary lenders.

(a) By the winter of 1983, FHLMC had accepted five energy ratings being implemented in localities across the country and used by primary lenders in these localities. See Sell More Homes with Freddie Mac's New Energy Policy, FHLMC Publication No. 21, February 1983.

3.3 PRIMARY (LOCAL) LENDERS

Primary or local lenders are the principal connections between homeowners and home buyers and the institutions that finance home purchases and home improvements. They became involved in the Massachusetts pilot energy rating project through direct contact with the developers of the rating, the workshops, and the written materials explaining the rating and its uses. In addition to these contacts, local lenders also became involved following the announced participation in this project by the secondary lenders (see previous section).

With the energy ratings, local lenders have the potential of increasing the number of eligible home buyers through a relaxation of debt-to-income ratios for home mortgages. They also have the opportunity for increasing the mortgage amount by the addition of the costs to undertake energy-efficiency improvements.

Eleven local lenders were interviewed in connection with the Massachusetts pilot project. The interviews yielded the following observations.

- Most local lenders were found to be extremely conservative in their interpretation of secondary lender guidelines on debt-to-income ratings. If these guidelines were "officially" relaxed for energy-efficient homes and if the ratings were accepted as justification for this relaxation, then the ratings would be used to qualify marginal borrowers.

- Lenders typically have several "gimmicks" to qualify borrowers who exceed the traditional ceiling on debt-to-income ratios for mortgages. This potential

benefit of the energy rating is not unique. Relatively few mortgage applicants (5 to 10 percent) approach or exceed the traditional ceilings for debt-to-income ratios.

- Aggressive and innovative bankers will use whatever marketing advantage they can to get a bigger share of the loan market. The energy rating and the new secondary lender policies represent a new service and thus a new marketing tool for these lenders.

- Peer pressure or a decline in market share of mortgage loans could make other lenders adopt the energy rating in their marketing efforts. Mortgage lending is a highly competitive business. However, at the moment, business is good and there is no need to look for new ways to market their loans.

- Many lenders rely on real estate brokers to bring them mortgage business. If brokers feel a poor rating would turn off home buyers, lenders will abandon the rating so as not to alienate brokers.

- For local lenders selling mortgages to the secondary market, mortgage lending has become an "assembly line" business where the smooth flow of paperwork is a substantial concern. The addition of the rating must be made compatible with these procedures. There was some concern over the delays that might develop in having to order a rating during the loan application process. Lenders prefer to have all the information including the rating at the time of loan application. Requesting a rating at a time of mortgage application may pose an unacceptable delay in the loan processing schedule.

- The added procedures and costs for appraising and reinspecting a home improvement loan that has been incorporated into a home mortgage may limit the marketing advantage of this new loan service.

- Central banks with outlying branches can fairly easily adopt the energy rating procedure. It has the potential of offering a simple set of specifications on the added value of an energy-efficient home, thus restricting the judgment called for by each loan officer on the added value of an energy-efficient home.

- One lender is currently marketing audits for Mass-Save.

- Some lenders have initiated energy loan programs in the past, especially in older urban areas, with poor response. They have a definite wait-and-see attitude with respect to the ratings.

Local lenders were not opposed to the use of energy ratings if they were available and if they perceived a real need to use them. At the present time their business in home mortgages and home improvement loans is brisk and they see no need to add the benefits of the ratings to their services.

3.4 REAL ESTATE AGENTS AND BROKERS

Real estate agents and brokers are interested in making a commission from the sale of homes. The more homes they sell within a given period of time, the more money they can make. Also, the more they know about a home, the better they can serve their sellers and buyers both in terms of marketing a property and in helping the buyer obtain financing. Massachusetts has a tough consumer protection law; therefore, real estate agents are interested in accurate information about a house to avoid any liability arising from misinformation.

Interviews with 12 real estate agents and brokers about the use of energy ratings in marketing homes yielded the following observations:

- Several real estate agents supported the concept of a rating and favor the type of information provided by the energy rating. They agreed that it would be an additional marketing tool to tout a home's energy-efficiency features or to limit the marketing damage created by an inefficient home by showing solutions to energy problems.

- During good times, when real estate moves fast, the energy rating would be far less significant than other marketing features and may present a burden if it increased the time necessary to close a deal.

- The share of home buyers described by brokers as marginal ranged from 5 to 10 percent at current interest rates. A high rating could be one of several vehicles to help these buyers qualify for higher debt-to-income ratio mortgages.

- Some agents indicated that by the time a real estate agent becomes involved in a house sale it is too late to request the energy rating. The rating should have been requested

by the homeowner before the property is listed. The initial days and weeks following a listing are most critical from a marketing standpoint. Delays caused by a rating request (one to two weeks[a]) could easily offset the value of the energy information.

- All real estate agents interviewed would not like to see the rating become a mandatory element of house transactions, especially because poor ratings have the potential for devaluing a house. They want the freedom in each case to use the rating or not use it depending on the situation. Agents are reluctant to provide any more information than necessary.

- A few agents indicated that once the case is made for using ratings, the required training of agents will be relatively easy. The difficult part will be in estsblishing self interest among agents in order to make the case for ratings. It may be easier to make the case and train for ratings in larger firms where managers oversee agents than in small operations where the time for additional training is very limited.

- Most agents would like to see the ratings performed by experts in the energy field. This relieves them of the responsibility and potential liability arising out of their untrained judgments.

(a) This is an estimate provided by Mass-Save for time-of-transfer requests. Normally the response period would be three to four weeks. There was no empirical evidence of the problems caused by rating delays and every effort was made by Mass-Save to minimize delays for real estate agents during this pilot project.

- The normalized results of ratings which eliminate life-style considerations are viewed as a positive feature in the ratings. Agents are accustomed to having to explain life-style variations.

- The rating scale currently used represents too high a standard. A good house may rate only a 6 or 7 which on a scale of 10, appears to represent a value little more than slightly above average.

- The relaxation in debt-to-income ratios made possible by an energy-efficient home was not considered an important feature of the rating. Agents felt that there were other ways to qualify homeowners (e.g., looking for a lender willing to take the risk in those few instances where the qualification limits were reached).

- Many buyers have remodeling plans for newly purchased homes. Several agents said that the market for immediate energy retrofits at the time of sale, however, is small.

- Energy retrofits may be more important after the buyer has experienced the actual heating costs.

- Real estate agents were primarily relating the use of ratings to the listing process and marketing support for the homeowners. Few agents commented on the buyers' need for the rating information.

- Within the hierarchy of realty organizations including the National Association of Realtors, the state associations, and local boards, the benefits of energy ratings are not yet clear-cut. Therefore, there is no apparent move to establish policy initiatives to implement the use of

ratings. What is needed is documentation of demonstrated results of how the ratings improved the home transfer process.

For real estate agents and brokers the rating can provide a good marketing tool, particularly for efficient homes. For inefficient homes the rating can be used to demonstrate solutions to energy problems; however, most agents and brokers would fear that a poor rating would frighten prospective homebuyers. The rating could help agents and brokers qualify marginal buyers, but relatively few prospective buyers were considered marginal. Any administrative delays in acquiring a rating would diminish its utility to the real estate community.

3.5 APPRAISERS

Appraisers' involvement with home energy ratings in the pilot project is somewhat limited. They take their lead in the home transfer process primarily from lenders and to a lesser extent from real estate agents. The function of appraisers is to estimate the market value of real estate for their clients. A home's energy-efficiency rating would constitute another feature reported on by the appraiser and considered along with other features in an assessment of marketplace value. Because appraising is not an exact science, the more information that is available, such as energy efficiency, the more confident an appraiser can be in estimating property value.

Interviews with four appraisers yielded the following observations.

- The estimated fuel bills in the energy rating can be very useful to the appraiser in calculating the property value differences among homes with varying heating costs. At the moment, the energy-efficiency score is a somewhat less useful piece of information, but in time it could act as a simple surrogate to fuel costs, especially with the constant variation in fuel prices.

- Ratings provide a uniform way of describing energy features through a summary of efficiency characteristics rather than individual construction features.

- Ratings must be available at the time an appraisal is requested. Typically, an appraiser only has five to seven days to prepare an appriasal and any delay in obtaining the rating would seriously hamper his procedure.

- Appraisers believe that energy ratings, as presently designed, must be performed by energy experts and not by

the appraiser. Lacking the training to provide a Mass-Save-type energy rating, the appraiser's role should simply be to report the rating results and to use the results along with other factors to determine property value.

- It may be unreasonable to expect appraisers to produce uniform appraisal guidelines and policy recommendations with regard to energy ratings from a national level because of the lack of s single national organization representing appraisers. On the other hand, it would be relatively simple to add uniform rating information to current appraisal forms and listings such as the SREA Market Data Center report.

In the future, it may be possible for appraisers to play a more active role in the energy rating process. FHLMC has added an energy addendum to the residential appraisal report form published in January 1983. According to the energy addendum, shown in Figure 4.1, the appraiser may include an accepted home energy rating such as the one used by Mass-Save, or the appraiser himself could make judgments about certain energy features of the house as listed on the form. FHLMC encourages the use of the energy addendum to justify relaxed underwriting ratios.

Home energy rating systems could be devised which would be procedurally simple yet accurate and which are designed for use by appraisers such as the Residential Energy Evaluation developed by Western Resources Institute as part of the Washington State Energy Evaluation Program.(4) If such systems were acceptable to appraisers and could overcome administrative problems such as the lack of guidelines from a national appraisers' organization, mentioned earlier, then perhaps energy ratings could be performed routinely at this point in the home transfer process.

ENERGY ADDENDUM—RESIDENTIAL APPRAISAL REPORT

This Energy Addendum is an optional report designed to assist appraisers in (1) describing the energy efficiency of the subject property and (2) estimating the value of energy-saving items in those instances when adequate comparable market data are not available. It may be used as an attachment to FHLMC Form 70, 72 and 465.

Borrower _____

Property address _____

PART I—Energy Checklist

In this section the appraiser should note the energy-efficient characteristics of the subject property and use these characteristics as a basis for rating the property's overall energy efficiency (high, adequate or low). The appraiser's rating of energy efficiency may be utilized by the lender to justify higher housing expense and total debt-to-income ratios for investment-quality loans.

The comment sections should be used to describe the specific features and the quality of installation of the energy-efficient item(s) or technique(s). For example, in the heating and cooling section below, if the Energy-efficient furnace box is checked by the appraiser, those features that make the furnace "energy efficient" should be explained.

INSULATION (*Check if present, state R value*)

- ☐ Attic/roof R-_____
- ☐ Walls R-_____
- ☐ Floors R-_____
- ☐ Slab perimeter R-_____
- ☐ Foundation walls: R-_____
- ☐ Water Heater
- ☐ Heat/cooling ducts or pipes

Comments (*Describe quality and adequacy*): _____

WINDOWS AND DOORS

- ☐ Double (storm) triple glazed windows
- ☐ Storm doors On ____ of ____ doors
- ☐ Weatherstripping
- ☐ Caulking
- ☐ Other: _____

Comments (*Describe quality and adequacy*): _____

HEATING AND COOLING

a. Conventional equipment

- ☐ Automatic setback thermostat
- ☐ Automatic flue damper
- ☐ Energy-efficient furnace/air conditioner
- ☐ Energy-efficient water heater
- ☐ Special fireplace devices/features (*Describe in comments*)
- ☐ Wood burning stove
- ☐ Other: _____

Comments (*Describe quality and adequacy*): _____

b. Solar equipment or design

- ☐ Passive solar design/landscaping — exterior (*Describe features below*)
- ☐ Passive solar design — interior (*Describe features below*)
- ☐ Solar space heating/cooling ☐ Back-up system
- ☐ Solar hot water heating
- ☐ Earth-sheltered housing design
- ☐ Other: _____

Comments (*Describe quality and adequacy*): _____

ENERGY RATING

Has an energy audit/rating been performed on the subject property?

☐ Yes (*Attach, if available*) ☐ No ☐ Unknown

Energy efficiency appears:

☐ High ☐ Adequate ☐ Low

General comments: _____

Date _____ Appraiser(s) signature(s) _____

FIGURE 4.1. Energy Addendum to FHLMC Residential Appraisal Report

3.6 MASS-SAVE AUDITORS

The auditors are a most important link in the rating process because they must accurately administer the rating if it is to be of value to the users. The rating results are expected to make a better product out of the basic audit and the auditors' overall presentation of energy-efficiency information to the homeowner.

The performance of the auditors was important to the acceptance of the rating and the audit by the homeowners. Based on the homeowner survey, most homeowners were very pleased with the auditors. Often the auditor was praised as being well-informed, courteous, helpful, and responsive to individual concerns. All of the Arlington customers and all but a few of the Plymouth customers were satisfied with the work of the auditors.

By and large, auditors in Massachusetts are young, eager to serve, and very committed to energy conservation. Interviews with five auditors and five Mass-Save staff members who participated in the pilot project were very positive and yielded the following observations:

- Auditors were very pleased to provide another energy conservation service to the homeowner in the form of the rating results.

- The auditors were successful in integrating the rating process with the RCS audit without difficulty. No part of the rating process, including data collection, computation or presentations to the homeowner, proved to be a burden to the auditors. An estimated 15 minutes were allocated to the rating and most auditors found that to be sufficient. In those cases where more time was required, the auditors gladly gave the time even though they were being paid on a

per audit basis and were not compensated for the additional time spent.

- Given the purposes of the rating in the lending and home sales process, auditors felt very responsible for the accuracy of the rating. They were reluctant to use homeowner-supplied data unless it could be verified. They also indicated a need for more training in the lending and home mortgage procedures to be of more help to homeowners.

- Auditors were somewhat concerned about the technical structure of the rating process and the need for judgments about certain house characteristics and housing types. In particular, estimates of infiltration levels and determination of length-width ratios in irregularly shaped homes often required a subjective estimate. The auditors would like to see less need for judgment on their part.

- The auditors did feel that computerization of the hand calculations would make their jobs easier and more accurate.

- In their eagerness to provide accurate data, auditors expressed concern over the overestimation of heating bills compared to the homeowner's actual experience. However, they felt that this technical problem could be overcome.

At the auditor and regional levels of Mass-Save there was universal agreement that the ratings were a useful service to the homeowner and presented no administrative or technical constraints when added to the basic audit. They would all like to see the pilot project become a routine service of Mass-Save.

3.7 UTILITIES

At the present time, utilities in the Massachusetts pilot project play a pivotal role in the energy-rating process because the rating is piggybacked on the federally mandated audits. In Massachusetts, the homeowner pays $10 for the audit.(a) During the pilot project the rating itself cost the utility an additional $5 per audit to perform. The actual cost to perform an audit is approximately $115. As with the cost of the audit, the incremental cost of the rating is subsidized by all ratepayers.

Interviews with representatives of three of the utilities who sponsor the Mass-Save organization yielded the following observations:

- Utilities view the ratings as a public service which they can provide and as another opportunity for a marketing contact with their customers. However, there is a small concern that homeowners do not identify utilities with Mass-Save.(b) It was pointed out that the participation of the utility should be made very clear for the marketing value of the contact to be realized.

(a) The audit recipient is charged $10 at the time of the audit. The remainder of the program expense is recovered from all ratepayers via a surcharge mechanism. In a Decision Research Corporation survey (December 1981), although 92 percent of audited customers supported the $10 cost of the audit, only one-third were supportive of the payment structure in which 90 percent of the true costs were borne by all ratepayers through a surcharge.

(b) According to an independent state-wide survey of audited customers conducted by Decision Research Corporation for Mass-Save in 1981, 83 percent of respondents believed it was appropriate for the utilities to offer an audit service through an organization such as Mass-Save.

- So long as the demand for audits is maintained, the unit cost of adding the rating will remain low. Utility representatives noted that Mass-Save has conducted over 100,000 energy audits, and there was some concern that demand for energy audits may now decline. The implications of this occurring are unclear. Should demand for audits fall, the cost of each audit and the incremental cost of each rating would rise. At a certain point, the utilities may become more interested in comparing the cost effectiveness of different auditing and possibly rating procedures. Alternatively, or perhaps in addition, should demand for audits fall, ratings may be more aggressively marketed as an enhancement to the audit in hopes of stimulating demand for both services.[a]

- The rating may also open a new market consisting of homeowners who intend to sell their homes and want to take advantage of the rating's influence on mortgage loans and retrofit loans. While this new market for ratings will include homeowners who might not have otherwise requested an audit, some of the requests for ratings may come from customers who had been previously audited and now seek a rating. The cost of providing a rating to these customers who require a second onsite visit will be considerably higher than the cost of providing the rating initially with the audit all in one visit.

(a) A survey of unaudited utility customers in Massachusetts conducted by Decision Reseach Corporation (December 1981) indicated that if an audit were offered, 50 percent would not want it, 25 percent were unsure, and only 25 percent would request one. Preliminary results of a similar 1983 survey indicate substantially the same ratios.

- Some concern was expressed about the fact that the cost of audits and rating is being absorbed by all ratepayers. Utilities are not totally in control of marketing efforts such as the ratings. Public service commissions have an important say in the matter. Utilities are concerned that, although improved energy efficiency is a benefit to all ratepayers, individual customers may balk at paying extra for a service they do not choose to receive. The commission may have to consider this in weighing competing demands for subsidy dollars such as those used to pay for the ratings. This would be especially true should demand for audits fall, resulting in a rise in the actual costs of both audits and ratings.

- According to federal legislation, utility companies are required to offer RCS audits until 1985.[a] If RCS audits are not offered after that time, other forms such as walk-thru audits may replace the RCS audits. Future rating procedures will be affected by and should be tailored to anticipated changes in the audit procedure.

- Fuel oil is the primary heating fuel in Massachusetts. Conservation programs such as the audit or rating would not particularly benefit utilities with load management

---

(a) Under title II, Section 215(a) of Public Law 95-619, the National Energy Conservation Policy Act, (NECPA), utilities are required to inform their residential customers of the audit program until January 1, 1985. Utilities should continue to offer audits to their customers for a reasonable time (6 months) thereafter, according to legal experts at DOE. Furthermore, some states have enacted separate RCS-type legislation which goes beyond the Federal RCS time requirements and some utilities will continue to offer the RCS type audit as a service to their customers.

problems which would be eased by reduced demand. On the other hand, utilities which are not supply constrained can maintain their sales level while receiving the public image benefit of being associated with the audit and the rating.

Because utilities enjoy wide access to homeowners, they can do more to promote the use of rating than can real estate brokers or lenders who will eventually use the rating at the time the home is sold. Much of the success of the rating concept will therefore depend upon the enthusiasm with which it is accepted and promoted by utilities.

4.0 RECOMMENDATIONS FOR FURTHER RESEARCH

The survey and personal interviews conducted in the Massachusetts pilot project did not yield conclusive answers to the major questions addressed. Because of the limitations of the project outlined earlier, it could not be determined that ratings did in fact increase the propensity of homeowners to improve the energy efficiency of their homes or that ratings could be successfully and routinely incorporated into the process of selling a property. It is also apparent that in addition to research on technical rating issues, a great deal of market research is needed to sell this or any other rating concept especially to homeowners. The 1.1 percent response rate to the rating service announcement during this pilot project is far from overwhelming.

Additional research should also be undertaken with the understanding that the widespread use of ratings will almost certainly take years to accomplish. The experience with the mileage ratings for new cars suggests that consumer awareness and use of these ratings in purchase decisions have evolved over the years - consumers did not instantly incorporate this information into their decisions. A recent evaluation of the mileage ratings also reinforces the need for technical and marketing research in order to promote the use of energy efficiency information.(2)

Participants generally agreed that the concept of an energy rating was a sound one. The results of this study highlight the need for additional and follow-up research on the energy rating concept, particularly in the following areas:

- Various options in the design of rating systems need to be explored. Further research is necessary to compare the advantages and disadvantages of standardized energy-efficiency rating procedures versus separate homegrown

procedures. These impacts must be measured in terms of costs and savings to the lender, real estate agents, homeowners, and possibly the appraisers.

- The energy rating pilot project only dealt with existing homes. There are many other rating and labeling schemes for new homes. The value of integrating an existing home rating system with new home rating systems needs to be investigated.

- Various methods of delivering the rating should be considered, especially those which do not require site visits. Linkage of the rating with the RCS audit proved very successful. With this arrangement, the rating is appended to an energy audit for an additional cost of approximately $5. Therefore, the bulk of the cost of performing a rating is borne by the audit which is, under the requirements of NECPA, heavily subsidized by all ratepayers in a utility's service area. To determine the true cost effectiveness of the rating, the fate of the RCS audit must be determined as well as utility plans to continue offering audits. For example, it has been suggested by several utilities that the "walk-thru" audit or class B mail-in audit is just as effective as the RCS audit. Can the rating be appended to these types of audits? And will they continue to provide lenders and real estate agents the necessary information?

- Simplified rating procedures, such as a simple slide-rule calculation, need to be compared with the more sophisticated Mass-Save ratings as a possible means of streamlining the rating procedure and avoiding troublesome

delays. Also, radically different types of "ratings" need to be explored as to their effectiveness in motivating homeowners to undertake energy efficiency retrofits. For example, the Vanscan program in Michigan drew over 40 percent of the homeowners in one town to view thermographs of their homes.(6)

- For new homes, some home energy rating systems have been developed where the rating is performed by the builder. This significantly reduces cost because an onsite visit by an outside rater is not required. The interesting research questions, however, include whether a builder is qualified to do a rating and whether the rating is objective when performed by a financially interested party.

- Another possible method of delivering the rating is to make an energy rating part of the appraisal process. As discussed in Section 3.5, this would require the development of a simple, fast, and accurate rating procedure which could be followed without special training. Experience in areas where appraisers have performed energy ratings should be studied. Presumably appraiser-conducted ratings could occur in areas not served by energy auditors. The rating, however, would be available only after a buyer was committed to a purchase. Possible effects of performing the rating at this point in the transaction process should also be considered. What would be the advantages or disadvantages for real estate agents, lenders, home buyers and sellers?

- Attention should also be given to whether and how a rating system can be developed in states where the delivery of energy audits is fragmentary and where there is no Mass-Save equivalent. In some cases, utilities may have excess capacity and may not be inclined to encourage energy conservation in the form of audits or ratings.

- Although administration of the ratings in the pilot project proceeded smoothly, participants identified some very real potential administrative barriers to the widespread implementation of a home energy rating. These included delays in obtaining a rating during a tight home sale or loan application schedule, the fear of having voluntary energy-efficiency "labels" become mandatory, and added red tape in the real estate or mortgage procedures. Alternative strategies need to be developed to overcome these barriers.

- A follow-up study of the Massachusetts pilot project should be undertaken after sufficient time has elapsed to test the effect of the rating in the housing market. During the pilot project only one home was sold with the benefit of a home mortgage that included an energy-efficiency improvement loan based on the energy rating. One case example is insufficient to demonstrate the effectiveness of the rating to lenders, real estate agents, and the homeowner public. The lending and real estate institutions need several more demonstrations before enough of a case can be made for the rating to develop their active support. As time progresses, more of the 500 or so ratings that were perfomed during the pilot project may take part in home sales. Homes that are sold

will have to be identified and compiled into case studies as further demonstrations of the rating's effectiveness and to clarify the benefits derived from the rating. A follow-up study might also possibly identify other groups such as tenants who would likely benefit from ratings once ratings are well established in the marketplace.

- The pilot project period was also an unusual time for lenders and extraordinary circumstances may have overshadowed the potential effects of energy ratings. The slow real estate market leading up to the project period followed by the dramatic drop in interest rates during the project period overwhelmed any considerations for energy efficiency in the lending process. Additional investigations during "normal" times and over a longer period of time need to be undertaken to determine the true benefits of relaxed debt-to-income ratios and energy retrofit loans.

- The observations made of the Mass-Save pilot project need to be compared to other energy rating systems in other parts of the country. This is necessary to understand the impacts of geographic differences, institutional differences, and technical differences in the application of ratings.

- Strategies also need to be developed to identify and support a "champion" organization willing to push for the adoption of an energy rating system. Ultimately the "champion" group may be homeowners or realtors or utilities, but for this to occur, there must be widespread familiarity and experience with the energy rating concept.

Finally, it is recommended that the various levels of government take an active role in stimulating experimentation with energy ratings to test the potential usefulness of this concept. Because it is difficult to demonstrate potential benefits clearly to the individual -- lender, real estate agent, and homeowner -- it may be easier to demonstrate these benefits to the community as a whole. Like other energy conservation efforts, there is a social benefit resulting from ratings and more efficient homes that is often easier to measure than individual benefits. If this is the case for energy ratings, then the role of governments will have to be more active. The following section outlines appropriate areas of activity for federal, state, and local governments to encourage the use of energy ratings.

5.0 THE GOVERNMENTS' ROLE

Government is the instrument by which we solve our collective problems. The inefficient use of energy is one such problem. Government at all levels can exert leadership in establishing priorities, giving information, and helping citizens meet future energy needs. Currently, many perceive that the price of all energy forms is dropping and that there is an "oil glut." In this environment, government should have programs to help maintain the momentum of conservation efforts that have been occurring. Information and technology transfer programs can complement a free-market pricing approach. Just as investing in a strategic petroleum reserve provides insurance in case of a supply disruption, investing in efficiency in buildings extends domestic supplies, allows consumers to cushion against future higher prices, aids in controlling inflation and can aid in economic recovery. Although the price of oil is decreasing, natural gas prices will continue to increase over the next few years, and over 55 percent of the homes are heated by natural gas; thus programs to minimize the effect of the rising costs of natural gas are important towards a healthy economic recovery.

A home energy rating system is an example of an information program to encourage energy conservation. It can give consumers energy-efficiency information at the time of purchase of their homes and also make money more easily available through the lending institutions for mortgages and energy retrofits. If the costs of energy-efficiency improvements can be paid through mortgage payments and not require additional down payments, more homes will be affordable to more homeowners and more conservation should occur. A barrier to implementing home energy ratings that all levels of government must address is that it is a voluntary program; it is not mandatory and there are no plans to make it mandatory. One way to address this issue is for all participants (real estate agents, appraisers, lending institutions, utilities and

government) to participate at the conceptual stage of the project; thus it becomes their projects. Government serves as a catalyst to obtain the appropriate participants, of both individuals and the various trade associations.

The following sub-sections summarize specific roles and issues for the various levels of government. There are several items that can be done either by the federal or state government, but efficiency is often obtained by federal model programs instead of 50 states creating their own programs independently.

5.1 FEDERAL GOVERNMENT

The federal government is in the best position to conduct research, provide information and act as a catalyst for home energy ratings. Specifically, the federal government could:

- Provide both general energy information regarding the price and availability of fuels now and in the next 20 years and specific energy conservation information regarding the costs and benefits of energy-efficient homes, and the appropriateness of considering energy efficiency at the time of purchase. This can be done through brochures, public service advertisements, and other means.

- Serve as a catalyst to obtain partnership with real estate brokers, appraisers, lenders, and utilities at the national level to develop and implement rating programs. These groups would develop policies and program information appropriate for their state and local members.

- Develop model training materials for energy ratings with the participants. Develop, if necessary, model certification methods.

- Sponsor research and pilot programs to demonstrate the most effective systems of varying levels of sophistication, in different climates, with new and existing homes, and with different delivery mechanisms: RCS audit, walk-through audit, mail-in audit, or slide rules.

- Evaluate and monitor various rating programs to determine whether they are used in mortgage lending practices, and whether they lead towards energy-efficient purchases.

- Standardize or certify various rating systems so that each state will not have to do it. Federal lending institutions have done this for several programs for new and existing homes (e.g., FHLMC has endorsed several home energy rating programs).

- Collect and analyze data to verify programs against real data. Determine the accuracy needed by the user; e.g., lenders claim that 20 percent accuracy is sufficient.(a)

- Provide technical assistance and a clearinghouse for state and local groups,

---

(a) If the rating is used as a comparison tool and not one representing absolute performance, there will be fewer problems. EPA mileage guides are considered to be inaccurate by as much as 25 percent, but do offer a relative comparison.

- Define the regulatory environment (e.g., the fate of RCS).

5.2 STATE GOVERNMENTS

In addition to protecting the consumers from rapidly rising energy costs, states, depending on their particular situation, would have different reasons for participating in home energy rating programs. The southern states, with rapid growth and a shortage of utility capacity, currently have active conservation programs such as rebates towards the purchase of efficient appliances. The northern states have higher energy prices, and high unemployment, but are looking for ways to promote economic development and provide affordable energy. Some states will be more aggressive than others in implementing rating programs.

State governments might do the following:

- Serve as a catalyst to organize the participants, both individuals and associations, and have them develop, introduce, and implement home ratings. Participation at the state level in this role would probably last two to three years and then ratings should be able to be implemented completely by the private sector.

- Coordinate with border states, where appropriate, (e.g., New York, New Jersey, and Connecticut) to assume uniformity of systems including standard occupancy conditions.

- Review systems to insure that they are consistent with any state building codes.

- Develop a certification proceas for raters/auditors.

- Institute or utilize existing consumer protection systems. If the existing RCS audit program is used, this may be less necessary than if systems are used in which homeowners provide the data as in a mail audit.

- Obtain any necessary legislation or utility commission orders for utility participation.

- Provide technical assistance, seed money, and visibility to participants at the local level.

If federal State Energy Conservation Program (SECP) funds are to be used, the states may have to work with the legislatures to obtain authority to spend funds for home energy ratings. SECP funds, provided as grants by the U.S. Department of Energy, could be used for energy rating programs, if such programs are listed as program measures in the state's SECP plan. These plans must be approved by the U.S. Department of Energy.

5.3 LOCAL GOVERNMENTS

The local government is the entity closest to the actual implementation of home energy-efficiency programs. If the state has an active program, local government will need to do less in developing training programs, rating systems, etc. If state governments have no programs, localities can totally implement a rating program. The role of the local government could be to:

- Work with all participants at the local level to organize, publicize, and implement programs (e.g., the Visalia, California program).

- Obtain uniformity of rating systems with adjacent governments.

The home energy rating concept has the potential to be of significant public benefit in encouraging energy conservation, but without the support of federal, state, and local government, research and attempts at implementation are likely to remain fragmentary and uncoordinated. As suggested in Section 4.0, governments must play a more active role in encouraging the development and use of this concept if it is to be successful.

APPENDIX A -- LIST OF INTERVIEWEES

The following table lists professional users of energy ratings who were interviewed in the course of the Massachusetts home energy rating evaluation. Most of the interviews were conducted in-person on the dates shown. Those interviews conducted by telephone are marked with a "T" alongside the interview date.

HOME ENERGY RATING INTERVIEWEES

ORGANIZATION	ROLE	NAME	TELEPHONE	LOCATION	INTERVIEW DATE
Case 1 -- Western Mass. (Broker Appeal)					
MASS SAVE	Pub Rel Mkt	Avi Gladstone	(413) 736-5639	Springfield	1/21/83
Old Colony Bank	Lender	Sheryl Pollack	(413) 536-5600	Springfield	1/21/83
Massamont	Realtor	Carolyn Jarmulowicz	(413) 773-5432	Greenfield	1/20/83
Town & Country	Realtor	Ann Hastings	(413) 253-3461	Amherst	1/20/83
Customers (6)		--		Western Mass.	
Case 2 -- Plymouth County (Customer Demand)					
MASS SAVE	Auditor	Valerie Allen	(617) 676-0290	Somerset	12/9/82
MASS SAVE	Auditor	Ed Sayers	(617) 676-0290	Somerset	12/9/82
MASS SAVE	Regional Mgr	Ed Sanders	(617) 676-0290	Somerset	12/9/82
MASS SAVE	Pub Rel Mkt	John Oinenan	(617) 676-0290	Somerset	3/29/83-T
Southbrook Realty	Realtor	Dennis Monahan	(617) 826-4021	Plymouth	2/1/83
Sullivan Realtors	Appraiser realtor	Bob McGuire	(617) 746-8400	Plymouth	2/28/83-T
Plymouth 5¢ Savings	Lender	Dennis Boulay	(617) 746-4600	Plymouth	2/1/83
Customers (100)		--		Plymouth	2/7/83

Note: A letter "T" after the date signifies a telephone contact. All other contacts are in-person visits.

HOME ENERGY RATING INTERVIEWEES (cont.)

ORGANIZATION	ROLE	NAME	TELEPHONE	LOCATION	INTERVIEW DATE
Case 3 -- Worcester (Lender Appeal)					
K.G. Mathews	Realtor	Joseph Mathews	(617) 754-7878	Worcester	2/10/83-T
Robert Love	Realtor	Tom Hiller	(617) 829-6601	Worcester	2/10/83-T
Consumers Savings Bank of Worcester	Lender	Roger Starbard	(617) 754-2653	Worcester	2/9/83
Case 4 -- Arlington (Customer Acceptance)					
MASS SAVE	Regional Mgr.	Pat McCarthy	(617) 935-9450	Woburn	1/18/83
MASS SAVE	Pub Rel Mkt	Joan Tabachnick	(617) 935-9450	Woburn	1/19/83
MASS SAVE	Auditor	David Neiburg	(617) 935-9450	Woburn	1/19/83
MASS SAVE	Auditor	Barbara Costello	(617) 935-9450	Woburn	1/19/83
MASS SAVE	Auditor	Kelvin Keregha	(617) 935-9450	Woburn	1/19/83
Ivers & Stein	Realtors	Louise Ivers	(617) 648-6500	Arlington	1/31/83
		Dot Stein	(617) 648-6500	Arlington	1/31/83
Scanlon Co.	Realtors	Bob Bowes	(617) 648-3050	Arlington	3/24/83
Lincoln Agency	Realtors	Jeff Sharp	(617) 259-0824	Lincoln	1/19/83
MAR	Realtors	Steve Allen	(617) 890-3700	Waltham	1/19/83
		Scott Donahue	(617) 890-3700	Waltham	3/25/83
Elliot & Cottschalk	Appraiser	Steve Elliot	(617) 235-6787	Wellesley	1/31/83
Cambridge Savings Bank	Lender	Wess Blair	(617) 864-8700 X135	Cambridge	3/24/83

HOME ENERGY RATING INTERVIEWEES (cont.)

ORGANIZATION	ROLE	NAME	TELEPHONE	LOCATION	INTERVIEW DATE
Case 4 -- Arlington (Continued)					
Boston 5¢ Savings Bank	Lender	Penny Hurley	(617) 742-6000	Boston	1/31/83
Shawmut	Lender	Barbara Burnham	(617) 292-3957	Boston	1/18/89
		Brewster Clifford	(617) 292-3619	Boston	1/18/83
New World Bank	Lender	Anne Lennon	(617) 482-2600	Boston	3/24/83
Coop Bank of Concord	Lender	Josiah Cushing	(617) 862-5873	Concord	3/25/83
Bank of NE	Lender	Jim Worrall	(617) 973-6279	Boston	1/18/83
1st Nat'l. Boston Mortgage Corp.	Lender	Jean Murgida	(617) 964-9530	Newton	1/21/83
Customers (150)		--			2/7/83
Other Project Participants					
FNMA	2nd Lender	Elizabeth Taylor	(202) 537-7524	D.C.	12/1/82
		Pete Scheuerer	(202) 537-7524	D.C.	3/18/83
IMI	Mortgage Insurer	Roger Blood	(617) 482-0610	Boston	12/19/82
MASS SAVE	Tech. Director	Dan Waintroob	(617) 720-2590	Boston	1/18/83
MASS SAVE	General manager	Jack Roll	(617) 720-2590	Boston	1/18/83
MICA	Mortgage Insurer	Steve Doehler	(617) 720-2590	D.C.	12/6/82
EWI	Prog. Mgr.	Kitty Cox	(617) 926-8600	Boston	11/23/82
SREA	Appraiser	Robert Morin	(202) 298-8497	D.C.	2/3/83-T
SREA	Appraiser	Donald Boyson	(303) 795-3072	Denver	2/4/83-T

HOME ENERGY RATING INTERVIEWEES (cont.)

ORGANIZATION	ROLE	NAME	TELEPHONE	LOCATION	INTERVIEW DATE
FHLMC	2nd Lender	Ron Haynie	(202) 789-4431	D.C.	11/23/82
Alliance	Prog. Consultant	Linda Schuck	(202) 857-0666	D.C.	10/14/82
PNL	Prog. Director	Paul Hendrickson	(509) 376-4253	Richland, WA	1/13/83
FNMA	Regional Office	Mark Spencer	(215) 574-1400	Philadelphia	3/10/83
NAR	Realtors	Thane Young	(202) 383-1104	D.C.	2/7/83
Nationwide Lending	E-7 program in MD	Vince Hardwick	(301) 468-9300	Rockville, MD	12/10/82-T
U.S. League	Lender	Harold Olin	(312) 644-3100	Chicago	2/10/83
NAHB	Builders	Marty Mintz	(202) 822-0200	D.C.	3/1/83
		Michael Bell	(202) 822-0200	D.C.	3/1/83
FHLMC	Regional Office	Marc Schaefer	(703) 685-2427	D.C.	2/28/83
EOER	State Energy Office	Marilyn Rowland	(617) 727-0704	Boston	1/31/83
		Dan Schumm	(617) 727-0704	Boston	1/31/83
Boston Edison	Utility	Paul Shea	(617) 424-2260	Boston	1/21/83
Com Electric	Utility	Gordon Jezard	(617) 580-1213	Boston	2/18/83-T
Com Gas	Utility	Peter George	(617) 481-7900	Boston	2/8/83-T
Mass Electric	Utility	John Amoroso	(617) 366-9011	Boston	2/8/83-T

APPENDIX B -- INTERVIEW GUIDES

The following outline represents a discussion guide for interviews with primary and secondary mortgage lenders, real estate agents or brokers, appraisers, Mass-Save officials, and auditors associated with the home energy rating project in Massachusetts.

NATIONAL ORGANIZATIONS

- Participating organizations

  - FHLMC
  - FNMA
  - NAR
  - NAHB
  - U.S. League of Savings Associations
  - Mortgage Insurance Co. of America

- Reason for participating in pilot project
- General knowledge of and interest in HERS
- Expectation of and goals for HERS
- Potential use of HERS by secondary lenders, brokers, etc.
- Importance of increased ratios vs. retrofit loans
- Expected problems with pilot project (e.g., administrative burdens)
- Potential advantages for secondary lenders, brokers, etc.
- Effect of HERS on retrofitting before or after home sale
- Effect of HERS on lenders' acceptance of retrofit loans
- Significance of energy costs to mortgage defaults
- Potential changes to improve HERS
- National applicability of HERS
- Effect on HERS of lower mortgage interest rates
- Comparison of HERS to other rating systems (e.g., California, Florida, Minnesota)
- Comparison of standardized rating to varied local ratings
- Role of secondary lenders with respect to other agencies (e.g., local lenders, appraisers, brokers) in successful adoption of HERS
- Potential role of government
- Comparison of experience with HERS relative to expectations
  - Additional time required

- Administrative problems encountered
- Effect of HERS on marketability of mortages to secondary lenders

Case 1: WESTERN MASSACHUSETTS (REAL ESTATE BROKERS)

1. Brokers

- Understanding of HERS
- Advantages and disadvantages of HERS
- Reasons for accepting HERS
- Actual experience with the use of HERS (e.g., on MLS form)
- Process for selecting HERS home owners
- Potential for using HERS routinely
- Need for training in use of HERS
- Changes needed to HERS information/format/delivery
- Difficulty/ease of "selling" HERS to lenders
- Home sellers' response to HERS (e.g., general response, effect on retrofitting before sale)
- Home buyers' response to HERS (e.g., significance relative to other factors, willingness to retrofit after sale)
- Best time for conducting HERS
- Impact of HERS on buyers' ability to qualify for mortgage

2. Lenders

- Understanding of HERS
- Advantages and disadvantages of HERS
- Use of HERS by local lender and with secondary lender
- Effect of HERS on lenders acceptance of retrofit loans
- Potential for qualifying more buyers vs. lowering risks on mortgages vs. selling retrofit loans
- Potential for using HERS routinely
- Best application of HERS

- Changes needed to HERS information/format/delivery
- Best time for conducting HERS
- Administrative burdens of HERS during mortgage application review
- Use of HERS by appraisers
- Liability from potential inaccuracies in HERS data

Case 2: PLYMOUTH COUNTY (CUSTOMER DEMAND)

1. Brokers

- Understanding of HERS
- Advantages and disadvantages of HERS
- Reasons for accepting HERS
- Process for selecting homeowners for HERS (if applicable)
- Use of HERS (e.g., on MLS form)
- Potential for using HERS routinely
- Need for training in use of HERS
- Changes needed to HERS information/format/delivery
- Best time for conducting HERS
- Home sellers' response to HERS (e.g., general response, effect on retrofitting before sale)
- Home buyers' response to HERS (e.g., significance relative to other factors)
- Impact of HERS on buyers' ability to qualify for mortgage

2. Lenders

- Understanding of HERS
- Reasons for accepting HERS
- Use of HERS by local lender and with secondary lender
- Use of HERS by branch offices of larger banks
- Effect of HERS on lenders' acceptance of retrofit loans
- Potential for qualifying more buyers vs. lowering risks on mortgages vs. selling retrofit loans

- Potential for using HERS routinely
- Best application of HERS
- Changes needed to HERS information/format/delivery
- Best time for conducting HERS
- Administrative burdens of HERS during mortgage application review
- Liability from potential inaccuracies in HERS data

3. Appraisers

- Understanding of HERS
- Need for training in use of HERS
- Use of HERS
- Changes to HERS information/format

4. HERS Customers (see Homeowner Interview Guide, Appendix C)

- Understanding of HERS before and after audit
- Reason for requesting HERS
- Impact of HERS on overall audit
- Use of HERS (e.g., retrofit, home sale)
- Response to HERS promotion
- Changes needed to HERS information/format/delivery

5. RCS Audit Customers without HERS

- Reason for not requesting HERS
- Understanding of the offer of HERS
- Plans to sell home and potential utility of HERS

6. Mass-Save

- Response rates for all audits in Plymouth County during pilot test vs. Mass - Save experience to date

- HERS requests as share of all audit requests
- Customer response to HERS
- Additional time and cost required by HERS

Case 3: WORCESTER (LENDERS)

1. Lender

- Understanding of HERS
- Advantages and disadvantages of HERS
- Reasons for accepting HERS
- Use of HERS by local lender and with secondary lenders
- Potential for using HERS routinely
- Best application of HERS
- Changes needed to HERS information/format/delivery
- Difficulty/ease of "selling" HERS to brokers
- Administrative burdens of HERS during mortgage application review
- Potential for qualifying more buyers vs. lowering risks on mortgages
- Liabilities from potential inaccuracies in HERS data

2. Brokers

- Understanding of HERS
- Advantages and disadvantages of HERS
- Reasons for accepting or rejecting HERS
- Changes needed to HERS information/format/delivery
- Home sellers' potential response to HERS (e.g., general response, effect on retrofitting before sale)
- Home buyers' potential response to HERS (e.g., significance relative to other factors)
- Impact of HERS on buyers' ability to qualify for mortgage

Case 4: ARLINGTON (CUSTOMER ACCEPTANCE)

1. Brokers

- Understanding of HERS
- Advantages and disadvantages of HERS
- Reasons for accepting or rejecting HERS
- Use of HERS (e.g., on MLS form)
- Potential for using HERS routinely
- Need for training in use of HERS
- Changes needed to HERS information/format/delivery
- Difficulty/ease of "selling" HERS to lenders
- Home sellers' response to HERS (e.g., general response, effect on retrofitting before sale)
- Home buyers' response to HERS (e.g., significance relative to other factors)
- Impact of HERS on buyers' ability to qualify for mortgage

2. Lenders

- Understanding of HERS
- Advantages and disadvantages of HERS
- Reasons for accepting or rejecting HERS
- Use of HERS by local lender and with secondary lender
- Use of HERS by branch offices of larger banks
- Effect of HERS on lenders' acceptance of retrofit loans
- Potential for qualifying more buyers vs. lowering risks on mortgages vs. selling retrofit loans
- Potential for using HERS routinely
- Best application of HERS
- Changes needed to HERS information/format/delivery
- Administrative burdens of HERS during mortgage application review
- Use of HERS by appraisers

- Liabilities from potential inaccuracies in HERS data

3. Appraisers

- Understanding of HERS
- Use of HERS
- Changes needed in HERS information/format

4. HERS Customers

All HERS Customers

- Reaction to HERS
  - Rating scale
  - Projected vs. past energy costs
  - Information delivery process
  - Credibility of information
  - Clarity of information
  - Perceived benefits beyond audit
- Retrofit actions taken

Home Sellers (add following issues)

- Use of HERS when selling home
- Ease of locating broker using HERS
- Effect of HERS on selling price
- Effect of HERS on house marketability
- Effect of HERS on pre-sale retrofit

5. Audit Customers, Not Receiving HERS

- Retrofit actions taken or planned

- Interest in a rating of home's relative energy efficiency
- Plans to sell home and potential utility of HERS

6. Mass-Save

- Customer response to HERS vs. RCS
- Additional time and cost required by HERS
- Potential confusion between HERS and RCS
- Administrative burdens
- Adequacy of training and materials
- Effect of HERS on marketability of RCS
- Ease/difficulty of HERS forms, calculations
- Needed changes to HERS information/format/delivery
- Review of all Mass-Save debriefings of auditors
- Additional time needed for HERS presentation, explanation

IMPLEMENTING AGENCIES

1. Mass-Save headquarters staff

- Expectations of pilot program
- Advantages and benefits of HERS
- Costs of HERS
- Potential for implementing statewide
- Next steps

2. Sponsoring utilities

- Expectations of pilot program
- Advantages and benefits of HERS
- Potential for implementing statewide

3. Energyworks

- Expectations of pilot program
- Technical problems in implementation
- Potential for implementing statewide

4. Massachusetts Executive Office of Energy Resources

- Expectations of pilot program
- Potential for statewide implementation

APPENDIX C -- HOMEOWNER INTERVIEW GUIDES

The following outlines represent the interview guide used for both rated and non-rated homes in Plymouth County and the community of Arlington. These interviews were conducted as an adjunct to the Mass-Save statewide survey of audited customers.

Arlington and Plymouth County Non-Rating Customers (Control Groups)

- Did you understand the results of the audit?
- Was the auditor's explanation of the audit results clear or were parts difficult to understand?
- Did the audit make any recommendations for improvements?
- Have you made, or do you plan to make, any of the recommended improvements?
- Did the audit influence your decision to make this improvement?
- Was the overall experience with your audit a useful one?
- If you were planning to sell your home, do you think the results of the audit would help you in selling the home?
- Would you recommend an energy audit to other people you know?

(Plymouth County Only)

- Were you aware that you could have requested a home energy rating as an addition to the Mass-Save audit?
- Why did you choose not to request a home energy rating?

Arlington and Plymouth County Rating Customers (Test Groups)

(In addition to the above questions)

- The heating cost estimate in your audit is based only on the characteristics of your home. Your actual costs may be different from the estimates depending upon the number of people in your household, the temperature you keep your house at, and things like that. Was this made clear to you in the audit report?

- Was the home energy rating a useful addition to the audit?

APPENDIX D -- STATISTICAL INFORMATION

The following discussion represents the statistical assumptions made in connection with the homeowner survey portion of the home energy rating evaluation.

There are three statistical questions to be answered in analyzing the observations of the homeowner survey.

1. Are the samples of rated and non-rated customers representative of all rated and non-rated customers in Arlington and in Plymouth County?

2. Are the differences in proportions for the response to a given survey question between the rated and non-rated samples significant?

3. Are the samples in Arlington and Plymouth County representative of the state as a whole?

In response to the first question, the following table illustrates the sample sizes and the populations from which they are drawn.

	Arlington		Plymouth	
	Test (Rated)	Control (Non-Rated)	Test (Rated)	Control (Non-Rated)
Population	83	77	246	300 (approx.)
Sample	50	50	50	50

The formula of a 95.5 percent confidence interval for an infinite population is:

$$\text{Confidence Interval} = \pm 2\ Sp$$

where Sp = standard error of the mean (of proportion) = $\sqrt{\frac{pq}{n}}$

p = expected percentage of occurence

q = 1 - p

n = sample size

For a finite population the 95.5 percent confidence interval is modified as follows:

$$Sp = \sqrt{1 - \frac{n}{N}} \times \sqrt{\frac{pq}{n}}$$

where N = population size.

The confidence interval for populations of 100, 300 or infinity with random samples of 50 is illustrated in Exhibit A. This exhibit indicates that a 95.5 percent confidence interval for the Arlington and Plymouth County tests has means that are within ± 5.9 percentage points and ± 7.7 percentage points, respectively, from the population means in these two communities for responses to yes or no binary questions (in a 90 percent-10 percent proportion).

In response to the second question on the significance of differences between the test and control group responses, the following assumptions are used. If two random samples are drawn and indicate that a given characteristic is in a certain proportion (i.e., response to a question), the difference between the two proportions can be tested to

Exhibit A

Confidence Intervals[1] for a Random Sample of 50

Population of 100 (Arlington)

Confidence Interval	Expected Percentage of Occurrence[2] 50/50	60/40	90/10
95.5%	± 9.9%	± 9.8%	± 5.9%

Population of 300 (Plymouth)

Confidence Interval			
95.5%	± 12.8%	± 12.6%	± 7.7%

Infinite Population (Statewide)

Confidence Interval			
95.5%	± 14%	± 13.8%	± 8.4%

---

1 If repeated random samples of the same size are drawn from a population, then in, say, 95.5 percent (i.e., the confidence interval) of the samples the population mean will be within this interval of the sample mean. For example, if the anticipated frequency of occurrence (see below) is 50/50, and the population is 100, then in 95.5 percent of the samples the mean will be within the interval ± 9.9 percent of the population mean.

2 Expected percentage of occurrence refers to responses to binary questions (e.g., yes or no). It is equal to the proportion of the population that is expected to respond in one way or the other. As the exhibit indicates it affects the estimate of the confidence interval.

determine whether it is significant or arises out of a sampling fluctuation by use of the statistic: $(P_1 - P_2)/S_D$,

where

$$S_D = \sqrt{pq\ (1/n_1 + 1/n_2)}$$

s_D = standard error of the mean (of proportions)

p_1 = expected total percentage of occurrence (i.e., yes responses)

$q_1 = 1-p_1$

n_1 = number in first sample (e.g., test group)

n_2 = number in second sample (e.g., control group)

Then comparing the ratio of the actual difference in response proportions with the standard error of the difference yields the probability that the difference is a chance difference due to sampling fluctuations.* Exhibit B provides the worksheets for the Arlington and Plymouth County calculations.

In response to the third question regarding the degree to which the Arlington and Plymouth County samples are representative of the statewide population, the following assumption is made.

Based on Mass-Save's projections for fiscal year 1983, approximately 64,000 audits would be performed in that year. Given that the RCS

---

* Statistical Methods, H. Arkin and R.R. Colton, pp. 188-223.

Exhibit B - Arlington and Plymouth County Test Case Work Sheets for Statistical Validity

Question No.	(Control) Proportion of Occurrence	(Test) Proportion of Occurrence	(D) Difference in Proportions	(p) Total Percentage of Occurence[1]	(S_D) Standard Error of Difference[2]	(D/S_D) Number of Standard Errors	Probability of Sampling Errors[3]	Statistically Valid Difference[4]
Arlington								
1	100%	94%	6%	0.97	3.4%	1.76	8%	NO
2	98	100	2	0.99	2	1	32	NO
3	90	88	2	0.89	6.3	0.32	>50	NO
4	78	84	6	0.81	7.8	0.77	43	NO
7	62	56	6	0.59	9.8	0.61	>50	NO
8	98	94	4	0.96	3.9	1	32	NO
Plymouth County								
1	98	96	2	0.97	3.4	0.59	>50	NO
2	96	100	4	0.98	2.8	1.43	15	NO
3	84	84	0	0.84	7.3	0		
4	56	70	14	0.63	9.7	1.44	15	NO
7	46	70	24	0.58	9.9	2.42	1.6	YES
8	92	96	4	0.94	4.7	0.85	39	NO

[1] Based on sample sizes of $n_1 = 50$ and $n_2 = 50$.

[2] $S_D = \sqrt{p\,(1-p)\,\left(\frac{1}{n_1} + \frac{1}{n_2}\right)} = \sqrt{p\,(1-p) \times .04}$

[3] Table 32a - The Probability of Occurence of Statistical Deviations of Different Magnitudes Relative to the Standard Error. P. 118 Statistical Methods, H. Arkin and R.R. Colton

[4] Where there is less than 4.55 percent chance that the observed difference is due to a sampling error.

program will extend beyond fiscal year 1983 and assuming that ratings were provided to all Mass-Save customers beginning in fiscal year 1983, the potential exists for over 100,000 ratings. What then is the statistical significance of a sample of 50 Arlington and 50 Plymouth County customers receiving a rating? For example, under the most favorable circumstances, the proportion of homes in the samples that would retrofit is likely (9 cases out of 10) to be within $\pm$ 8.4 percent of the actual proportion of all Mass-Save customers (see Exhibit A). This significance, however, is contingent upon the degree to which the samples of 50 are representative of all potential rating customers. Because the samples would be randomly drawn from Mass-Save customers only in Plymouth County and Arlington, not in the state as a whole, there must be a presumption of bias in the sample. Accordingly an inference drawn from the survey results and applied to the state as a whole must be similarly biased.

In summary, the survey of rated and non-rated customers in Arlington and Plymouth County should produce quite accurate estimates of the behavior of all audit and rating customers in those communities during the pilot program. However, the ability to infer statistically accurate estimates for the behavior of audit customers across the state is substantially limited. While the sample size reduces the level of accuracy, the more important factor is the inherent bias of the sample itself. Basically one cannot predict statewide behavior from the behavior of the residents of one city and one county.

APPENDIX E -- PRESS COVERAGE

The following are summaries of news articles and other publicity related to the Massachusetts home energy rating pilot project.

Hon. Richard L. Ottinger (NY) in Congressional Record, 9/30/82.

As chairman of the Subcommittee on Energy Conservation and Power, Congressman Ottinger is looking to the Massachusetts experience with HERS to provide a model for other States and localities in identifying houses which may be eligible for higher-than-usual debt-to-income ratios as criteria for mortgages. Freddie Mac and Fannie Mae indicated at a Subcommittee hearing their willingness to consider the purchasing of mortgages made under more lenient guidelines based on home energy efficiency, and FHLMC also suggested that a nationwide energy rating system be developed to provide information to the housing and finance industry. The rating system being tested in Massachusetts could apply to new as well as existing homes, especially if builders/buyers were aware that the additional costs of energy conservation measures would not disqualify many prospective buyers.

"HERS Success Leads to 'Energy Saver Loan Plan,'" Baystate Realtor Hi-Lites, 1/83.

> "Energy Saver Loan" is a program offered by the Bank of New England in which the cost of energy improvements can be funded as part of a first mortgage. In many cases the lower heating bills will more than offset the higher mortgage costs.
>
> A survey of the first 100 homeowners requesting a rating show 20 percent plan to sell their homes within two years.

Quote, Phoebe Morse, 2/1/83.

> Ms. Morse received an Energy Saver Loan from the Bank of New England. This loan, which was based on a home energy rating, made possible all necessary energy improvements to her home.

"Bank of N.E. is First to Write FNMA Energy Policy Loan," Banker and Tradesman, 12/29/82.

> FNMA policy, announced in October, 1982, permits a bank to include the costs of energy-related improvements in a mortgage and to sell the loan immediately into the secondary market even before the improvements have been completed. The Bank of New England's Energy Saver Loan Program is the first under this policy. An energy audit is required.

"Rating Energy Efficiency of Houses Helps Obtain Financing", Community Finance Forum (FHLMC), 12/82.

> FHLMC had participated in an ad hoc national work group studying the development of a reliable HERS in Massachusetts. Included in this study was the review of twenty mock loans to test the rating's usefulness. The result was increased flexibility in evaluating the debt-to-income ratio of borrowers whose homes received a favorable rating. The rating is valuable as a uniform measure of energy efficiency that can be used by the entire housing and finance industry. FHLMC has agreed to use the rating to justify the purchase of higher ratio loans.

Letter and Press Release, Mass Save News, 1/12/83.

> This description of the HERS pilot program emphasizes how ratings enable energy efficiency to be rewarded in the marketplace through approval of more lenient mortgage loan ratios by primary lenders and acceptance of such mortgages by FNMA and FHLMC. Through programs such as the Bank of New England's "Energy Saver Loan" the costs of increasing the energy efficiency of a home could be recaptured by the savings in energy bills, especially if the costs are spread out over the

life of the mortgage. A survey of the first 100 HERS participants indicated 20 plan to sell their homes within 2 years. All 100 expect the rating to be useful in selling their homes.

Press Release, Mass Save, Inc., 10/12/82.

The HERS test program in Plymouth is announced; residents are invited to request a rating. The rating is publicized as a means of helping to finance energy improvements, helping to regain energy investments at the time of resale and helping buyers of energy efficiency homes to qualify for higher mortgages.

"Sell More Homes with Freddie Mac's New Energy Policy," (pamphlet).

Programs which assist lenders in identifying energy-efficient homes for purposes of evaluating debt-to-income ratios on loans are listed, including Massachusetts HERS. The major energy escrow provisions are described: up to 10 percent of the loan can be used for energy improvements; the lender establishes an escrow account for these improvements; the loans can go to Freddie Mac before the improvements are completed. The new form to be used by lenders provides for an energy rating.

"Energy Conservation" by Bob McGuire, Chairman of the Energy Committee, Baystate Realtor Hi-Lites, 10/82.

This article describes the HERS pilot project, particularly in how the availability of ratings may affect realtors: in providing an objective assessment of the energy efficiency of the home; in obtaining financing; in explaining high heating bills to a prospective buyer.

Hi-Ho Gram, Plymouth County Board of Realtors, 9/82.

This is an announcement of the HERS pilot project and Bank of New England's new Energy Saver Loan Program.

"Bank of New England Writes First FNMA Energy Policy Loan," Press Release, Bank of New England, 12/10/82.

This release describes the new FNMA energy policy, which permits banks to include the cost of energy improvements in a mortgage loan which can then be sold immediately into the secondary market. The Bank of New England's Energy Saver Loan, developed under this policy, is available to all homeowners seeking mortgage financing, and is expected to encourage energy conservation improvements which will lower utility bills, qualify homeowners for federal or state income tax credits, and enhance the value of their homes.

"Energy Policy Loan," Boston Herald American, 12/15/82.

The first Energy Saver Loan written by the Bank of New England under the FNMA energy policy was announced.

"Home Energy Rating Facts," Randolph Herald (and others), 10/21/82.

This article explains a home energy rating, what it includes, and who may receive one through Mass-Save. It also lists benefits of the rating to buyers and sellers in valuing a house, qualifying for a mortgage, projecting energy costs, and estimating and financing the cost of energy improvements. The rating enables mortgage lenders to qualify more buyers and real

estate appraisers to compare energy efficiency of similar properties. Real estate brokers find ratings useful in assessing and marketing a house.

"Mass-Save Conducts First-in-the-Nation Energy Test in Plymouth County," South Shore News, 10/20/83.

This article describes the home energy rating and how it can be used to compare the energy efficiency of individual homes, to obtain favorable financing for energy improvements, to enhance the sales value of a home and to assist buyers in qualifying for slightly higher mortgages. The pilot project is discussed and participation encouraged.

"Plymouth County Residents to Test New Rating System," Easton Bulletin, 10/21/82.

This announcement of the HERS pilot project in Plymouth describes the home energy rating and its value to homeowners, home buyers and sellers, real estate brokers, appraisers, and mortgage lenders. Emphasis is on financial advantages -in obtaining energy improvement loans, in valuing a house for resale, in obtaining a mortgage. Supporting agencies and organizations are mentioned, and participation is encouraged.

(Untitled magazine article - no date given - magazine unknown)

Florida has instituted an energy-efficiency rating system applicable to new homes based on a point system specficially designed for Florida's climate. The code is fexible enough to allow builders to make choices among energy-saving features, and is useful to home buyers in comparing homes. Posting of ratings in new homes is now voluntary. California is implementing a new energy code based on each of 16 climate zones in the State. The

Home Builders Assn. of Greater Kansas City offers medals to builders for energy efficiency based on a point system similar to Florida's, but with different climate-related emphasis.

"What's New at Freddie Mac," speech given by William R. Thomas, Jr., Executive Vice President Mortgage Services, FHLMC, at the National Association of Home Builders Convention, 1/23/83.

Among the current program enhancements mentioned in this speech was a new energy underwriting policy which will enable lenders to identify energy-efficient properties more easily and to qualify more buyers. More flexible debt-to-income ratios will be considered for energy-efficient homes. FHLMC has sought to recognize various programs that assist in documenting the energy efficiency of a property. The NAHB Thermal Performance Guidelines was mentioned as an example.

REFERENCES

(1) Decision Research Corporation. July 1982. The Use of Home Energy Audits and Home Energy Rating Systems in the Home Selection Process. Lexington, Massachusetts.

(2) Energy and Environmental Analysis, Inc. April 23, 1982. Automobile Consumer Response to Fuel Economy Information and Technology. Arlington, Virginia

(3) Federal Home Loan Mortgage Corporation. 1980. Energy Survey: Facts and Findings. Washington, D.C.

(4) Hendrickson, P. L., et al. 1982. Overview of Existing Residential Energy-Efficient Rating Systems and Measuring Tools. PNL-4359, Pacific Northwest Laboratory, Richland, Washington.

(5) Lawrence Berkeley Laboratory. March 1982. Computerized Instrumented Residential Audit CIRA. PUB-425, Berkeley, California.

(6) Waschsberger, K. January/February 1982. "It's Working in Grand Haven." Michigan Natural Resources, pp. 26-33.

ABBREVIATIONS

Btu - British thermal unit

CIRA - Computerized Instrumented Residential Audit

EOER - Executive Office of Energy Resources

EPA - Environmental Protection Agency

EWI - Energyworks, Inc.

FHLMC - Federal Home Loan Mortgage Corporation

FNMA - Federal National Mortgage Association

HERS - Home energy rating system

IMI - Investors Mortgage Insurance Company

MAR - Massachusetts Association of Realtors

MICA - Mortgage Insurance Companies of America

MLS - Multiple Listing Service

MPG - Miles per gallon

NAHB - National Association of Home Builders

NAR - National Association of Realtors

NECPA - National Energy Conservation Policy Act

PNL - Pacific Northwest Laboratory

RCS - Residential Conservation Service

SECP - State Energy Conservation Program

SREA - Society of Real Estate Appraisers

PNL-4764
UC-95d

DISTRIBUTION

No. of Copies

OFFSITE

20 S. Heard
U.S. Department of Energy
Office of Building Energy R&D
Forrestal Building
1000 Independence Avenue S.W.
Washington, D.C. 20585

J. Millhone
Director, Office of Building Energy R&D
U.S. Department of Energy
Forrestal Building
1000 Independence Avenue S.W.
Washington, D.C. 20585

E. Freeman
Office of Building Energy R&D
U.S. Department of Energy
1000 Independence Ave. S.W.
Washington, D.C. 20585

27 DOE Technical Information Center

L. Athmer
Salt River Project
P.O. Box 1980
Phoenix, AZ 85001

B. Batson
Bonneville Power Administration
P.O. Box 3621
Portland, OR 97208

I. Birnbaum
Solar Applications Branch
Tennessee Valley Authority
310 TVA Credit Union Building
Chattanooga, TN 37401

No. of Copies

J. B. Bishop
Gulf States Utilities Company
P.O. Box 2951
Beaumont, TX

K. Bittenbeyder
110 Athol Road
North Orange, MA 01364

C. Bloodgood
Bumblebee Energy Systems
28 Richey Place
Trenton, NJ 08618

C. R. Booz
Solar Computer Corporation
1580 Gaylord
Denver, CO 80206

B. Bower
Department of Veteran & Community Affairs
Howard Building
2571 Executive Center Circle East
Tallahassee, FL 32301

D. G. Carter
Carter Engineering, Inc.
1107 Spring Street
Silver Spring, MD 20910

N. Clark
Bonneville Power Administration
P.O. Box 3621, M.S.-KT
Portland, OR 97208

No. of Copies

R. Copper
Chestnut Hall
3900 Chestnut Street
Philadelphia, PA 19104

5 K. Cox
Energyworks, Inc.
44 Hunt Street
Watertown, MA 02172

T. Crow
Ohio Department of Energy
30 East Broad Street
Columbus, OH 43215

D. Davia
Public Service Company
of Colorado
550 15th Street
Denver, CO 80202

G. Duffy
Air Conditioning, Htg. &
Ref. News
Box 2600
Troy, MI 48099

P. Durkin
Heat Loss Analysis, Inc.
536 Bonanza Avenue
Anchorage, AK 99502

D. Fielman
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814

T. Foley
Northwest Power Planning
Council
700 S.W. Taylor
Suite 205
Portland, OR 97205

No. of Copies

D. Ford
Colorado Office of
Energy Conservation
1525 Sherman Street, 4th Floor
Denver, CO 80203

B. Fournier
Public Service Company of
New Hampshire
1000 Elm Street
Manchester, NH 03105

S. Foute
6990 Pierson Street
Arvada, CO 80004

10 M. Frankel
Centaur Associates
Suite 465
1120 Connecticut Ave. N.W.
Washington, D.C. 20036

E. G. Galassi
Illinois Power Company
500 South 17th Street
Decatur, IL 62525

B. Gillmore
Public Service Company of
New Mexico
Alvarado Square
Albuquerque, NM 87158

J. Grady
Federal National Mortgage
Association
510 Walnut Street, 16th Floor
Philadelphia, PA 19106

T. Grether
Insulation Division
Owens-Corning Fiberglas
Corporation
Toledo, OH 43659

No. of
Copies

B. Griffin
Edison Electric Institute
1111 19th Street, N.W.
Washington, D.C. 20036

G. Haddow
Pacific Gas and Electric
Company
77 Beale Street
San Francisco, CA 94106

J. Hailey
Pacific Gas and Electric
Company
77 Beale Street
San Francisco, CA 94106

C. Hibberd
Division of Facilities
Construction and Management
4110 State Office Building
Capitol Complex
Salt Lake City, UT 84114

D. C. Hittle
P.O. Box 4005
U.S. Army Construction
Engineering Research Lab.
Champaign, IL 61820

K. Hoffman
AHP Energy Associates
3787 N. Lexington
St. Paul, MN 55112

P. Hollander
Cornerstones Energy Group
54 Cumberland Street
Brunswick, ME 04011

B. Hunn
Los Alamos National
Laboratory
P.O. Box 1663
Los Alamos, NM 87545

No. of
Copies

D. M. Ikle
Conservation Management
Corporation
7010 Glenbrook Road
Washington, D.C. 20014

M. Karnitz
P.O. Box X
Oak Ridge National Laboratory
Oak Ridge, TN 37830

E. Kenneth
American Institute of Architects
1735 New York Avenue N.W.
Washington, D.C. 20006

R. Kent
New Technologies Institute
44 Monterey Blvd.
San Franisco, CA 94131

D. Kitts
Dow Chemical Company
Drawer H
Walnut Creek, CA 94596

J. Kortecamp
Director of Education
National Association of Realtors
430 North Michigan
Chicago, IL 60611

T. Kusuda
National Bureau of Standards
Department of Commerce
Washington, D.C. 20234

A. Larson
Swedish Consulate General
10880 Wilshire Blvd, Suite 914
Los Angeles, CA 90024

G. Lay
Nebraska Energy Office
P.O. Box 95085
Lincoln, NE 68509

No. of Copies

T. Lechner
Electric Power Research Institute
3412 Hillview Avenue
Palo Alto, CA 94304

M. Levine
Lawrence Berkeley Laboratory
University of California
Berkeley, CA 94720

B. Loew
Massachussetts Office of Energy Resources
145 State Street
Springfield, MA 01103

J. Luboff
Institute for Public Policy
University of Washington
3935 University Way N.E.
Seattle, WA 98105

T. S. Lundy
Oak Ridge National Laboratory
P.O. Box X
Oak Ridge, TN 37830

A. Malean
Washington State Energy Office
400 E. Union
Olympia, WA 98504

J. Marquardt
Enercom, Inc.
2323 South Hardy Drive
Tempe, AZ 85282

M. Messenger
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814

D. Metzler
City of Visalia
707 West Acequia Street
Visalia, CA 93291

No. of Copies

B. Miller
Central Power and Light Company
P.O. Box 2121
Corpus Christi, TX 78403

M. Mintz
National Association of Home Builders
15th and M Streets N.W.
Washington, D.C. 20005

W. R. Mixon
Oak Ridge National Laboratory
P.O. Box X
Oak Ridge, TN 37830

D. Morazzi
Governor's Energy Council
P.O. Box 8010
Harrisburg, PA 17105

S. Morgan
T.D.C.
11 Beacon Street, #1100
Boston, MA 02108

National Community Energy Management Center
400 North Capitol Street N.W.
Suite 390
Washington, D.C. 20001

A. Okagaki
Alternative Energy Resources
424 Stapleton Building
Billings, MT 59101

H. Olin
Director, Architectural & Construction Research
U.S. League of Savings Associations
111 East Wacker Drive
Chicago, IL 60601

No. of Copies

P. Ossinger
Bonneville Power Administration
P.O. Box 3621
Portland, OR 97208

L. Palmiter
Ecotope Group
2328 East Madison
Seattle, WA 98112

D. Patterson
Texas Power & Light Company
Box 226331
Dallas, TX 75266

H. L. Parry
Puget Sound Power and Light Co.
Puget Power Building
Bellevue, WA 98009

F. Porter
Puget Sound Power
& Light Co.
Puget Power Building
Bellevue, WA 98009

T. Potter
SERI 15/3
1617 Cole Blvd.
Golden, CO 80401

N. L. Raab
Union Electric Company
1901 Gratiot Street
St. Louis, MO 63103

J. Reese
New York State Energy
Office
Building 2
Empire State Plaza
Albany, NY 12223

No. of Copies

M. Schaeffer
Federal Home Loan Mortgage
Corporation
1776 G Street N.W.
P.O. Box 37248
Washington, D.C. 20013

K. Schmid
National Homes Corporation
Earl Avenue and Wallace Street
Lafayette, IN 47903

L. Schuck
Alliance to Save Energy
1925 K Street N.W.
Suite 507
Washington, D.C. 20006

J. Shaw
Kansas City Power and
Light Company
P.O. Box 679
Kansas City, MO 64141

G. Simon
Sigma Group
1029 J Street, Suite 500
Sacramento, CA 95814

K. Smith
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814

R. Sonderegger
Building 90-3074
Lawrence Berkeley Laboratory
Universtiy of California
Berkeley, CA 94720

G. Steel
P.O. Box 2369
Rancho Santa Fe, CA 92067

No. of
Copies

L. Stiles
Office of Energy Research
University of Illinois
901 South Mathews
Urbana, IL 61801

S. Stiles
302 W. Vermont
Urbana, IL 61801

National Institute for
Building Sciences
1015 15th Street N.W.
Suite 700
Washington, D.C. 20005

B. Taylor
Duke Power Company
422 South Church Street
Charlotte, NC 28242

G. Thompson
Conservation Foundation
1717 Massachusetts Avenue
Washington, D.C. 20036-2094

J. Veigel
Alternative Energy Corp.
P.O. Box 12699
Research Triangle Park, NC 27709

D. Vohs
Iowa Energy Policy Council
Capital Complex
Des Moines, IA 50319

B. Wagner
Lawrence Berkeley Laboratory
Building 90-3058
Berkeley, CA 94720

D. Waintroob
Mass-Save
131 State Street
Suite 1050
Boston, MA 02109

No. of
Copies

J. Walsh
Computerized Energy Audits, Inc.
2933 Nogales Court
Boulder, CO 80301

M. Weedal
Bonneville Power Administration
P.O. Box 3621
Portland, OR 97208

M. Weinstein
Route 1 Box 240
Burton, WA 98013

ONSITE

DOE Richland Operations Office

H. E. Ransom

38 Pacific Northwest Laboratory

W. B. Ashton
S. Balistocky
D. B. Belzer
B. A. Garrett-Price
P. L. Hendrickson(25)
R. P. Mazzucchi
R. G. Rivera
Publishing Coordination (2)
Technical Information (5)